

# ZION WIP Report

## NPS Retaining Wall Inventory Program Zion National Park



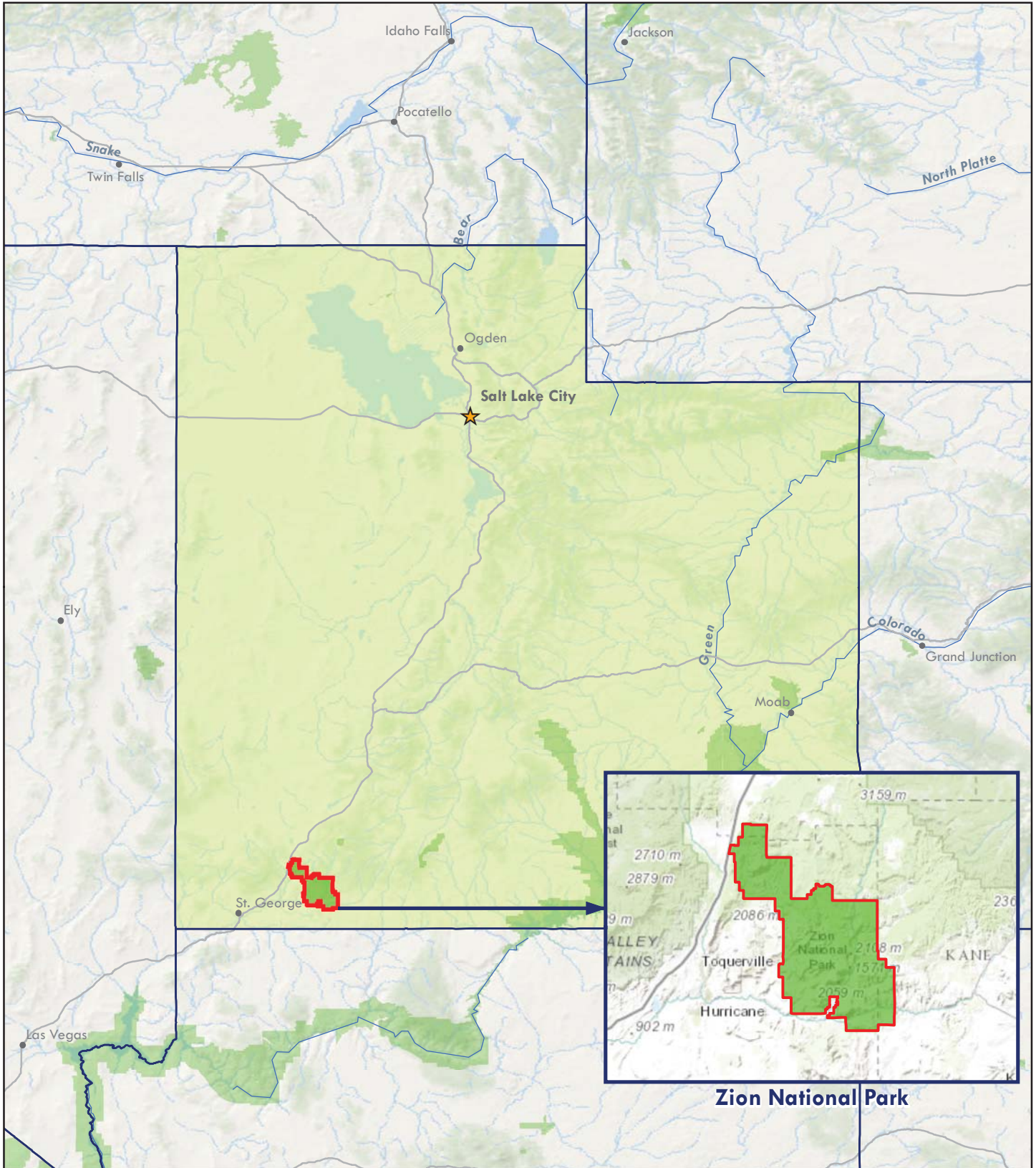
**Federal Lands Highway  
Road Inventory Program**

### Prepared By:

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

**Data Collection Date: December 2006  
Report Date: October 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**

The Federal Lands Highway Division (FLH) of the Federal Highway Administration (FHWA), in partnership with the National Park Service (NPS), has conducted a retaining wall inventory and condition assessment as part of the NPS Retaining Wall Inventory Program (WIP). This inventory provides information to the NPS Facility Management Software System (FMSS) regarding such things as type, size and location of retaining structures, as well as the condition of these facilities and consequences of failure. In addition, when wall and/or adjacent element deficiencies are identified, repair recommendations and estimated costs are also provided, suitable for use as FMSS work orders.

The main intent of this effort is to determine the backlog of needs associated with retaining wall assets – equipment features ascribed to the “parent” roadway asset. Inventory and condition assessments (pavement only) for the roads themselves are conducted under the NPS Road Inventory Program (RIP). Prior to development of the WIP, the vast majority of retaining walls were not accounted for in FMSS. Based on WIP inventory work to date, NPS wall assets are valued at well over \$400M. A second and equally important intent of this effort is to inform and improve project selection, prioritization, and development activities and processes at NPS regions/parks, FLH Division offices and the NPS Denver Service Center.

In support of WIP, a comprehensive procedures manual (available at the following link: <http://www.cflhd.gov/programs/techDevelopment/geotech/WIP/>) was developed to document the data collection and management process, wall attribute and element definitions, and team member responsibilities for conducting retaining wall inventories and condition assessments. This manual was used for nearly 3,500 wall assessments initially conducted between 2007 and 2008 within 34 national parks. WIP is supported by several key components described in the procedures manual, including a comprehensive training program for field inspectors, an Oracle-based database for long-term data management, unique data collection forms, a supporting field guide, and a wall repair/replace cost estimate guide.

Ultimately, condition assessments for retaining wall structures are expressed as deferred maintenance costs, which are then divided by current year replacement costs to arrive at a “Facility Condition Index” (FCI). Coupling this condition prioritization index with an “Asset Priority Index” (API), which measures the feature’s importance to the mission of the park, capital asset investments are made more efficiently. This approach appropriately focuses maintenance and construction priorities on value, rather than solely on cost. Wall inventory condition and cost data are transferred from the WIP database to FMSS, the primary asset documentation, management and planning platform maintained at each park. In addition, wall data are also provided to the Road Inventory Program to update equipment assets associated with the parent roadway asset.

Initial inventories were conducted based on RIP Cycle 3 data, but future planning has ensured updates to WIP will occur simultaneously with RIP. For long-term data management purposes, the WIP database will be linked to the larger, parent RIP database and be updated under the responsibility of the RIP Database Administrator.

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 wall (Tier 3). Tier 1 presents park wall location maps and an overall park-specific summary narrative of the results of the wall inventory program. Tier 2 presents route overview maps with associated wall summary information. Tier 3 presents individual wall information in a three-page detailed format, including a photograph of each wall. Appendix A provides a condensed summary of wall inventory definitions and assessment categories to assist in reading this report.

# Park Retaining Wall Location Maps



Zion National Park

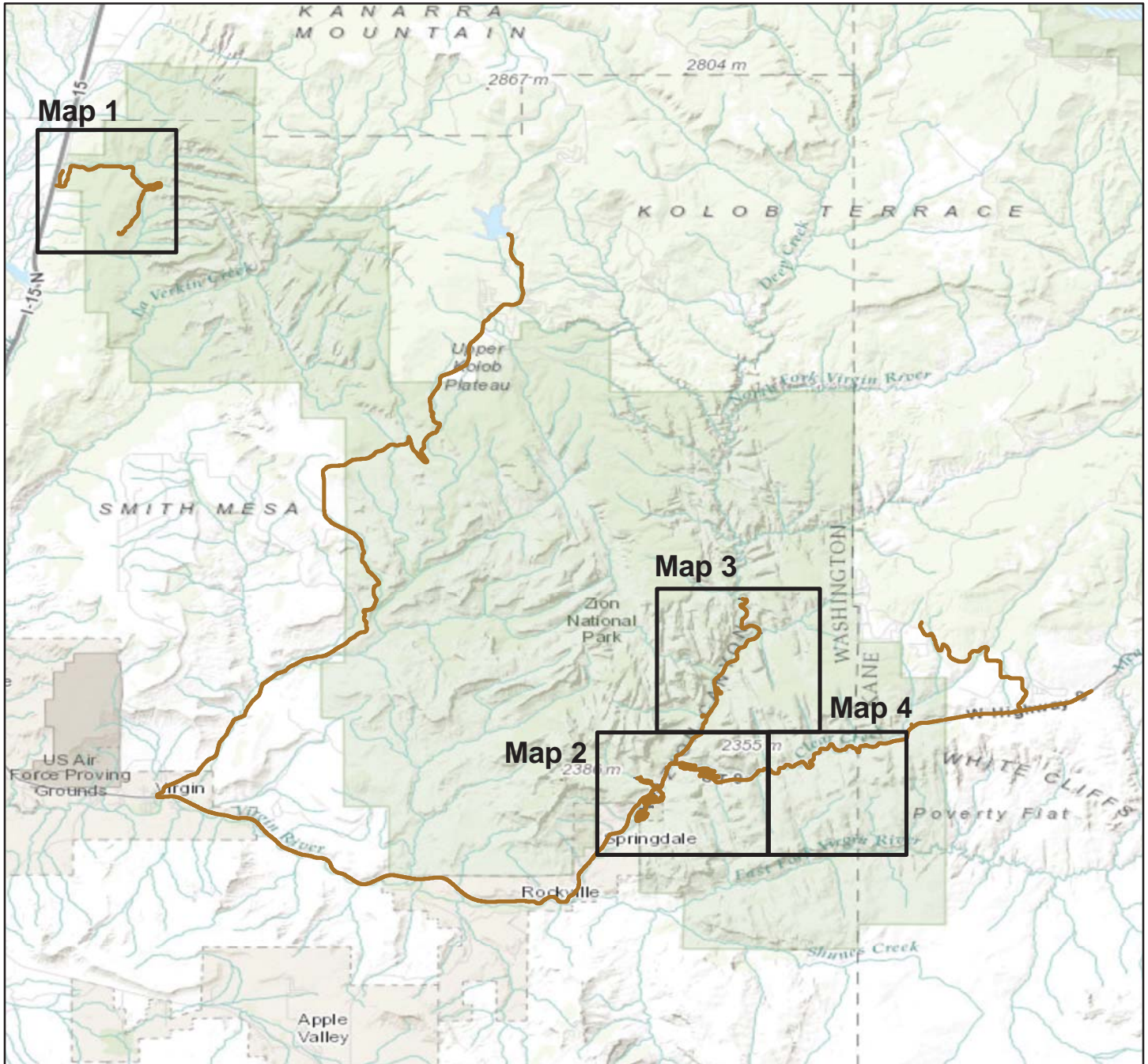


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# Zion National Park

## WALL 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

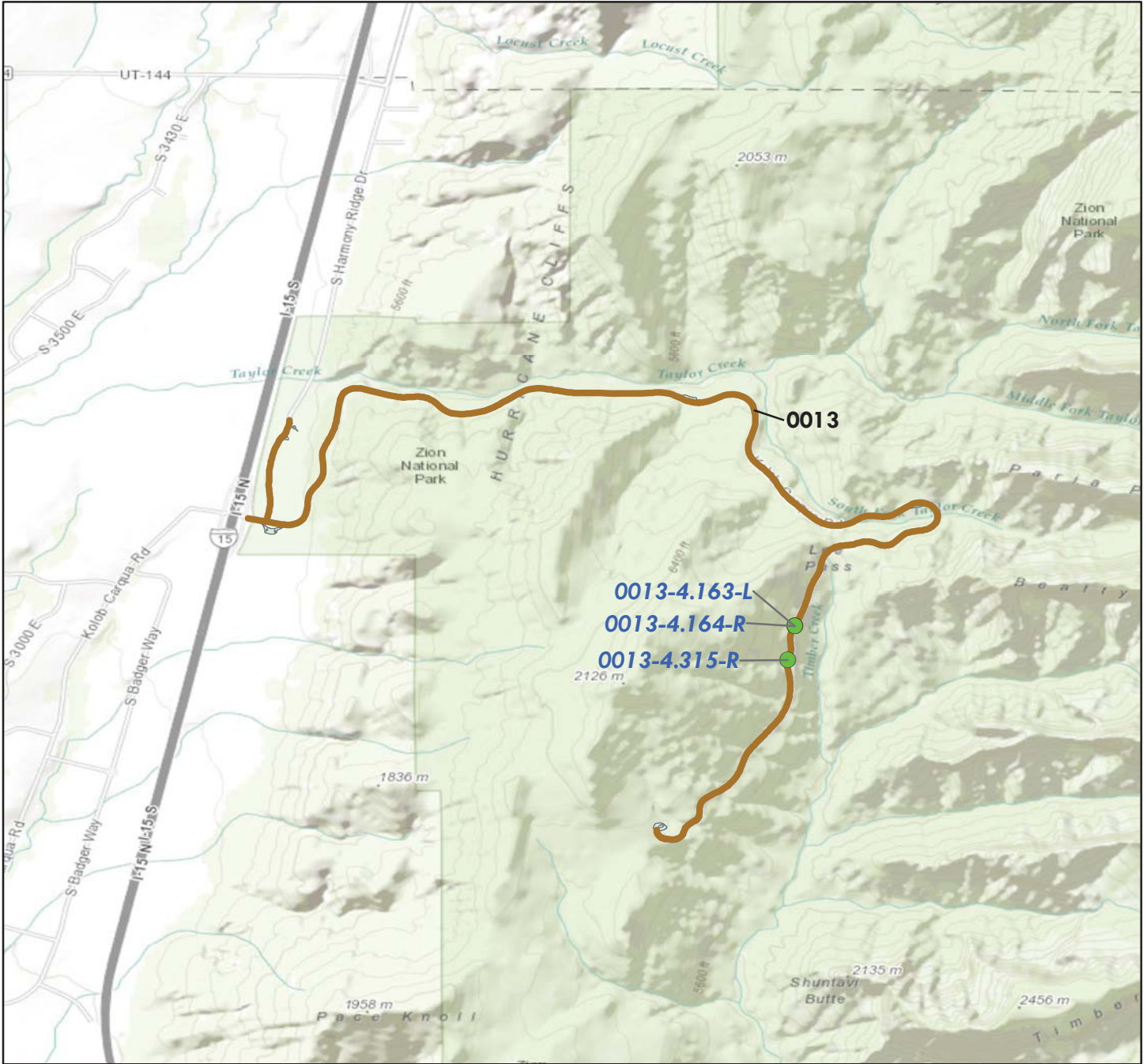
 RIP Collected Routes



# Zion National Park

## WALL 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

● Wall Locations

— RIP Collected Routes

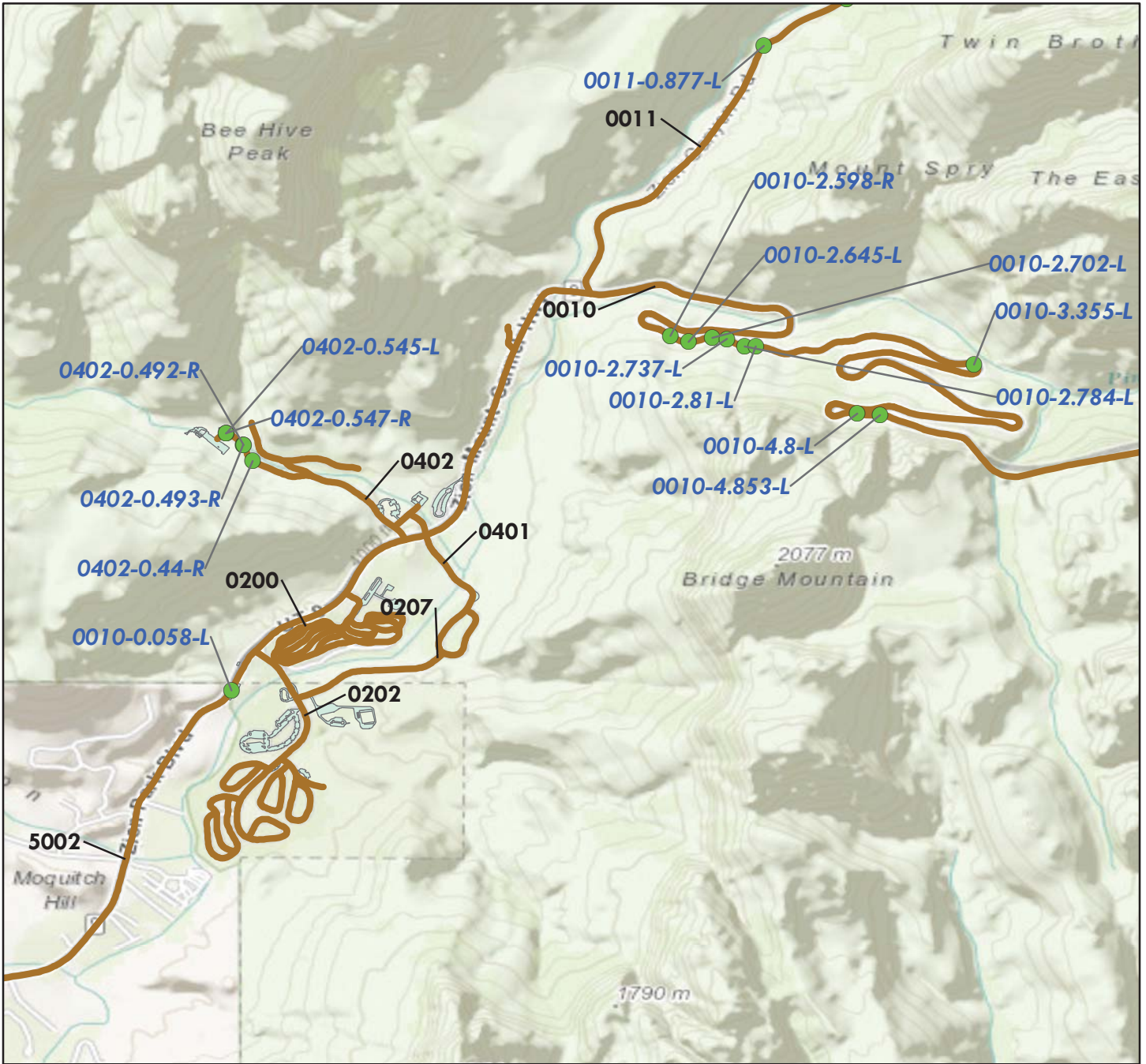




# Zion National Park

## WALL 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

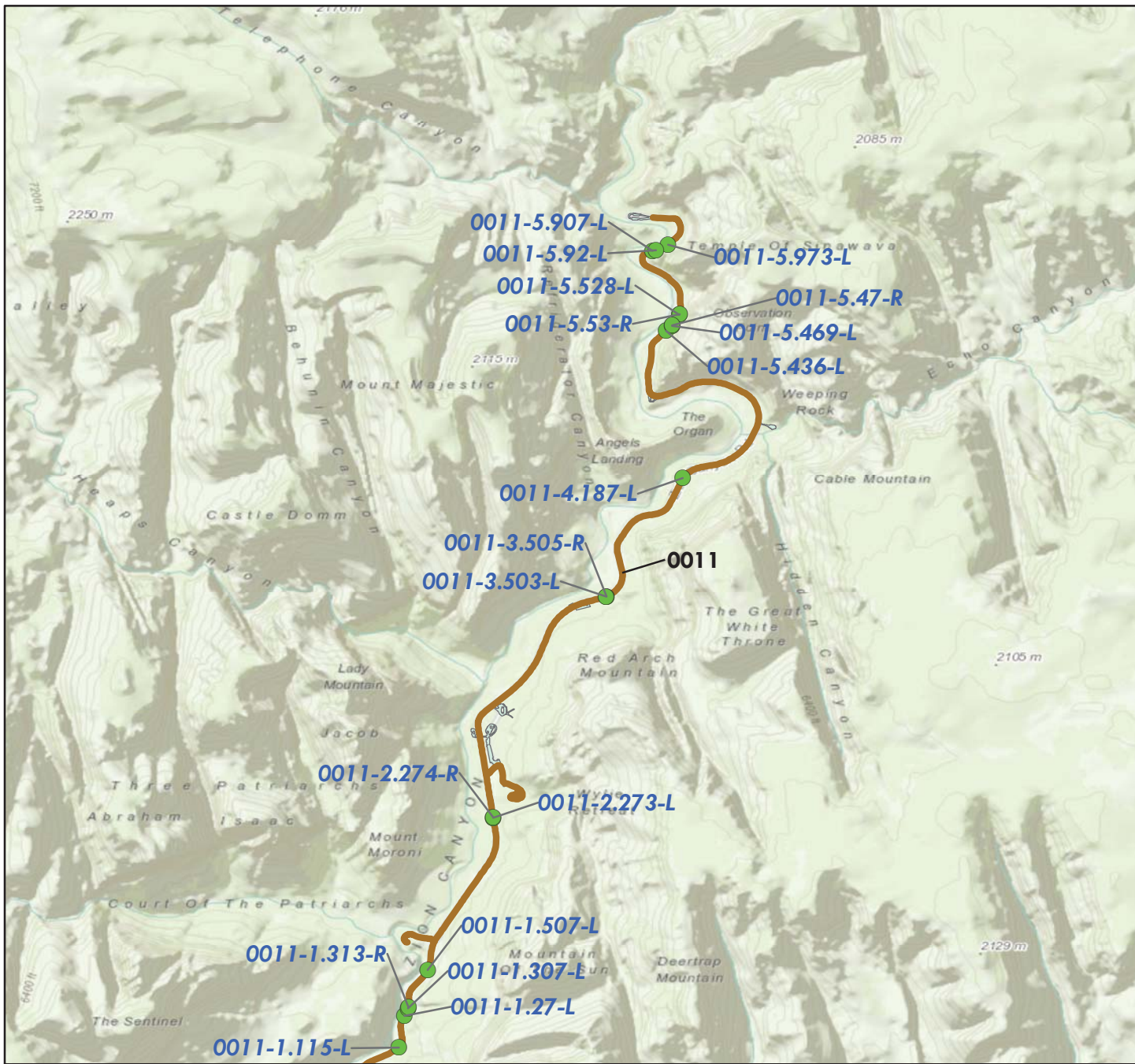
- Wall Locations
- RIP Collected Routes



# Zion National Park

## WALL LOCATION MAP

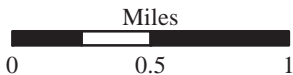
### Map 3



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

● Wall Locations

— RIP Collected Routes



# Zion National Park

## WALL LOCATION MAP

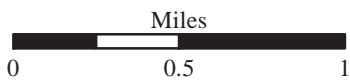
### Map 4



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

● Wall Locations

— RIP Collected Routes



# Tier 1 Park Retaining Wall Overview



Zion National Park



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## Parkwide Summary: Zion National Park

Initial retaining wall inspections were conducted at Zion National Park in 2006, and encompassed all known retaining wall structures associated with Park roadways - including structure's retaining cuts and fills, as well as qualifying headwalls at culverts. For the purposes of the assessment, walls must be a minimum of 4 feet in maximum height of retained earth and greater than 6 feet in maximum height for culvert headwalls. This does not include the height of parapet or guardwall above a retaining wall. In general, guardwall or parapets are not included in this assessment, but were inspected for Zion National Park in 2010 under a separate effort as part of the Guardwall/Rail Inventory Program (GIP). A report for GIP is available under separate cover.

All paved roadways and parking areas listed in the RIP Route Identification Report were inspected for walls. Occasionally, unpaved routes not in RIP were inventoried due to their future programmatic addition at the park, which was a decision made on site specific to each park.

The following tables provide an overview of the findings of this inspection and assessment effort. In all, 63 walls were inventoried on the routes listed below.

**Table 1: Number of Walls by Route**

<b>Route Number</b>	<b>Route Name</b>	<b>No. of Walls</b>
0010	ZION-MT CARMEL HIGHWAY	36
0011	ZION SCENIC CANYON DRIVE	19
0013	KOLOB CANYON ROAD	3
0402	MAINTENANCE ACCESS ROAD	5

The following table shows the number of walls broken out by seven possible categories of basic wall function.

**Table 2: Number of Walls by Wall Function**

<b>Wall Function</b>	<b>No. of Walls</b>
CW - Cut Wall	1
FW - Fill Wall	28
HW - Head Wall	32
SP - Slope Protection	1
SW - Switchback Wall	1

The following table shows the primary wall types that were inventoried and assessed. There are 24 possible primary wall types, which are summarized in Appendix A.

**Table 3: Number of Walls by Primary Wall Type**

Primary Wall Type	No. of Walls
GC, Gravity - Mass Concrete	2
GD, Gravity - Dry Stone	5
GM, Gravity - Mortared Stone	53
GRR, Other - Grouted Riprap, Class 4	1
MW, MSE - Welded Wire Face	1
TW, Other - T Wall - Proprietary	1

The following table shows the number of walls by one of six categories of recommended action along with associated 2007 costs and the number of walls that are in each recommended action category. The majority of walls have a recommendation of *No Action* or *Monitor*; work orders were created for all other recommended actions.

**Table 4: Number of Walls by Recommended Action and Associated 2007 Cost**

Recommended Action	2007 Repair Costs*	No. of Walls
No Action	\$0	41
Monitor	\$0	0
Maintenance	\$18,657	9
Repair Elements	\$67,142	10
Replace Elements	\$155,435	2
Replace Wall	\$22,380	1
<b>Totals</b>	<b>\$263,614</b>	<b>63</b>

\*2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

The following table categorizes the number of walls 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 walls are listed by individual wall in Tier 3 of this report.

**Table 5: Number of Walls Grouped by Associated 2007 Cost**

<b>Cost Range*</b>	<b>No. of Walls</b>
\$0	41
\$1 - \$25,000	19
\$25,001 - \$50,000	1
\$50,001 - \$100,000	2
\$100,001 - \$250,000	0
\$250,001 - \$500,000	0
\$500,001 - \$1,000,000	0
\$1,000,001 - \$2,000,000	0
\$2,000,001 - \$3,000,000	0
\$3,000,001 - \$4,000,000	0
<b>Total Number of Walls</b>	<b>63</b>

\*2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Routine inspection and performing the noted maintenance will greatly aid in the continued performance of all walls at Zion National Park. Work orders for walls needing maintenance generally included items such as replacing missing stones, replacing mortar, filling voids at the top or bottom of fill walls, and clearing vegetation.

Work orders for walls needing localized element repairs generally included items such as adding riprap protection to the wall foundation, replacing missing sections of dry stone walls, replacing culverts, grouting voids in walls, and patching/restoring roadway pavement. While decaying mortar generally does not threaten wall stability in the near term, grout repair will extend the life of these walls.

Work orders for walls needing major repairs (replace elements or replace wall) generally include items such as foundation repair or replacement, fill voids, repair roadway shoulder, replace or extend retaining wall in either height or length, rebuild failed segments of walls, repair elements across 50% or more of the wall, remove and recompact backfill material, add scour protection (typically with riprap, concrete, or rock fill), and remove/reset culvert headwalls. Due to the large unit items associated with major repairs, recommendations vary by specific wall and are presented in Tier 3 of this report.

WIP identified 55 critically deficient walls nationally based on wall ratings less than 49 (poor/critical overall condition). The following table presents the walls in Zion National Park that are on this list and have been elevated to the Park Regional Coordinators in a Regional Park Summary Memorandum. Generally, these are walls with major repair element recommendations that may be a priority for repair work in your park.

**Table 6: Number of Walls by Route**

<b>Wall Identification</b>	<b>Failure Consequence<sup>(1)</sup></b>	<b>Wall Rating<sup>(2)</sup></b>	<b>Recommended Action<sup>(3)</sup></b>	<b>2007 Repair Costs<sup>(4)</sup></b>
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No critically deficient walls.

Notes: 1) Low consequence of failure and/or no recommended action may indicate repairs are not needed.

2) Wall ratings listed range from 0-49 (Poor/Critical).

3) Information was prepared for project planning purposes only. Actual repair work order scopes and actual costs will need to be evaluated based on current pay item unit prices for specific locations.

4) 2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.



# Tier 2 Route Retaining Wall Overview



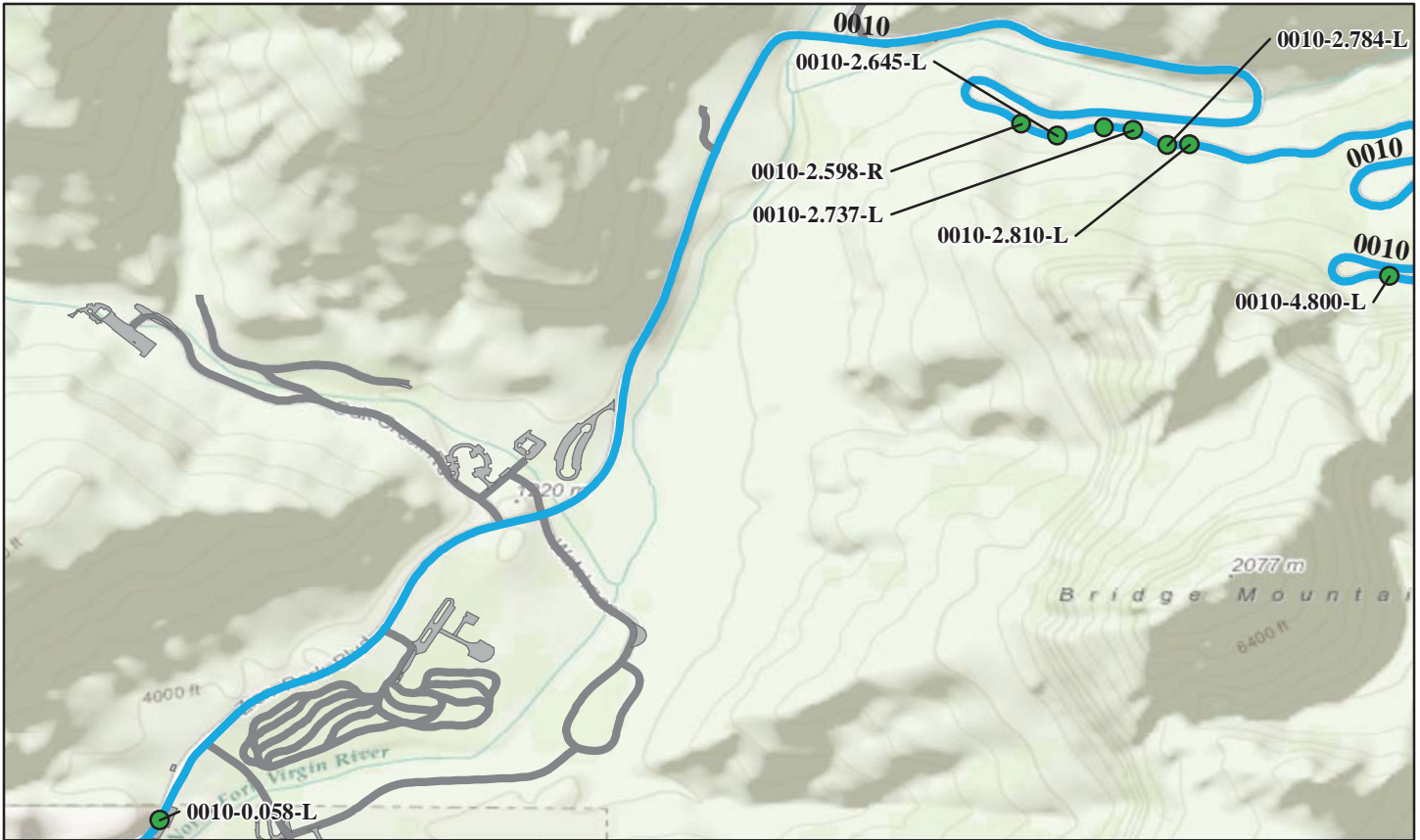
Zion National Park



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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

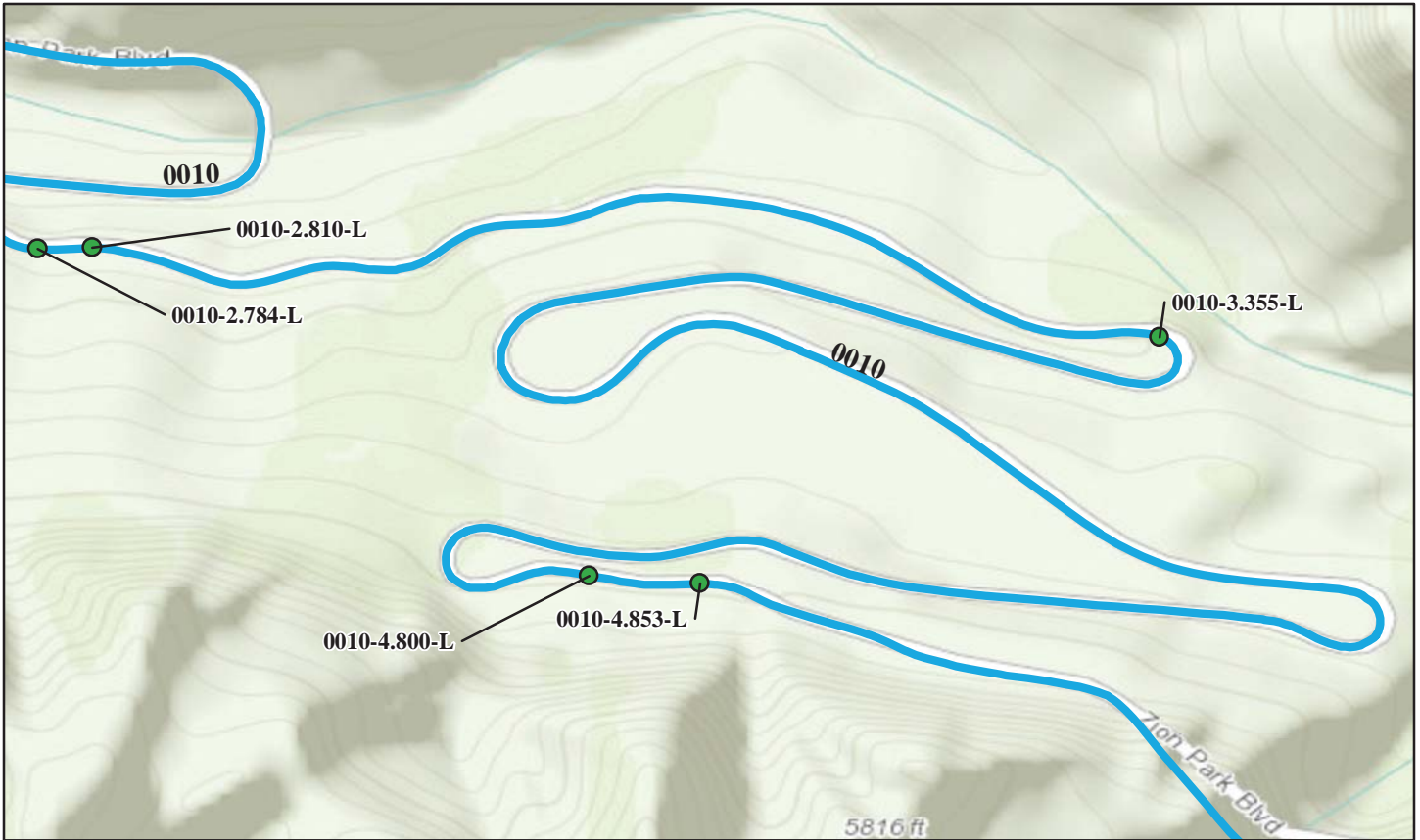
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-0.058-L 12/7/2006	148	106	Gravity - Mortared Stone	Cut Wall	100	\$0.00
ZION-0010-2.598-R 12/6/2006	70	14	Gravity - Mortared Stone	Head Wall	84	\$3,839.00
ZION-0010-2.645-L 12/6/2006	783	87	Gravity - Mortared Stone	Fill Wall	88	\$4,900.00
ZION-0010-2.702-L 12/6/2006	848	101	Gravity - Mortared Stone	Fill Wall	93	\$0.00
ZION-0010-2.737-L 12/6/2006	1,804	164	Gravity - Mortared Stone	Fill Wall	75	\$3,000.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-2.784-L 12/6/2006	180	30	Gravity - Mortared Stone	Fill Wall	84	\$0.00
ZION-0010-2.810-L 12/6/2006	930	155	Gravity - Mortared Stone	Fill Wall	92	\$0.00
ZION-0010-3.355-L 12/6/2006	1,450	145	Gravity - Mortared Stone	Fill Wall	74	\$0.00
ZION-0010-4.800-L 12/6/2006	774	129	Gravity - Mortared Stone	Switchback Wall	98	\$0.00
ZION-0010-4.853-L 12/6/2006	643	134	Gravity - Mortared Stone	Fill Wall	97	\$0.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-5.633-R 12/5/2006	33	11	Gravity - Mortared Stone	Head Wall	93	\$5,881.00
ZION-0010-6.511-L 12/6/2006	264	44	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0010-6.512-R 12/6/2006	940	108	Gravity - Mortared Stone	Fill Wall	100	\$0.00
ZION-0010-6.548-L 12/6/2006	63	14	Gravity - Mortared Stone	Head Wall	94	\$2,112.00
ZION-0010-6.552-R 12/6/2006	50	16	Gravity - Dry Stone	Head Wall	98	\$0.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-6.908-R 12/6/2006	950	95	Gravity - Mortared Stone	Fill Wall	100	\$0.00
ZION-0010-7.168-L 12/6/2006	32	9	Gravity - Mortared Stone	Head Wall	96	\$980.00
ZION-0010-7.215-L 12/6/2006	43	14	Gravity - Mortared Stone	Head Wall	98	\$0.00
ZION-0010-7.220-R 12/6/2006	936	104	Gravity - Mortared Stone	Fill Wall	98	\$1,444.00
ZION-0010-7.570-L 12/6/2006	111	27	Gravity - Mortared Stone	Head Wall	100	\$0.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-7.570-R 12/6/2006	220	40	Gravity - Mortared Stone	Head Wall	82	\$723.00
ZION-0010-8.065-R 12/6/2006	3,388	440	Gravity - Mortared Stone	Fill Wall	96	\$5,760.00
ZION-0010-8.388-L 12/6/2006	30	11	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0010-8.537-R 12/6/2006	288	34	Gravity - Mortared Stone	Head Wall	76	\$1,000.00
ZION-0010-8.538-L 12/6/2006	215	43	Gravity - Mortared Stone	Fill Wall	78	\$0.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-8.867-L 12/6/2006	253	38	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0010-8.867-R 12/6/2006	253	40	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0010-9.616-R 12/6/2006	590	118	Gravity - Mortared Stone	Fill Wall	96	\$750.00
ZION-0010-9.700-R 12/6/2006	1,000	158	Gravity - Mortared Stone	Fill Wall	94	\$500.00
ZION-0010-9.755-R 12/7/2006	600	100	Gravity - Mortared Stone	Fill Wall	92	\$0.00

\*2007 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

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No Data

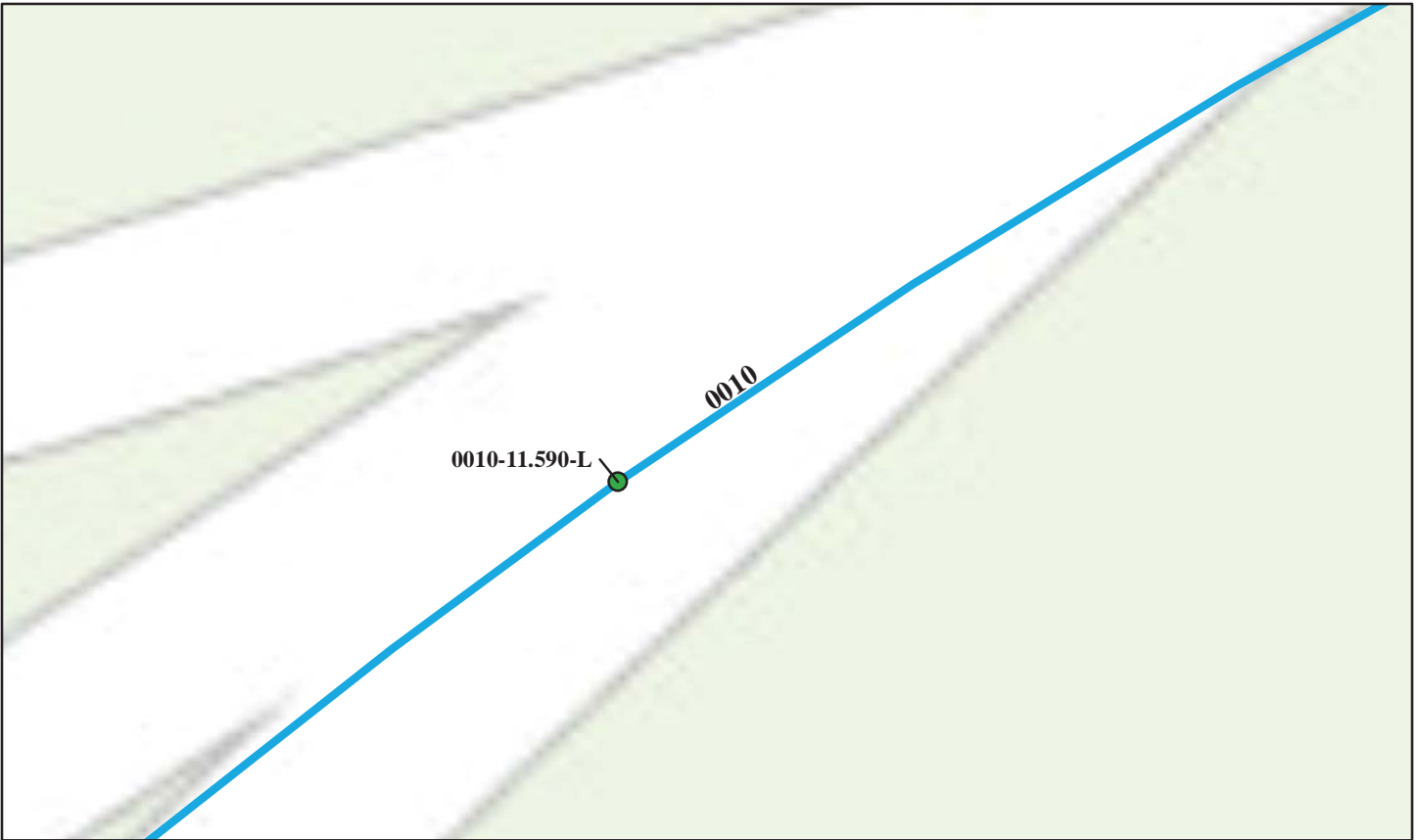
Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-9.885-R 12/7/2006	120	40	Gravity - Mortared Stone	Fill Wall	100	\$0.00
ZION-0010-9.896-R 12/7/2006	526	81	Gravity - Mortared Stone	Fill Wall	85	\$4,830.00
ZION-0010-9.957-R 12/7/2006	791	118	Gravity - Mortared Stone	Fill Wall	95	\$0.00
ZION-0010-11.248-R 12/7/2006	31	7	Gravity - Dry Stone	Head Wall	100	\$0.00
ZION-0010-11.276-L 12/7/2006	904	170	MSE - Welded Wire Face	Fill Wall	100	\$0.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0010-11.590-L 12/7/2006	74	24	Gravity - Mortared Stone	Head Wall	100	\$0.00

\*2007 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

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Good to Excellent (70 - 100)

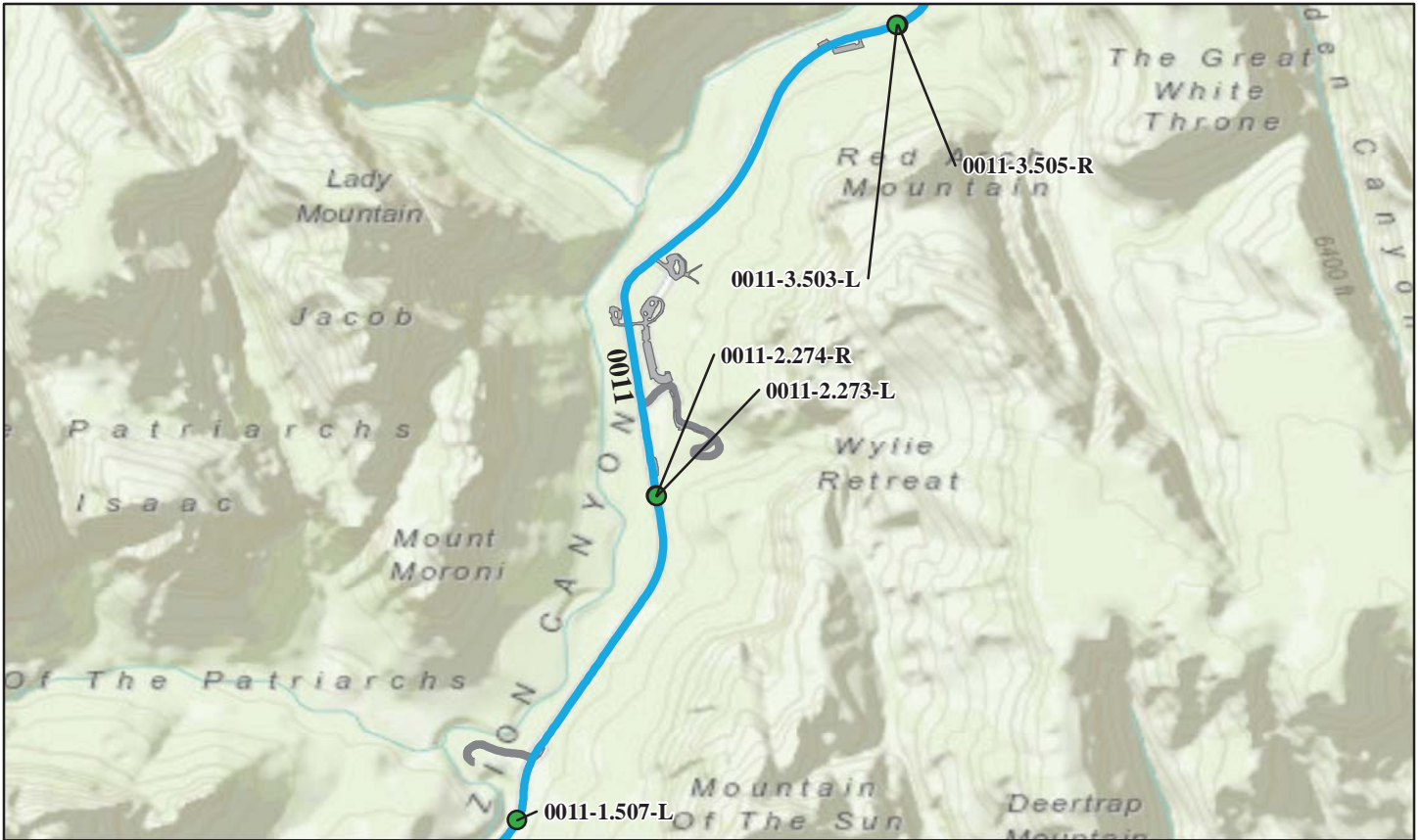
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0011-0.877-L 12/5/2006	5,002	435	Other - T Wall - Proprietary	Fill Wall	97	\$0.00
ZION-0011-1.115-L 12/5/2006	464	103	Gravity - Mortared Stone	Fill Wall	98	\$0.00
ZION-0011-1.270-L 12/5/2006	904	113	Gravity - Mortared Stone	Fill Wall	69	\$42,750.00
ZION-0011-1.307-L 12/5/2006	69	23	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0011-1.313-R 12/5/2006	1,500	100	Gravity - Mortared Stone	Fill Wall	54	\$58,875.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

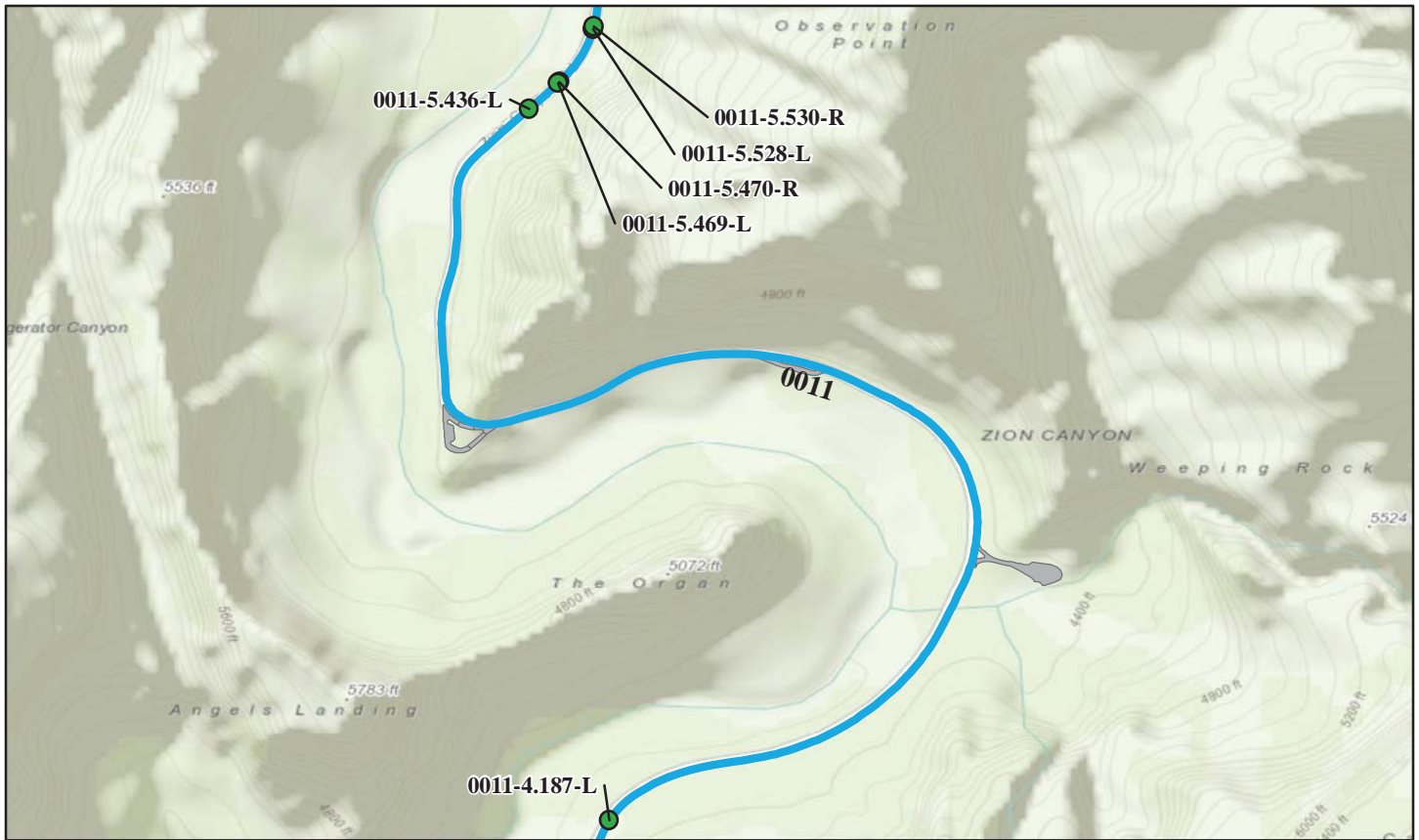
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0011-1.507-L 12/5/2006	378	86	Gravity - Mortared Stone	Fill Wall	100	\$0.00
ZION-0011-2.273-L 12/5/2006	138	34	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0011-2.274-R 12/5/2006	128	32	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0011-3.503-L 12/5/2006	139	33	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0011-3.505-R 12/5/2006	116	29	Gravity - Mortared Stone	Head Wall	100	\$0.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

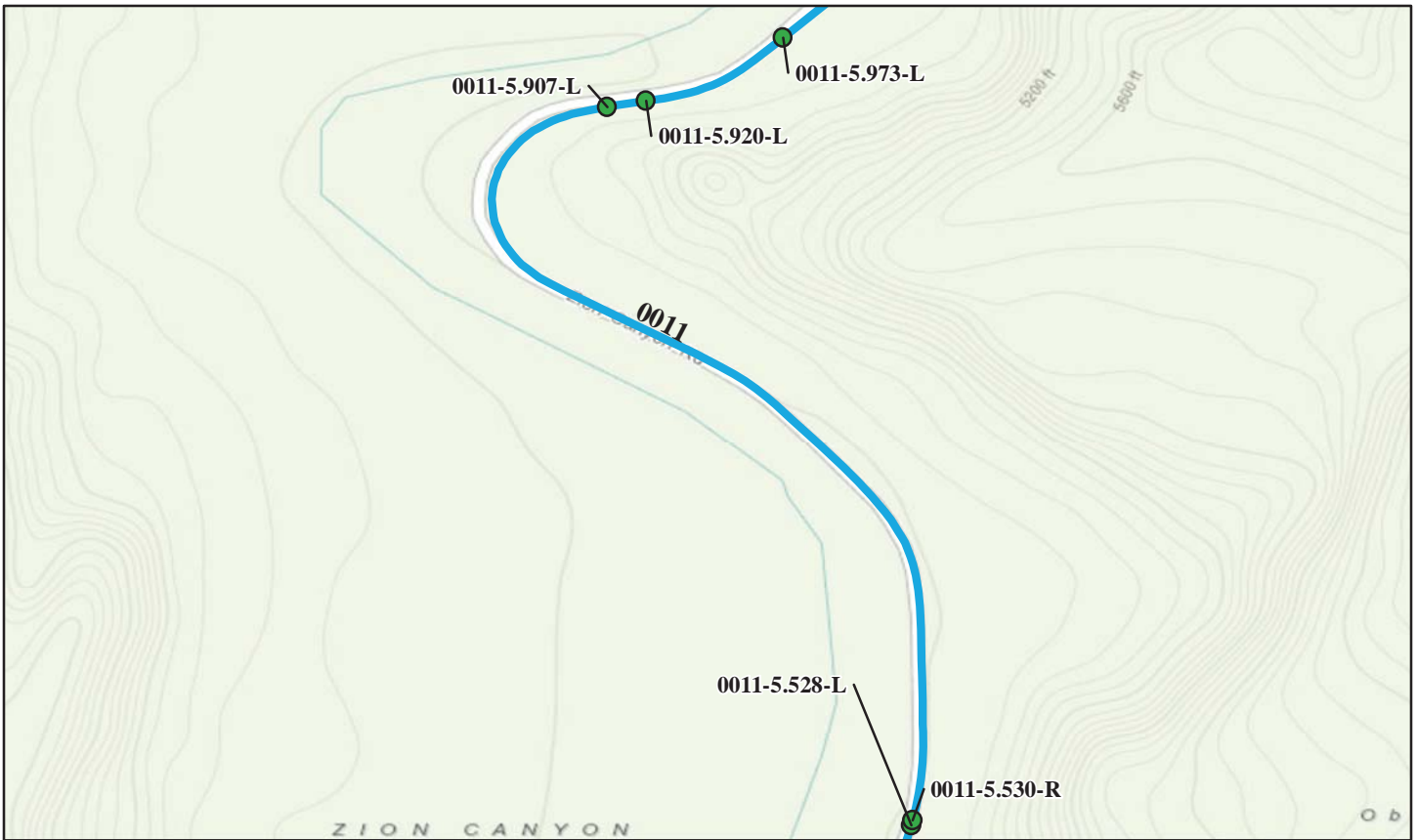
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0011-4.187-L 12/5/2006	27	10	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0011-5.436-L 12/5/2006	40	8	Gravity - Dry Stone	Head Wall	78	\$22,380.00
ZION-0011-5.469-L 12/5/2006	42	17	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0011-5.470-R 12/5/2006	274	61	Gravity - Mortared Stone	Fill Wall	99	\$0.00
ZION-0011-5.528-L 12/5/2006	100	20	Gravity - Mortared Stone	Head Wall	93	\$1,750.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0011-5.530-R 12/5/2006	36	9	Gravity - Mortared Stone	Head Wall	97	\$1,750.00
ZION-0011-5.907-L 12/5/2006	375	75	Gravity - Dry Stone	Fill Wall	89	\$330.00
ZION-0011-5.920-L 12/5/2006	1,200	280	Other - Grouted Riprap, Class 4	Slope Protection	70	\$96,560.00
ZION-0011-5.973-L 12/5/2006	435	87	Gravity - Dry Stone	Fill Wall	94	\$0.00

\*2007 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

### Retaining Wall Condition Legend – Wall Condition Rating

Critical / Poor (0 - 49)

Fair (50 - 69)

Good to Excellent (70 - 100)

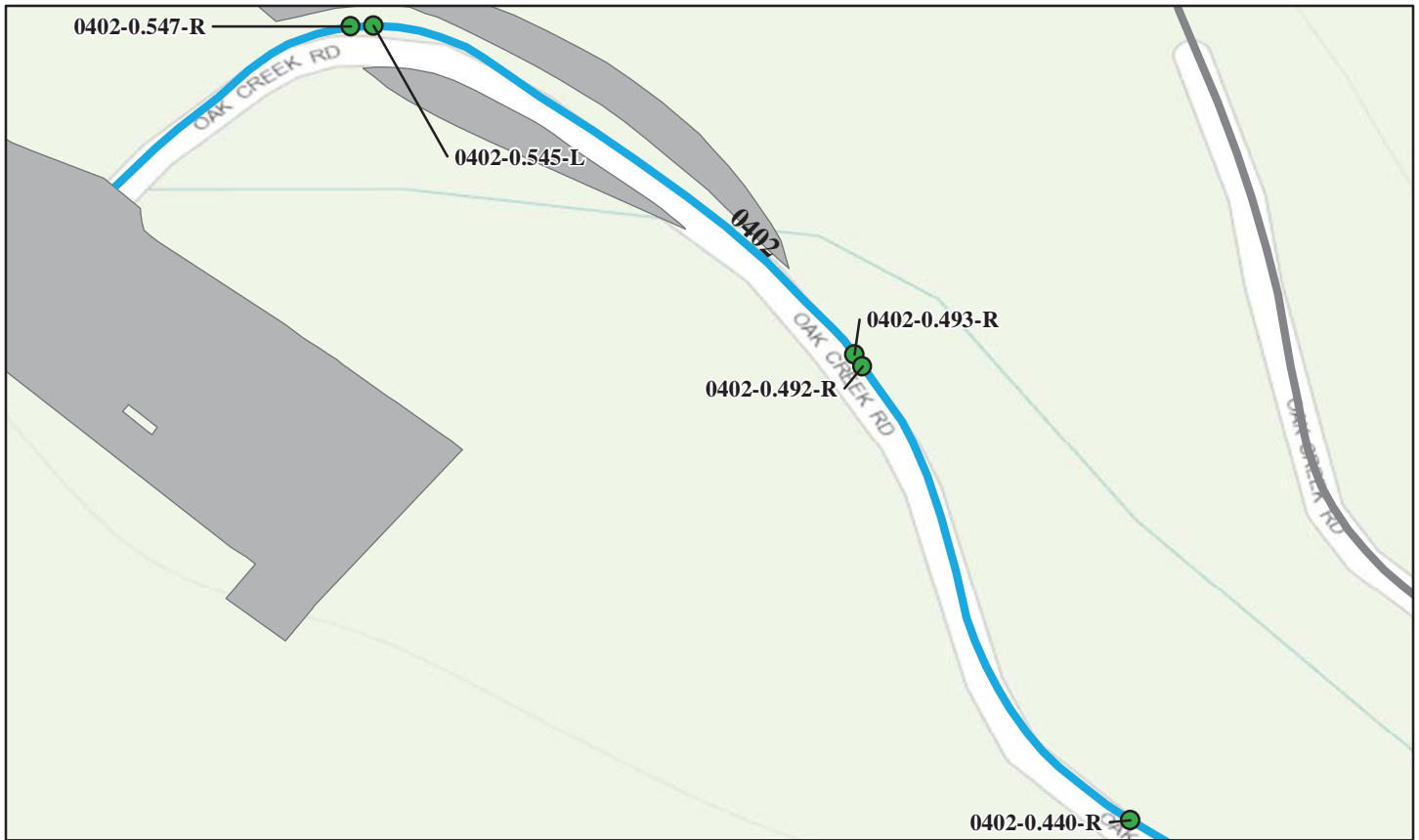
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0013-4.163-L 12/7/2006	108	36	Gravity - Mortared Stone	Head Wall	97	\$0.00
ZION-0013-4.164-R 12/7/2006	36	12	Gravity - Mass Concrete	Head Wall	100	\$0.00
ZION-0013-4.315-R 12/7/2006	68	20	Gravity - Mass Concrete	Head Wall	100	\$0.00

\*2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

## ROUTE 0402: MAINTENANCE ACCESS 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

### Retaining Wall Condition Legend – Wall Condition Rating

<b>Critical / Poor (0 - 49)</b>	<b>Fair (50 - 69)</b>	<b>Good to Excellent (70 - 100)</b>	<b>No Data</b>
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
ZION-0402-0.440-R 12/5/2006	368	92	Gravity - Mortared Stone	Fill Wall	100	\$0.00
ZION-0402-0.492-R 12/5/2006	89	24	Gravity - Mortared Stone	Head Wall	100	\$0.00
ZION-0402-0.493-R 12/5/2006	67	29	Gravity - Mortared Stone	Head Wall	96	\$0.00
ZION-0402-0.545-L 12/4/2006	158	33	Gravity - Mortared Stone	Head Wall	94	\$1,250.00
ZION-0402-0.547-R 12/4/2006	149	30	Gravity - Mortared Stone	Head Wall	93	\$2,250.00

\*2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Tier 3 Retaining Wall Details



Zion National Park



Federal Lands Highway  
Road Inventory Program



<b>Wall ID:</b>	ZION-0010-0.058-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Cut Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Start wall at 2.5 ft height. Stone extends 49 ft back. Wall at west entrance sign.		

**Wall Measurements**

<b>Wall Length (ft.):</b>	106	<b>Face Area (sq.):</b>	148
<b>Average Wall Height (ft.):</b>	1	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	1

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	NO DISTRESS	10
STONE MASONRY 8.00	NO DISTRESS	10
LATERAL SLOPE 0.50	NO DISTRESS	10
UPSLOPE 0.50	GOOD	10

**Repair Recommendations**

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_0.058\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-2.598-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	84	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	3 ft diameter culvert headwall		

### Wall Measurements

<b>Wall Length (ft.):</b>	14	<b>Face Area (sq.):</b>	70
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Rocks blocking inlet of culvert have potential to block flow, resulting in damage to roadway.	8
WALL FOUNDATION MATERIAL 8.00	No scour at base.	10
STONE MASONRY 8.00	Cracked and displaced .5 to 3" at both ends. Two stones at center of wall are degrading and spalling.	8
CULVERT 0.50	3' diameter CMP in good condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good Condition.	10
DOWNSLOPE 1.00	Stream channel - Rocks partially blocking inlet, may cause overtopping.	6
LATERAL SLOPE 1.00	Erosion in RT ditch has damaged end of wall. Repaired by clumping riprap to fill 10' wide erosion of embankment.	6
VEGETATION 1.00	Bush growing out of center of wall has caused surface spelling of two adjacent stones up to 3" deep.	6

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Remove and reset masonry stone at both ends of wall: Estimate 10 sq ft x 1.5' thick = 0.6 CUYD. Extend wall ahead 10': average 5' high x 10' long x 1.5' width = 2.8 CUYD. Remove stones at inlet: Backhoe and dump truck for one hour each.
<b>Repair Cost:</b>	\$3,839

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_2.598\_R\_1.jpg

<b>Wall ID:</b>	ZION-0010-2.645-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	88	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Mortared stone fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	87	<b>Face Area (sq.):</b>	783
<b>Average Wall Height (ft.):</b>	9	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	14	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Outlet erosion at CMP severe but not effecting wall/foundation now. Needs repair soon.	7
WALL FOUNDATION MATERIAL 8.00	No distress	10
STONE MASONRY 8.00	No significant distress. Minor bulging at 24" CMP on wall face.	10
DOWNSLOPE 0.50	Very steep (+30 deg). Stable, slightly eroded.	8
LATERAL SLOPE 0.50	Steep. Signs of erosion repair.	8
CURB/BERM/DITCH 0.50	Berm at start of wall recently added to. No distress.	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress, settlement.	10
TRAFFIC BARRIER/FENCE 0.50	No deflection	10
WALL DRAINS 5.00	4 8" drains and a 24" CMP in wall face. Severe outlet channel erosion under CMP. 5' deep within 10 ft of wall base.	3

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Place erosion control armor in outlet channel of 24" CMP. $25 \times 6 \times 4 = 600 \text{cf}$ $600/27 = 22 \text{cy}$ . Use 25cy x \$196/cy = \$4900 Used FHWA unit cost for Class 3 riprap.
<b>Repair Cost:</b>	\$4,900

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_2.645\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-2.702-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	93	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry fill wall		

### Wall Measurements

<b>Wall Length (ft.):</b>	101	<b>Face Area (sq.):</b>	848
<b>Average Wall Height (ft.):</b>	8	<b>Face Angle (deg.):</b>	85
<b>Maximum Wall Height (ft.):</b>	16	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Generally good performance, however top of wall at tallest section is rotating out.	9
WALL FOUNDATION MATERIAL 8.00	No distress.	10
STONE MASONRY 8.00	Excellent condition.	10
CULVERT 0.50	18" diameter CMP @ 25' from wall start and shotguns 4' above base of wall, causing minor erosion at toe.	8
WALL DRAINS 0.50	One 6" drain pipe in tallest section. Inadequate for wall this size.	9
DOWNSLOPE 0.50	Steep, rocky slope - stable.	10
ROAD/SIDEWALK/SHOULDER 1.00	Patched adjacent to parapet from wall rotation.	6
LATERAL SLOPE 1.00	Erosion and loss of shoulder width at end of wall and 10' beyond.	7
TRAFFIC BARRIER/FENCE 1.00	Slight rotation (3" horz offset) outward of parapet.	7

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0010-2.702-L.**



<b>Wall ID:</b>	ZION-0010-2.737-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	75	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Inspected 10 years ago. Large cracks noted then do not appear to have changed.		

### Wall Measurements

<b>Wall Length (ft.):</b>	164	<b>Face Area (sq.):</b>	1804
<b>Average Wall Height (ft.):</b>	11	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	19	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Cracking would normally be considered severe. No change in ten years however.	8
WALL FOUNDATION MATERIAL 8.00	Steep. No distress.	9
STONE MASONRY 8.00	Full-height vertical cracks in 1st 50 ft of wall. Stones fractured, crack edges worn. Same cracking as from survey 10 years ago.	6
DOWNSLOPE 0.50	Steep, well vegetated.	9
LATERAL SLOPE 0.50	Steep	9
UPSLOPE 0.50	Steep, stable, well vegetated.	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
TRAFFIC BARRIER/FENCE 1.00	Guardwall tipped outward for 1st 90 ft.	6
CURB/BERM/DITCH 1.00	Edge drain for surface water eroded at outlet.	7

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Place erosion control armor in surface drain outlet channel. 6'x20'x3' = 360cf 360/27 = 13.3cy. Use 15cy x \$200/cy = \$3,000
<b>Repair Cost:</b>	\$3,000

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

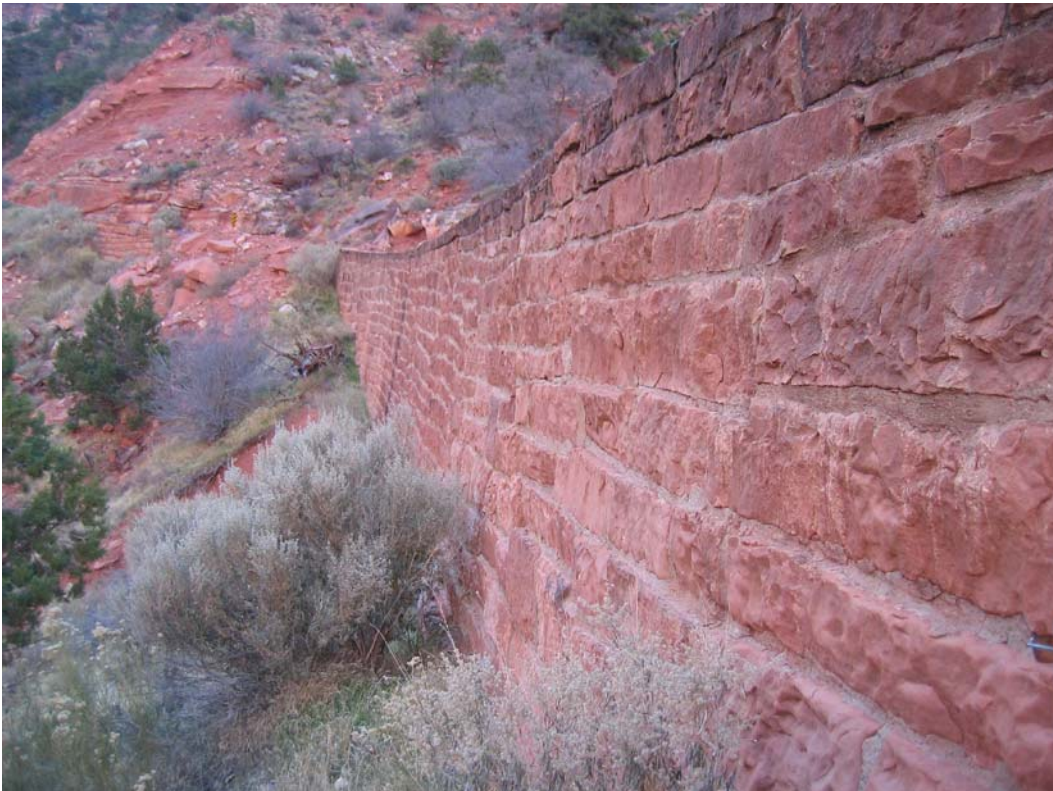
# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_2.737\_L\_1.jpg



ZION\_0010\_2.737\_L\_2.jpg

<b>Wall ID:</b>	ZION-0010-2.784-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	84	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	30	<b>Face Area (sq.):</b>	180
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	10	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Generally in good condition. Erosion at ends and base is causing wall rotation.	8
WALL FOUNDATION MATERIAL 8.00	Toe at center of wall is undermined for 4' length and 6" under wall. End is undermined for last 6' Wall is rotating outward about 1" horizontally.	8
STONE MASONRY 8.00	Good condition, some minor vegetation damage.	10
VEGETATION 0.50	Several small bushes are growing in face, causing minor damage to mortar.	9
DOWNSLOPE 0.50	Steep, stable slope.	10
ROAD/SIDEWALK/SHOULDER 1.00	Patched from wall rotation.	6
LATERAL SLOPE 1.00	Loss of shoulder due to erosion at beginning of wall and 10' back on line. Last 6' of wall is undermined to 12' depth.	7
TRAFFIC BARRIER/FENCE 1.00	Parapet is rotating with wall. Parapet grout is in poor condition with about 10% voids.	7

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_2.784\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0010-2.810-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	92	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	155	<b>Face Area (sq.):</b>	930
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	11	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Overall performance is good.	10
WALL FOUNDATION MATERIAL 8.00	Undermined near center for 3' length.	10
STONE MASONRY 8.00	Good condition with minor (1/32") cracks throughout mortar. Several 1/8" full height cracks.	9
DOWNSLOPE 0.50	Steep, well vegetated, stable slope.	10
LATERAL SLOPE 0.50	Good condition.	10
WALL DRAINS 0.50	Two 8" drains near center.	10
ROAD/SIDEWALK/SHOULDER 1.00	Patched from parapet rotation.	7
TRAFFIC BARRIER/FENCE 1.00	Parapet rotating out 2".	7

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_2.810\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0010-3.355-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	74	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry fill wall		

### Wall Measurements

<b>Wall Length (ft.):</b>	145	<b>Face Area (sq.):</b>	1450
<b>Average Wall Height (ft.):</b>	10	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	14	<b>Vertical Offset (ft.):</b>	17

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Although cracks show slope movement has caused significant wall distress, wall is performing well.	8
WALL FOUNDATION MATERIAL 8.00	Distress to masonry. Possibly due to slope movement.	7
STONE MASONRY 8.00	Two full height cracks near center up to 1" wide. Six other full height cracks at last 1/3 of wall with 2" horizontal displacement, 5" horz. Displacement. Crack monitors (bolts) in place.	7
WALL DRAINS 0.50	Two 8" drains observed. Probably inadequate drainage.	8
LATERAL SLOPE 0.50	Good condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10
DOWNSLOPE 1.00	Potential creeping colluvium.	6

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_3.355\_L\_1.jpg**



**ZION\_0010\_3.355\_L\_2.jpg**



<b>Wall ID:</b>	ZION-0010-4.800-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	98	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Switchback Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry cut wall on switchback		

### Wall Measurements

<b>Wall Length (ft.):</b>	129	<b>Face Area (sq.):</b>	774
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	-1

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good.	10
WALL FOUNDATION MATERIAL 8.00	No distress.	10
STONE MASONRY 8.00	Good condition, .025 to 0.5" vertical crack at beginning of wall, minor 1/8" vertical crack at center.	10
CURB/BERM/DITCH 0.50	Paved ditch at base of wall is in good condition.	10
LATERAL SLOPE 0.50	Good condition, warps into slope.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10
UPSLOPE 0.50	32 degrees, stable, well vegetated.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_4.800\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-4.853-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	97	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry fill wall		

**Wall Measurements**

<b>Wall Length (ft.):</b>	134	<b>Face Area (sq.):</b>	643
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	0

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
WALL FOUNDATION MATERIAL 8.00	No distress, concrete footing exposed for 10' near center of wall from minor surface erosion.	10
STONE MASONRY 8.00	Good Condition	10
TRAFFIC BARRIER/FENCE 0.50	Mortar/rock separation last 30'.	8
CURB/BERM/DITCH 0.50	Good condition.	10
DOWNSLOPE 0.50	Steep, stable, well vegetated.	10
LATERAL SLOPE 0.50	Abuts into 2-3' parapet wall at ends..	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10

**Repair Recommendations**

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_4.853\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0010-5.633-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	93	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	3 ft diameter culvert headwall		

### Wall Measurements

<b>Wall Length (ft.):</b>	11	<b>Face Area (sq.):</b>	33
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good	10
WALL FOUNDATION MATERIAL 8.00	No scour.	10
STONE MASONRY 8.00	Good condition. Top 2' of wall has been displaced and reset without mortar.	9
CULVERT 1.00	3' diameter culvert is rusted-out at bottom for 12" width.	5
DOWNSLOPE 0.50	Stable stream Channel	10
VEGETATION 0.50	Well vegetated lateral slopes	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Repair rusted-out culvert for 12" width x 40' length x average 3" depth. Assume concrete gutter item, 40 LNFT. Remove and reset masonry stone. 2' height x 11' length X 18" WIDTH = 1.5 CUYD. Costs based on cost guide RWIP basis. Item 60905-1000
<b>Repair Cost:</b>	\$5,881

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0010-5.633-R.**

<b>Wall ID:</b>	ZION-0010-6.511-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	16 ft wide x 8 ft high masonry culvert headwall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	44	<b>Face Area (sq.):</b>	264
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	12	<b>Vertical Offset (ft.):</b>	48

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Excellent, a work of art!	10
WALL FOUNDATION MATERIAL 8.00	No distress.	10
STONE MASONRY 8.00	Excellent condition, beautiful masonry work!	10
CULVERT 0.50	16' wide x 8' high stone masonry arch culvert, good condition.	10
DOWNSLOPE 0.50	Flat streambed, no scour.	10
LATERAL SLOPE 0.50	Good Condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10
UPSLOPE 0.50	Steep, well vegetated, stable.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_6.511\_L\_1.jpg**



<b>Wall ID:</b>	ZION-0010-6.512-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Fill wall downstream from 14 ft dia stone arch headwall. Headwall area included in wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	108	<b>Face Area (sq.):</b>	940
<b>Average Wall Height (ft.):</b>	9	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	15	<b>Vertical Offset (ft.):</b>	39

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good performance	10
WALL FOUNDATION MATERIAL 8.00	No distress	10
STONE MASONRY 8.00	No distress	10
CURB/BERM/DITCH 0.50	Outlet channel for culvert above headwall eroded and repaired.	8
DOWNSLOPE 0.50	Sandy stream bottom. No undermining.	10
LATERAL SLOPE 0.50	In-place rock at or near surface both ends.	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
UPSLOPE 0.50	Road fill. Stable	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_6.512\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0010-6.548-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	94	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Twin 3 ft diameter CMP headwall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	14	<b>Face Area (sq.):</b>	63
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	17

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition, culvert size restricts flow, causing scour on side an above headwall during high water. Existing embankment is now over steepened, and raveling.	9
WALL FOUNDATION MATERIAL 8.00	No scour, wall on rock.	10
STONE MASONRY 8.00	Excellent work and condition	10
CULVERT 0.50	Good condition., possibly undersized.	9
DOWNSLOPE 0.50	Rock Streambed.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10
LATERAL SLOPE 1.00	Scoured at beginning of wall from high water events is causing erosion and oversteepened embankment that is now susceptible to surface sloughs that threaten roadway shoulder.	6
UPSLOPE 1.00	Oversteepened, raveling to shoulder	6

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Place rock armor: 14' slope distance x 14' length x average 3' deep = 22 CUYD Class 3 Riprap. Costs based on cost guide RWIP basis. Item 25101-3000 Placed riprap, class 3. 22 cuyd @ \$ 196/ cuyd = \$2112
<b>Repair Cost:</b>	\$2,112

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_6.548\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0010-6.552-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	98	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Dry stacked rockery wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	16	<b>Face Area (sq.):</b>	50
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	16

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good performance	10
WALL FOUNDATION MATERIAL 8.00	In-place rock	10
PLACED STONE 8.00	Wall damaged above 1st culvert from side cast material. 2'x5' area	10
CURB/BERM/DITCH 0.50	Erosion channel above first culvert recently filled with stone	10
CULVERT 0.50	twin 36" cmp	10
LATERAL SLOPE 0.50	Rock	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_6.552\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0010-6.908-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry fill wall.		

**Wall Measurements**

<b>Wall Length (ft.):</b>	95	<b>Face Area (sq.):</b>	950
<b>Average Wall Height (ft.):</b>	10	<b>Face Angle (deg.):</b>	85
<b>Maximum Wall Height (ft.):</b>	17	<b>Vertical Offset (ft.):</b>	0

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Excellent condition.	10
WALL FOUNDATION MATERIAL 8.00	No distress.	10
STONE MASONRY 8.00	Excellent condition.	10
DOWNSLOPE 0.50	2' x 8' flat bench at toe is stable and well vegetated.	10
LATERAL SLOPE 0.50	Good condition, transitions into outcrops.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good Condition	10
TRAFFIC BARRIER/FENCE 0.50	Parapet 1.5' high in good condition	10

**Repair Recommendations**

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_6.908\_R\_1.jpg



<b>Wall ID:</b>	ZION-0010-7.168-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	96	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	3 ft diameter CMP headwall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	9	<b>Face Area (sq.):</b>	32
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	16

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition, poor alignment causes minor erosion.	9
WALL FOUNDATION MATERIAL 8.00	No scour, on rock.	10
STONE MASONRY 8.00	Good condition.	10
CULVERT 0.50	Poorly aligned with stream, causing erosion of lateral slope.	8
LATERAL SLOPE 0.50	Minor erosion at beginning of headwall	9
ROAD/SIDEWALK/SHOULDER 0.50	Good Condition.	10
UPSLOPE 0.50	Flat bench @ 1:4 for 10' then steep, well vegetated embankment.	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Fill scoured pocket at end of wall with class 3 riprap. Estimated quantity =5 CUYD. Cost based on cost guide RWIP basis. Item 25101-3000. Placed riprap , CLASS 3 - 5 cuyd @ \$ 196/ CUYD = \$ 980
<b>Repair Cost:</b>	\$980

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_7.168\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-7.215-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	98	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Mortared stone head wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	14	<b>Face Area (sq.):</b>	43
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	1

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	No distress	10
WALL FOUNDATION MATERIAL 8.00	No distress	10
STONE MASONRY 8.00	No distress	10
CULVERT 0.50	18" cmp	10
LATERAL SLOPE 0.50	Rock	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_7.215\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-7.220-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	98	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone masonry fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	104	<b>Face Area (sq.):</b>	936
<b>Average Wall Height (ft.):</b>	9	<b>Face Angle (deg.):</b>	86
<b>Maximum Wall Height (ft.):</b>	11	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	No distress.	10
STONE MASONRY 8.00	Good condition, one 3/4" open full height crack.	10
ROAD/SIDEWALK/SHOULDER 0.50	Minor shoulder erosion at ends of wall.	8
LATERAL SLOPE 0.50	Minor erosion at beginning of wall	10
DOWNSLOPE 0.50	Moderate slope, stable, well vegetated.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Place rubble masonry waterway at end of wall: 10' length x 3' width x 6" depth = 1.25 CUYD. Cost based on cost guide RWIP basis. Item 62001-All Rubble Masonry. 1.25 CUYD @ \$ 1155/ CUYD = \$ 1,444
<b>Repair Cost:</b>	\$1,444

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_7.220\_R\_1.jpg

<b>Wall ID:</b>	ZION-0010-7.570-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	4 36 in cmp at east portal of short tunnel		

### Wall Measurements

<b>Wall Length (ft.):</b>	27	<b>Face Area (sq.):</b>	111
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good performance	10
WALL FOUNDATION MATERIAL 8.00	Rock	10
STONE MASONRY 8.00	No distress	10
CULVERT 0.50	4 36" cmp	10
LATERAL SLOPE 0.50	Rock	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_7.570\_L\_1.jpg**



<b>Wall ID:</b>	ZION-0010-7.570-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	82	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Four 3 ft CMP headwall and wingwalls.		

### Wall Measurements

<b>Wall Length (ft.):</b>	40	<b>Face Area (sq.):</b>	220
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good, moderately scoured along base of foundation.	9
WALL FOUNDATION MATERIAL 8.00	Scoured over 30% of base (sandstone abrasion). Scour holes 6" to 12" deep.	7
STONE MASONRY 8.00	Fair condition, recent repointing. Wingwall is newer and is in good condition.	8
CULVERT 0.50	four 3' diameter CMP, slight rust in bottom 12".	9
VEGETATION 0.50	Shrubs growing in scour hole at base.	9
DOWNSLOPE 0.50	Bedrock streambed.	10
LATERAL SLOPE 0.50	Good condition	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Place concrete in scour holes: Estimated quantity = 0.5 CUYD concrete. Cost based on cost guide RWIP basis. Item 60101-000 Concrete - 0.5 CuYd @ \$ 1446/ CuYd = \$ 723
<b>Repair Cost:</b>	\$723

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_7.570\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0010-8.065-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	96	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Mortared stone fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	440	<b>Face Area (sq.):</b>	3388
<b>Average Wall Height (ft.):</b>	8	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	12	<b>Vertical Offset (ft.):</b>	1

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good.	9
WALL FOUNDATION MATERIAL 8.00	First half - steep, well vegetated soil. Second half - rock	10
STONE MASONRY 8.00	No distress	10
CURB/BERM/DITCH 0.50	Road edge drained with stone-lined channels. Working well	10
DOWNSLOPE 0.50	Steep - rock and well vegetated soil	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
WALL DRAINS 0.50	Weep holes. Working	10
LATERAL SLOPE 1.00	Slope eroded at wall start. Wall end exposed. End dumped material not effective in repair.	7

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Construct stone-lined drainage channel and spillway at wall start 15'x5'. Armor slope with stone at channel outlet 30'x5'x1.5'. Spillway - $(15 \times 5) / 9 = 8.33 \text{ sy} \times 1 \text{ m} / 1.196 \text{ sy} = 7 \text{ sm}$ . Use $8 \text{ sm} \times \$475 / \text{sm} = \$3800$ Used FHWA paved waterway cost 2003 inflated
<b>Repair Cost:</b>	\$5,760

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_8.065\_R\_1.jpg

<b>Wall ID:</b>	ZION-0010-8.388-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Headwall for 2 in CMP		

### Wall Measurements

<b>Wall Length (ft.):</b>	11	<b>Face Area (sq.):</b>	30
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	NO DISTRESS	10
STONE MASONRY 8.00	EXCELLENT	10
CULVERT 0.50	24" CMP, NO DISTRESS	10
LATERAL SLOPE 0.50	NO EROSION, WELL VEGETATED	10
UPSLOPE 0.50	GOOD	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_8.388\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-8.537-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	76	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Wall height from top of tunnel.		

### Wall Measurements

<b>Wall Length (ft.):</b>	34	<b>Face Area (sq.):</b>	288
<b>Average Wall Height (ft.):</b>	8	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	15	<b>Vertical Offset (ft.):</b>	9

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Performing well	9
WALL FOUNDATION MATERIAL 8.00	UNDERMINING AT END OF ARCH OPENING; 1' VERTICAL x 1' HORIZ x 3' DEEP - UNDERNEATH VERTICAL CRACK	6
STONE MASONRY 8.00	FULL HEIGHT VERTICAL CRACK THROUGH MORTAR AND STONE; 5" AT TOP TAPERING TO 1" AT BOTTOM. PLUMB, NO DEFLECTION OR ROTATION	8
CULVERT 0.50	NO DISTRESS. ROCK TUNNEL	10
LATERAL SLOPE 0.50	STABLE, VEGETATED	10
ROAD/SIDEWALK/SHOULDER 0.50	NO DISTRESS	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Repair foundation undermining. Remove loose material and tie foundation repair into rock so that additional undermining is prevented. Monitor vertical crack in wall and any associated deflection of wall.
<b>Repair Cost:</b>	\$1,000

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_8.537\_R\_1.jpg



<b>Wall ID:</b>	ZION-0010-8.538-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	78	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Fill wall on left.		

### Wall Measurements

<b>Wall Length (ft.):</b>	43	<b>Face Area (sq.):</b>	215
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	8

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good.	8
WALL FOUNDATION MATERIAL 8.00	SCORING ABOUT 5' LENGTH AND 6" DEEP; BEGINNING FOUNDATION ON END 5 SETTLING	7
STONE MASONRY 8.00	FULL LENGTH CRACKING; 1/2" WIDE. 2" WIDE CRACK 2.5' FROM WALL END. NO DEFLECTION NOTED	8
DOWNSLOPE 0.50	STEEP; NO EROSION	10
LATERAL SLOPE 0.50	WELL VEGETATED	10
UPSLOPE 0.50	WELL VEGETATED	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_8.538\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-8.867-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1928
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Stone arch culvert with wingwalls 14 ft diameter arch		

### Wall Measurements

<b>Wall Length (ft.):</b>	38	<b>Face Area (sq.):</b>	253
<b>Average Wall Height (ft.):</b>	7	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	12	<b>Vertical Offset (ft.):</b>	16

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	EXCELLENT CONDITION; NO UNDERMINING	10
STONE MASONRY 8.00	NO DISTRESS	10
CULVERT 0.50	STONE ARCH CULVERT	10
LATERAL SLOPE 0.50	NO EROSION	10
UPSLOPE 0.50	WELL VEGETATED	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_8.867\_L\_1.jpg

<b>Wall ID:</b>	ZION-0010-8.867-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Headwall for 7 ft radius stone masonry culvert		

### Wall Measurements

<b>Wall Length (ft.):</b>	40	<b>Face Area (sq.):</b>	253
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	12	<b>Vertical Offset (ft.):</b>	15

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	GOOD	10
STONE MASONRY 8.00	NO DISTRESS	10
CULVERT 0.50	GOOD CONDITION, 7' RADIUS STONE MASONRY	10
LATERAL SLOPE 0.50	WELL VEGETATED, NO EROSION	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_8.867\_R\_1.jpg

<b>Wall ID:</b>	ZION-0010-9.616-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	96	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Fill wall on right.		

### Wall Measurements

<b>Wall Length (ft.):</b>	118	<b>Face Area (sq.):</b>	590
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	10

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good performance	9
WALL FOUNDATION MATERIAL 8.00	GOOD, NO UNDERMINING	10
STONE MASONRY 8.00	NO DISTRESS, GOOD CONDITION	10
UPSLOPE 0.50	WELL VEGETATED	10
LATERAL SLOPE 1.00	UNDERMINING OF RIPRAP SLOPE PROTECTION AT BEGINNING OF WALL; 4' DEEP x 15' LENGTH. DOESN'T SEEM TO AFFECT WALL PERFORMANCE.	7

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Excavate beneath undermined slope protection (to rock) and replace with mortared riprap.
<b>Repair Cost:</b>	\$750

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_9.616\_R\_1.jpg



<b>Wall ID:</b>	ZION-0010-9.700-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 06, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	94	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Fill wall on right.		

### Wall Measurements

<b>Wall Length (ft.):</b>	158	<b>Face Area (sq.):</b>	1000
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	10	<b>Vertical Offset (ft.):</b>	26

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	9
WALL FOUNDATION MATERIAL 8.00	NO DISTRESS	10
STONE MASONRY 8.00	NO DISTRESS	10
UPSLOPE 1.00	EROSION IN UPSLOPE OF UP TO 3' DEEP AT BEGINNING OF WALL; EROSION DUE TO ROAD SURFACE RUNOFF	6
CURB/BERM/DITCH 1.00	TOP OF EXISTING STONE CURB FLUSH WITH PAVEMENT, NOT USEFUL IN PROTECTING SLOPE	7

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Carry roadway drainage to adequate system by providing Curb/berm along shoulder of roadway. Existing stone curb could be raised to protect wall upslope.
<b>Repair Cost:</b>	\$500

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_9.700\_R\_1.jpg

<b>Wall ID:</b>	ZION-0010-9.755-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	92	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Fill wall on right.		

### Wall Measurements

<b>Wall Length (ft.):</b>	100	<b>Face Area (sq.):</b>	600
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	85
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	GOOD SHAPE, PERFORMING WELL	10
STONE MASONRY 8.00	GAPS IN MASONRY, MINOR CRACKING AND SEPARATION OF MORTAR	8
CULVERT 0.50	18" CMP CROSS DRAIN IN GOOD SHAPE	10
DOWNSLOPE 0.50	ROCK; STEEP; NO EROSION	10
LATERAL SLOPE 0.50	NO EROSION	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_9.755\_R\_1.jpg

<b>Wall ID:</b>	ZION-0010-9.885-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Fill wall on right.		

**Wall Measurements**

<b>Wall Length (ft.):</b>	40	<b>Face Area (sq.):</b>	120
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	3

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good performance	10
WALL FOUNDATION MATERIAL 8.00	NO DISTRESS	10
STONE MASONRY 8.00	NO DISTRESS	10
LATERAL SLOPE 0.50	ERODING DUE TO ROADWAY DRAINAGE	9
CULVERT 0.50	18" CMP, NO DISTRESS	10
DOWNSLOPE 0.50	STEEP, TALUS SLOPE; NO EROSION	10

**Repair Recommendations**

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_9.885\_R\_1.jpg

<b>Wall ID:</b>	ZION-0010-9.896-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	85	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Mortared stone fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	81	<b>Face Area (sq.):</b>	526
<b>Average Wall Height (ft.):</b>	6	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Equals foundation rating.	8
WALL FOUNDATION MATERIAL 8.00	Slight undermine at midwall above exposed rock	8
STONE MASONRY 8.00	End 14' added recently to repair erosion. Virtually no distress in masonry. Joint separation between original and repaired wall end.	10
CULVERT 0.50	"Shotgun" ditch relief culvert (12") at wall end. Minor erosion at outlet.	9
DOWNSLOPE 0.50	Eroded soil above shallow rock. Erosion channels 1ft deep vegging in. Slope +30deg.	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Excavate loose material down to rock at foundation line and place concrete from wall base down to rock. 20'long x 2' high x 2' deep. Excavate by hand - 2 crew 6 hrs - 12 hrsx\$40/hr = \$480. Used CESS hourly labor rate. Place concrete (20x2x2)/27 = 3cy
<b>Repair Cost:</b>	\$4,830

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_9.896\_R\_1.jpg**



<b>Wall ID:</b>	ZION-0010-9.957-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	95	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Mortared stone fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	118	<b>Face Area (sq.):</b>	791
<b>Average Wall Height (ft.):</b>	7	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	14	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	Mostly rock. Rock near surface where not visible.	10
STONE MASONRY 8.00	1" wide full height vertical crack 7 ft from wall end. Crack edges rounded and worn. Wall end settled - likely cause of crack. Probably "settled out".	9
DOWNSLOPE 0.50	Steep rock and stable fill. About 100 ft to stream at -36deg.	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

**Retaining Wall Condition Photos**



**ZION\_0010\_9.957\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0010-11.248-R		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1992
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	Gravity - Mortared Stone
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	3 ft dia cmp headwall - probably built in early 90s fts w/bridge project		

**Wall Measurements**

<b>Wall Length (ft.):</b>	7	<b>Face Area (sq.):</b>	31
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	11

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	No distress	10
STONE MASONRY 8.00	No distress	10
LATERAL SLOPE 0.50	Steep, partly vegetated. No erosion.	9
CULVERT 0.50	No distress	10

**Repair Recommendations**

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0010-11.248-R.**

<b>Wall ID:</b>	ZION-0010-11.276-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1990
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	MSE - Welded Wire Face
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	Stone
<b>General Description:</b>	Checkerboard mesa parking area wall. Mse wall constructed in 1990		

### Wall Measurements

<b>Wall Length (ft.):</b>	170	<b>Face Area (sq.):</b>	904
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	15	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good performance	10
WALL FOUNDATION MATERIAL 8.00	NO DISTRESS	10
STONE MASONRY 8.00	GOOD CONDITION. VERTICAL CRACK IN MORTAR APPROX. 25' FROM END OF WALL	10
DOWNSLOPE 0.50	WELL VEGETATED	10
LATERAL SLOPE 0.50	GOOD CONDITION	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0010: ZION-MT CARMEL HIGHWAY**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0010-11.276-L.**

<b>Wall ID:</b>	ZION-0010-11.590-L		
<b>Route Name:</b>	ZION-MT CARMEL HIGHWAY		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1990
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	2 ft dia cmp inlet		

### Wall Measurements

<b>Wall Length (ft.):</b>	24	<b>Face Area (sq.):</b>	74
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	8

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	No distress	10
STONE MASONRY 8.00	No distress	10
CULVERT 0.50	24" cmp - looks new	10
LATERAL SLOPE 0.50	Stable fill	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# Zion National Park

ROUTE 0010: ZION-MT CARMEL HIGHWAY

## Retaining Wall Condition Photos



ZION\_0010\_11.590\_L\_1.jpg



<b>Wall ID:</b>	ZION-0011-0.877-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1996
<b>*Wall Rating:</b>	97	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Other - T Wall - Proprietary
<b>Surface Treatment:</b>	Painted	<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	Formlined Concrete
<b>General Description:</b>	T wall is precast concrete face panels with concrete T reinforcing tied to face panels.		

### Wall Measurements

<b>Wall Length (ft.):</b>	435	<b>Face Area (sq.):</b>	5002
<b>Average Wall Height (ft.):</b>	12	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	18	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Wall undermined, failed and rebuilt two years after initial construction in 1994. Monitor erosion potential.	9
WALL FOUNDATION MATERIAL 8.00	Steep but well armored by large (Class 5+) riprap. About 20-30 ft SD from Virgin River. No sign of undermining.	10
CONCRETE 8.00	Precast panels. Minor isolated cracking	10
UPSLOPE 0.50	Section of over steepened (1:1 or steeper), raveling coluvuim at beginning of wall. Rockfall may impact parapet/wall.	9
DOWNSLOPE 0.50	20-30 ft SD to Virgin River. Armored with large riprap. Stable.	10
LATERAL SLOPE 0.50	Well vegetated and stable	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
TRAFFIC BARRIER/FENCE 0.50	Guardwall - no deflection	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_0.877\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-1.115-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	98	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Mortared stone fill wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	103	<b>Face Area (sq.):</b>	464
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	2 ft bench in front of toe.	10
STONE MASONRY 8.00	One full height vertical crack along joint at about 65ft.	10
CULVERT 0.50	3' CMP. Outlet extended. Paved channel below outlet steep but good condition.	10
DOWNSLOPE 0.50	Stable, well vegetated	10
LATERAL SLOPE 0.50	Stable, flat, well vegetated	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
WALL DRAINS 0.50	Two" diameter drains	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_1.115\_L\_1.jpg**



**ZION\_0011\_1.115\_L\_2.jpg**

<b>Wall ID:</b>	ZION-0011-1.270-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	69	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Large horizontal offset from roadway. Wall near River		

### Wall Measurements

<b>Wall Length (ft.):</b>	113	<b>Face Area (sq.):</b>	904
<b>Average Wall Height (ft.):</b>	8	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	9	<b>Vertical Offset (ft.):</b>	14

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Wall a long way from road so consequence of failure is very low. Most of wall in good condition.	7
WALL FOUNDATION MATERIAL 8.00	Not supporting last 15 ft of wall. No distress elsewhere	8
PILES AND SHAFTS 8.00	3 full height cracks through mortar and stone up to 1.5" wide. Wall end settling and deflecting for last 15 ft. Minor debonding along mortar joints in general.	6
STONE MASONRY 8.00	Wall end settling and deflecting for last 15 ft. Last 5' of wall missing. 3 full height cracks through stone and mortar up to 1.5" thick.	6
DOWNSLOPE 0.50	Steep, protected by class 5 riprap. 20' to Virgin River	10
LATERAL SLOPE 0.50	Stable and vegetated	10
UPSLOPE 0.50	Stable, well vegetated	10
WALL DRAINS 0.50	3 3" wall drains at toe.	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Remove and replace last 15 feet of wall. Place large (1/2 cy or larger) foundations stones or CIP concrete foundation beneath replaced wall section. Foundation: 5cy*\$1400/cy structural concrete = \$7,000. Remove and replace masonry stone wall: 13cy*\$2
<b>Repair Cost:</b>	\$42,750

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0011: ZION SCENIC CANYON DRIVE**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0011-1.270-L.**

<b>Wall ID:</b>	ZION-0011-1.307-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Culvert headwall, 6 ft x 6 ft CIP Box-u/s end		

### Wall Measurements

<b>Wall Length (ft.):</b>	23	<b>Face Area (sq.):</b>	69
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	13

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	No distress.	10
STONE MASONRY 8.00	No distress. One missing stone at top of wingwall.	10
CULVERT 0.50	No distress.	10
LATERAL SLOPE 0.50	Stable, well vegetated.	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress.	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0011: ZION SCENIC CANYON DRIVE**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0011-1.307-L.**



<b>Wall ID:</b>	ZION-0011-1.313-R		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	54	<b>Maintenance Action:</b>	Replace Elements

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	Cantilever - Sheet Pile
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Masonry wall with sheet pile foundation and scour protection.		

### Wall Measurements

<b>Wall Length (ft.):</b>	100	<b>Face Area (sq.):</b>	1500
<b>Average Wall Height (ft.):</b>	15	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	15	<b>Vertical Offset (ft.):</b>	13

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Consequence of wall failure low but slope erosion threatening roadway. Previous wall and slope repairs ineffective.	5
WALL FOUNDATION MATERIAL 8.00	Sheetpile acting as masonry wall foundation. Piles extend well below waterline. Failed on wall end about 30 ft.	5
STONE MASONRY 8.00	5' section missing from wall begin. 20' section at wall end collapsed. Full height vertical cracks 5-10' in from current wall end. Rating based on end failure	5
PILES AND SHAFTS 8.00	Sheetpile lower wall with concrete backfill/cap. Failed over last 20 ft of wall. Good condition elsewhere. Rating lowered because of end condition.	6
DOWNSLOPE 0.50	10' to river from toe. Potential for scour but none evident for most of wall.	9
CULVERT 0.50	6x6 CIP concrete box.	10
WALL DRAINS 0.50	8 2" wall drains	10
LATERAL SLOPE 5.00	Deep (5'+), full height erosion channels in slope at wall end extending 50' beyond wall. Wall end badly eroded. Energy dissipation repair attempts (logs, brush) not effective.	3

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Rebuild a wall section of 25' x 15' = 375 s.f. Repair costs based on 375 s.f. x \$157.00 per s.f. = \$58,875.
<b>Repair Cost:</b>	\$58,875

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0011: ZION SCENIC CANYON DRIVE**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0011-1.313-R.**

<b>Wall ID:</b>	ZION-0011-1.507-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Mortared stone fill wall.		

**Wall Measurements**

<b>Wall Length (ft.):</b>	86	<b>Face Area (sq.):</b>	378
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	9	<b>Vertical Offset (ft.):</b>	0

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good.	10
WALL FOUNDATION MATERIAL 8.00	2' bench at toe, no visible distress.	10
STONE MASONRY 8.00	Excellent condition, minor spalling. Minor open cracks in grout. One full height vertical crack 1/8" through stone and concrete.	10
CULVERT 0.50	18" @ wall toe, good condition.	10
DOWNSLOPE 0.50	Moderate steep (40 degrees), well vegetated, stable.	10
LATERAL SLOPE 0.50	Excellent condition, well vegetated.	10
ROAD/SIDEWALK/SHOULDER 0.50	Excellent condition, Missing or loose capstones (4).	10

**Repair Recommendations**

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_1.507\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-2.273-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Box culvert headwall and wingwalls.		

### Wall Measurements

<b>Wall Length (ft.):</b>	34	<b>Face Area (sq.):</b>	138
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good.	10
WALL FOUNDATION MATERIAL 8.00	No scour.	10
STONE MASONRY 8.00	Excellent condition.	10
CULVERT 0.50	13' x 6' CIP box culvert, good condition.	10
DOWNSLOPE 0.50	Stable streambed.	10
LATERAL SLOPE 0.50	Stable, well vegetated.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_2.273\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-2.274-R		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Box culvert headwall and wingwalls		

### Wall Measurements

<b>Wall Length (ft.):</b>	32	<b>Face Area (sq.):</b>	128
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Excellent	10
WALL FOUNDATION MATERIAL 8.00	No scour	10
STONE MASONRY 8.00	Excellent Condition	10
CULVERT 0.50	13' x 6' CIP box culvert, good condition	10
LATERAL SLOPE 0.50	Good condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	Excellent condition.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_2.274\_R\_1.jpg**



<b>Wall ID:</b>	ZION-0011-3.503-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Box culvert headwall and wingwalls.		

### Wall Measurements

<b>Wall Length (ft.):</b>	33	<b>Face Area (sq.):</b>	139
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good.	10
WALL FOUNDATION MATERIAL 8.00	No distress.	10
STONE MASONRY 8.00	No distress.	10
CULVERT 0.50	14' x 5' CIP box culvert, good condition.	10
LATERAL SLOPE 0.50	Good condition, stable.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_3.503\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-3.505-R		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Box culvert headwall and wingwalls		

### Wall Measurements

<b>Wall Length (ft.):</b>	29	<b>Face Area (sq.):</b>	116
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good.	10
WALL FOUNDATION MATERIAL 8.00	No scour.	10
STONE MASONRY 8.00	Excellent condition.	10
CULVERT 0.50	14' x 5' CIP box culvert, good condition.	10
DOWNSLOPE 0.50	Flat streambed, no scour.	10
LATERAL SLOPE 0.50	Stable, well vegetated.	10
ROAD/SIDEWALK/SHOULDER 0.50	Excellent condition.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_3.505\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0011-4.187-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Culvert headwall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	10	<b>Face Area (sq.):</b>	27
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
WALL FOUNDATION MATERIAL 8.00	NO DISTRESS	10
STONE MASONRY 8.00	NO DISTRESS	10
CULVERT 0.50	18" CMP	10
LATERAL SLOPE 0.50	STABLE, NO EROSION	10
ROAD/SIDEWALK/SHOULDER 0.50	NO DISTRESS	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_4.187\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-5.436-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	2004
<b>*Wall Rating:</b>	78	<b>Maintenance Action:</b>	Replace Wall

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Dry stacked rockery wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	8	<b>Face Area (sq.):</b>	40
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Fair, recently placed wall is inadequate length to support road embankment.	4
WALL FOUNDATION MATERIAL 8.00	Adequate.	10
PLACED STONE 8.00	Good condition.	10
LATERAL SLOPE 1.00	Poor condition due to surface runoff causing erosion of roadway shoulder rock.	4
ROAD/SIDEWALK/SHOULDER 1.00	Shoulder at ends of wall have eroded to edge of asphalt for a distance of 4' on each side of wall.	4
DOWNSLOPE 0.50	Steep, marginal vegetation due to recently placed fill.	10
CULVERT 0.50	18" CMP, good condition.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Masonry stone retaining wall: All cost data from cost guide RWIP basis. Structure Excavation: (30' x 7' x 5')/27 = 40 cu yd ITEM 20303-0300, 40 cu yd x \$39/cu yd = \$1,560. Class A Stone masonry wall
<b>Repair Cost:</b>	\$22,380

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_5.436\_L\_1.jpg**



<b>Wall ID:</b>	ZION-0011-5.469-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Culvert headwall and wingwalls 36 in cmp - inlet basin lined with stone - not included in wall.		

**Wall Measurements**

<b>Wall Length (ft.):</b>	17	<b>Face Area (sq.):</b>	42
<b>Average Wall Height (ft.):</b>	2	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	1

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
WALL FOUNDATION MATERIAL 8.00	NO DISTRESS	10
STONE MASONRY 8.00	NO DISTRESS	10
CULVERT 0.50	NO DISTRESS	10
LATERAL SLOPE 0.50	STABLE, VEGETATED	10
ROAD/SIDEWALK/SHOULDER 0.50	NO DISTRESS	10

**Repair Recommendations**

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0011: ZION SCENIC CANYON DRIVE**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0011-5.469-L.**

<b>Wall ID:</b>	ZION-0011-5.470-R		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	99	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Wall end at end of concrete foundation. Foundation in river. Foundation appears to have been added after initial construction.		

### Wall Measurements

<b>Wall Length (ft.):</b>	61	<b>Face Area (sq.):</b>	274
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	85
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	11

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
WALL FOUNDATION MATERIAL 8.00	CONCRETE FOUNDATION AND EROSION PROTECTION	10
STONE MASONRY 8.00	NO DISTRESS	10
UPSLOPE 0.50	STEEP - 37 DEGREE, WELL VEGETATED ROAD FILL	9
CULVERT 0.50	NO DISTRESS	10
LATERAL SLOPE 0.50	STABLE ROAD FILL, FLATTER THAN UPSLOPE	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0011: ZION SCENIC CANYON DRIVE**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0011-5.470-R.**

<b>Wall ID:</b>	ZION-0011-5.528-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	93	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	36 in culvert with headwall and wing walls.		

### Wall Measurements

<b>Wall Length (ft.):</b>	20	<b>Face Area (sq.):</b>	100
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
WALL FOUNDATION MATERIAL 8.00	NO SCOUR	10
STONE MASONRY 8.00	EXCELLENT CONDITION. WINGWALLS ADDED LATE - DRY LAID STONE SHOWS MINOR SETTLEMENT	9
CULVERT 1.00	36" CMP RUSTED OUT ON BOTTOM FOR 16" WIDTH	5
DOWNSLOPE 0.50	MASONRY LINED CHANNEL	10
LATERAL SLOPE 0.50	GOOD CONDITION, WELL VEGETATED	10
ROAD/SIDEWALK/SHOULDER 0.50	GOOD CONDITION	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Repair rusted out culvert, 40' length, 16" bottom width. See corresponding Headwall MP 5.464 for cost estimate.
<b>Repair Cost:</b>	\$1,750

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_5.528\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-5.530-R		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	97	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	36 in CMP culvert headwall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	9	<b>Face Area (sq.):</b>	36
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	1

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
WALL FOUNDATION MATERIAL 8.00	No scour	10
STONE MASONRY 8.00	Excellent condition	10
LATERAL SLOPE 0.50	Minor erosion from ditch runoff	9
CULVERT 1.00	3" diameter, rusted out along 16" width across bottom	5
ROAD/SIDEWALK/SHOULDER 0.50	Good Condition	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Repair rusted-out bottom of culvert for 16" width x 40' length. Repair consists of lining base of culvert with concrete for 24" width x 40' length average 3" depth. Total length = 40' of Concrete Gutter. Cost based on const guide RWIP basis. ITEM 60905
<b>Repair Cost:</b>	\$1,750

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_5.530\_R\_1.jpg**



<b>Wall ID:</b>	ZION-0011-5.907-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1970
<b>*Wall Rating:</b>	89	<b>Maintenance Action:</b>	Maintenance

**Wall Description**

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Dry stacked rockery wall.		

**Wall Measurements**

<b>Wall Length (ft.):</b>	75	<b>Face Area (sq.):</b>	375
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	55
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	6

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good function, requires minor repairs	9
WALL FOUNDATION MATERIAL 8.00	Toe at high water line with no scouring	10
PLACED STONE 8.00	Some mortar at beginning if wall from adjacent grouted riprap. Large voids and minor loss of stone/stone contact.	8
LATERAL SLOPE 0.50	Wall upstream, flat downstream.	10
VEGETATION 1.00	Trees 4-8" diameter growing from face causing moderate distress	7

**Repair Recommendations**

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	General wall maintenance: Remove trees from wall. Chink voids with small (4-8") stones. Labor 6 hours @ \$55/hr = \$330
<b>Repair Cost:</b>	\$330

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_5.907\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-5.920-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1970
<b>*Wall Rating:</b>	70	<b>Maintenance Action:</b>	Replace Elements

### Wall Description

<b>Wall Function:</b>	Slope Protection	<b>Primary Wall Type:</b>	Other - Grouted Riprap, Class 4
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Slope protection of stream bank adjacent to road.		

### Wall Measurements

<b>Wall Length (ft.):</b>	280	<b>Face Area (sq.):</b>	1200
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	72
<b>Maximum Wall Height (ft.):</b>	8	<b>Vertical Offset (ft.):</b>	6

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good	10
WALL FOUNDATION MATERIAL 8.00	Inadequate embedment - susceptible to undermining and wall collapse.	6
PLACED STONE 8.00	70' undermined section near center off wall - due to poor embedment.	6
SHOTCRETE 8.00	Poor quality of workmanship compromises function	6
LATERAL SLOPE 0.50	Adjacent dry-laid walls are in good condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition, not affected by damaged section	10
UPSLOPE 0.50	Gentle slope, well vegetated.	10
DOWNSLOPE 1.00	Stream bed - on outside of bend making the slope protection highly susceptible to scour	6

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Remove 70' of grouted wall, conserve stones. Excavate toe trench 5' deep x 10' wide. Reconstruct grouted riprap. All costs based on cost guide RWIP basis. Wall removal: 6' ht x 70' length x 10' width = 160 cu yd. ITEM 30203-0300 Concrete removal
<b>Repair Cost:</b>	\$96,560

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_5.920\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0011-5.973-L		
<b>Route Name:</b>	ZION SCENIC CANYON DRIVE		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	94	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Roadway embankment support at end of 2 in culvert outlet. Wall continues as erosion protection.		

### Wall Measurements

<b>Wall Length (ft.):</b>	87	<b>Face Area (sq.):</b>	435
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	60
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	6

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good performance	10
WALL FOUNDATION MATERIAL 8.00	In river - check for undermining during low water. Probably none.	8
PLACED STONE 8.00	Toe in river - no distress	10
CULVERT 0.50	24" CMP, good condition.	10
LATERAL SLOPE 0.50	Wall on both sides - not supporting road, downstream different wall type	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress.	10
VEGETATION 0.50	Willows growing from face, 1-3" diameter.	9

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0011: ZION SCENIC CANYON DRIVE**

**Retaining Wall Condition Photos**



**ZION\_0011\_5.973\_L\_1.jpg**

<b>Wall ID:</b>	ZION-0013-4.163-L		
<b>Route Name:</b>	KOLOB CANYON ROAD		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1960
<b>*Wall Rating:</b>	97	<b>Maintenance Action:</b>	No Action

**Wall Description**

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	4.5 ft high x 3.5 ft wide elliptical culvert headwall		

**Wall Measurements**

<b>Wall Length (ft.):</b>	36	<b>Face Area (sq.):</b>	108
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	85
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	0

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good	10
WALL FOUNDATION MATERIAL 8.00	2' flat bench at toe, good condition.	10
STONE MASONRY 8.00	Poor quality masonry work. Good condition, minor cracks in mortar adjacent to stones throughout wall.	9
CULVERT 0.50	Good condition.	10
LATERAL SLOPE 0.50	Good condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress.	10
UPSLOPE 0.50	Steep, stable, well vegetated.	10

**Repair Recommendations**

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0013: KOLOB CANYON ROAD**

**Retaining Wall Condition Photos**



**ZION\_0013\_4.163\_L\_1.jpg**



<b>Wall ID:</b>	ZION-0013-4.164-R		
<b>Route Name:</b>	KOLOB CANYON ROAD		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1967
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mass Concrete
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Headwall for 48 in cmp		

### Wall Measurements

<b>Wall Length (ft.):</b>	12	<b>Face Area (sq.):</b>	36
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	1

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	GOOD CONDITION; NO CRACKING	10
CONCRETE 8.00	GOOD CONDITION. MINOR SPALLING ON TOP OF HEADWALL	10
CULVERT 0.50	48" CMP; NO DISTRESS	10
LATERAL SLOPE 0.50	WELL VEGETATED	10
ROAD/SIDEWALK/SHOULDER 0.50	GOOD	10
UPSLOPE 0.50	STEEP	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0013: KOLOB CANYON ROAD**

**Retaining Wall Condition Photos**



**ZION\_0013\_4.164\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0013-4.315-R		
<b>Route Name:</b>	KOLOB CANYON ROAD		
<b>Inspection Date:</b>	December 07, 2006	<b>Approximate Year Built:</b>	1967
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mass Concrete
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Concrete headwall for 48 in cmp		

### Wall Measurements

<b>Wall Length (ft.):</b>	20	<b>Face Area (sq.):</b>	68
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	13

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	EXCELLENT	10
CONCRETE 8.00	NO DISTRESS	10
CULVERT 0.50	48" CMP; NO DISTRESS	10
LATERAL SLOPE 0.50	WELL VEGETATED	10
UPSLOPE 0.50	13' WELL VEGETATED	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0013: KOLOB CANYON ROAD**

**Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0013-4.315-R.**

<b>Wall ID:</b>	ZION-0402-0.440-R		
<b>Route Name:</b>	MAINTENANCE ACCESS ROAD		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Fill wall in Oak Creek adjacent to road embankment.		

### Wall Measurements

<b>Wall Length (ft.):</b>	92	<b>Face Area (sq.):</b>	368
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	75
<b>Maximum Wall Height (ft.):</b>	7	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good	10
WALL FOUNDATION MATERIAL 8.00	No distress	10
STONE MASONRY 8.00	No distress	10
LATERAL SLOPE 0.50	Minor erosion at beginning corner, stable road fill.	9
CULVERT 0.50	18" cmp with no distress.	10
DOWNSLOPE 0.50	Streambed with no scour.	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0402: MAINTENANCE ACCESS ROAD**

**Retaining Wall Condition Photos**



**ZION\_0402\_0.440\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0402-0.492-R		
<b>Route Name:</b>	MAINTENANCE ACCESS ROAD		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Box culvert and wingwalls downstream side.		

### Wall Measurements

<b>Wall Length (ft.):</b>	24	<b>Face Area (sq.):</b>	89
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	1

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	Streambed, no distress.	10
STONE MASONRY 8.00	No distress.	10
CULVERT 0.50	16' x 3' CIP box. Minor spalling of concrete edges.	10
DOWNSLOPE 0.50	No scour.	10
LATERAL SLOPE 0.50	Good shape. Signs of culvert overtopping.	10
ROAD/SIDEWALK/SHOULDER 0.50	No problems.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0402: MAINTENANCE ACCESS ROAD**

**Retaining Wall Condition Photos**



**ZION\_0402\_0.492\_R\_1.jpg**



<b>Wall ID:</b>	ZION-0402-0.493-R		
<b>Route Name:</b>	MAINTENANCE ACCESS ROAD		
<b>Inspection Date:</b>	December 05, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	96	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	CIP Box culvert with headwall and wingwalls		

### Wall Measurements

<b>Wall Length (ft.):</b>	29	<b>Face Area (sq.):</b>	67
<b>Average Wall Height (ft.):</b>	2	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	In stream. Good	10
STONE MASONRY 8.00	2 missing stones along wall top, otherwise no distress	9
CULVERT 0.50	16x3 CIP box culvert. Minor spalling of concrete edge, 1 ft of exposed rebar	9
LATERAL SLOPE 0.50	Minor erosion at end of wingwall.	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	None
<b>Repair Cost:</b>	\$0

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

**Zion National Park**  
**ROUTE 0402: MAINTENANCE ACCESS ROAD**

**Retaining Wall Condition Photos**



**ZION\_0402\_0.493\_R\_1.jpg**

<b>Wall ID:</b>	ZION-0402-0.545-L		
<b>Route Name:</b>	MAINTENANCE ACCESS ROAD		
<b>Inspection Date:</b>	December 04, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	94	<b>Maintenance Action:</b>	Maintenance

**Wall Description**

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Wingwalls and header for CIP box culvert 11 x 7.5		

**Wall Measurements**

<b>Wall Length (ft.):</b>	33	<b>Face Area (sq.):</b>	158
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	12	<b>Vertical Offset (ft.):</b>	2

**Assessed Elements**

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Erosion could undermine wingwall.	9
WALL FOUNDATION MATERIAL 8.00	CIP concrete slightly raveled. Providing good wall support	10
STONE MASONRY 8.00	Minor cracking right side and slight debonding	10
CURB/BERM/DITCH 1.00	Missing curb allowing sheet flow from roadway onto lateral wall slope	4
LATERAL SLOPE 0.50	Erosion susceptible and signs of erosion on downgrade end. Dumped stone and asphalt used to correct erosion	8
CULVERT 0.50	11x7.5 CIP box. Some ravel and exposed rebar. Distress not effecting wall stability.	9

**Repair Recommendations**

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Install 50 lf asphalt curb along road from wall to existing paved downdrain. \$25/lf*50 = \$1,250 - Used FHWA unit cost
<b>Repair Cost:</b>	\$1,250

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0402: MAINTENANCE ACCESS ROAD**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0402-0.545-L.**

<b>Wall ID:</b>	ZION-0402-0.547-R		
<b>Route Name:</b>	MAINTENANCE ACCESS ROAD		
<b>Inspection Date:</b>	December 04, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	93	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	11 x 7.5 CIP box culvert with wingwalls and header. 30 x 8 wire wrapped stone stream revetment upstream of wingwall		

### Wall Measurements

<b>Wall Length (ft.):</b>	30	<b>Face Area (sq.):</b>	149
<b>Average Wall Height (ft.):</b>	5	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	11	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Slight upper wall repair needed	9
WALL FOUNDATION MATERIAL 8.00	CIP concrete in stream. Slightly raveled but good wall support/port	10
STONE MASONRY 8.00	Dislodged and fractured stones about 5'x3' at wall top.	9
CULVERT 0.50	Some ravel, about 1.5 ft exposed rebar. Good wall support.	9
LATERAL SLOPE 0.50	Wire wrapped stone on upper end. Good condition	10
ROAD/SIDEWALK/SHOULDER 0.50	Good condition.	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Remove and reset upper wall stones for 5x3 area. \$150/sfx15sf = \$2,250 Used FHWA unit cost for reset stone masonry
<b>Repair Cost:</b>	\$2,250

2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

# **Zion National Park**

**ROUTE 0402: MAINTENANCE ACCESS ROAD**

## **Retaining Wall Condition Photos**

**Condition photos are not available for ZION-0402-0.547-R.**

# Appendix A

## Summary of WIP Definitions



Zion National Park



Federal Lands Highway  
Road Inventory Program

# **Appendix A**

## **Summary of WIP Definitions and Assessment Categories**



## **Wall Naming Convention**

Unique “Wall Identification” names were assigned to the retaining walls that were inventoried. The Wall Identification includes the Park Name, the RIP Route Number (e.g., **0013**), the beginning milepoint of a wall (e.g., **0.622**) and the side of the road the wall is located on (e.g., **L.**) relative to the primary direction of travel (direction of increasing mileposts). Thus, a typical wall identified would have the following format: **YOSE-0013-0.622-L.**

For roadways not in RIP, park-supplied route numbers were used or the convention RRR#. Similarly, for parking areas not in RIP, the park-supplied parking area number or the convention PPP# was used. Also for parking areas, walls are numbered in ascending order as they are encountered when traveling counterclockwise around the parking area (most common direction of traffic flow). Parking area walls are designated P1, P2, P3, etc. as new walls are encountered.

**- NPS Retaining Wall Inventory Program Field Guide (WIFG)-**

**Retaining Wall Acceptance Criteria**

- \*All classes of paved roadways and parking areas included in the RIP Route Investigation Report and/or identified by park staff.
- \*Walls must reside within the constructed roadway/parking area prism.
- \*Maximum wall height, including only that portion actively retaining soil and/or rock, must be  $\geq 4$  ft. (>6ft for culvert headwalls).
- \*Consider known/verifiable wall embedment in determining maximum retaining wall height. Include fully buried retaining structures.
- \*Walls have an internal wall face angle  $\geq 45^\circ$  ( $\geq 1H:1V$  face slope ratio).
- \*Include all walls where the intent is to support/protect the travelway, and where failure would require replacement with a retaining wall.

**Definitions**

<b>Design Criteria</b>	Measure of how well current design criteria are satisfied: <b>None</b> - Does not meet any known standards. <b>Non-AASHTO</b> - Does not meet AASHTO, but is consistent with other structures of its type/period with good performance. <b>AASHTO</b> - Apparently meets current AASHTO Geometric, Design, Materials, and Construction Standards.
<b>Consequence of Failure</b>	<b>Low</b> - No loss of roadway, no to low public risk, no impact to traffic during wall repair/replacement <b>Moderate</b> - Hourly to short-term closure of roadway, low-to-moderate public risk, multiple alternate routes available <b>High</b> - Seasonal to long-term loss of roadway, substantial loss-of-life risk, no alternate routes available
<b>Action</b>	Select from: <b>No Action, Monitor, Maintenance, Repair Elements, Replace Elements, and Replace Wall</b>
<b>Weighting Factor</b>	Weighting Factor to be applied to the Condition Rating (CR). When indicated on the Condition Assessment Input Form: WF=0.5 for CR=8-10; WF=1.0 for CR=4-7; and WF=5 for CR=1-3.
<b>Data Reliability</b>	Estimate of how well observed conditions represent wall performance, and if additional investigations may be warranted. <b>1-Poor</b> Conditions cannot be sufficiently observed to rate element(s), warranting additional investigations to better define element performance and/or to determine the cause(s) or poor performance. <b>2-Good</b> Observed conditions are sufficient to rate the conditions of wall element(s); however, additional investigations would be useful to better understand element performance. <b>3-Very Good</b> Observed conditions clearly describe wall performance. Additional investigations are not needed.

**Wall Function Codes**

[FW] Fill Wall	[BW] Bridge Wall	[SW] Switchback Wall
[CW] Cut Wall	[HW] Head Wall	[SP] Slope Protection [FL] Flood Wall

**Wall Type Codes**

[AH] Anchor, Tieback H-Pile	[CC] Crib, Concrete	[MG] MSE, Geosynthetic Wrapped Face
[AM] Anchor, Micropile	[CM] Crib, Metal	[MP] MSE, Precast Panel
[AS] Anchor, Tieback Sheet Pile	[CT] Crib, Timber	[MS] MSE, Segmental Block
[BC] Bin, Concrete	[GB] Gravity, Concrete Block/ Brick	[MW] MSE, Welded Wire Face
[BM] Bin, Metal	[GC] Gravity, Mass Concrete	[SN] Soil Nail
[CL] Cantilever, Concrete	[GD] Gravity, Dry Stone	[TP] Tangent/ Secant Pile
[CP] Cantilever, Soldier Pile	[GG] Gravity, Gabion	[OT] Other, User Defined
[CS] Cantilever, Sheet Pile	[GM] Gravity, Mortared Stone	[NO] None

**Architectural Facing Type Codes**

[BV] Brick Veneer	[PF] Planted Face	[SS] Simulated Stone
[CO] Cementitious Overlay	[SC] Sculpted Shotcrete	[SV] Stone Veneer
[FF] Fractured Fin Concrete	[SH] Shotcrete (nozzle finish)	[TI] Timber
[FL] Formlined Concrete	[SM] Steel/Metal	[OT] Other, User Defined
[PC] Plain Concrete (float finish or light texture)	[SO] Stone	[NO] None

**Surface Treatment Codes**

[BG] Bush Gun (tool-textured concrete)	[PS] Preservative	[WS] Weathering Steel
[CA] Color Additive	[SE] Silane Sealer	[OT] Other, User Defined
[GL] Galvanized	[ST] Stain	[NO] None
[PA] Painted	[TR] Tar Coated	

### Condition Ratings

Condition Ratings apply to all Primary and Secondary Wall Elements, and are intended to assist in consistently defining element **severity**, **extent**, and **repair/replace urgency** of wall element distresses.

<b>9-10 (Excellent)</b>	-Any defects are minor and are within normal range for <i>newly constructed or fabricated</i> elements. -Defects may include those typically caused from fabrication or construction.
<b>7-8 (Good)</b>	-Low-to-moderate extent of low severity distress. -Distress present does not significantly compromise the element function, nor is there significantly severe distress to major structural components of an element.
<b>5-6 (Fair)</b>	-High extent of low severity distress and/or low-to-medium extent of medium to high severity distress. -Distress present does not compromise element function, but lack of treatment may lead to impaired function/elevated risk of element failure in the near term.
<b>3-4 (Poor)</b>	-Medium-to-high extent of medium-to-high severity distress. -Distress present threatens element function, and strength is obviously compromised and/or structural analysis is warranted. -The element condition does not pose an immediate threat to wall stability and road closure is not necessary.
<b>1-2 (Critical)</b>	-Medium-to-high extent of high severity distress. -Element is no longer serving intended function. Element performance threatening overall stability of the wall at the time of inspection.

### Wall Performance Condition Ratings

<b>Performance</b>	Evaluation of overall wall performance as indicated by observations not necessarily captured by observed distresses for specific elements, including global wall distresses (rotation, settlement, translation, displacement, etc.) and/or evidence of prior repairs that may further indicate component problems.	<p><b>Good to Excellent</b> - No observation of distresses not already captured by individual element condition assessment. No combination of element distresses indicating unseen problems or creating significant performance problems. No history of remediation or repair to wall or adjacent elements.</p> <p><b>Fair</b> - Some observed global distress is not associated with specific elements. Some observation of element distress combinations that indicate wall component problems. Minor work on primary elements or major work on secondary elements has occurred improving overall wall function.</p> <p><b>Poor to Critical</b> - Global wall rotation, settlement, and/or overturning is readily apparent. Combined element distresses clearly indicate serious stability problems with components or global wall stability. Major repairs have occurred to wall structural elements, though functionality has not improved significantly.</p>
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