

GLAC WIP Report

NPS Retaining Wall Inventory Program Glacier National Park



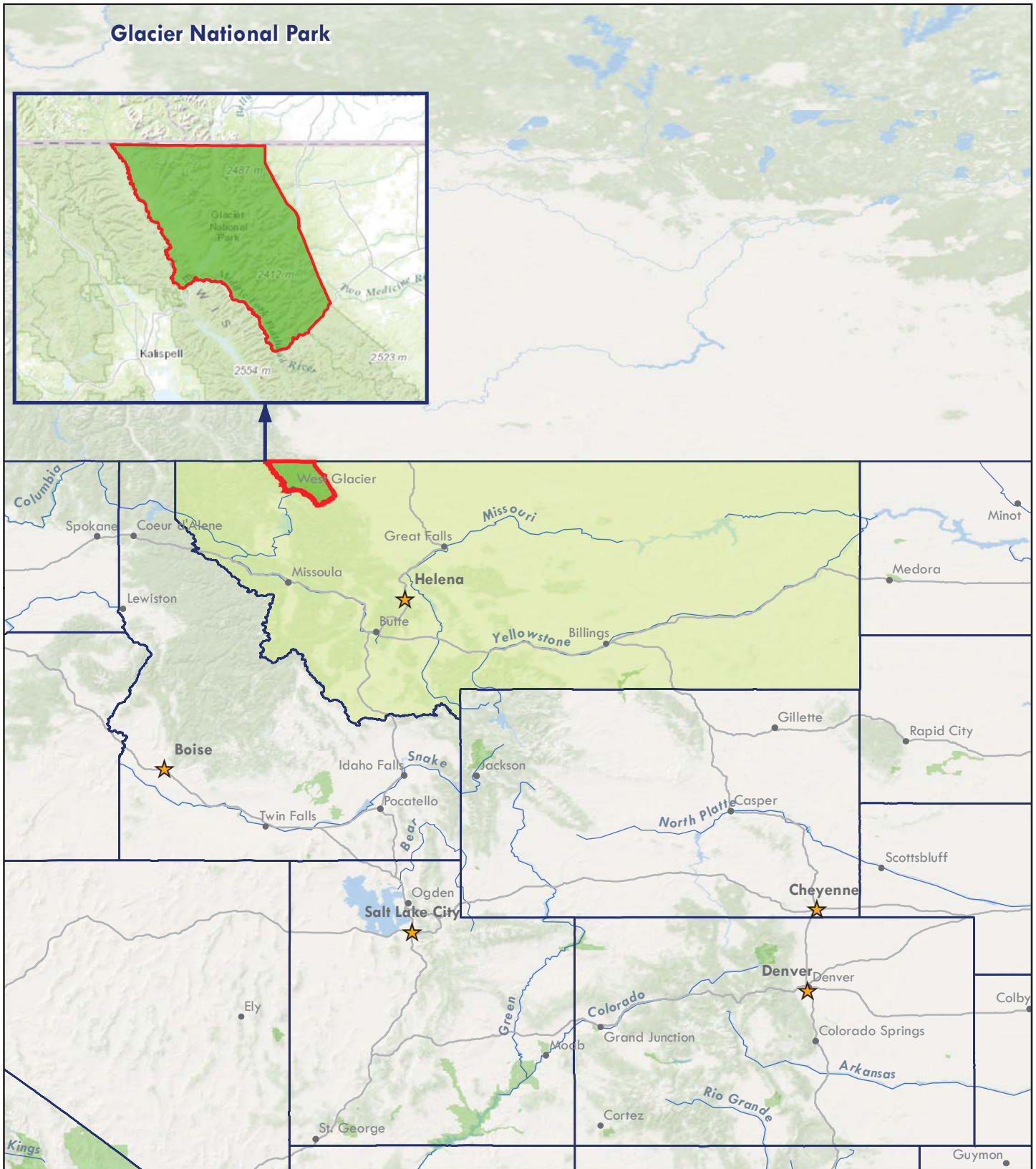
**Federal Lands Highway
Road Inventory Program**

Prepared By:

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

**Data Collection Date: September 2007
Report Date: October 2015**

Glacier National Park in Montana



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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Table of Contents

SECTION	PAGE NO.
1. INTRODUCTION	1 - 1
2. PARK RETAINING WALL LOCATION MAPS Retaining Wall Location Maps	2 - 1
3. TIER 1 - PARK RETAINING WALL OVERVIEW	3 - 1
4. TIER 2 - ROUTE RETAINING WALL OVERVIEW	4 - 1
5. TIER 3 - RETAINING WALL DETAILS	5 - 1
6. APPENDIX A - SUMMARY OF WIP DEFINITIONS AND ASSESSMENT CATEGORIES	A - 1

Introduction



Glacier 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



Glacier National Park

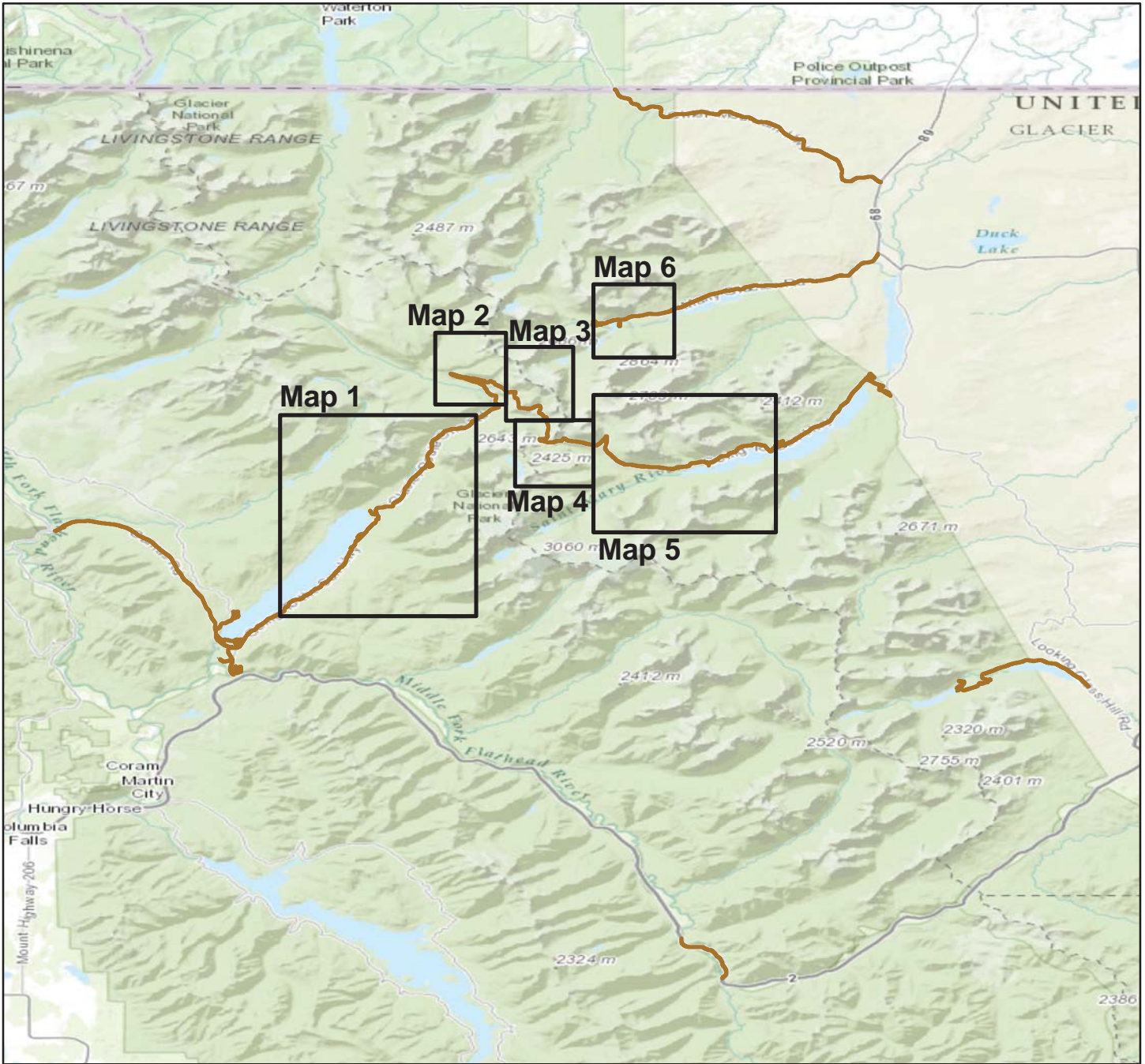


Federal Lands Highway
Road Inventory Program

Glacier 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



Glacier 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 (not all labeled)

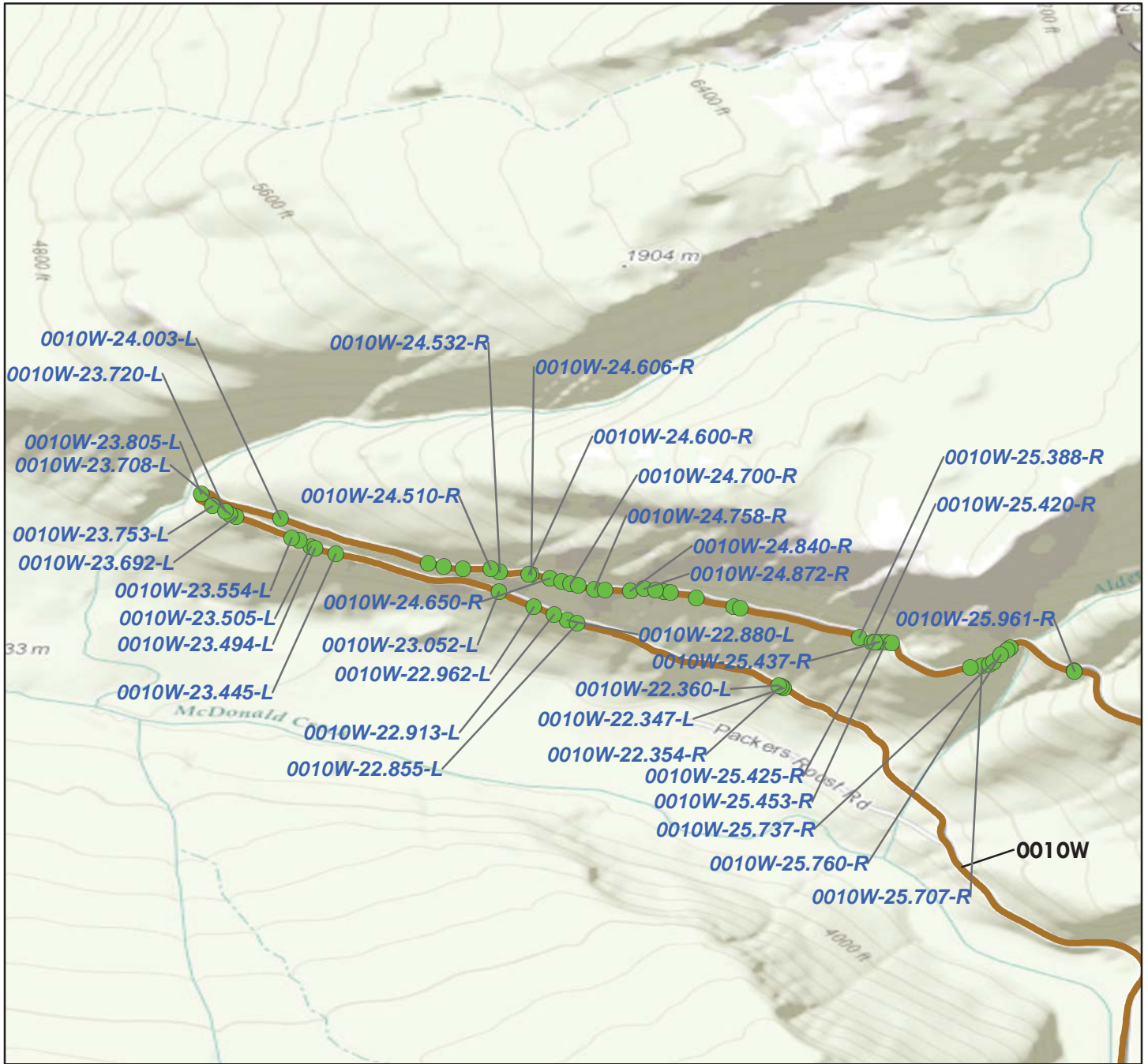
— RIP Collected Routes



Glacier National Park

WALL LOCATION MAP

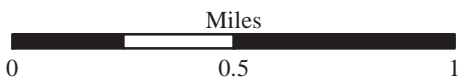
Map 2



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 (Not all labeled)

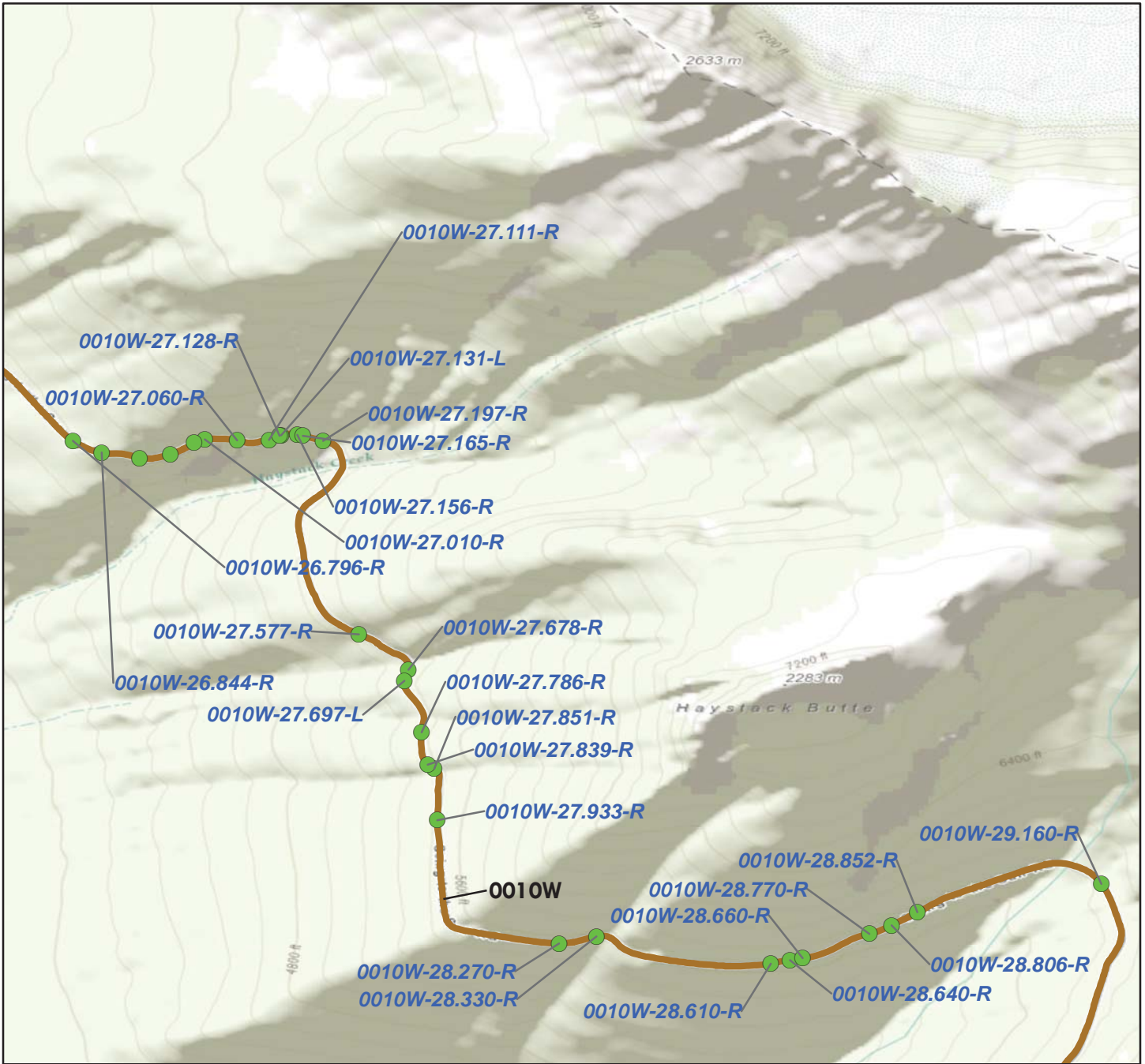
— RIP Collected Routes



Glacier National Park

WALL LOCATION MAP

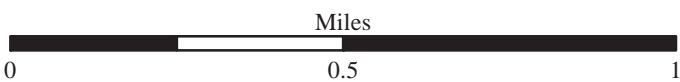
Map 3



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 (Not all labeled)

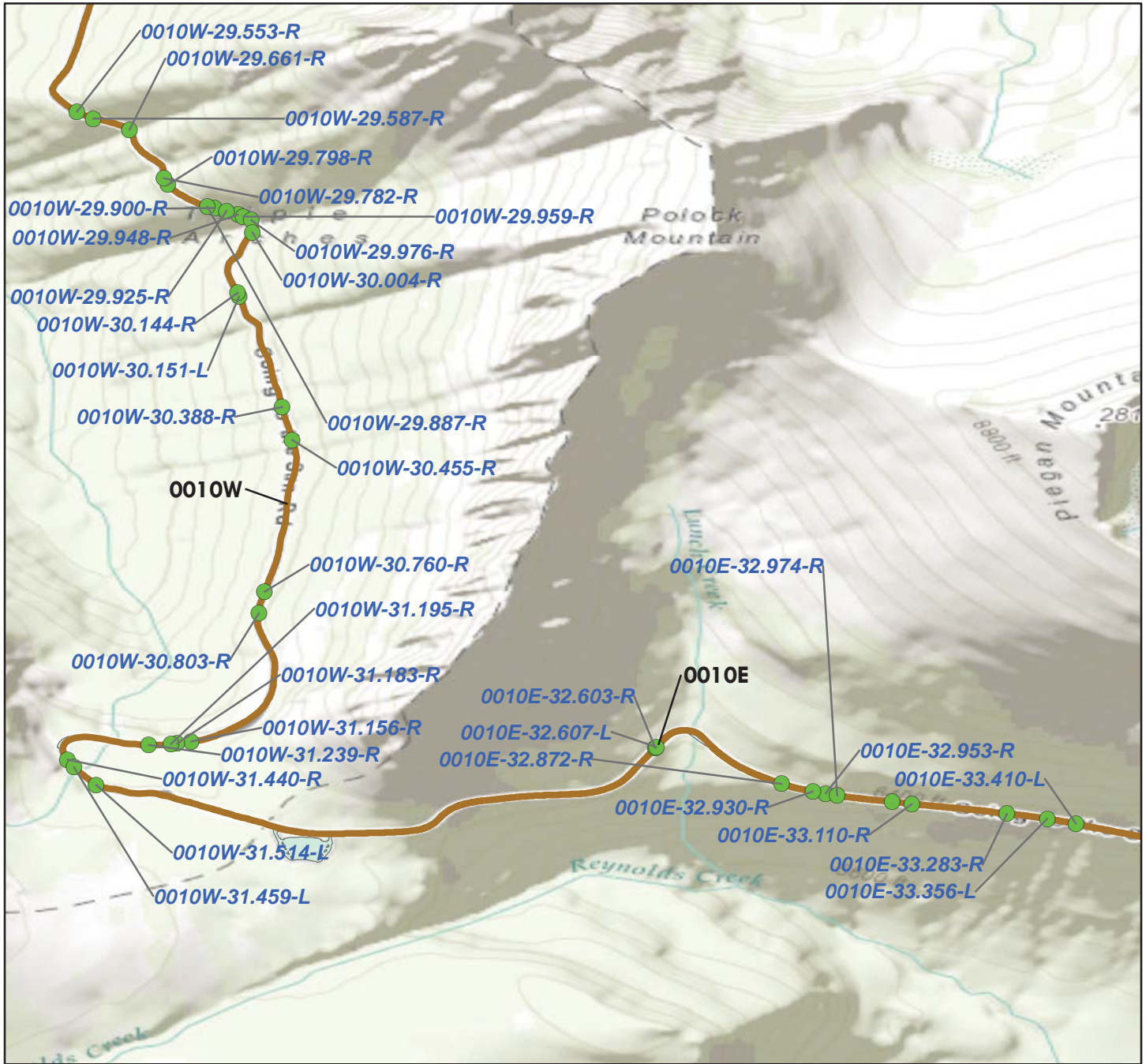
— RIP Collected Routes



Glacier National Park

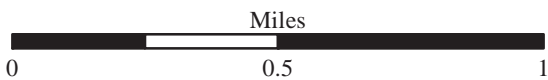
WALL LOCATION MAP

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



Glacier National Park

WALL LOCATION MAP

Map 6



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



Glacier National Park



Federal Lands Highway
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Parkwide Summary: Glacier National Park

Initial retaining wall inspections were conducted at Glacier National Park in 2007, 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 Glacier 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, 172 walls were inventoried on the routes listed below.

Table 1: Number of Walls by Route

Route Number	Route Name	No. of Walls
0010E	GOING TO THE SUN ROAD EAST	20
0010W	GOING TO THE SUN ROAD WEST	142
0014	MANY GLACIER ROAD	7
0948A	SUN POINT PICNIC AREA A	1
0948B	SUN POINT PICNIC AREA B	2

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

Wall Function	No. of Walls
CW - Cut Wall	4
FW - Fill Wall	124
HW - Head Wall	44

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
AH, Anchor - Tieback H-Pile	1
CL, Cantilever - Concrete	13
GC, Gravity - Mass Concrete	1
GD, Gravity - Dry Stone	20
GM, Gravity - Mortared Stone	133
MW, MSE - Welded Wire Face	4

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	91
Monitor	\$0	0
Maintenance	\$385,080	31
Repair Elements	\$1,606,580	40
Replace Elements	\$397,900	8
Replace Wall	\$183,500	2
Totals	\$2,573,060	172

*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

Cost Range*	No. of Walls
\$0	91
\$1 - \$25,000	54
\$25,001 - \$50,000	12
\$50,001 - \$100,000	7
\$100,001 - \$250,000	7
\$250,001 - \$500,000	1
\$500,001 - \$1,000,000	0
\$1,000,001 - \$2,000,000	0
\$2,000,001 - \$3,000,000	0
\$3,000,001 - \$4,000,000	0
Total Number of Walls	172

*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 Glacier 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 Glacier 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

Wall Identification	Failure Consequence⁽¹⁾	Wall Rating⁽²⁾	Recommended Action⁽³⁾	2007 Repair Costs⁽⁴⁾
GLAC-0014-10.972-L	MODERATE	48	REPLACE ELEMENTS	\$26,920
GLAC-0014-10.973-L	MODERATE	48	REPLACE ELEMENTS	\$26,920

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



Glacier National Park



Federal Lands Highway
Road Inventory Program

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST



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)

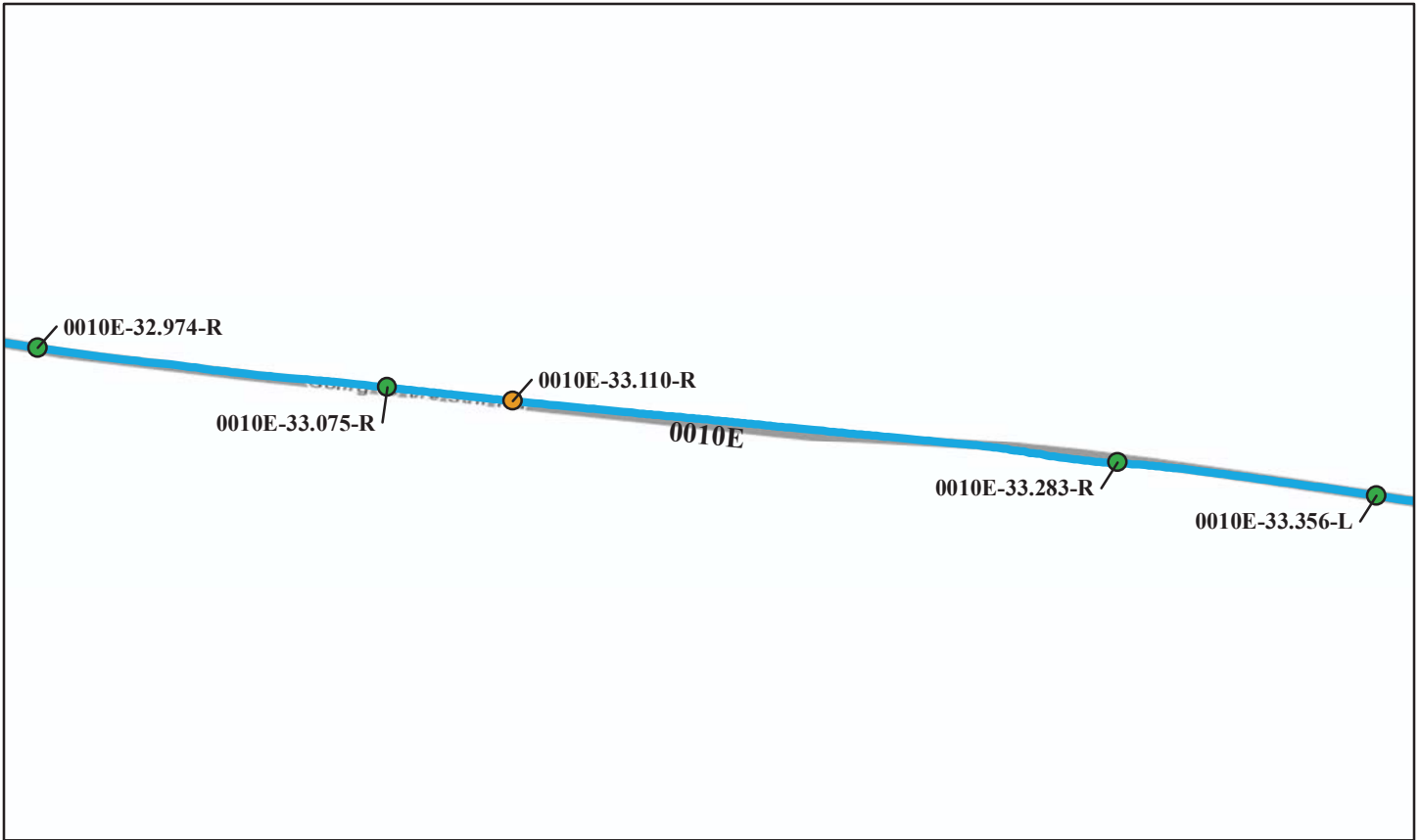
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010E-32.603-R 9/15/2007	152	31	Gravity - Mortared Stone	Head Wall	87	\$0.00
GLAC-0010E-32.607-L 9/15/2007	72	25	Gravity - Mortared Stone	Head Wall	85	\$0.00
GLAC-0010E-32.872-R 9/15/2007	1,415	128	Gravity - Mortared Stone	Fill Wall	83	\$21,000.00
GLAC-0010E-32.930-R 9/15/2007	1,270	121	Gravity - Mortared Stone	Fill Wall	82	\$0.00
GLAC-0010E-32.953-R 9/15/2007	280	111	Gravity - Mortared Stone	Fill Wall	64	\$117,600.00

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST



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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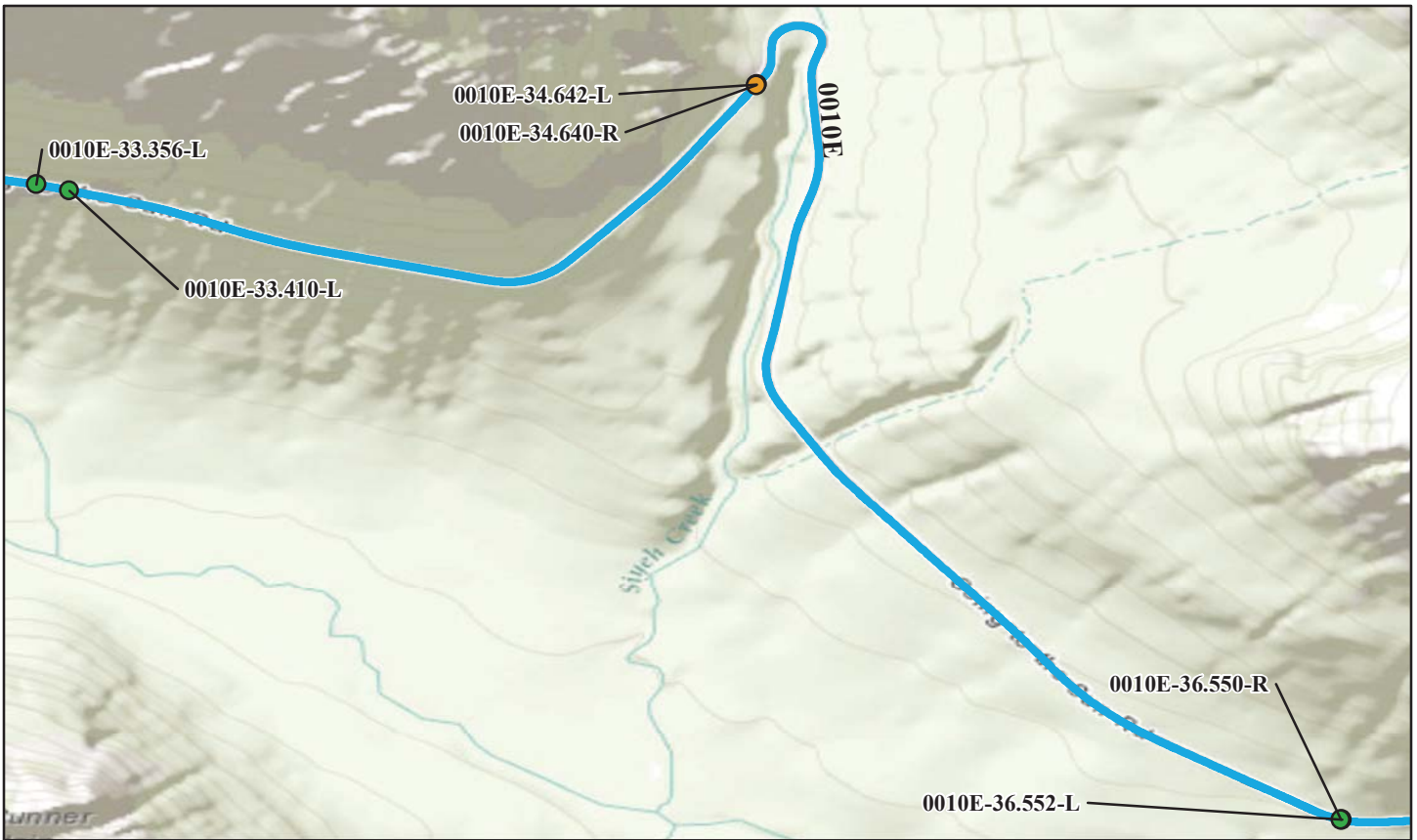
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010E-32.974-R 9/15/2007	2,055	83	Gravity - Mortared Stone	Fill Wall	90	\$0.00
GLAC-0010E-33.075-R 9/15/2007	810	122	Gravity - Mortared Stone	Fill Wall	80	\$12,000.00
GLAC-0010E-33.110-R 9/15/2007	2,900	202	Gravity - Mortared Stone	Fill Wall	69	\$310,000.00
GLAC-0010E-33.283-R 9/15/2007	3,820	298	MSE - Welded Wire Face	Fill Wall	87	\$0.00
GLAC-0010E-33.356-L 9/15/2007	91	13	Gravity - Dry Stone	Cut Wall	86	\$0.00

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST



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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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
GLAC-0010E-33.410-L 9/15/2007	192	24	Gravity - Dry Stone	Cut Wall	89	\$0.00
GLAC-0010E-34.640-R 9/15/2007	400	46	Gravity - Mortared Stone	Head Wall	65	\$26,000.00
GLAC-0010E-34.642-L 9/15/2007	265	52	Gravity - Mortared Stone	Head Wall	85	\$0.00
GLAC-0010E-36.550-R 9/11/2007	245	46	Gravity - Mortared Stone	Head Wall	80	\$9,000.00
GLAC-0010E-36.552-L 9/11/2007	220	28	Gravity - Mortared Stone	Head Wall	75	\$0.00

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST



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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
GLAC-0010E-41.426-R 9/11/2007	1,470	81	Gravity - Mortared Stone	Fill Wall	82	\$60,000.00
GLAC-0010E-41.454-R 9/11/2007	4,600	218	Gravity - Mortared Stone	Fill Wall	77	\$36,000.00
GLAC-0010E-43.188-R 9/11/2007	1,700	125	Gravity - Mortared Stone	Fill Wall	82	\$0.00
GLAC-0010E-43.216-R 9/11/2007	2,200	140	Gravity - Mortared Stone	Fill Wall	78	\$0.00
GLAC-0010E-43.243-R 9/11/2007	950	115	Gravity - Mortared Stone	Fill Wall	79	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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
GLAC-0010W-5.102-L 7/8/2007	104	19	Gravity - Mortared Stone	Head Wall	84	\$500.00
GLAC-0010W-6.137-L 9/12/2007	2,800	140	Anchor - Tieback H-Pile	Fill Wall	78	\$0.00
GLAC-0010W-9.791-R 7/8/2007	87	37	Gravity - Mortared Stone	Head Wall	78	\$0.00
GLAC-0010W-9.801-L 7/8/2007	486	150	Gravity - Mortared Stone	Head Wall	90	\$0.00
GLAC-0010W-10.230-L 7/8/2007	118	21	Gravity - Mortared Stone	Head Wall	73	\$4,840.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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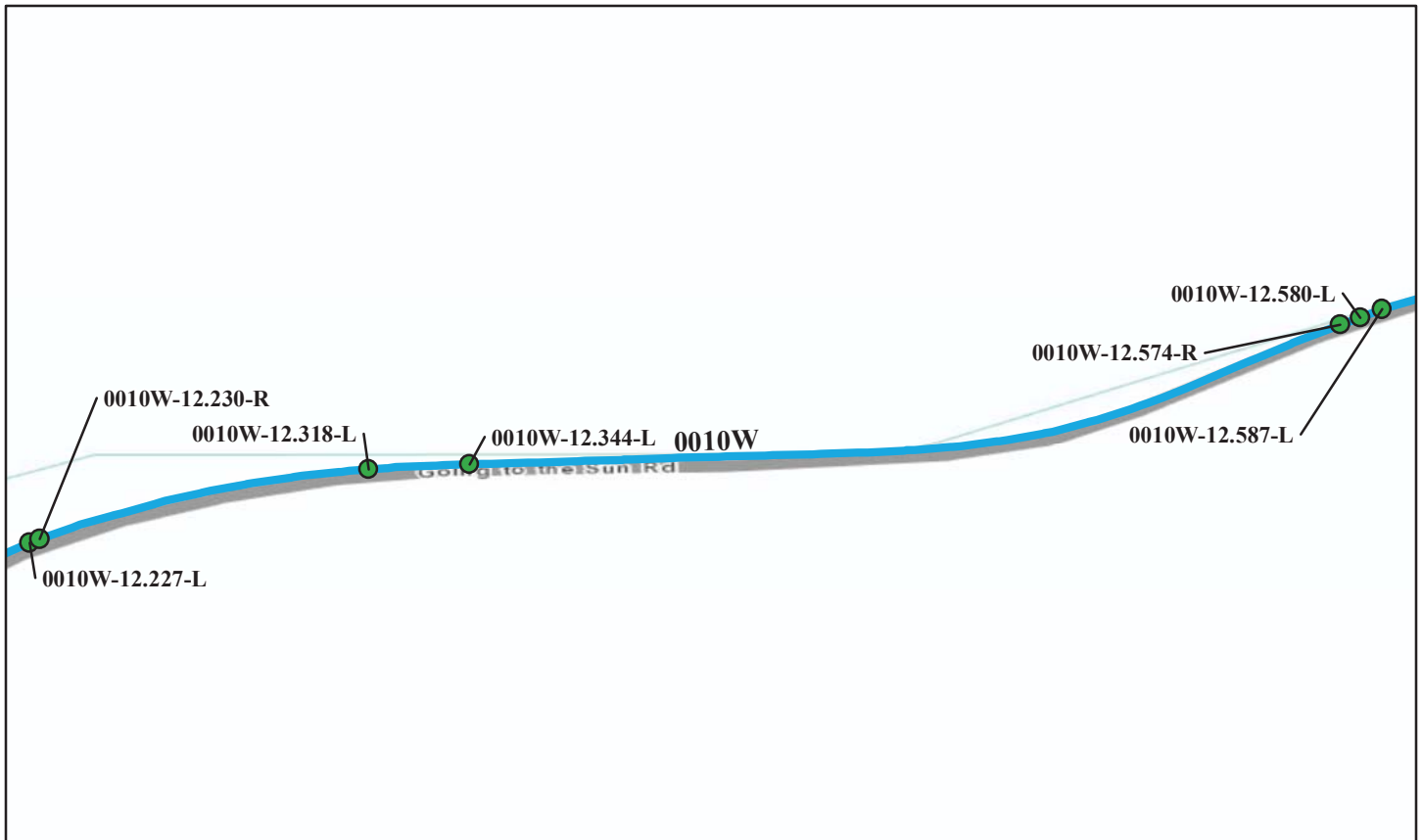
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GLAC-0010W-10.230-R 7/8/2007	86	22	Gravity - Mortared Stone	Head Wall	78	\$1,600.00
GLAC-0010W-10.231-L 7/8/2007	118	21	Gravity - Mortared Stone	Head Wall	73	\$4,840.00
GLAC-0010W-10.555-L 7/8/2007	429	67	Gravity - Mortared Stone	Head Wall	80	\$3,220.00
GLAC-0010W-10.557-R 7/8/2007	380	67	Gravity - Mortared Stone	Head Wall	81	\$0.00
GLAC-0010W-12.227-L 7/9/2007	39	10	Gravity - Mortared Stone	Head Wall	77	\$1,570.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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
GLAC-0010W-12.230-R 7/9/2007	69	20	Gravity - Mortared Stone	Head Wall	80	\$440.00
GLAC-0010W-12.318-L 7/9/2007	1,720	157	Gravity - Mortared Stone	Fill Wall	78	\$38,700.00
GLAC-0010W-12.344-L 7/9/2007	2,720	217	Gravity - Mortared Stone	Fill Wall	80	\$30,600.00
GLAC-0010W-12.574-R 7/9/2007	181	44	Gravity - Mortared Stone	Head Wall	79	\$1,700.00
GLAC-0010W-12.580-L 7/9/2007	271	37	Gravity - Mortared Stone	Head Wall	77	\$2,030.00

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

Glacier National Park

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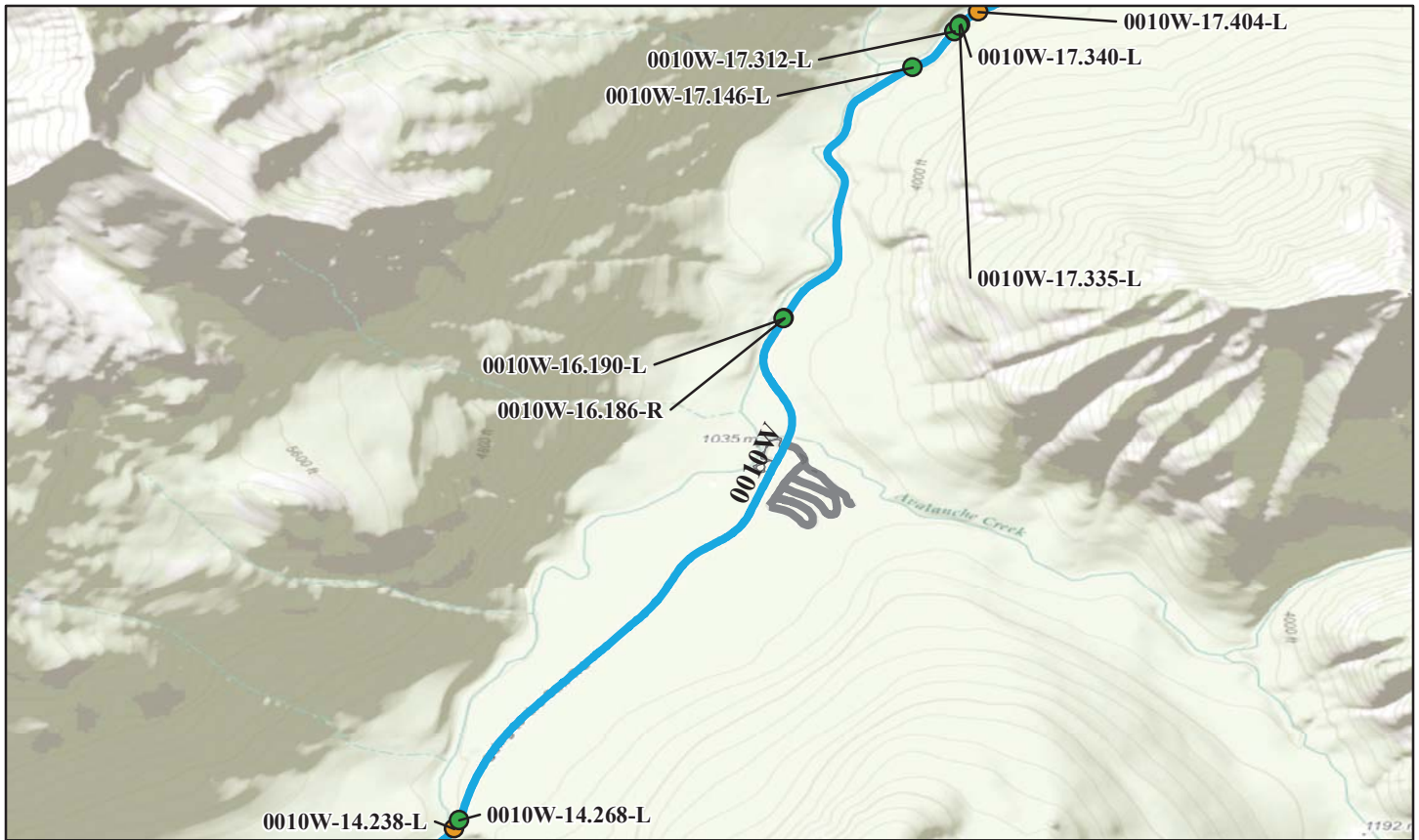
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-12.587-L 7/9/2007	1,065	128	Gravity - Mortared Stone	Fill Wall	74	\$12,630.00
GLAC-0010W-12.862-L 7/9/2007	471	75	Gravity - Mortared Stone	Fill Wall	71	\$9,300.00
GLAC-0010W-13.358-R 7/11/2007	153	30	Gravity - Mortared Stone	Head Wall	82	\$1,300.00
GLAC-0010W-13.360-L 7/11/2007	162	32	Gravity - Mortared Stone	Head Wall	82	\$440.00
GLAC-0010W-14.238-L 7/11/2007	635	97	Gravity - Dry Stone	Fill Wall	68	\$6,520.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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
GLAC-0010W-14.268-L 7/11/2007	3,880	556	Gravity - Mortared Stone	Fill Wall	75	\$89,500.00
GLAC-0010W-16.186-R 7/11/2007	180	93	Gravity - Mortared Stone	Head Wall	75	\$7,950.00
GLAC-0010W-16.190-L 7/11/2007	118	94	Gravity - Mortared Stone	Head Wall	69	\$4,770.00
GLAC-0010W-17.146-L 7/11/2007	5,358	460	Gravity - Dry Stone	Fill Wall	74	\$9,160.00
GLAC-0010W-17.312-L 7/12/2007	1,477	106	Gravity - Dry Stone	Fill Wall	77	\$3,200.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

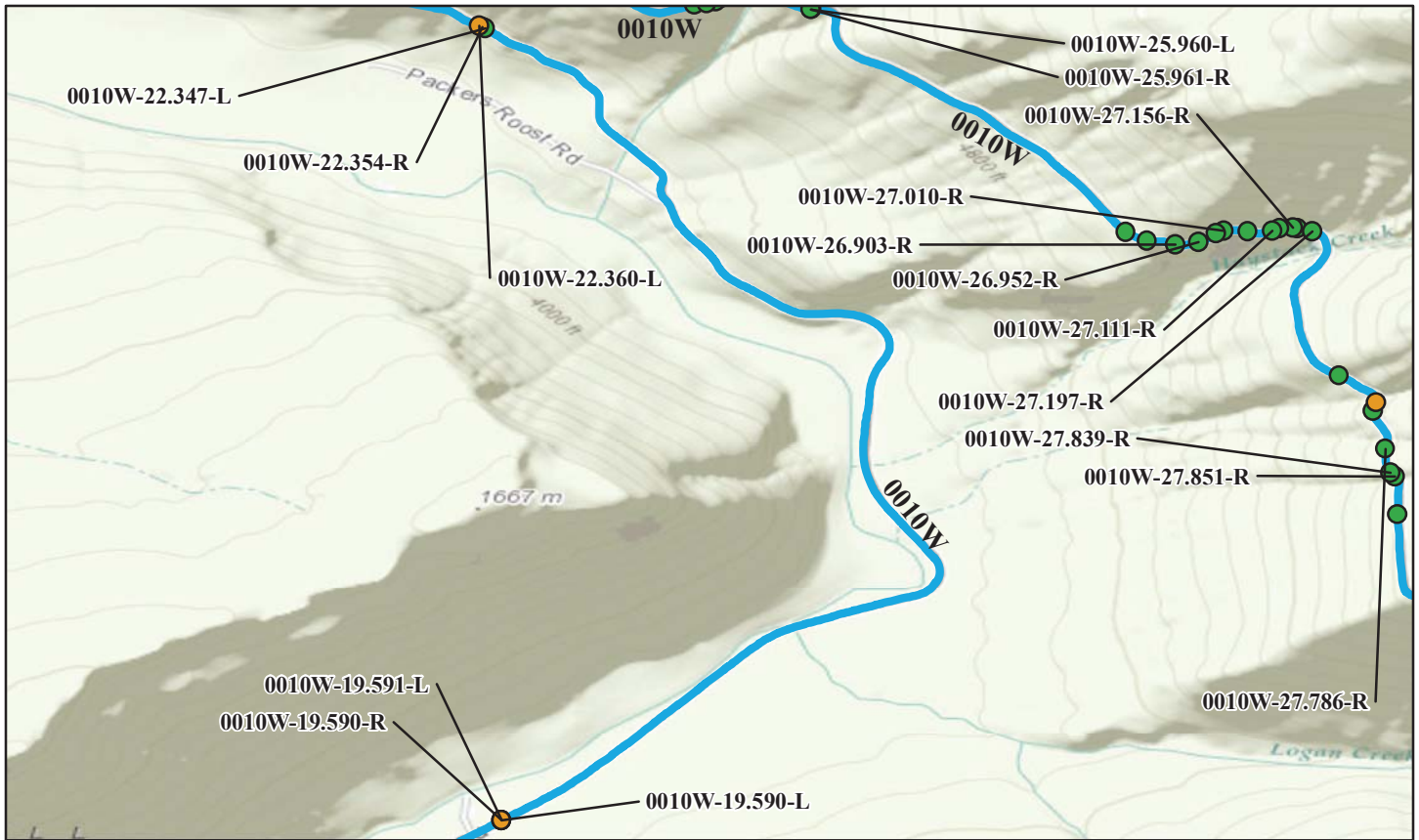
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-17.335-L 7/12/2007	384	31	Gravity - Mass Concrete	Fill Wall	85	\$0.00
GLAC-0010W-17.340-L 7/12/2007	1,327	105	Gravity - Mortared Stone	Fill Wall	72	\$68,600.00
GLAC-0010W-17.404-L 7/12/2007	695	113	Gravity - Mortared Stone	Fill Wall	68	\$46,910.00
GLAC-0010W-18.748-R 7/13/2007	135	41	Gravity - Mortared Stone	Head Wall	63	\$13,470.00
GLAC-0010W-18.750-L 7/13/2007	37	26	Gravity - Mortared Stone	Head Wall	79	\$440.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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
GLAC-0010W-19.590-L 7/13/2007	118	31	Gravity - Mortared Stone	Head Wall	68	\$6,750.00
GLAC-0010W-19.590-R 7/13/2007	83	32	Gravity - Mortared Stone	Fill Wall	82	\$0.00
GLAC-0010W-19.591-L 7/13/2007	118	31	Gravity - Mortared Stone	Head Wall	68	\$6,750.00
GLAC-0010W-22.347-L 9/12/2007	210	37	Gravity - Mortared Stone	Head Wall	78	\$0.00
GLAC-0010W-22.354-R 9/12/2007	200	37	Gravity - Mortared Stone	Head Wall	77	\$4,500.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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

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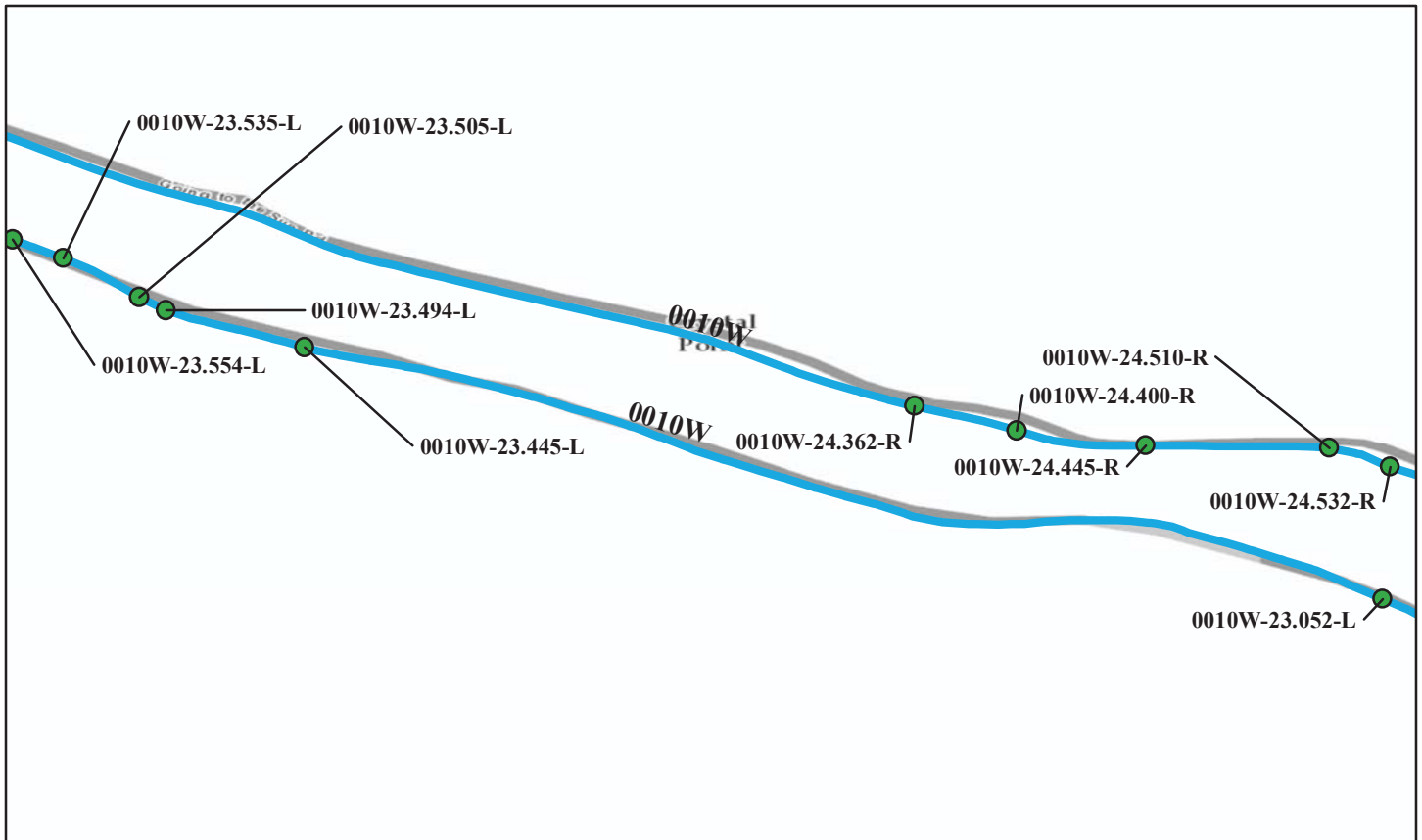
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-22.360-L 9/12/2007	60	21	Gravity - Mortared Stone	Head Wall	66	\$0.00
GLAC-0010W-22.855-L 9/12/2007	665	133	Cantilever - Concrete	Fill Wall	75	\$4,500.00
GLAC-0010W-22.880-L 9/12/2007	680	156	Gravity - Mortared Stone	Fill Wall	65	\$3,500.00
GLAC-0010W-22.913-L 9/12/2007	635	91	Gravity - Mortared Stone	Fill Wall	82	\$14,250.00
GLAC-0010W-22.962-L 9/12/2007	450	76	Gravity - Mortared Stone	Fill Wall	72	\$9,750.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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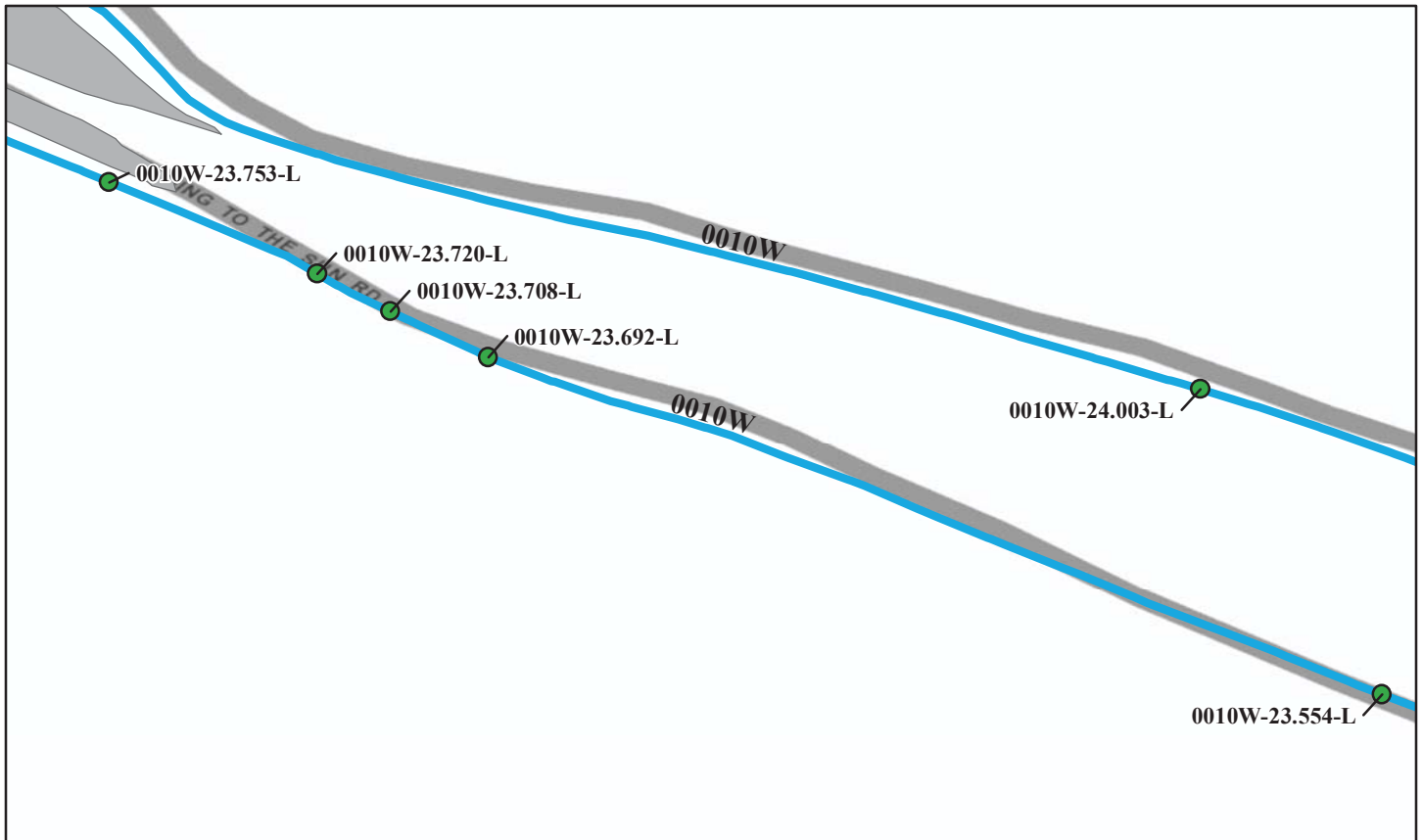
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-23.052-L 9/16/2007	750	82	Gravity - Mortared Stone	Fill Wall	70	\$16,875.00
GLAC-0010W-23.445-L 9/12/2007	515	78	Gravity - Mortared Stone	Fill Wall	90	\$0.00
GLAC-0010W-23.494-L 9/12/2007	200	51	Gravity - Mortared Stone	Fill Wall	78	\$0.00
GLAC-0010W-23.505-L 9/12/2007	400	61	Gravity - Mortared Stone	Fill Wall	73	\$12,000.00
GLAC-0010W-23.535-L 9/12/2007	150	44	Gravity - Mortared Stone	Fill Wall	79	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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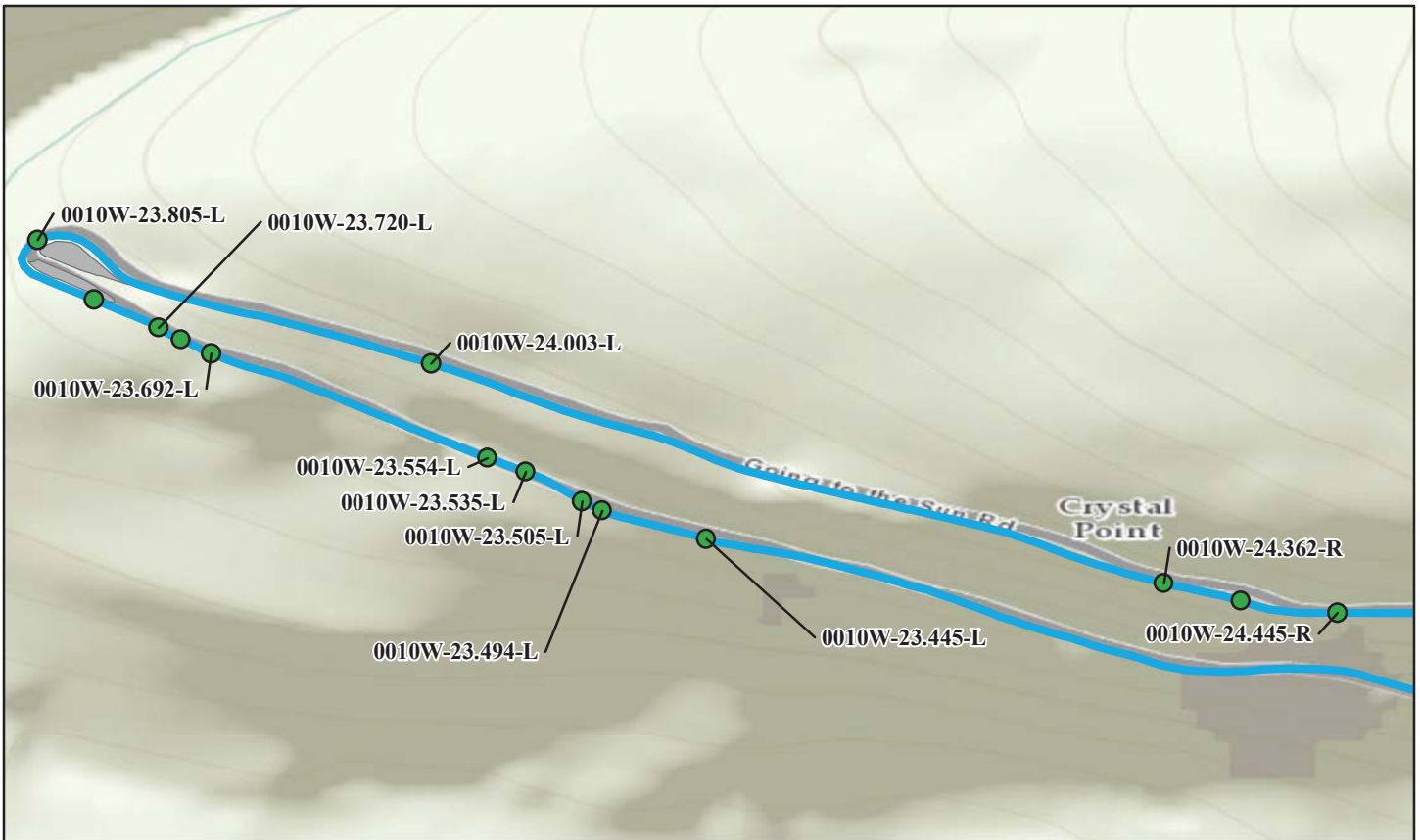
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-23.554-L 9/12/2007	800	300	Gravity - Mortared Stone	Fill Wall	72	\$6,400.00
GLAC-0010W-23.692-L 9/12/2007	1,055	87	Gravity - Dry Stone	Fill Wall	71	\$3,500.00
GLAC-0010W-23.708-L 9/12/2007	210	27	Gravity - Mortared Stone	Fill Wall	77	\$0.00
GLAC-0010W-23.720-L 9/16/2007	840	152	Gravity - Mortared Stone	Fill Wall	71	\$0.00
GLAC-0010W-23.753-L 9/16/2007	160	56	Gravity - Dry Stone	Fill Wall	77	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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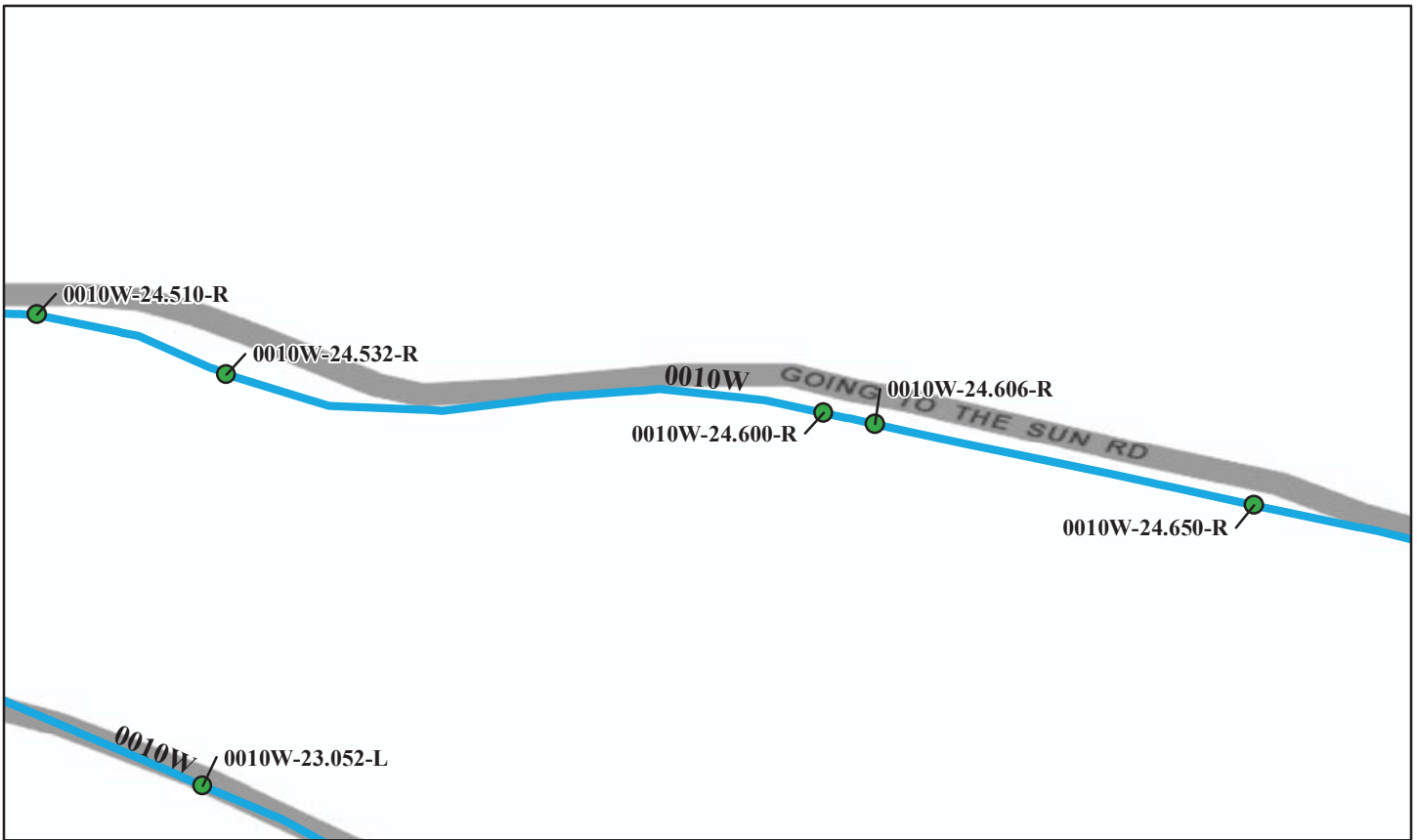
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-23.805-L 9/12/2007	185	53	Gravity - Mortared Stone	Fill Wall	90	\$0.00
GLAC-0010W-24.003-L 9/12/2007	4,600	135	Gravity - Dry Stone	Fill Wall	80	\$0.00
GLAC-0010W-24.362-R 9/15/2007	510	91	MSE - Welded Wire Face	Fill Wall	90	\$0.00
GLAC-0010W-24.400-R 9/15/2007	170	38	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-24.445-R 9/15/2007	640	106	MSE - Welded Wire Face	Fill Wall	90	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

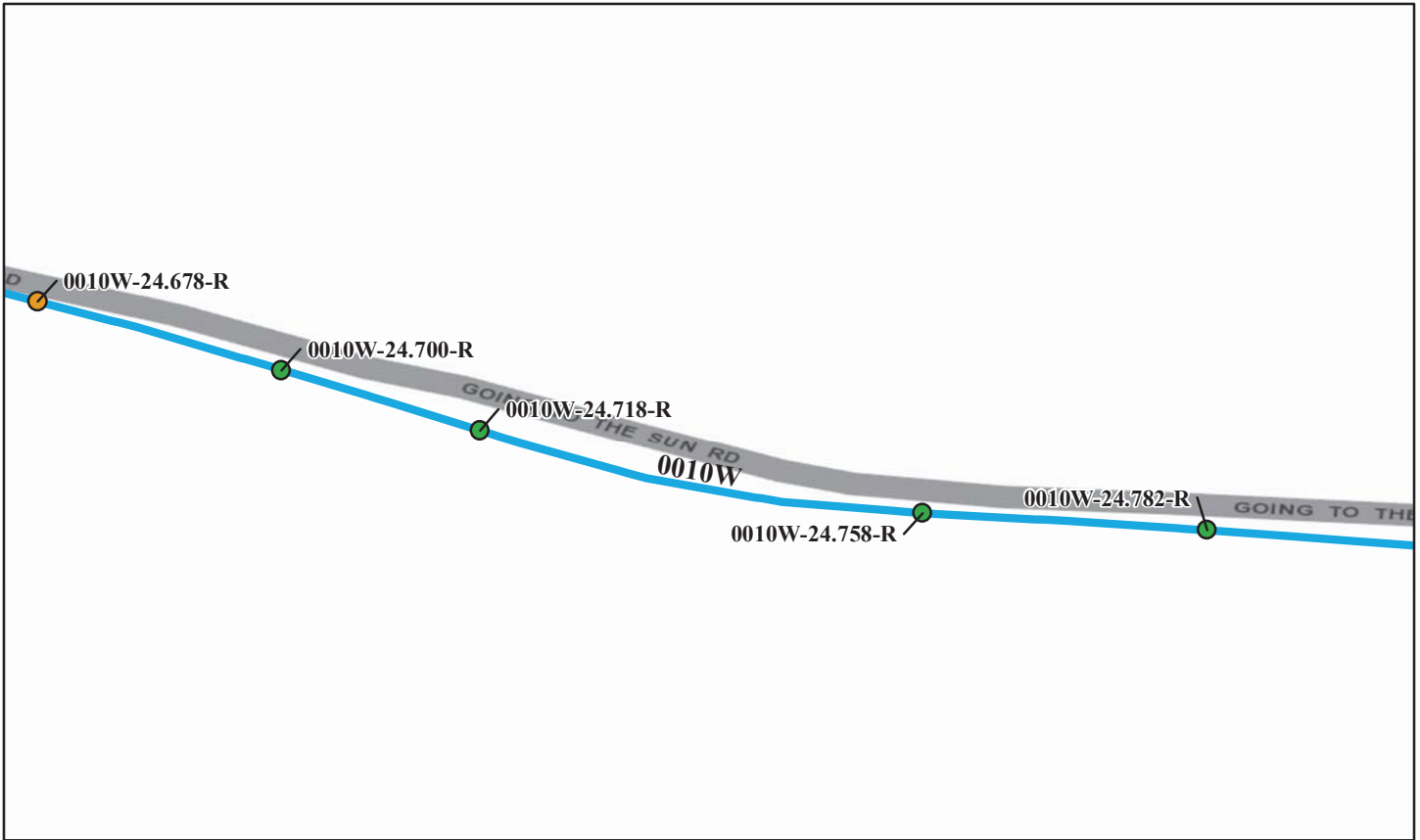
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-24.510-R 9/15/2007	570	114	MSE - Welded Wire Face	Fill Wall	87	\$0.00
GLAC-0010W-24.532-R 9/15/2007	1,100	90	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-24.600-R 9/15/2007	140	23	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-24.606-R 9/15/2007	2,040	227	Gravity - Mortared Stone	Fill Wall	70	\$0.00
GLAC-0010W-24.650-R 9/15/2007	735	74	Gravity - Mortared Stone	Head Wall	83	\$27,750.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

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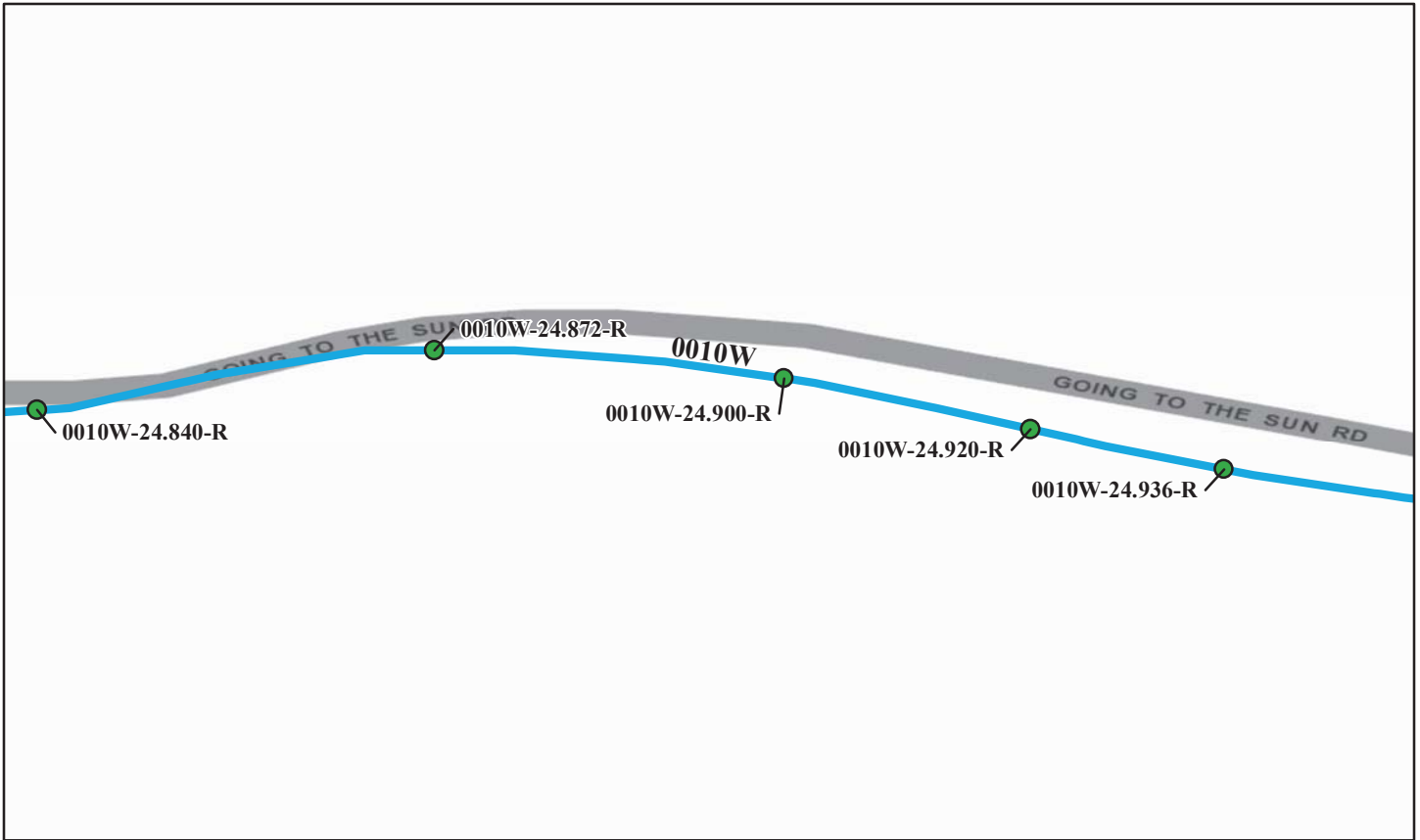
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-24.678-R 9/15/2007	130	54	Gravity - Mortared Stone	Fill Wall	68	\$1,000.00
GLAC-0010W-24.700-R 9/15/2007	200	30	Gravity - Mortared Stone	Fill Wall	78	\$0.00
GLAC-0010W-24.718-R 9/15/2007	1,800	150	Gravity - Mortared Stone	Fill Wall	78	\$33,750.00
GLAC-0010W-24.758-R 9/15/2007	160	32	Gravity - Dry Stone	Fill Wall	77	\$0.00
GLAC-0010W-24.782-R 9/15/2007	470	80	Gravity - Mortared Stone	Fill Wall	82	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

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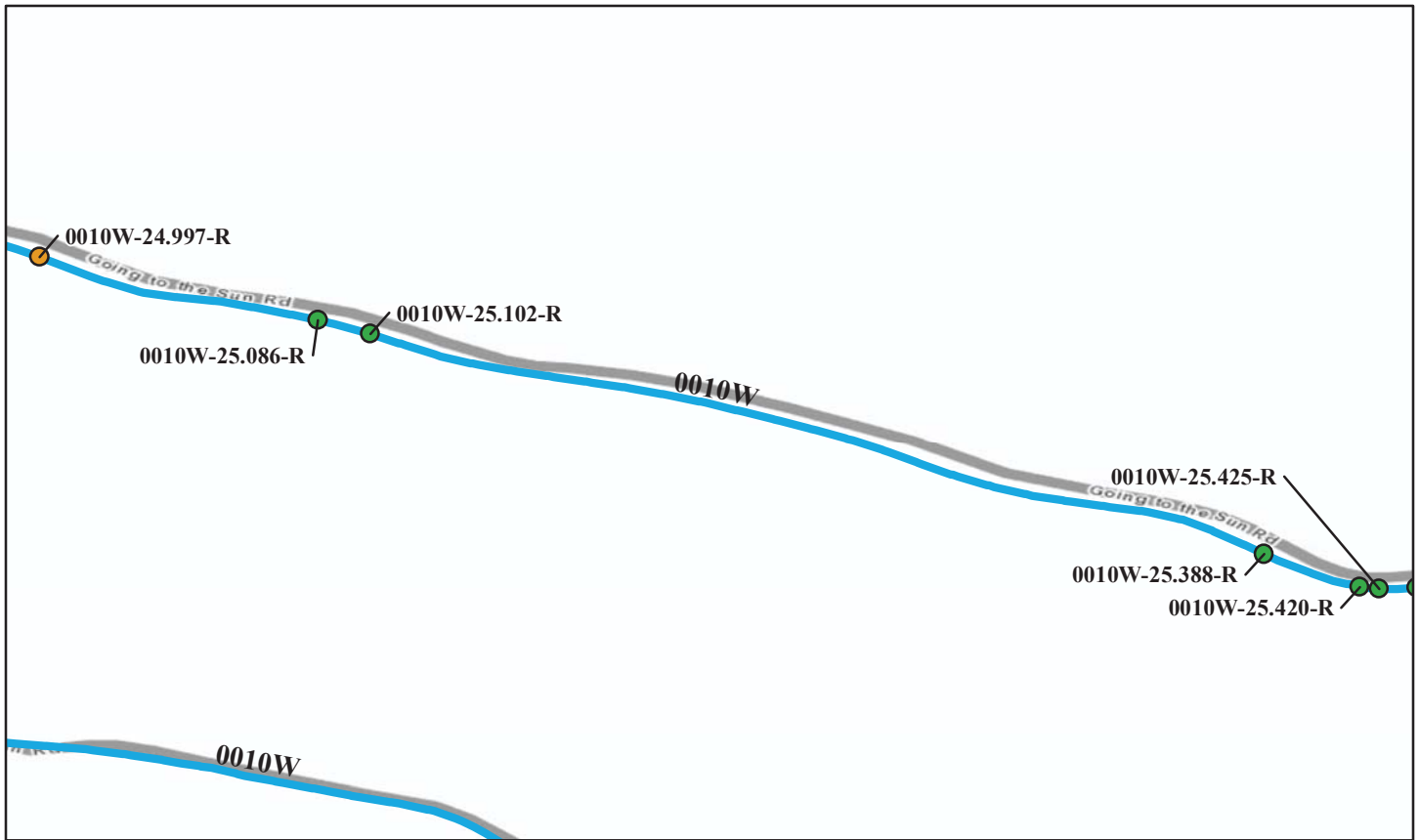
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-24.840-R 9/15/2007	460	70	Gravity - Mortared Stone	Fill Wall	80	\$0.00
GLAC-0010W-24.872-R 9/15/2007	170	43	Gravity - Mortared Stone	Fill Wall	90	\$0.00
GLAC-0010W-24.900-R 9/15/2007	1,160	99	Gravity - Mortared Stone	Fill Wall	80	\$0.00
GLAC-0010W-24.920-R 9/15/2007	360	75	Gravity - Mortared Stone	Fill Wall	78	\$0.00
GLAC-0010W-24.936-R 9/15/2007	108	48	Gravity - Mortared Stone	Fill Wall	80	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

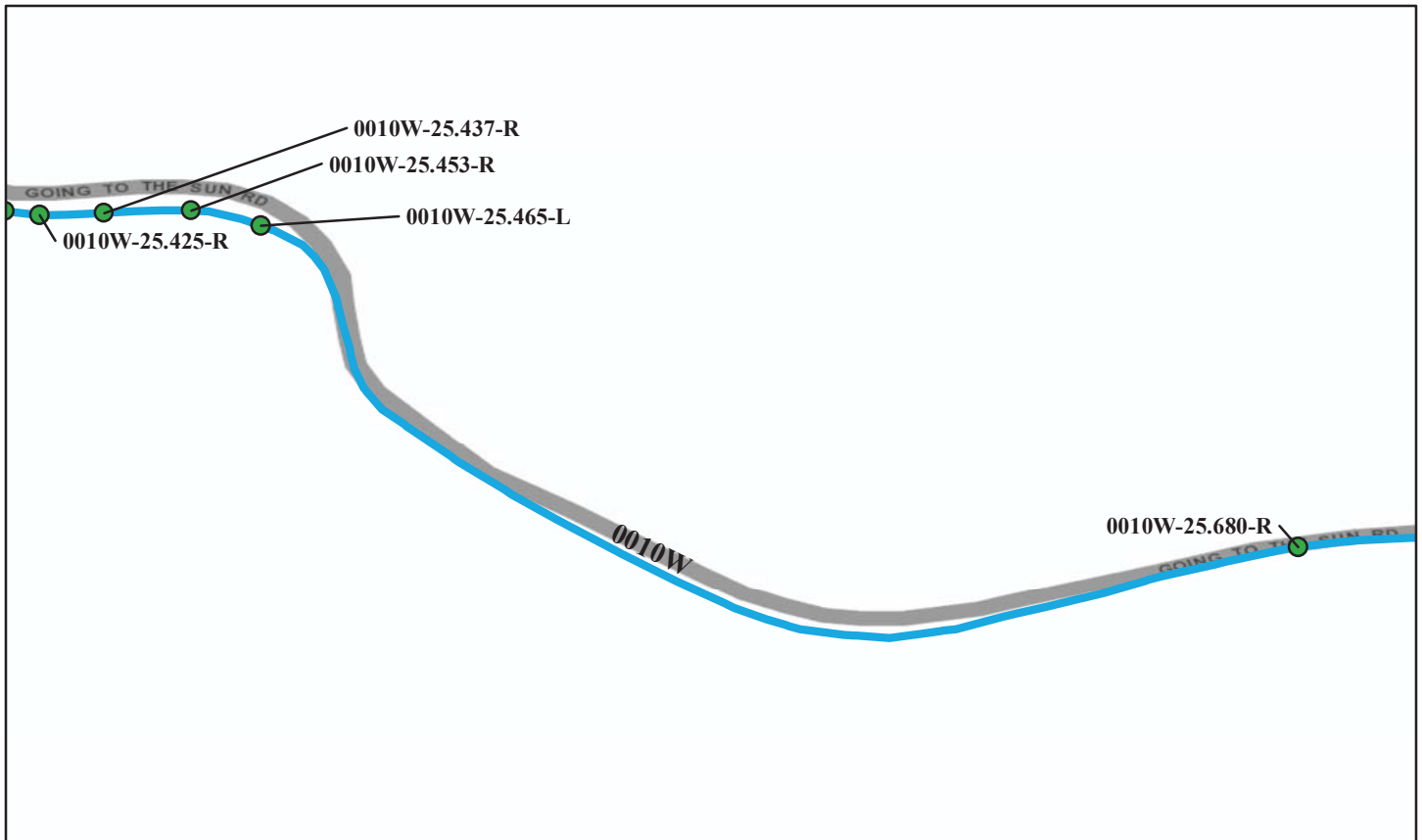
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-24.997-R 9/15/2007	310	35	Cantilever - Concrete	Fill Wall	67	\$3,700.00
GLAC-0010W-25.086-R 9/15/2007	360	55	Gravity - Mortared Stone	Fill Wall	83	\$0.00
GLAC-0010W-25.102-R 9/15/2007	325	43	Gravity - Mortared Stone	Fill Wall	89	\$0.00
GLAC-0010W-25.388-R 9/12/2007	670	169	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-25.420-R 9/12/2007	110	24	Gravity - Mortared Stone	Fill Wall	80	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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
GLAC-0010W-25.425-R 9/12/2007	300	65	Gravity - Mortared Stone	Fill Wall	78	\$0.00
GLAC-0010W-25.437-R 9/12/2007	720	62	Gravity - Mortared Stone	Fill Wall	87	\$0.00
GLAC-0010W-25.453-R 9/12/2007	1,150	113	Gravity - Mortared Stone	Fill Wall	81	\$116,000.00
GLAC-0010W-25.465-L 9/12/2007	80	22	Gravity - Mortared Stone	Head Wall	79	\$6,700.00
GLAC-0010W-25.680-R 9/13/2007	860	84	Gravity - Mortared Stone	Fill Wall	83	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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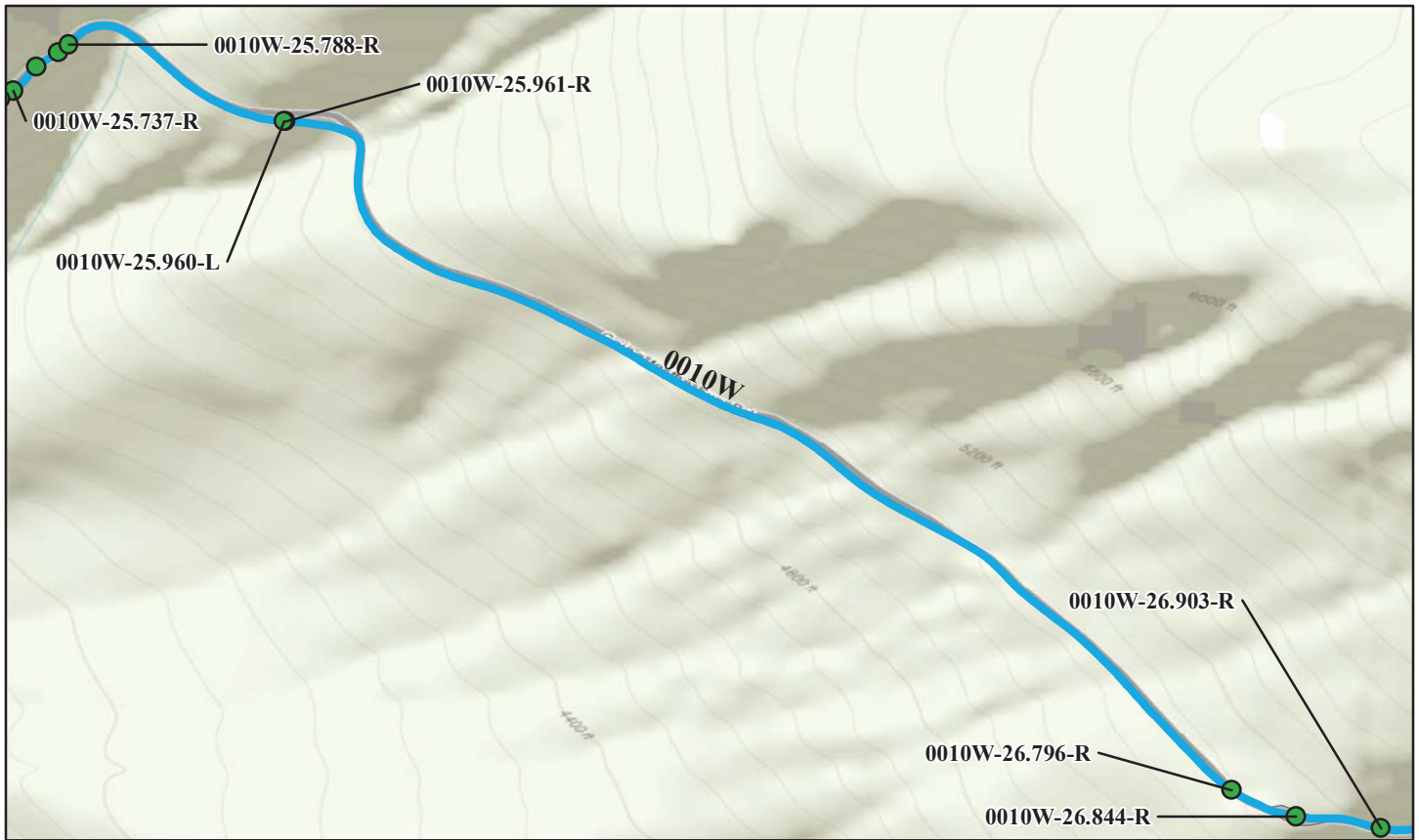
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-25.707-R 9/13/2007	420	52	Gravity - Mortared Stone	Fill Wall	75	\$15,750.00
GLAC-0010W-25.725-R 9/13/2007	380	45	Gravity - Mortared Stone	Fill Wall	78	\$0.00
GLAC-0010W-25.737-R 9/13/2007	900	121	Gravity - Mortared Stone	Fill Wall	74	\$116,000.00
GLAC-0010W-25.760-R 9/13/2007	1,385	104	Gravity - Mortared Stone	Fill Wall	75	\$42,250.00
GLAC-0010W-25.778-L 9/13/2007	360	48	Gravity - Mortared Stone	Fill Wall	75	\$73,500.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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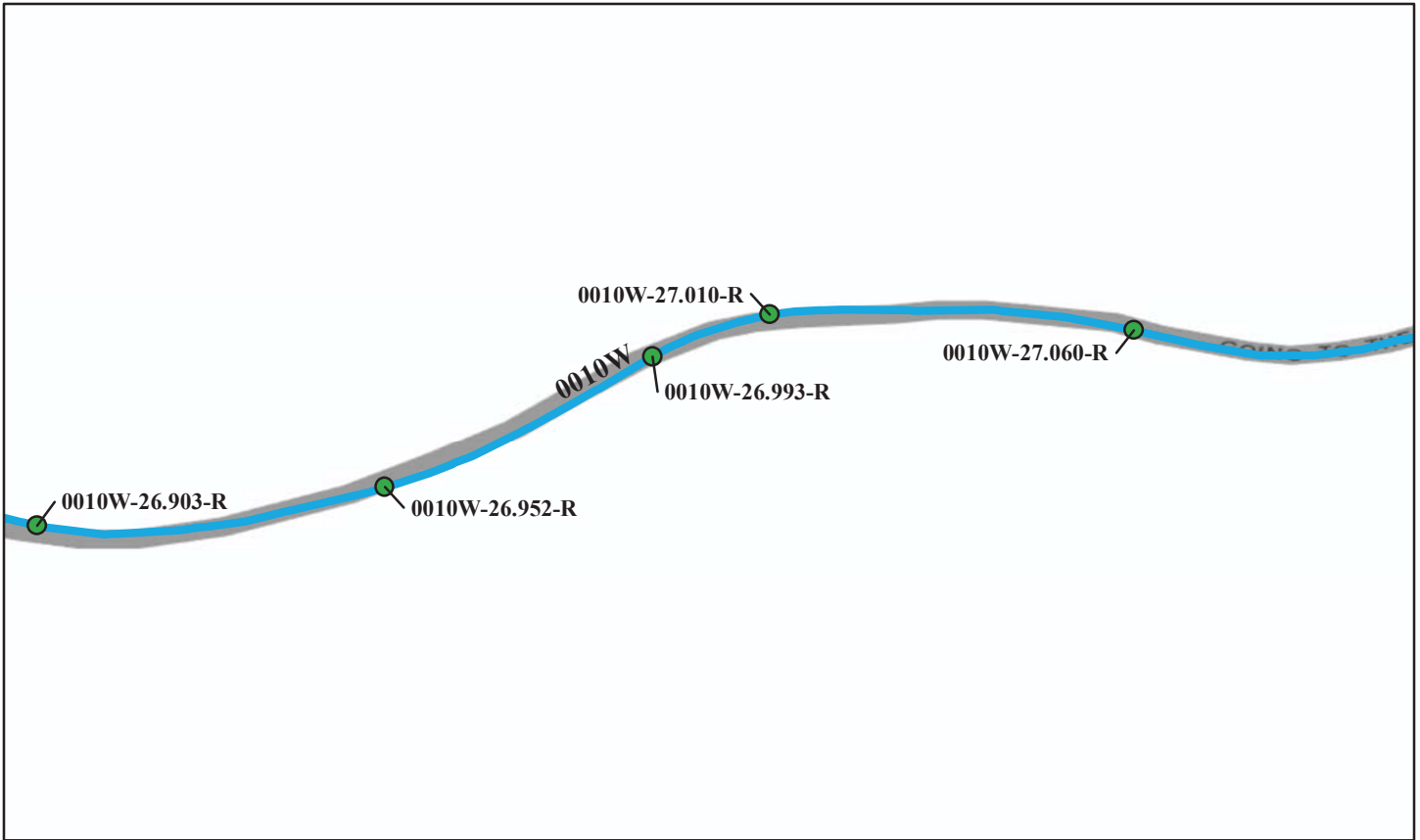
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-25.788-R 9/13/2007	300	25	Gravity - Dry Stone	Fill Wall	83	\$0.00
GLAC-0010W-25.960-L 9/13/2007	290	24	Gravity - Mortared Stone	Head Wall	83	\$0.00
GLAC-0010W-25.961-R 9/13/2007	65	16	Gravity - Mortared Stone	Head Wall	75	\$1,875.00
GLAC-0010W-26.796-R 9/13/2007	764	153	Gravity - Mortared Stone	Fill Wall	82	\$5,625.00
GLAC-0010W-26.844-R 9/13/2007	1,170	213	Gravity - Mortared Stone	Fill Wall	78	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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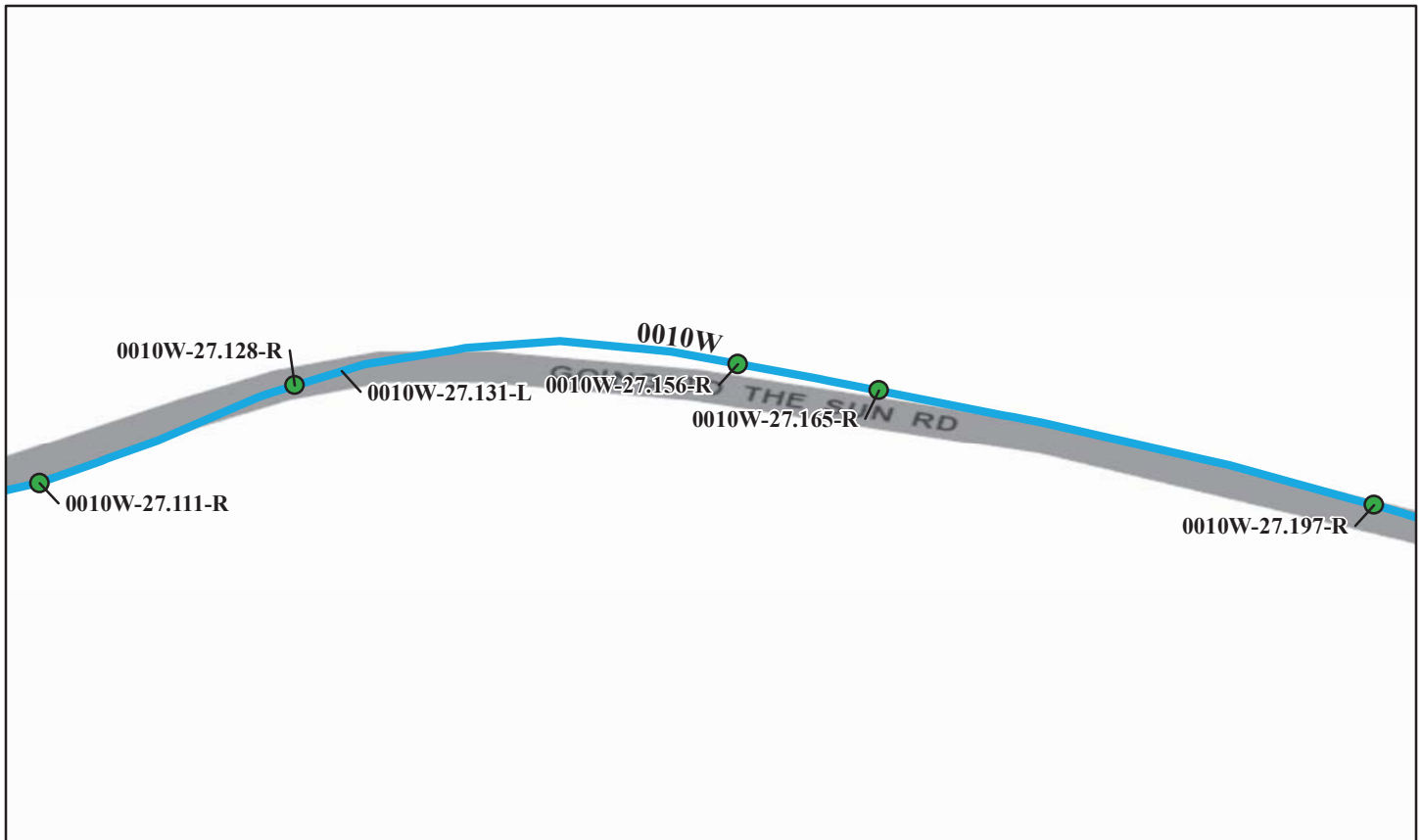
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-26.903-R 9/13/2007	1,570	165	Gravity - Mortared Stone	Fill Wall	80	\$60,000.00
GLAC-0010W-26.952-R 9/13/2007	1,400	146	Gravity - Mortared Stone	Fill Wall	74	\$145,000.00
GLAC-0010W-26.993-R 9/13/2007	370	70	Gravity - Mortared Stone	Fill Wall	82	\$0.00
GLAC-0010W-27.010-R 9/13/2007	500	60	Cantilever - Concrete	Fill Wall	85	\$0.00
GLAC-0010W-27.060-R 9/13/2007	1,300	169	Cantilever - Concrete	Fill Wall	87	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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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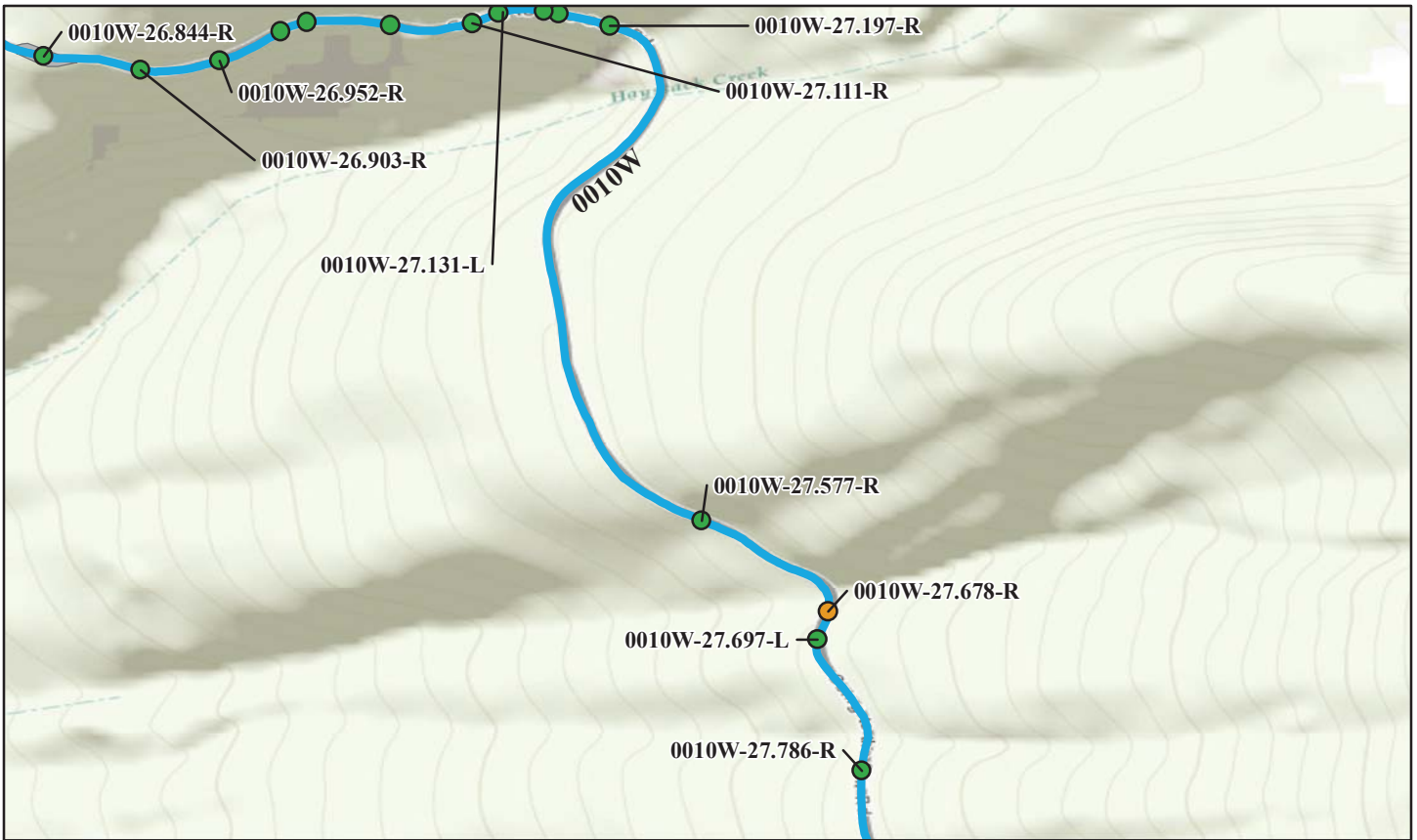
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-27.111-R 9/13/2007	750	119	Cantilever - Concrete	Fill Wall	85	\$0.00
GLAC-0010W-27.128-R 9/13/2007	920	121	Cantilever - Concrete	Fill Wall	89	\$0.00
GLAC-0010W-27.131-L 9/13/2007	80	25	Gravity - Mortared Stone	Head Wall	61	\$10,875.00
GLAC-0010W-27.156-R 9/13/2007	400	56	Cantilever - Concrete	Fill Wall	89	\$0.00
GLAC-0010W-27.165-R 9/13/2007	1,070	175	Cantilever - Concrete	Fill Wall	83	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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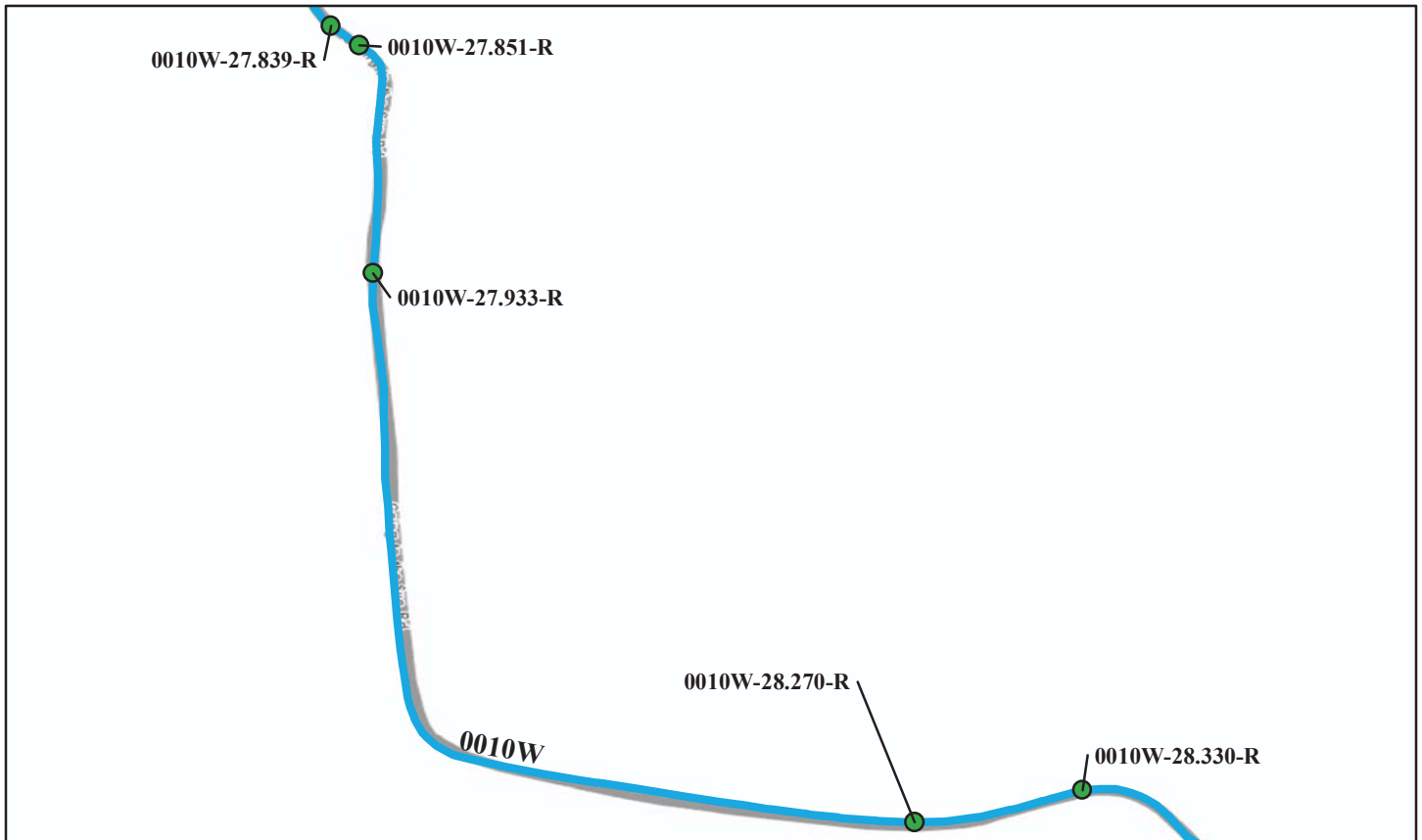
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-27.197-R 9/13/2007	360	41	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-27.577-R 9/13/2007	730	86	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-27.678-R 9/13/2007	2,130	172	Gravity - Mortared Stone	Fill Wall	64	\$120,000.00
GLAC-0010W-27.697-L 9/13/2007	240	37	Gravity - Mortared Stone	Head Wall	78	\$0.00
GLAC-0010W-27.786-R 9/13/2007	1,300	150	Gravity - Mortared Stone	Fill Wall	73	\$50,750.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

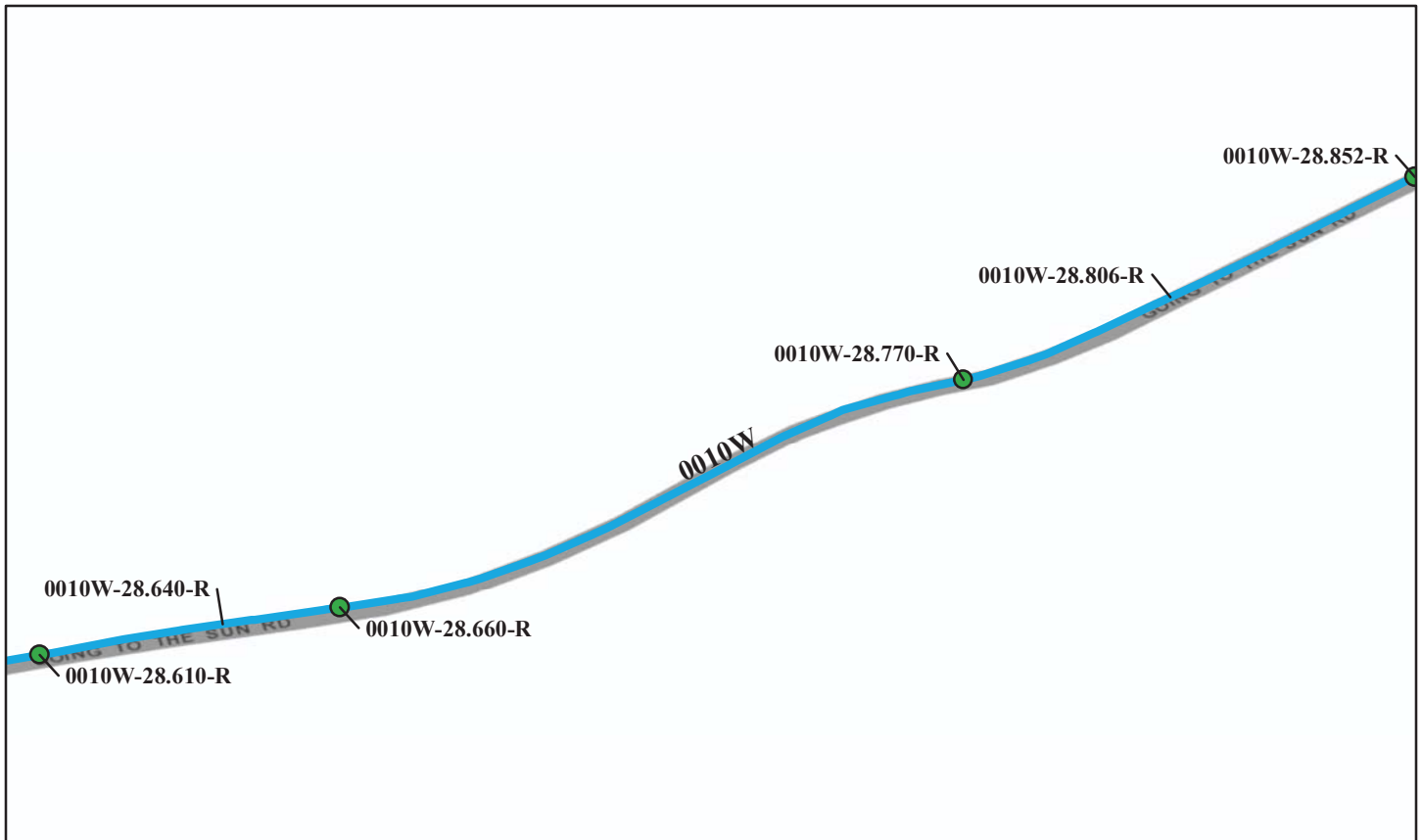
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-27.839-R 9/13/2007	150	35	Gravity - Dry Stone	Fill Wall	73	\$0.00
GLAC-0010W-27.851-R 9/13/2007	480	69	Gravity - Dry Stone	Fill Wall	85	\$0.00
GLAC-0010W-27.933-R 9/13/2007	830	82	Gravity - Dry Stone	Fill Wall	70	\$0.00
GLAC-0010W-28.270-R 9/14/2007	110	44	Cantilever - Concrete	Fill Wall	87	\$2,750.00
GLAC-0010W-28.330-R 9/14/2007	45	14	Cantilever - Concrete	Fill Wall	80	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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
GLAC-0010W-28.610-R 9/14/2007	1,100	70	Gravity - Dry Stone	Fill Wall	80	\$0.00
GLAC-0010W-28.640-R 9/14/2007	640	77	Gravity - Mortared Stone	Fill Wall	56	\$14,000.00
GLAC-0010W-28.660-R 9/14/2007	215	33	Gravity - Dry Stone	Fill Wall	80	\$0.00
GLAC-0010W-28.770-R 9/14/2007	930	67	Gravity - Dry Stone	Fill Wall	88	\$0.00
GLAC-0010W-28.806-R 9/14/2007	1,600	210	Gravity - Mortared Stone	Fill Wall	61	\$2,560.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

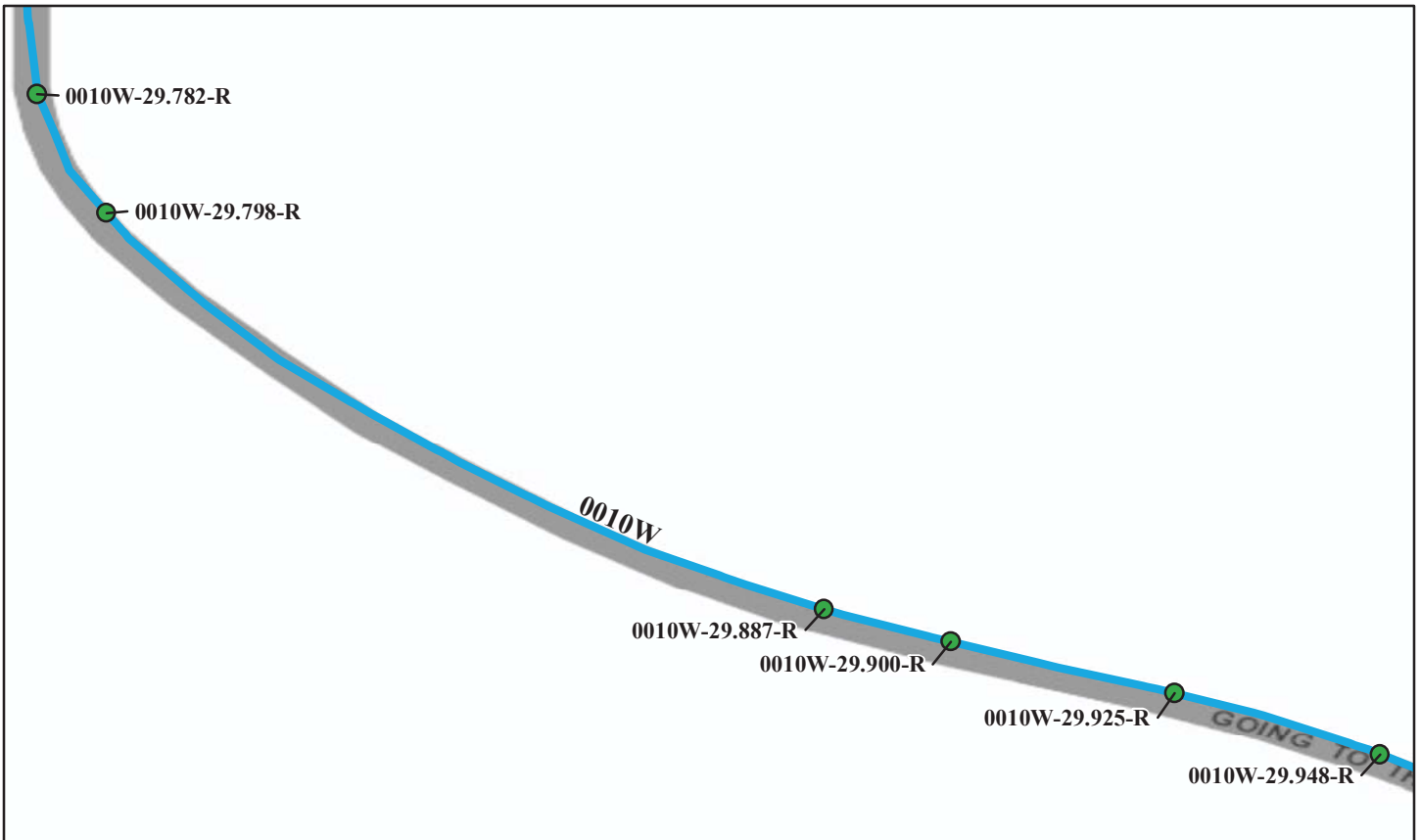
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-28.852-R 9/14/2007	570	80	Gravity - Mortared Stone	Fill Wall	84	\$0.00
GLAC-0010W-29.160-R 9/14/2007	350	60	Gravity - Dry Stone	Fill Wall	74	\$0.00
GLAC-0010W-29.553-R 9/14/2007	820	115	Gravity - Mortared Stone	Fill Wall	72	\$200,000.00
GLAC-0010W-29.587-R 9/14/2007	535	42	Gravity - Dry Stone	Fill Wall	79	\$0.00
GLAC-0010W-29.661-R 9/14/2007	140	35	Gravity - Mortared Stone	Fill Wall	79	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

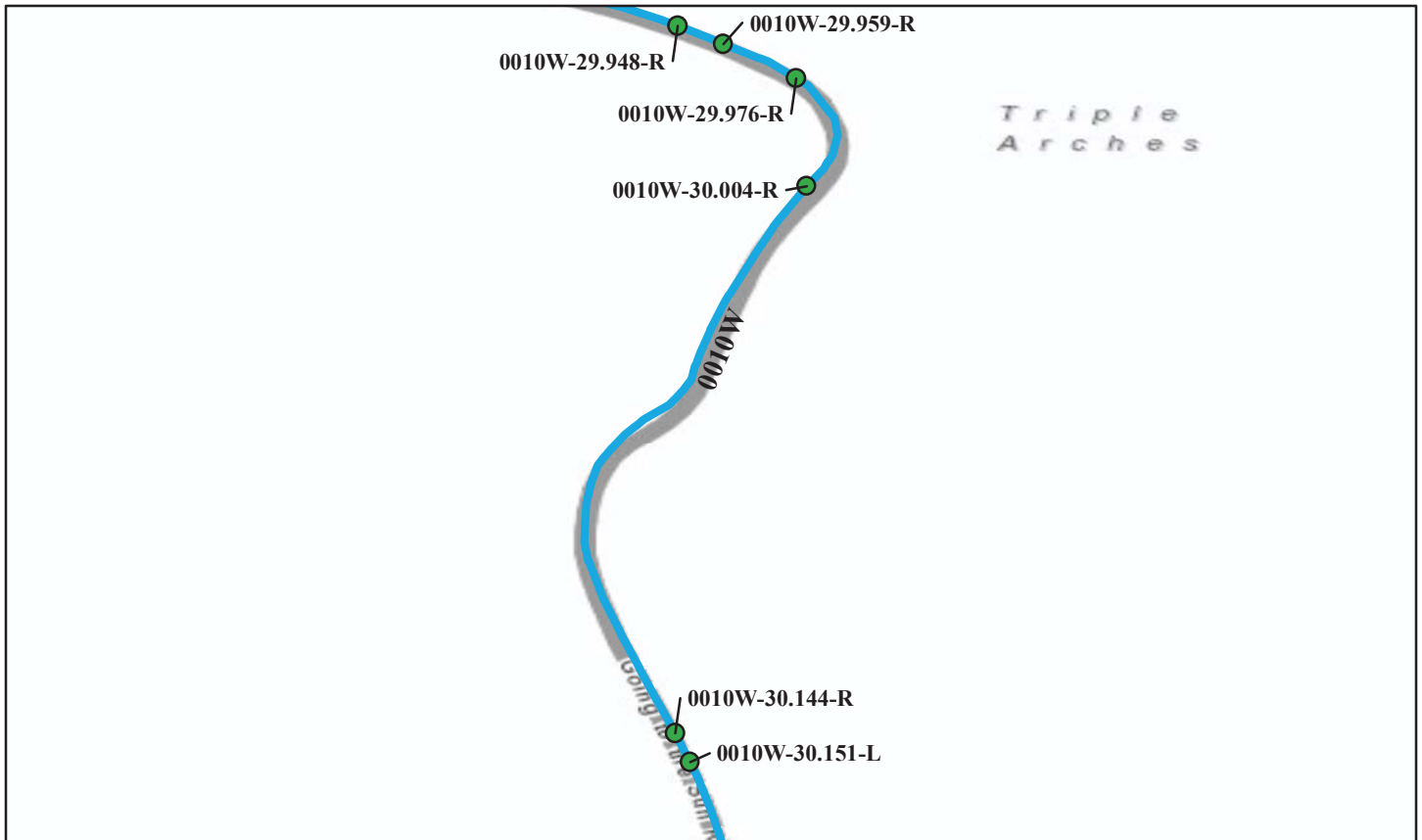
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-29.782-R 9/14/2007	171	57	Cantilever - Concrete	Fill Wall	80	\$3,000.00
GLAC-0010W-29.798-R 9/14/2007	3,930	342	Cantilever - Concrete	Fill Wall	85	\$0.00
GLAC-0010W-29.887-R 9/14/2007	590	85	Gravity - Mortared Stone	Fill Wall	78	\$0.00
GLAC-0010W-29.900-R 9/14/2007	760	89	Gravity - Mortared Stone	Fill Wall	75	\$0.00
GLAC-0010W-29.925-R 9/14/2007	1,210	128	Gravity - Mortared Stone	Fill Wall	82	\$18,000.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

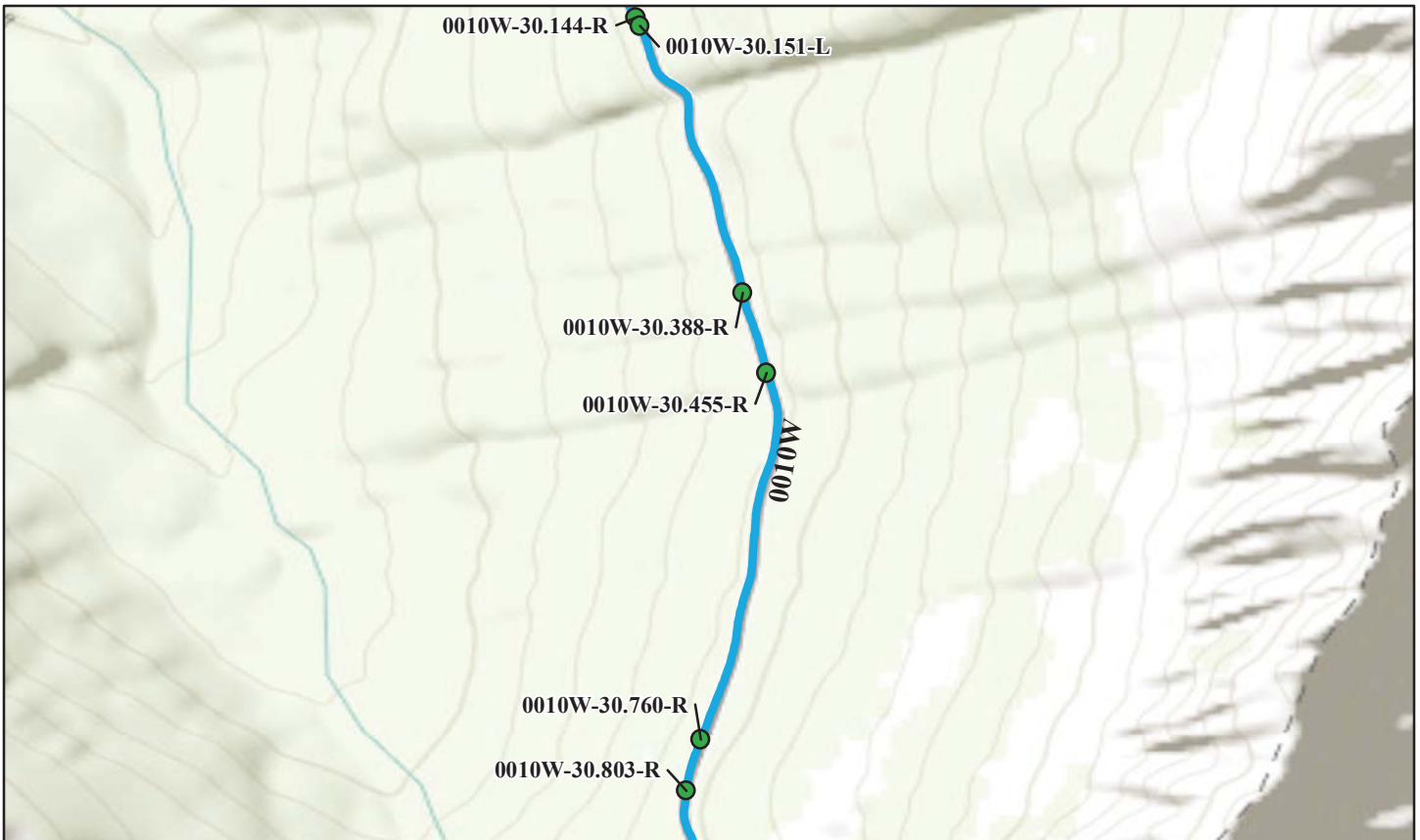
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-29.948-R 9/14/2007	90	28	Gravity - Mortared Stone	Fill Wall	80	\$0.00
GLAC-0010W-29.959-R 9/14/2007	1,200	80	Gravity - Mortared Stone	Fill Wall	80	\$0.00
GLAC-0010W-29.976-R 9/14/2007	490	54	Gravity - Mortared Stone	Fill Wall	75	\$15,000.00
GLAC-0010W-30.004-R 9/14/2007	130	46	Cantilever - Concrete	Fill Wall	87	\$0.00
GLAC-0010W-30.144-R 9/14/2007	1,500	106	Gravity - Mortared Stone	Fill Wall	85	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

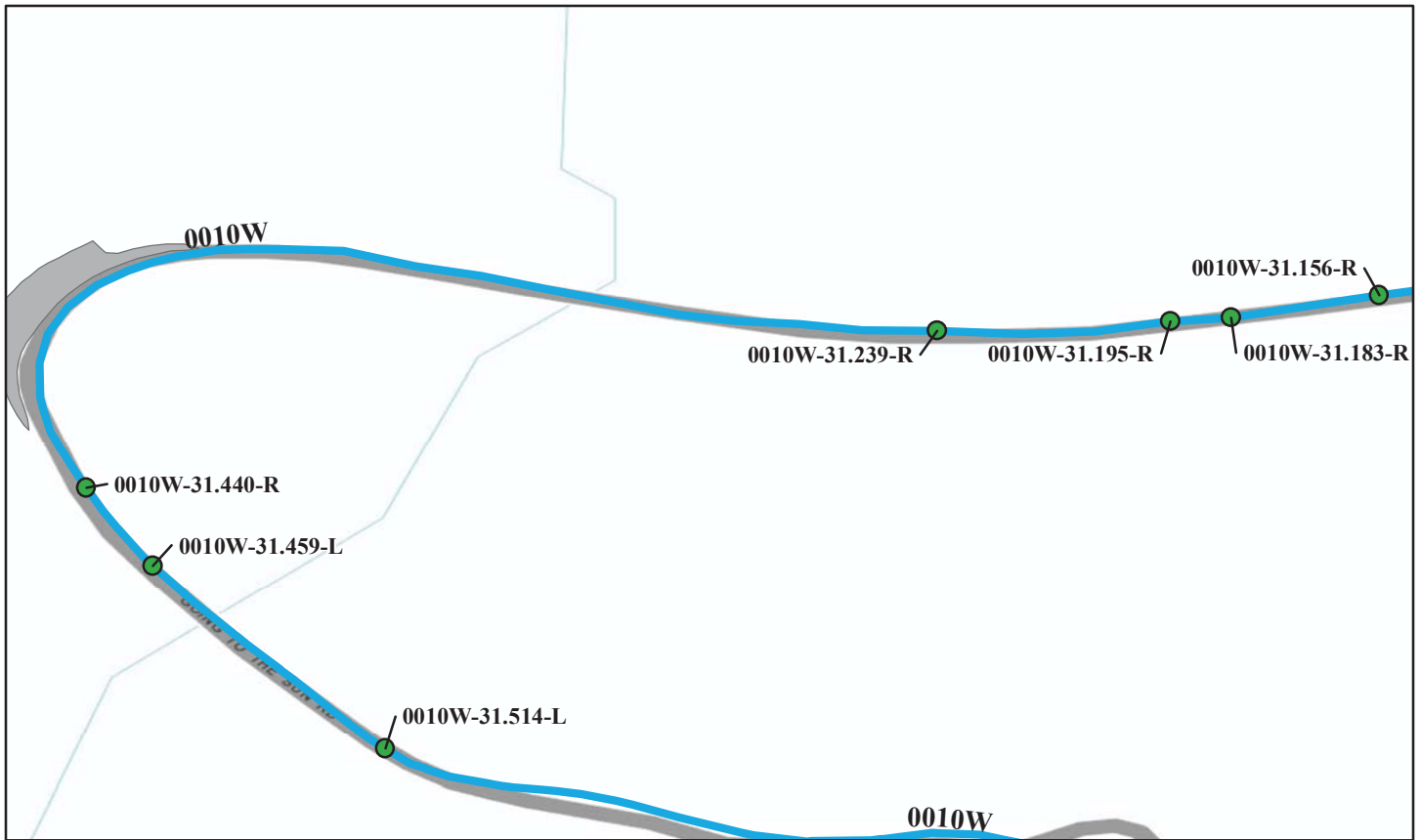
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-30.151-L 9/14/2007	110	20	Gravity - Mortared Stone	Head Wall	77	\$40,000.00
GLAC-0010W-30.388-R 9/14/2007	330	50	Gravity - Mortared Stone	Fill Wall	80	\$0.00
GLAC-0010W-30.455-R 9/14/2007	450	62	Gravity - Dry Stone	Fill Wall	89	\$0.00
GLAC-0010W-30.760-R 9/14/2007	400	109	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-30.803-R 9/14/2007	650	122	Gravity - Mortared Stone	Fill Wall	70	\$46,500.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

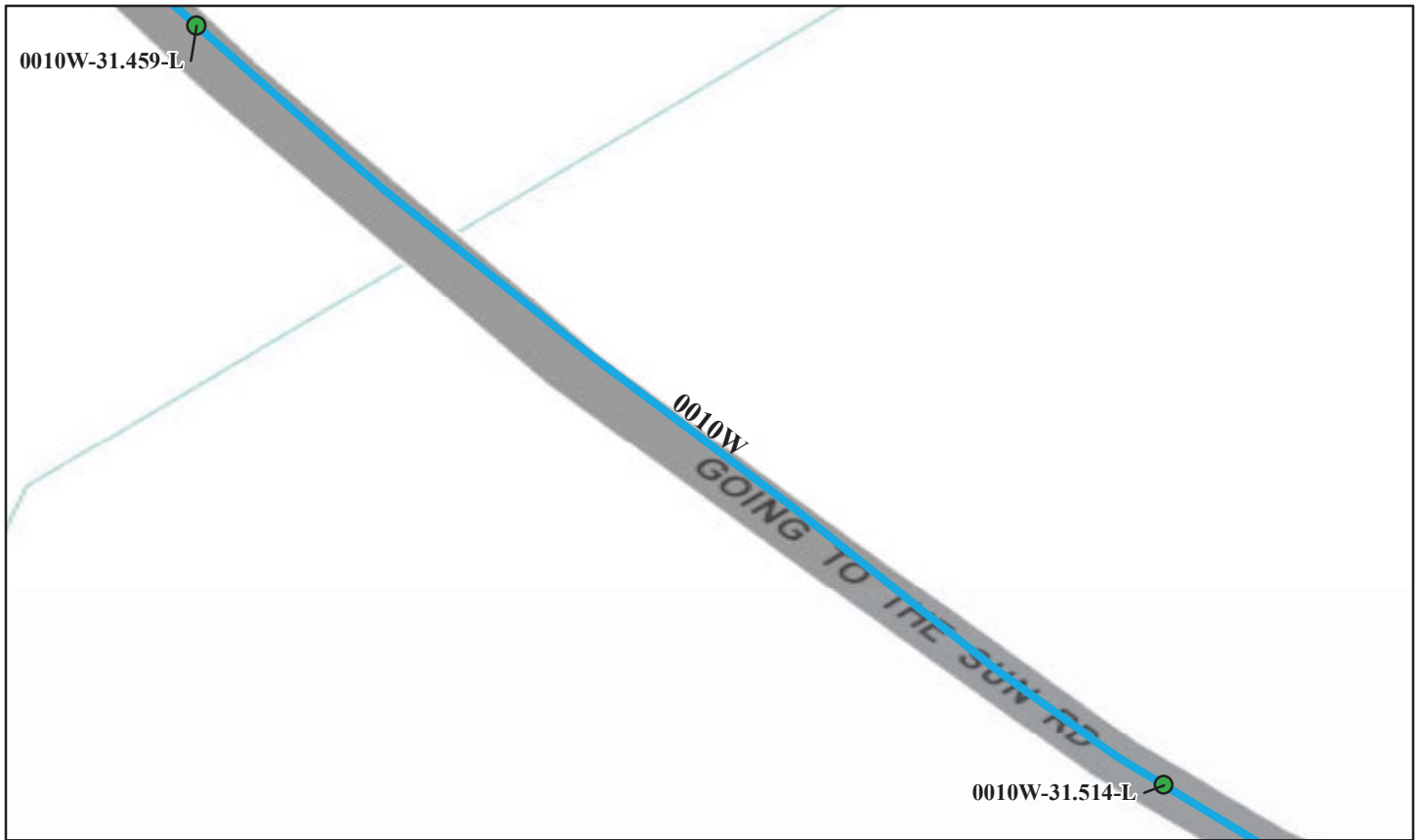
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Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-31.156-R 9/14/2007	280	70	Gravity - Mortared Stone	Fill Wall	85	\$0.00
GLAC-0010W-31.183-R 9/14/2007	430	50	Gravity - Mortared Stone	Fill Wall	75	\$0.00
GLAC-0010W-31.195-R 9/14/2007	250	77	Gravity - Mortared Stone	Fill Wall	80	\$0.00
GLAC-0010W-31.239-R 9/14/2007	122	61	Gravity - Mortared Stone	Fill Wall	70	\$180,000.00
GLAC-0010W-31.440-R 9/15/2007	710	168	Gravity - Mortared Stone	Cut Wall	82	\$0.00

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST



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)

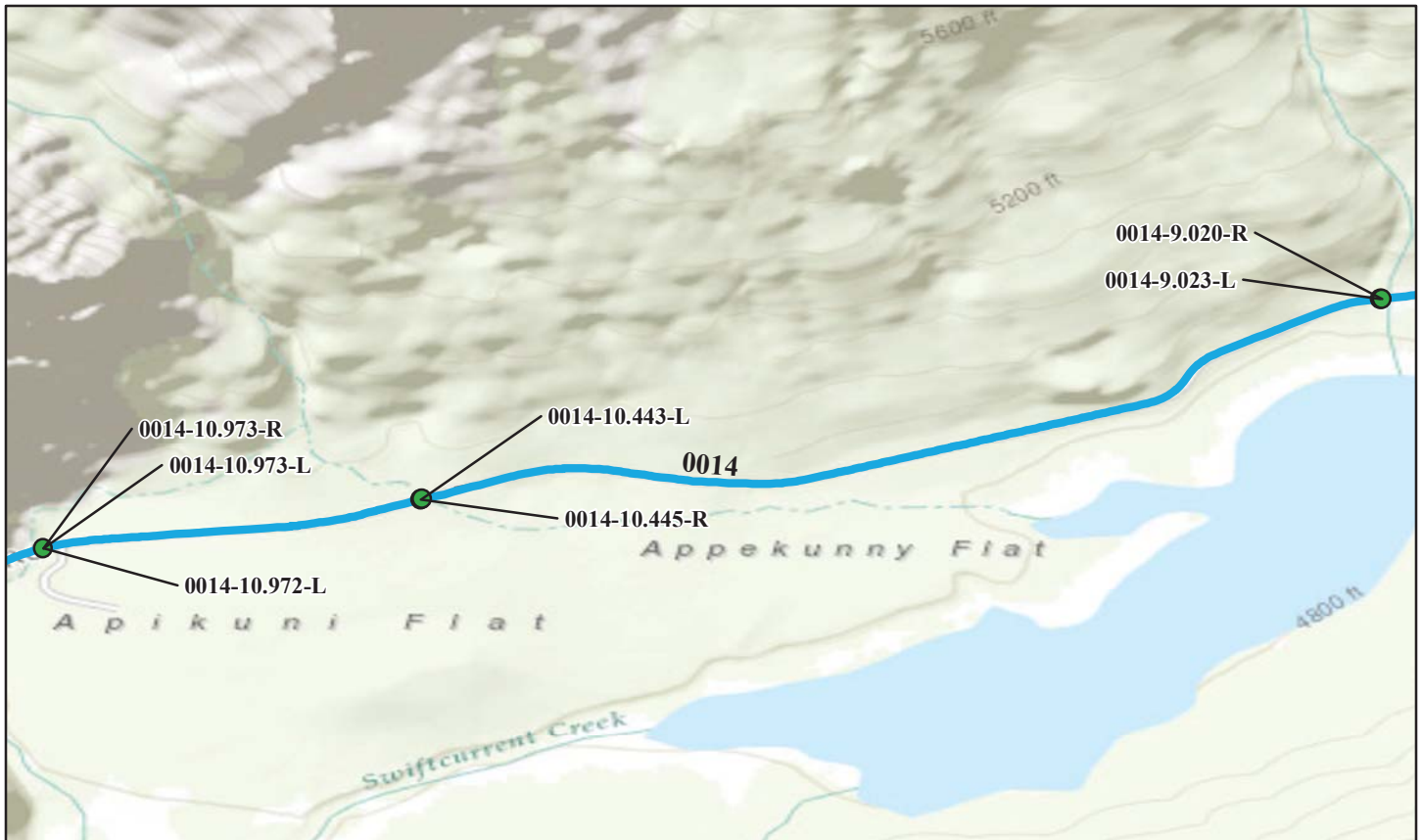
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0010W-31.459-L 9/15/2007	190	53	Gravity - Dry Stone	Fill Wall	80	\$0.00
GLAC-0010W-31.514-L 9/15/2007	90	18	Gravity - Mortared Stone	Head Wall	84	\$350.00

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

Glacier National Park

ROUTE 0014: MANY GLACIER 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)

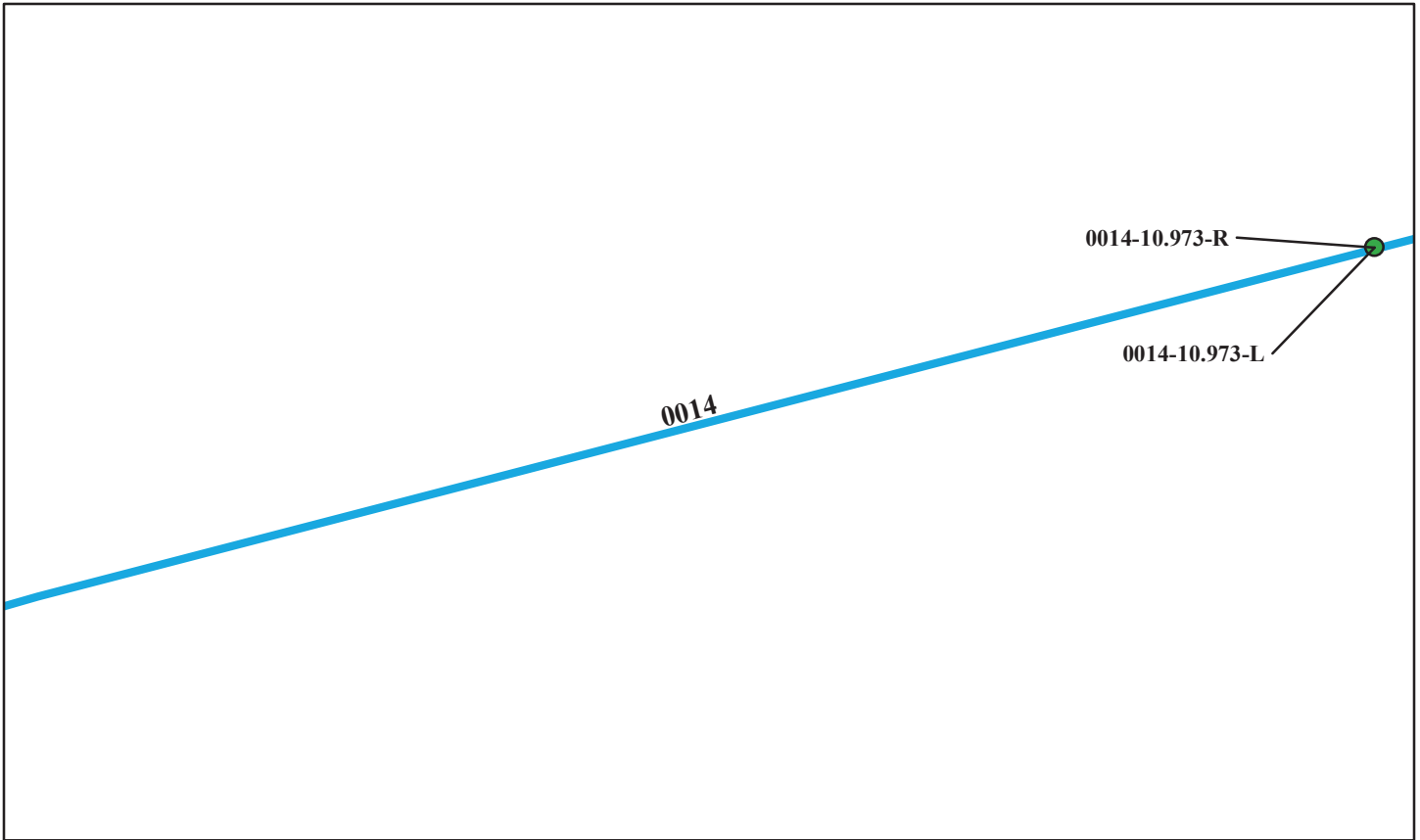
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0014-9.020-R 7/10/2007	140	67	Gravity - Mortared Stone	Head Wall	71	\$7,300.00
GLAC-0014-9.023-L 7/10/2007	123	68	Gravity - Mortared Stone	Head Wall	80	\$3,770.00
GLAC-0014-10.443-L 7/10/2007	138	70	Gravity - Mortared Stone	Head Wall	78	\$3,070.00
GLAC-0014-10.445-R 7/10/2007	135	68	Gravity - Mortared Stone	Head Wall	80	\$4,040.00
GLAC-0014-10.972-L 7/10/2007	222	31	Gravity - Mortared Stone	Head Wall	48	\$26,920.00

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

Glacier National Park

ROUTE 0014: MANY GLACIER 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)

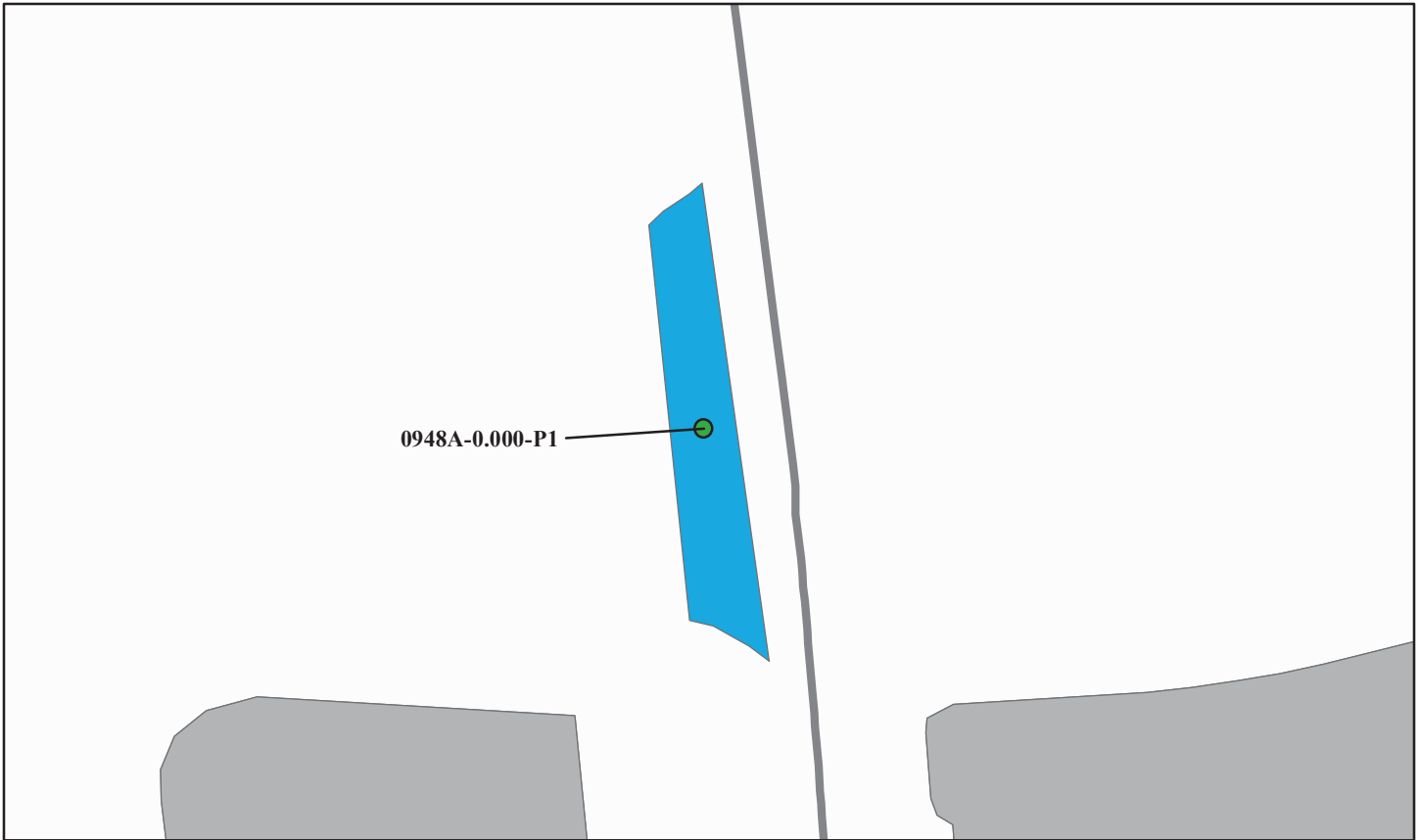
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0014-10.973-L 7/10/2007	222	31	Gravity - Mortared Stone	Head Wall	48	\$26,920.00
GLAC-0014-10.973-R 7/10/2007	140	31	Gravity - Mortared Stone	Head Wall	71	\$0.00

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

Glacier National Park

ROUTE 0948A: SUN POINT PICNIC AREA A



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)

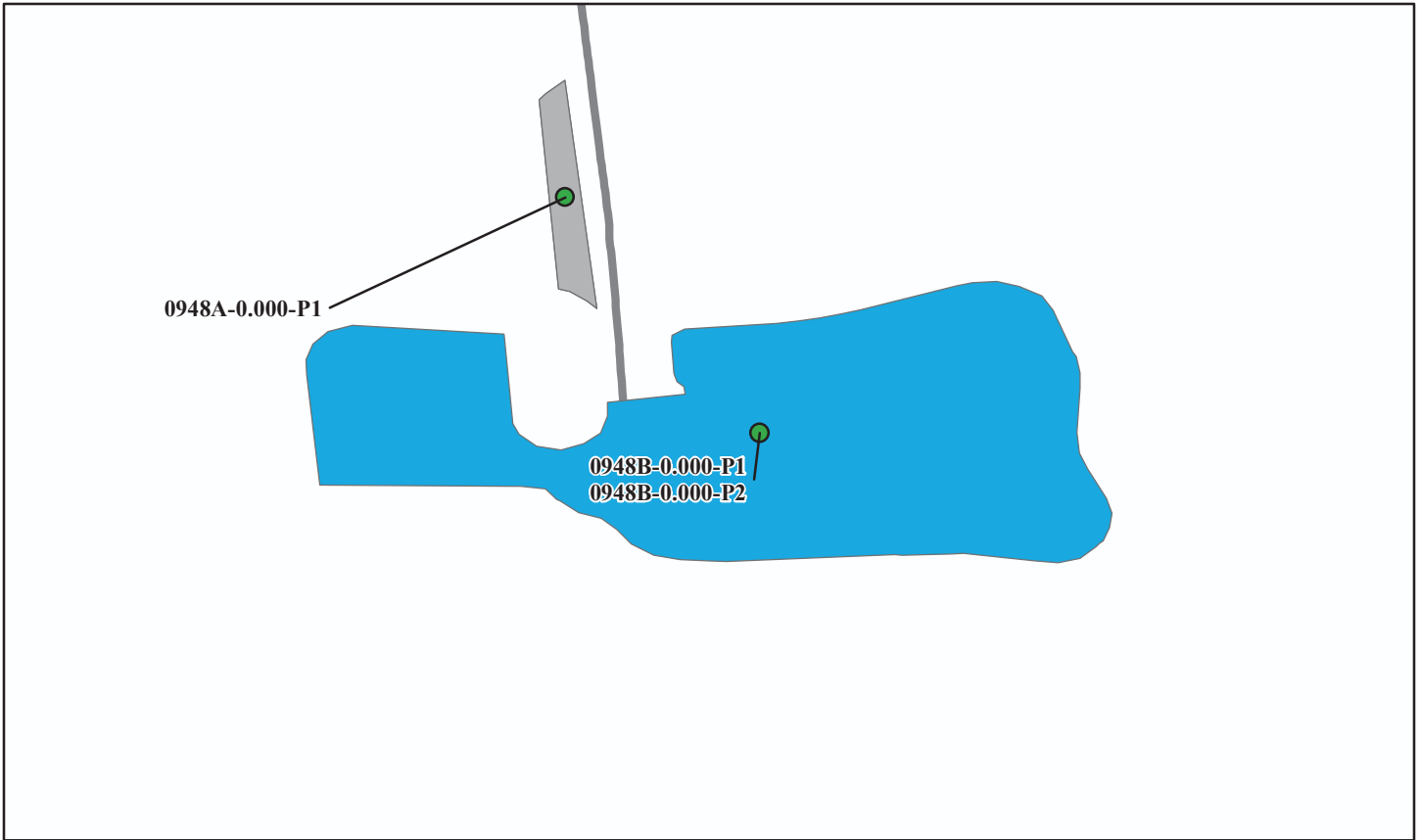
No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
GLAC-0948A-0.000-P1 9/11/2007	600	122	Gravity - Mortared Stone	Cut Wall	77	\$2,000.00

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

Glacier National Park

ROUTE 0948B: SUN POINT PICNIC AREA B



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
GLAC-0948B-0.000-P1 9/11/2007	580	136	Gravity - Mortared Stone	Fill Wall	75	\$21,750.00
GLAC-0948B-0.000-P2 9/11/2007	320	78	Gravity - Mortared Stone	Fill Wall	79	\$80,000.00

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

Tier 3 Retaining Wall Details



Glacier National Park



Federal Lands Highway
Road Inventory Program

Wall ID:	GLAC-0010E-32.603-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	87	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Outlet stone masonry head wall for a 4 ft x 4 ft box culvert at Lunch Creek		

Wall Measurements

Wall Length (ft.):	31	Face Area (sq.):	152
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	-3

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Solid bedrock, minor undermining on first 10' of wall - monitor	8
MORTAR 8.00	Very minor weathering and debonding of mortar	9
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	4' x 4' concrete box culvert	8
WALL DRAINS 0.50	2 drains on each side of culvert - 4"	8
DOWNSLOPE 0.50	Solid bedrock, streambed	9
LATERAL SLOPE 0.50	Roadway fill	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress noted	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_32.603_R_1.jpg

Wall ID:	GLAC-0010E-32.607-L		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet stone masonry headwall for 4 ft x 4 ft box culvert at Lunch Creek		

Wall Measurements

Wall Length (ft.):	25	Face Area (sq.):	72
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	Minor debonding	8
STONE MASONRY 8.00	No distress noted	9
CULVERT 0.50	4' x 4' concrete box culvert, very minor cracking	8
DOWNSLOPE 0.50	Stone and mortar creek bed armoring through culvert, minor scour of mortar	8
LATERAL SLOPE 0.50	Bedrock down wall, no distress, loose sand up wall, minor creep	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
UPSLOPE 0.50	Bedrock, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_32.607_L_1.jpg

Wall ID:	GLAC-0010E-32.872-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	83	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	128	Face Area (sq.):	1415
Average Wall Height (ft.):	11	Face Angle (deg.):	85
Maximum Wall Height (ft.):	28	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Moderate debonding over 20% of wall with some missing mortar	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Thin, wet soil layer over steep bedrock cliff, minor creep	8
LATERAL SLOPE 0.50	Talus over shallow bedrock, some end-dumped material, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	Minor cracking	8
CULVERT 0.50	36" cmp culvert outlets through wall into bedrock slot, no distress	9
WALL DRAINS 0.50	None, no apparent distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 20% of wall (280 sqft) Repoint: 280 sqft x \$75/sqft = \$21,000 Total=\$21,000
Repair Cost:	\$21,000

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_32.872_R_1.jpg

Wall ID:	GLAC-0010E-32.930-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	121	Face Area (sq.):	1270
Average Wall Height (ft.):	10	Face Angle (deg.):	85
Maximum Wall Height (ft.):	15	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No distress	8
WALL FOUNDATION MATERIAL 8.00	Soil, bedrock, stable	8
STONE MASONRY 8.00	Large angular blocks, no distress	8
MORTAR 8.00	Repointed in 2000, no distress	9
DOWNSLOPE 0.50	Bedrock, talus, stable	8
WALL DRAINS 0.50	2" drains throughout face	9
LATERAL SLOPE 1.00	Soil, talus, minor erosion	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_32.930_R_1.jpg

Wall ID:	GLAC-0010E-32.953-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	64	Maintenance Action:	Replace Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Gravity - Dry Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry and dry laid fill wall		

Wall Measurements

Wall Length (ft.):	111	Face Area (sq.):	280
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Dry laid portion is bulging, stone masonry section is performing well	6
WALL FOUNDATION MATERIAL 8.00	Voids and undermining beneath placed stone; bedrock and soil	6
PLACED STONE 8.00	Apparent movement of placed stone section with voids between bedrock and toe stones	5
MORTAR 8.00	Minor cracking and debonding of mortar < 5% of face	7
STONE MASONRY 8.00	Wall stone masonry is large angular blocks, no distress	8
DOWNSLOPE 0.50	Bedrock, talus	8
LATERAL SLOPE 0.50	Bedrock, talus	8
TRAFFIC BARRIER/FENCE 1.00	50' of guardwall is damaged or missing due to rock fall	4
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Replace dry laid section (110 sqft) and 50' of guardwall. Replace dry laid section with stone masonry: 110 sqft x \$160/sqft = \$17,600. Replace stone masonry guardwall: 50 lnft x \$2,000 = \$100,000. Total=\$117,600
Repair Cost:	\$117,600

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_32.953_R_1.jpg

Wall ID:	GLAC-0010E-32.974-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	90	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall repaired in 2001		

Wall Measurements

Wall Length (ft.):	83	Face Area (sq.):	2055
Average Wall Height (ft.):	24	Face Angle (deg.):	85
Maximum Wall Height (ft.):	38	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Repointed in 2001, no distress	9
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
WALL DRAINS 0.50	2" diameter finger drains installed in 2001, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_32.974_R_1.jpg

Wall ID:	GLAC-0010E-33.075-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall on east side of east tunnel		

Wall Measurements

Wall Length (ft.):	122	Face Area (sq.):	810
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, one 3 foot section of wall is undermined because bedrock has failed below wall	8
MORTAR 8.00	Portions of wall have been repointed in past, moderate to severe debonding with cracks up to 1" diameter over 20% of wall, some voids in mortar up to 4" deep	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Bedrock cliff bands, some loose blocks below wall	8
ROAD/SIDEWALK/SHOULDER 0.50	May be up to 3" of separation between asphalt shoulder and guardwall, no distress in overlay	8
LATERAL SLOPE 0.50	24" cmp culvert outlet with small stone masonry wall at beginning of wall, bedrock cliff at end of wall, no distress	9
WALL DRAINS 0.50	None, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Impact damage	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 20% of wall (160 sqft) Repoint: 160 sqft x \$75/sqft = \$12,000 Total=\$12,000
Repair Cost:	\$12,000

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_33.075_R_1.jpg

Wall ID:	GLAC-0010E-33.110-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	69	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	202	Face Area (sq.):	2900
Average Wall Height (ft.):	14	Face Angle (deg.):	85
Maximum Wall Height (ft.):	32	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock and soil	8
MORTAR 8.00	40% of wall face mortar shows voids, missing mortar; mainly in top 8' of wall and above culvert at station 52	5
STONE MASONRY 8.00	Large angular blocks, efflorescence staining isolated cracking	7
CULVERT 0.50	24" cmp culvert at station 52	8
TRAFFIC BARRIER/FENCE 1.00	110' of guardwall damaged or missing	4
WALL DRAINS 0.50	Throughout wall face	8
DOWNSLOPE 1.00	Steep talus slope	7
LATERAL SLOPE 1.00	Bedrock and talus	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 40% of wall face (1200 sqft), Replace 110' of guardwall. Repoint: 1200 sqft x \$75/sqft=\$90,000. Replace stone masonry guardwall= 110 lnft x \$2,000/lnft = \$220,000. Total=\$310,000
Repair Cost:	\$310,000

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_33.110_R_1.jpg

Wall ID:	GLAC-0010E-33.283-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	2007
*Wall Rating:	87	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	MSE - Welded Wire Face
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone faced MSE fill wall under construction at time of inspection - no facing yet		

Wall Measurements

Wall Length (ft.):	298	Face Area (sq.):	3820
Average Wall Height (ft.):	12	Face Angle (deg.):	85
Maximum Wall Height (ft.):	19	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, under construction	9
WALL FOUNDATION MATERIAL 8.00	Stable, rock	8
WIRE/GEOSYNTHETIC FACING 8.00	No distress	9
DOWNSLOPE 0.50	Steep talus slope with minor raveling	8
LATERAL SLOPE 0.50	Steep talus slope with minor raveling	8
ARCHITECTURAL FACING 0.50	Not faced yet, still under construction	9
TRAFFIC BARRIER/FENCE 0.50	No barrier yet	9
WALL DRAINS 0.50	None apparent	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_33.283_R_1.jpg

Wall ID:	GLAC-0010E-33.356-L		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	2007
*Wall Rating:	86	Maintenance Action:	No Action

Wall Description

Wall Function:	Cut Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall above 48 in cmp culvert		

Wall Measurements

Wall Length (ft.):	13	Face Area (sq.):	91
Average Wall Height (ft.):	7	Face Angle (deg.):	45
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Weak bedrock or talus, no apparent distress	8
PLACED STONE 8.00	1-4 foot boulders, voids, no distress	9
LATERAL SLOPE 0.50	Steep talus, minor raveling	8
CULVERT 0.50	48" cmp culvert inlet, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
WALL DRAINS 0.50	None, no distress	9
UPSLOPE 1.00	Steep talus, minor raveling, rock fall area with new rock fall fence	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_33.356_L_1.jpg

Wall ID:	GLAC-0010E-33.410-L		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	2007
*Wall Rating:	89	Maintenance Action:	No Action

Wall Description

Wall Function:	Cut Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid cut wall		

Wall Measurements

Wall Length (ft.):	24	Face Area (sq.):	192
Average Wall Height (ft.):	8	Face Angle (deg.):	45
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Talus or weak bedrock, no distress	9
PLACED STONE 8.00	Large boulders, voids, no distress	9
UPSLOPE 0.50	Steep, loose talus, minor raveling	8
CULVERT 0.50	48" cmp culvert inlet with heavy steel debris guard, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	New roadway section in 2007, no distress	9
WALL DRAINS 0.50	None, no distress	9
LATERAL SLOPE 1.00	Loose talus, potential slump area, minor raveling and rilling	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_33.410_L_1.jpg

Wall ID:	GLAC-0010E-34.640-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	65	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Outlet stone masonry headwall at Siyeh Creek		

Wall Measurements

Wall Length (ft.):	46	Face Area (sq.):	400
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	-33

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	15' of wall and culvert undermined, material is cobbles	4
MORTAR 8.00	20% of mortar shows voids, debonding, missing	6
STONE MASONRY 8.00	Large angular blocks, no distress	8
DOWNSLOPE 0.50	Bedrock and cobble channel	8
LATERAL SLOPE 0.50	Talus fill slope	8
WALL DRAINS 0.50	None	8
CULVERT 1.00	10' x 10' cip concrete box culvert, interior 2' of cip box shows severe deterioration, spalling with rebar exposure	5
UPSLOPE 1.00	Talus and soil fill slope	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint 20% of face (80 sqft), repair undermining (60 sqft). Repoint: 80 sqft x \$75/sqft = \$6,000. Underpinning/stabilization: 60 sqft x \$200/sqft = \$12,000. Culvert repair: 3 cyd x \$1,500/cyd = \$4,500. 10 man-days x \$350/day = \$3,500
Repair Cost:	\$26,000

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_34.640_R_1.jpg

Wall ID:	GLAC-0010E-34.642-L		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet stone masonry headwall at Siyeh Creek		

Wall Measurements

Wall Length (ft.):	52	Face Area (sq.):	265
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	-27

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Coarse, firm, alluvium, no distress	9
MORTAR 8.00	Minor debonding	8
STONE MASONRY 8.00	No distress	9
UPSLOPE 0.50	Moderate to steep fill slope, minor erosion due to foot traffic	8
LATERAL SLOPE 0.50	Moderate, coarse fill, no distress	9
WALL DRAINS 0.50	None, no distress	9
CULVERT 1.00	10' x 10' concrete box culvert, concrete sidewall and slab base has exposed steel reinforcing due to stream flow	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_34.642_L_1.jpg

Wall ID:	GLAC-0010E-36.550-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall for Piegan Pass Trail underpass		

Wall Measurements

Wall Length (ft.):	46	Face Area (sq.):	245
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Firm soil, no distress	9
MORTAR 8.00	Minor to moderate debonding over 50% of wall, small cracks to 1/2" and missing mortar over 5% of wall; minor efflorescence	7
STONE MASONRY 8.00	Fracturing along joints and spalling on 5% of wall	8
CULVERT 0.50	Minor cracking in box culvert (14' x 7.5'), minor efflorescence from cracks at interface with stone wall elements	8
LATERAL SLOPE 0.50	Moderate, fill slope, mild creep/raveling	8
DOWNSLOPE 0.50	Horse trail and drainage channel, no distress	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 50% of wall (120 sqft). Repoint: 120 sqft x \$75/sqft = 9,000. Total = \$9,000
Repair Cost:	\$9,000

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_36.550_R_1.jpg

Wall ID:	GLAC-0010E-36.552-L		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall for Piegan Pass Trail underpass		

Wall Measurements

Wall Length (ft.):	28	Face Area (sq.):	220
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, rock	8
MORTAR 8.00	Isolated cracking, debonding	7
STONE MASONRY 8.00	Weathered stone with internal fractures, angular	7
CULVERT 0.50	10' x 7.5' concrete box culvert	8
UPSLOPE 0.50	Soil, Trail, stable	8
WALL DRAINS 0.50	None	8
LATERAL SLOPE 1.00	Soil, minor erosion	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_36.552_L_1.jpg

Wall ID:	GLAC-0010E-41.426-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	81	Face Area (sq.):	1470
Average Wall Height (ft.):	18	Face Angle (deg.):	85
Maximum Wall Height (ft.):	33	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	Mild to moderate debonding over 50% of wall face	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress in overlay	9
WALL DRAINS 0.50	None seen, no distress	9
TRAFFIC BARRIER/FENCE 1.00	30' of guardwall on top of retaining wall at wall start has been removed by avalanche	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repair 30' of guardwall Stone masonry guardwall repair: 30 lnft x \$2,000/lnft = \$60,000 Total=\$60,000
Repair Cost:	\$60,000

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_41.426_R_1.jpg

Wall ID:	GLAC-0010E-41.454-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	77	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall at Deadhorse Point		

Wall Measurements

Wall Length (ft.):	218	Face Area (sq.):	4600
Average Wall Height (ft.):	21	Face Angle (deg.):	85
Maximum Wall Height (ft.):	23	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Minor debonding	7
STONE MASONRY 8.00	Rectangular blocks, no distress	8
DOWNSLOPE 0.50	Bedrock and talus, stable	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 1.00	Cracked and missing stones along 80% length of guardwall	5

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repair 180' of guardwall Stone masonry guardwall repair: 180 lnft x \$200/lnft = \$36,000 Total=\$36,000
Repair Cost:	\$36,000

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

Glacier National Park
ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_41.454_R_1.jpg

Wall ID:	GLAC-0010E-43.188-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	125	Face Area (sq.):	1700
Average Wall Height (ft.):	13	Face Angle (deg.):	85
Maximum Wall Height (ft.):	29	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, far end of wall is undermined below guardwall, otherwise no distress	8
MORTAR 8.00	Mild debonding over 50% of wall, moderate debonding over 5% of wall	8
STONE MASONRY 8.00	No distress	9
ROAD/SIDEWALK/SHOULDER 0.50	1" crack across road in overlay, no distress otherwise	8
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
WALL DRAINS 0.50	Several drain openings built into base of wall, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Guardwall undermined up to 1' back at far end of wall for 3' along wall	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_43.188_R_1.jpg

Wall ID:	GLAC-0010E-43.216-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall at Golden Stairs pullout		

Wall Measurements

Wall Length (ft.):	140	Face Area (sq.):	2200
Average Wall Height (ft.):	15	Face Angle (deg.):	85
Maximum Wall Height (ft.):	27	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Mostly bedrock, stable	8
MORTAR 8.00	Minor degradation, debonding	7
STONE MASONRY 8.00	Large, irregular, angular blocks with minor weathering and cracking	8
DOWNSLOPE 0.50	Bedrock and talus	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_43.216_R_1.jpg

Wall ID:	GLAC-0010E-43.243-R		
Route Name:	GOING TO THE SUN ROAD EAST		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	79	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall at Golden Stairs pullout		

Wall Measurements

Wall Length (ft.):	115	Face Area (sq.):	950
Average Wall Height (ft.):	8	Face Angle (deg.):	90
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock except for last 20 feet of wall	8
MORTAR 8.00	Mild to moderate debonding over 50% of wall	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Mostly bedrock, some firm/coarse shot rock for last 20 feet of wall	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress except for last 10 feet of wall where lateral crack runs in traffic lane	8
WALL DRAINS 0.50	Several drain outlets near base of wall, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Guardwall at end of wall has failed for 80 feet	6
LATERAL SLOPE 1.00	Mild slope creep at end of wall	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010E: GOING TO THE SUN ROAD EAST

Retaining Wall Condition Photos



GLAC_0010E_43.243_R_1.jpg

Wall ID:	GLAC-0010W-5.102-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	84	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Headwall for 36 in CMP is performing well. Slight maintenance required on stone and mortar at culvert outfall.		

Wall Measurements

Wall Length (ft.):	19	Face Area (sq.):	104
Average Wall Height (ft.):	5	Face Angle (deg.):	90
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	-1

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry headwall is performing well with only minor stone and mortar maintenance required at culvert outfall.	9
WALL FOUNDATION MATERIAL 8.00	Founded on gravelly creek bed with subangular cobbles. Minor scouring at culvert outfall but no undermining of wall.	8
MORTAR 8.00	Except for directly below and adjacent to the culvert outfall, only moderate weathering, spalling and debonding. Lichens growing in mortar channels throughout. At the culvert outfall, some stones are loose and need to be reset and remortared.	8
STONE MASONRY 8.00	Hard relatively-unweathered subangular stones to 1 ft. max. , No evidence of stone degradation. Stones are well interlocked with small even grout channels. No evidence of batter distress.	9
DOWNSLOPE 0.50	Gravelly cobbley creek bed with only minor scour directly below outfall, no undermining of wall.	9
LATERAL SLOPE 0.50	Gentle fill or natural slopes, well vegetated, no erosion from road runoff.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress, shoulder and fill slope are well vegetated. No erosion from road runoff.	9
WALL DRAINS 0.50	No wall drains installed. No evidence of internal drainage distress.	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Mortar is degraded and a few stones are loose or missing at culvert outfall. Reset loose stones and replace missing stones with local stones from creek bed. 2 Laborers x 4 hrs. x \$55/hr = \$440. Mortar, etc. = \$60. Total = \$500
Repair Cost:	\$500

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

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_5.102_L_1.jpg

Wall ID:	GLAC-0010W-6.137-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1996
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Anchor - Tieback H-Pile
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Tied back soldier pile wall with buried face. 0.2 miles beyond left side pullout silt fence remains at toe, next to lake.		

Wall Measurements

Wall Length (ft.):	140	Face Area (sq.):	2800
Average Wall Height (ft.):	20	Face Angle (deg.):	90
Maximum Wall Height (ft.):	21	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Minor erosion of toe material due to wave action from lake	7
ANCHOR HEADS 8.00	Buried	8
LAGGING 8.00	Buried	8
PILES AND SHAFTS 8.00	Buried	8
LATERAL SLOPE 0.50	Soil, vegetation	8
WALL DRAINS 0.50	None	8
ROAD/SIDEWALK/SHOULDER 1.00	Small chimney void on roadway shoulder near wall face.	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_6.137_L_1.jpg

Wall ID:	GLAC-0010W-9.791-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Headwall for 4 ft x 8 ft Box Culvert at Sprague Creek. Wingwall portions are performing well but mortar and stone are degrading next to the concrete box culvert which is spalling badly. Repair the adjacent wall with the culvert.		

Wall Measurements

Wall Length (ft.):	37	Face Area (sq.):	87
Average Wall Height (ft.):	2	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	-4

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry wall is performing well in the wingwall portions, but is deteriorated adjacent to the box culvert. The degradation is largely associated with the degradation of the concrete in the culvert.	8
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed with minor scour of wall.	8
MORTAR 8.00	Mortar has only moderate weathering, spalling, debonding throughout except adjacent to the box culvert where degradation of the mortar is excessive and is associated with the culvert concrete degradation.	7
STONE MASONRY 8.00	Hard relatively-unweathered stones to 1,5 ft. max. For most of the wall, the stones are well interlocked and not loose. Adjacent to and above the box culvert, the stones are loose or missing largely associated with the degradation of the culvert concrete	8
UPSLOPE 0.50	Gentle gravelly streambed with only slight scour potential.	8
WALL DRAINS 0.50	No wall drains installed. Some evidence of mortar distress possibly from poor internal drainage.	8
LATERAL SLOPE 0.50	Gentle fill and natural slopes on both sides, well vegetated.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulder are well vegetation and no shoulder erosion.	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos

Condition photos are not available for GLAC-0010W-9.791-R.

Wall ID:	GLAC-0010W-9.801-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	90	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Headwall for 4 ft x 8 ft box culvert outlet at Sprague Creek. Wall is performing well but the concrete at the end of the box culvert is spalling badly exposing the rebar. Mortar and stones need to be monitored adjacent to culvert.		

Wall Measurements

Wall Length (ft.):	150	Face Area (sq.):	486
Average Wall Height (ft.):	3	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	-4

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry headwall is performing well, but ends of concrete box culvert are spalling badly exposing rebar. The stones and mortar adjacent to the culvert need to be monitored as degradation of the concrete in the culvert progresses. Repair the adjace	9
WALL FOUNDATION MATERIAL 8.00	Firm soil and gravelly streambed. No evidence of scour and no undermining at outlet.	9
MORTAR 8.00	Only minor weathering, debonding and spalling noted. Mostly lichen covered. No loose stones noted.	9
STONE MASONRY 8.00	Hard relatively-unweathered angular stones to 1.5 ft. max. Well interlocked with even narrow grout seams. No batter distress noted.	9
DOWNSLOPE 0.50	Gently sloped gravelly streambed with no evidence of undermining or downstream scour.	9
LATERAL SLOPE 0.50	Gentle fill and natural slopes on both sides, well vegetated, no erosion noted.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulders are gently sloped, well vegetated and show no erosion evidence.	9
WALL DRAINS 0.50	No drains installed. No evidence of internal drainage problems.	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos

Condition photos are not available for GLAC-0010W-9.801-L.

Wall ID:	GLAC-0010W-10.230-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	73	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Headwall at outlet of 4 ft x 6 ft culvert. Wall is performing well but this culvert is grossly undersized for the current stream volume. Severe scour and undermining problem below the outlet needs to be corrected.		

Wall Measurements

Wall Length (ft.):	21	Face Area (sq.):	118
Average Wall Height (ft.):	5	Face Angle (deg.):	90
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	-3

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry wall is performing well, but culvert is grossly undersized for the current stream volume causing severe scouring and undermining at the culvert outlet. Stream channel upslope from the road appears to carrying much more water than was probab	7
WALL FOUNDATION MATERIAL 8.00	Gravelly channel with a deep scour hole below culvert outlet caused by the undersizing of this culvert for its current stream volume. Hole is 2.5 ft. deep below outlet and has undermined to 4 ft. under the culvert.	5
MORTAR 8.00	Only moderate weathering, debonding and spalling noted. Lichen covered. Does not need maintenance at this time.	8
STONE MASONRY 8.00	Hard relatively-unweathered angular stones to 2 ft. max. No batter or degradation stress noted.	9
LATERAL SLOPE 0.50	Gentle fill and natural slopes on both sides, well vegetated, no erosion noted.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulder is gently sloped and grass covered. No shoulder erosion.	9
WALL DRAINS 0.50	No drains installed. No evidence of internal drainage distress.	9
DOWNSLOPE 1.00	Gravelly streambed with deep scour hole and undermining of culvert due to undersizing of culvert.	5

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Fill scour hole and undermined section under culvert. 2 Laborers x 4 hr. x \$55/hr. = \$440. Riprap, 20 cu.yd. x \$200/cu.yd. = \$4400. Total = \$4840. Note that this is a temporary fix. The real problem is the undersized culvert
Repair Cost:	\$4,840

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_10.230_L_1.jpg

Wall ID:	GLAC-0010W-10.230-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	78	Maintenance Action:	Maintenance
Wall Description			
Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet headwall for 4 ft x 6 ft box culvert still performing but mortar is degrading and lateral slopes are eroding. Culvert is grossly undersized for the current stream volume and should be replaced with a larger culvert.		
Wall Measurements			
Wall Length (ft.):	22	Face Area (sq.):	86
Average Wall Height (ft.):	3	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	-2
Assessed Elements			
Element (Weighting Factor)	Narrative		Condition Rating (0 - 10)
PERFORMANCE 8.00	Overall the wall is performing well but needs maintenance to fill erosion channels in lateral slopes. Mortar is degrading but is still performing satisfactorily. This culvert is grossly undersized and need to be replaced with a larger one. At that time		8
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed with no scour or undermining.		9
MORTAR 8.00	the condition of the mortar is only fair with spalling, cracking and debonding noted throughout. No loose or missing stones noted.		6
STONE MASONRY 8.00	Hard relatively-unweathered angular stones to 2.5 ft. max. No degradation or batter distress noted.		9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulders are gravelly with moderate grass cover.		9
UPSLOPE 0.50	Gravelly streambed with no evidence of scour potential.		9
WALL DRAINS 0.50	No drains installed. No evidence of internal drainage distress.		9
LATERAL SLOPE 1.00	Lateral slopes show moderate erosion extending to the stream and toe of wall. Stream may have flowed over the lateral slopes. Erosion channels need to be filled.		5
Repair Recommendations			
Failure Consequence:	LOW		
Recommendation Narrative:	Place large rock in erosion channels in lateral slope, use local material source. 2 Laborers x 4 hr. x \$55/hr. = \$440. End loader x 4 hr. x \$170/hr. = \$680. Dump truck x 4 hr. x \$120/hr. = \$480. Total = \$1600. Note that this is a temporary fix.		
Repair Cost:	\$1,600		
2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.			

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_10.230_R_1.jpg

Wall ID:	GLAC-0010W-10.231-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	73	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Headwall at outlet of 4 ft x 6 ft culvert. Wall is performing well but this culvert is grossly undersized for the current stream volume. Severe scour and undermining problem below the outlet needs to be corrected.		

Wall Measurements

Wall Length (ft.):	21	Face Area (sq.):	118
Average Wall Height (ft.):	5	Face Angle (deg.):	90
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	-3

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry wall is performing well, but culvert is grossly undersized for the current stream volume causing severe scouring and undermining at the culvert outlet. Stream channel upslope from the road appears to carrying much more water than was probab	7
WALL FOUNDATION MATERIAL 8.00	Gravelly channel with a deep scour hole below culvert outlet caused by the undersizing of this culvert for its current stream volume. Hole is 2.5 ft. deep below outlet and has undermined to 4 ft. under the culvert.	5
MORTAR 8.00	Only moderate weathering, debonding and spalling noted. Lichen covered. Does not need maintenance at this time.	8
STONE MASONRY 8.00	Hard relatively-unweathered angular stones to 2 ft. max. No batter or degradation stress noted.	9
LATERAL SLOPE 0.50	Gentle fill and natural slopes on both sides, well vegetated, no erosion noted.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulder is gently sloped and grass covered. No shoulder erosion.	9
WALL DRAINS 0.50	No drains installed. No evidence of internal drainage distress.	9
DOWNSLOPE 1.00	Gravelly streambed with deep scour hole and undermining of culvert due to undersizing of culvert.	5

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Fill scour hole and undermined section under culvert. 2 Laborers x 4 hr. x \$55/hr. = \$440. Riprap, 20 cu.yd. x \$200/cu.yd. = \$4400. Total = \$4840. Note that this is a temporary fix. The real problem is the undersized culvert
Repair Cost:	\$4,840

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos

Condition photos are not available for GLAC-0010W-10.231-L.

Wall ID:	GLAC-0010W-10.555-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	80	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Headwall at outlet for concrete arch culvert at Snyder Creek. Wall is performing well. There is some local grout deterioration which should be repointed. Local seepage was noted at grout lines which should be monitored.		

Wall Measurements

Wall Length (ft.):	67	Face Area (sq.):	429
Average Wall Height (ft.):	6	Face Angle (deg.):	86
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well, but could use a small amount of repointing of the mortar and monitoring of grout line seepage.	8
WALL FOUNDATION MATERIAL 8.00	Concrete footing under the culvert section and firm soil under the wingwall. Some deterioration of the concrete which could eventually loose support for the adjacent wall, but currently not a factor. No scouring or undermining of the wall.	8
MORTAR 8.00	Most of the wall has only minor degradation. About 10 % of the wall area has more extensive weathering and cracking and distress from seepage at grout lines.	7
STONE MASONRY 8.00	Hard relatively-unweathered angular stones to 2 ft. max. Well interlocked with even narrow grout seams. No degradation or batter distress noted.	9
DOWNSLOPE 0.50	Gently sloped gravelly streambed with cobbles. No scour distress noted.	8
LATERAL SLOPE 0.50	Gentle fill and natural slopes on both sides, well vegetated, stable with no erosion distress noted.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulders are paved to sidewalk and curb wall.	9
WALL DRAINS 1.00	No drains installed. Some evidence of local seepage at the grout lines at several locations in the lower half of the wall.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Repoint local mortar deterioration in about 10 % of the wall area: Repoint Mortar (0.10 x 429 sqft.) x \$75/sq.ft. = \$3220
Repair Cost:	\$3,220

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_10.555_L_1.jpg

Wall ID:	GLAC-0010W-10.557-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 08, 2007	Approximate Year Built:	Unknown
*Wall Rating:	81	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Headwall at inlet of concrete arch culvert at Snyder Creek. Wall is performing well and no action required.		

Wall Measurements

Wall Length (ft.):	67	Face Area (sq.):	380
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well with only minor mortar degradation. Need to monitor mortar and degradation of the concrete footing for the culvert as it might affect the adjacent wall.	8
WALL FOUNDATION MATERIAL 8.00	Concrete footing under culvert, firm soil under wingwalls. Concrete footing are moderately weathered and could cause a bearing problem for the adjacent wall. Currently not a problem but should be monitored for future degradation.	7
MORTAR 8.00	Mortar in good shape with only minor debonding and weathering, a few minor spalling areas.	8
STONE MASONRY 8.00	Hard, relatively unweathered, angular stones. Well interlocked with even grout lines. No degradation or batter distress noted.	9
LATERAL SLOPE 0.50	Stable fill slopes ranging from gentle to steep. No erosion distress noted.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulder is paved to sidewalk and guard wall.	9
UPSLOPE 0.50	Gravelly streambed. No scour or undermining.	9
WALL DRAINS 0.50	Four drains installed in each wingwall. No evidence of internal drainage distress.	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_10.557_R_1.jpg

Wall ID:	GLAC-0010W-12.227-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	77	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Gravity - Dry Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall at outlet of 36 in concrete culvert with dry-place stone extensions on ends. Performing well but mortar above and adjacent to culvert is deteriorating and some stones need to be reset.		

Wall Measurements

Wall Length (ft.):	10	Face Area (sq.):	39
Average Wall Height (ft.):	3	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	-16

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs some mortar work adjacent to and above the culvert. Some stone work in both the masonry and dry-placed sections can also be done.	8
WALL FOUNDATION MATERIAL 8.00	Stable streambed with no scour distress or undermining.	9
MORTAR 8.00	Mortar is in good shape except adjacent to the concrete culvert where it is debonded and badly deteriorated (est. 15 sq. ft. of wall area).	6
PLACED STONE 8.00	Hard, durable angular stones to 12 in. max.. No interlock and probably dumped.	7
STONE MASONRY 8.00	Hard relatively unweathered angular stones to 18 in. max. Well interlocked with even grout lines. Only minor degradation noted and no batter distress.	8
DOWNSLOPE 0.50	Stable gravelly streambed with no scour distress or undermining.	9
LATERAL SLOPE 0.50	Gentle natural slopes, stable and tree covered.	9
ROAD/SIDEWALK/SHOULDER 0.50	No pavement distress noted. Shoulders show no erosion distress and are grass covered.	9
WALL DRAINS 0.50	NO drains installed. No evidence of internal draining noted.	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	1. Replace a few dry-placed stones and reset loose stones above the stone-masonry wall. Use local material. 2 Laborers x 4 hr. x \$55/hr. = \$440. 2. Repoint mortar adjacent to concrete culvert. Repoint 15 sqft. x \$75/sq.ft. = \$1130. Total = \$1570
Repair Cost:	\$1,570

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_12.227_L_1.jpg

Wall ID:	GLAC-0010W-12.230-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	80	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Gravity - Dry Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall at inlet to 36 in concrete culvert with dry-placed stones at ends. Wall is performing well but need to restack some dry-placed stones and monitor mortar.		

Wall Measurements

Wall Length (ft.):	20	Face Area (sq.):	69
Average Wall Height (ft.):	3	Face Angle (deg.):	89
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	-9

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry wall is performing well. One small stone is missing at right base which should be replaced. Dry-place stone should be restacked to clear streambed.	8
WALL FOUNDATION MATERIAL 8.00	Stable gravelly streambed. No scour distress noted.	9
PLACED STONE 8.00	Hard durable angular stones to 12 in. max. No interlock and probably dumped.	7
MORTAR 8.00	Mortar is in good condition except for minor local spalling.	8
STONE MASONRY 8.00	Hard relatively unweathered angular stones to 18 in. max. Well interlocked with even grout seams. One small stone loose at right base.	8
LATERAL SLOPE 0.50	Stable gentle slopes with downed trees.	8
ROAD/SIDEWALK/SHOULDER 0.50	No pavement distress. Shoulder shows no erosion distress and is stable and grass covered.	9
UPSLOPE 0.50	Stable gravelly streambed. No scour distress or undermining.	9
WALL DRAINS 0.50	No drains installed. No evidence of internal drainage distress.	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Replace one loose stone at right base in stone masonry wall and restack dry-placed stones to clear streambed. 2 Laborers x 4hr. X \$55/hr. = \$440
Repair Cost:	\$440

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_12.230_R_1.jpg

Wall ID:	GLAC-0010W-12.318-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	78	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall supporting fill, performing well. Mortar has locations of significant debonding which is currently not affect the structure but will need repointing.		

Wall Measurements

Wall Length (ft.):	157	Face Area (sq.):	1720
Average Wall Height (ft.):	10	Face Angle (deg.):	81
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	-11

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but repointing of mortar should be considered in locations of significant debonding and degradation (about 30 % of wall area). Degradation is currently not affecting structure.	8
WALL FOUNDATION MATERIAL 8.00	Founded on stable but steep rock outcrop. Tree covered in thin soil mantle.	8
MORTAR 8.00	Mortar is generally in good shape but there are locations of significant debonding. Some degradation from weathering and spalling mostly in locations of seepage at the grout lines. About 30 % of the surface area should be repointed.	6
STONE MASONRY 8.00	Hard durable angular stones to 3 ft. max. Only minor degradation noted. No budging or batter distress noted.	9
DOWNSLOPE 0.50	Stable but steep rock outcrop. Tree covered in thin soil mantle.	8
LATERAL SLOPE 0.50	Tree-covered soil overburden over shallow rock to the left and another wall to the right	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress noted in road and sidewalk.	9
WALL DRAINS 1.00	No drains installed. About 10 % of the lower half of wall shows locations of internal drainage distress with seepage stains from grout lines.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint mortar in locations of severe debonding and degradation (about 30 % of the wall area) Repoint mortar (0,30 x 1720 sqft.) x \$75/sq.ft. = \$38700
Repair Cost:	\$38,700

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos

Condition photos are not available for GLAC-0010W-12.318-L.

Wall ID:	GLAC-0010W-12.344-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	80	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall supporting fill. Performing well but has a few locations of significant mortar degradation which should be repointed. Degradation is currently not affecting the structure.		

Wall Measurements

Wall Length (ft.):	217	Face Area (sq.):	2720
Average Wall Height (ft.):	12	Face Angle (deg.):	84
Maximum Wall Height (ft.):	25	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs some local mortar maintenance. Mortar degradation is currently not affecting the structure.	8
WALL FOUNDATION MATERIAL 8.00	Founded on shallow stable rock outcrop. Tree covered. No undermining, bulging, or batter distress noted.	9
MORTAR 8.00	Mortar is generally in good shape except for about 15 % of the wall which has significant debonding, weathering, and spalling degradation.	7
STONE MASONRY 8.00	Hard durable angular stones to 3 ft. max. A few location of minor surficial spalling.	8
DOWNSLOPE 0.50	Shallow stable but steep rock outcrop. Tree covered.	8
WALL DRAINS 0.50	No drains installed. A few locations with evidence of internal drainage problems with seepage stains from grout lines.	8
LATERAL SLOPE 0.50	To the left is another wall. To the right is steep stable shallow in place rock, tree covered.	9
ROAD/SIDEWALK/SHOULDER 0.50	No pavement distress noted. Shoulders are paved to the curb wall with no distress noted.	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint mortar in locations of severe debonding, weathering, and spalling degradation (about 15 % of wall area). Repoint mortar (0.15 x 2720 sqft.) x \$75/sq.ft. = \$30,600
Repair Cost:	\$30,600

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_12.344_L_1.jpg

Wall ID:	GLAC-0010W-12.574-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	79	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at upper side of the horse trail underpass. Performing well. Minor mortar maintenance needed.		

Wall Measurements

Wall Length (ft.):	44	Face Area (sq.):	181
Average Wall Height (ft.):	4	Face Angle (deg.):	90
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs minor maintenance along the sides and base to remove spalling bedrock, replace stones and regrout at contact.	8
WALL FOUNDATION MATERIAL 8.00	Founded on firm soil or in place rock outcrop. Some voids at the contact with the rock (mostly along the sides and not the base) where the rock has exfoliated and is spalling. No evidence of bulging or batter distress.	7
MORTAR 8.00	Mortar is in good shape except at the contact with the bedrock where degradation is associated with foundation rock exfoliation and spalling (about 10 sqft. of the wall area).	8
STONE MASONRY 8.00	Hard durable angular stone to 2 ft. max. Well interlocked with even grout seams.	9
LATERAL SLOPE 0.50	Gentle natural slopes with tree cover in shallow overburden on both sides. Horse trail is cut into bedrock outcrop.	8
ROAD/SIDEWALK/SHOULDER 0.50	No pavement distress. Shoulder is paved to the guardwall and shows no distress.	9
UPSLOPE 0.50	Stable horse trail.	9
WALL DRAINS 1.00	No drains installed. Some evidence of minor internal drainage distress at seepage stains from grout lines.	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Remove the spalling bedrock at the side contacts with the wall and replace with native stones, regrout and repoint the adjacent wall stones. 2 Laborers x 8 hr. x \$55/hr. = \$880. Repoint mortar 10 sqft. x \$75/sq.ft. = \$750. Materials = \$70. Total = \$1700
Repair Cost:	\$1,700

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_12.574_R_1.jpg

Wall ID:	GLAC-0010W-12.580-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	77	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall on left side of horse trail underpass. Performing well but needs minor mortar maintenance.		

Wall Measurements

Wall Length (ft.):	37	Face Area (sq.):	271
Average Wall Height (ft.):	7	Face Angle (deg.):	90
Maximum Wall Height (ft.):	19	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs minor mortar maintenance. Poor quality rock in foundation and possible internal drainage distress need to be monitored.	8
WALL FOUNDATION MATERIAL 8.00	Thin-bedded bedrock which is breaking up and exfoliating which may eventually cause loss of bearing for the wall. Currently no bulging or batter distress noted.	7
MORTAR 8.00	Mortar is in good shape except for local debonding, spalling, and weathering in about 10 % of the wall surface area.	7
STONE MASONRY 8.00	Hard Durable angular stones to 3 ft. max. Well interlocked with even grout lines. No degradation distress noted.	9
DOWNSLOPE 0.50	Bedrock outcrop in horse trail.	9
ROAD/SIDEWALK/SHOULDER 0.50	No pavement distress, shoulders are paved to the guardwall and show no distress.	9
LATERAL SLOPE 1.00	At the start is a thin-bedded steep rock outcrop is only marginally stable and shows signs of eventual failure which should not affect the wall. At the end is the start of another wall.	7
WALL DRAINS 1.00	No drains installed in wall. Contact with the concrete underpass and some groundwater seepage stains indicate some internal drainage stress.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint mortar in locations of excessive debonding, spalling and weathering degradation (about 10 % of the wall area). Repoint mortar (0.10 x 271 sq. ft.) x \$75/sq.ft. = \$2030
Repair Cost:	\$2,030

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_12.580_L_1.jpg

Wall ID:	GLAC-0010W-12.587-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	74	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall supporting fill slope. Wall is performing well but has a foundation problem: a 10 ft. long section of the wall near the east end has the foundation soil creeping away from it and undermining the wall.		

Wall Measurements

Wall Length (ft.):	128	Face Area (sq.):	1065
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but has a short section of undermined foundation that needs to be repaired. Minor mortar maintenance is also needed.	7
WALL FOUNDATION MATERIAL 8.00	Mostly shallow bedrock on a gentle slope. Near the east end there is a 10 ft. long section where the foundation material is soil and broken rock which is creeping away from the wall and causing an undermined cavity which extends back under the wall. No	7
MORTAR 8.00	Mortar is in good condition except for about 10 % of the wall area which has moderate cracking and debonding.	8
STONE MASONRY 8.00	Hard durable angular stones to 2 ft. max. Well interlocked with even grout lines. Degradation evidence is minor.	8
DOWNSLOPE 0.50	Gentle slope with a short wall at the horse trail. Overburden is shallow and tree covered over thin-bedded bedrock.	8
LATERAL SLOPE 0.50	At the start is the horse trail headwall. At the end is a tree covered bench on shallow bedrock.	8
WALL DRAINS 0.50	Only minor evidence of internal drainage distress.	8
ROAD/SIDEWALK/SHOULDER 1.00	Some minor cracking and sagging of pavement. Shoulder is paved to guardwall which show: no distress.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	1. Repair a 10 ft. long section of foundation that is being undermined. Excavate for and install a 3 ft. high x 10 ft. long concrete footing. 2 Laborers x 16 hr. x \$55/hr. = \$1760. Excavator 4 hr. x \$150/hr. = \$600. Dump truck 4 hr. x \$120/hr. = \$480
Repair Cost:	\$12,630

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_12.587_L_1.jpg

Wall ID:	GLAC-0010W-12.862-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 09, 2007	Approximate Year Built:	Unknown
*Wall Rating:	71	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone Masonry wall supporting fill slope. Performing well but mortar needs maintenance.		

Wall Measurements

Wall Length (ft.):	75	Face Area (sq.):	471
Average Wall Height (ft.):	6	Face Angle (deg.):	87
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs mortar maintenance. Seepage at grout lines in lower half of wall needs to be monitored.	7
WALL FOUNDATION MATERIAL 8.00	Firm soil over shallow thin-bedded bedrock. No bulging or batter distress noted.	8
MORTAR 8.00	Mortar is debonding on at least 50 % of the wall area and spalling on at least 25 %. Mortar shows surficial degradation where groundwater has been seeping from grout lines.	6
STONE MASONRY 8.00	Hard durable angular stones to 1.5 ft. max. Well interlocked with even grout lines. Several stones are missing.	7
DOWNSLOPE 0.50	Fairly flat for 2 ft. then about a 40 degree slope on shallow bedrock.	8
LATERAL SLOPE 0.50	Shallow bedrock that drops steeply to the river. Well vegetated w/ over 50 yr. old trees.	8
ROAD/SIDEWALK/SHOULDER 0.50	No pavement distress noted. Shoulder is paved to guardwall which shows no distress.	9
WALL DRAINS 1.00	Tile drain at center bottom of wall, no internal wall drains. Seepage at grout lines throughout the lower half of wall.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	1. Replace and reset loose and missing stones, use local stones. 2 laborers x 4 hr. x \$55/hr. = \$440. Materials = \$30. Subtotal = \$470. 2. Repoint mortar at locations with severe debonding and spalling (about 25 % of wall area). Repoint mortar
Repair Cost:	\$9,300

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_12.862_L_1.jpg

Wall ID:	GLAC-0010W-13.358-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 11, 2007	Approximate Year Built:	Unknown
*Wall Rating:	82	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at inlet to 6 ft. round concrete culvert. Performing well but inlet is buried by debris and possibly beaver activity. Need to clean inlet and install beaver screen if necessary.		

Wall Measurements

Wall Length (ft.):	30	Face Area (sq.):	153
Average Wall Height (ft.):	5	Face Angle (deg.):	90
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	-3

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Headwall is performing well but inlet is plugged and needs to be cleaned out. Plugging may be due to beaver activity and if so a beaver screen may need to be installed to prevent future plugging.	8
WALL FOUNDATION MATERIAL 8.00	Swampy upstream and inlet plugged so not able to see foundation material. No evidence of foundation problems on this shallow grade.	8
MORTAR 8.00	Only minor evidence of mortar distress from debonding, weathering and spalling. Joints are moss and lichen covered and difficult to see.	8
STONE MASONRY 8.00	Hard durable angular rock with negligible amount of degradation. Well interlocked with even grout lines.	9
LATERAL SLOPE 0.50	Fairly steep but stable fill slopes on both sides, well vegetated with grass and brush.	8
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement or shoulder distress.	9
WALL DRAINS 0.50	No drains installed and not evidence of internal drainage distress.	9
UPSLOPE 1.00	Ponded and swampy channel partly due to plugged inlet to culvert.	6

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Remove debris from culvert inlet and check for beaver activity. If debris is due to beaver activity install a beaver screen. Backhoe 4 hr. x \$120/hr. = \$480. 2 laborers x 4 hr. x \$55/hr. = \$440. Beaver screen (?) = \$380. Total = \$1300
Repair Cost:	\$1,300

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_13.358_R_1.jpg

Wall ID:	GLAC-0010W-13.360-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 11, 2007	Approximate Year Built:	Unknown
*Wall Rating:	82	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at outlet for 6 ft. diameter concrete culvert. Wall is performing well. Shoulder erosion needs maintenance. Mortar needs monitoring.		

Wall Measurements

Wall Length (ft.):	32	Face Area (sq.):	162
Average Wall Height (ft.):	5	Face Angle (deg.):	90
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	-4

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well. Erosion gully at end in shoulder and fill slope needs to be filled. Mortar in upper stones needs to be monitored.	8
WALL FOUNDATION MATERIAL 8.00	Founded on a gravelly streambed with water backed up submerging about 1/4th of culvert outlet. Gravel bar deposit from McDonald Creek is largely responsible for the submergence. No evidence of any scour, bulging or batter distress.	8
MORTAR 8.00	Mortar degradation is minimal throughout except upper stones which show local weathering and debonding distress which should be monitored.	8
STONE MASONRY 8.00	Hard durable angular stones to 2 ft. max. with negligible degradation. Well interlocked with even grout lines.	9
DOWNSLOPE 0.50	Ponded water in gravelly channel due to gravel bar along McDonald Creek, No scour distress or potential noted.	8
WALL DRAINS 0.50	No drains installed. No evidence of internal drainage problems.	9
LATERAL SLOPE 1.00	Steep fill slopes with moderate vegetative cover. Erosion gully at end needs to be filled.	7
ROAD/SIDEWALK/SHOULDER 1.00	No evidence of pavement distress. Shoulder has erosion gully at end of wall which needs to be filled.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Place rock in small gully eroded in shoulder and fill slope at end of wall. Use local material. 2 Laborers x 4 hr. x \$55/hr. = \$440
Repair Cost:	\$440

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_13.360_L_1.jpg

Wall ID:	GLAC-0010W-14.238-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 11, 2007	Approximate Year Built:	Unknown
*Wall Rating:	68	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry-placed stone wall supporting fill slope is performing well for about the first 70 ft. of length. About the last 20 ft. of length was founded on a sloping rock surface, was not properly keyed into the rock and has failed.		

Wall Measurements

Wall Length (ft.):	97	Face Area (sq.):	635
Average Wall Height (ft.):	6	Face Angle (deg.):	78
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well for about the first 70 ft. of length. The last about 20 ft. of length was founded on steeply sloping bedrock, was not properly keyed in, and has failed. Need to rebuild this failed section.	7
WALL FOUNDATION MATERIAL 8.00	Massive in place rock, no evidence of undermining, no bulging or batter distress for the first 70 ft. of wall length. About the last 20 ft. of wall length has failed as it was founded on the sloping bedrock and not properly keyed in.	5
PLACED STONE 8.00	Hard durable angular stone to 1.5 ft. max. with negligible degradation. Well interlocked with small void spaces.	8
LATERAL SLOPE 0.50	Steep stable massive in place rock on both sides, bench at top to road elevation, well vegetated in thin mantle of soil.	8
ROAD/SIDEWALK/SHOULDER 0.50	Wall has a wide horizontal setback from the road. No road or shoulder distress noted.	9
WALL DRAINS 0.50	No drains installed and no internal drainage distress noted.	9
DOWNSLOPE 1.00	Steep but stable massive in place rock.	7

Repair Recommendations

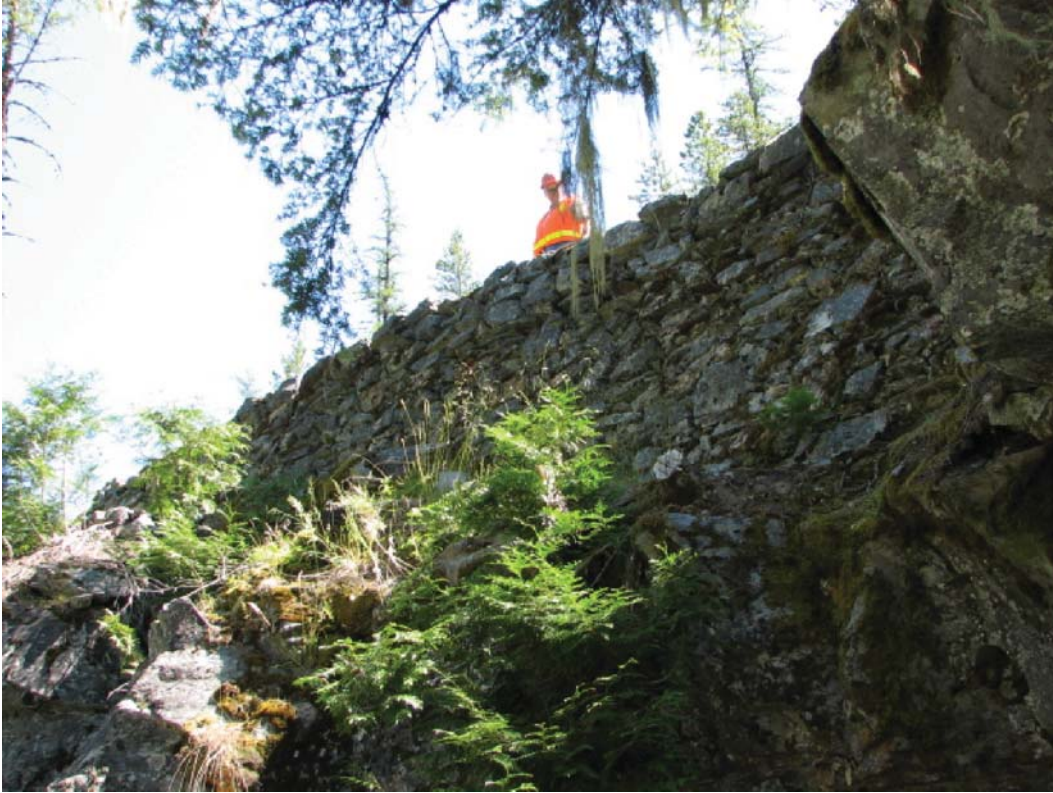
Failure Consequence:	MODERATE
Recommendation Narrative:	Remove failed section of wall, excavate to key wall into firm foundation, reconstruct a GD wall approx. 25 ft. x 4 ft., reshape top of slope. Excavator 4hr. x \$120/hr. = \$480. Dump truck 4hr. x \$150/hr. = \$600. 2 laborers x 4hr. x \$55/hr. = \$440.
Repair Cost:	\$6,520

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_14.238_L_1.jpg

Wall ID:	GLAC-0010W-14.268-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 11, 2007	Approximate Year Built:	Unknown
*Wall Rating:	75	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall supporting fill slope. Performing well but need mortar maintenance and monitoring for possible settlement and wall displacement about 160 ft. from the start of the wall.		

Wall Measurements

Wall Length (ft.):	556	Face Area (sq.):	3880
Average Wall Height (ft.):	6	Face Angle (deg.):	86
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs mortar maintenance. Need to monitor for possible settlement about 160 ft. from the start of the wall and for mortar degradation at seepage locations.	8
WALL FOUNDATION MATERIAL 8.00	Mostly founded on steep shallow in place rock. At about 160 ft. from the start of the wall there is evidence of settlement of the wall and vertical displacement. There are no other indications of bulging or batter distress. This displacement is minor a	8
MORTAR 8.00	Mortar is generally in good condition with locations where debonding and degradation has progressed to where it should be repointed. These locations are mostly in the upper 1.5 ft. of the wall extending into the guardwall section (about 50 % of this area	7
STONE MASONRY 8.00	Mostly hard durable angular stones to 4 ft. max, Interlocking is only fair with uneven and enlarged grout lines. A few stones are exfoliating and spalling and will eventually cause voids. Currently this is not affecting the structure.	8
DOWNSLOPE 0.50	Steep but stable in place rock with a vegetated bench at the base of the wall.	8
LATERAL SLOPE 0.50	Steep but stable shallow in place rock on both sides, well vegetated.	8
WALL DRAINS 0.50	No drains installed. Some evidence of seepage at the grout lines which at this time does not appear to have degraded the mortar but needs to be monitored.	8
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulder is paved to the guardwall which shows no distress.	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Reset stones and repoint about 50 % of the upper 1.5 ft. of the wall (guardwall) and about 20 % of the rest of the wall face. Reset stones & Repoint mortar ((0.50 x 1.5 ft. x 556 ft.) + (0.20 x 3880 sqft.)) x \$75/sq.ft. = \$89,500.
Repair Cost:	\$89,500

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_14.268_L_1.jpg

Wall ID:	GLAC-0010W-16.186-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 11, 2007	Approximate Year Built:	Unknown
*Wall Rating:	75	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at inlet to triple-arch culvert at Avalanche Creek. Wall is performing well but needs mortar maintenance.		

Wall Measurements

Wall Length (ft.):	93	Face Area (sq.):	180
Average Wall Height (ft.):	1	Face Angle (deg.):	90
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but the mortar has severe deterioration adjacent to and above the concrete arches.	7
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed on fairly gentle gradient. Wingwall are founded on firm soil. Some scour at inlet to arches but they are founded on concrete footings with no undermining. No evidence of batter distress.	8
MORTAR 8.00	Mortar has significant debonding and degradation adjacent to and above the concrete arches. About 80 % of the area above the arches (extends into the guardwall) and 20 % of the remainder of the wall area should be repointed.	6
STONE MASONRY 8.00	Hard durable angular stones to 2 ft. max with negligible degradation. Well interlocked with even grout seams.	9
UPSLOPE 0.50	Gravelly streambed with minor scour distress.	8
LATERAL SLOPE 0.50	Gentle natural and fill slopes with foot traffic trails, Well vegetated. Very little evidence of erosion into drainage.	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress noted in pavement or sidewalk.	9
WALL DRAINS 1.00	No drains installed. There is significant evidence of seepage from the grout lines and contacts with the concrete arches which is causing mortar distress.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint the locations of severe mortar deterioration primarily above (extends into the guardwall) and adjacent to the concrete arches. Repoint mortar ((0.50 x 1.5 ft. x 93 ft.) + (0.20 x 180 sqft.)) x \$75/sq.ft. = \$7950
Repair Cost:	\$7,950

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_16.186_R_1.jpg

Wall ID:	GLAC-0010W-16.190-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 11, 2007	Approximate Year Built:	Unknown
*Wall Rating:	69	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at outlet to triple concrete arches at Avalanche Creek. Wall is still performing but minor batter displacement on both sides of the concrete arches needs monitoring. Also needs mortar maintenance.		

Wall Measurements

Wall Length (ft.):	94	Face Area (sq.):	118
Average Wall Height (ft.):	1	Face Angle (deg.):	90
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is still performing but needs to be monitored for batter displacement. Mortar needs maintenance.	7
WALL FOUNDATION MATERIAL 8.00	Firm soil and gravelly streambed with currently little evidence of scour damage. However, note the displacement for the stone masonry toward the stream which could have resulted from either a preexisting settlement or scour foundation problem. Monitorin	8
MORTAR 8.00	Mortar has significant deterioration above and adjacent to the concrete arches largely due to the deterioration and spalling of the concrete. About 20 % of the area above the arches (extends into the guardwall area) and 30 % of the remainder of the wall	6
STONE MASONRY 8.00	Hard durable angular stones are well interlocked with even grout lines. At about 17 ft. and 75 ft, from the start of the wall, the entire wall is displaced about 0.5 in. away from the arches and toward the stream. Needs to be monitored for future batter	6
DOWNSLOPE 0.50	Gravelly streambed with relatively gentle gradient. No evidence of recent scour.	8
LATERAL SLOPE 0.50	Gentle fill and natural slopes with vegetation and foot trails. No evidence of erosional distress.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of distress to pavement or sidewalk.	9
WALL DRAINS 0.50	No drains installed and no evidence of internal drainage distress.	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint locations of severe mortar deterioration especially above (extends into the guardwall) and adjacent to the concrete arches. Repoint mortar ((0.20 x 94 ft. x 1.5 ft.) + (0.30 x 118 sqft.)) x \$75/sq.ft. = \$4770
Repair Cost:	\$4,770

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_16.190_L_1.jpg

Wall ID:	GLAC-0010W-17.146-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 11, 2007	Approximate Year Built:	Unknown
*Wall Rating:	74	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry-placed stone wall supporting fill. Performing well but needs maintenance of surface stone and additional erosion protection at the start.		

Wall Measurements

Wall Length (ft.):	460	Face Area (sq.):	5358
Average Wall Height (ft.):	11	Face Angle (deg.):	68
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs maintenance of the stones at the top of the wall and extension or rip raping to correct erosion problem at the start.	8
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed with cobbles. Some scour damage at the start of the wall needs to be corrected.	8
PLACED STONE 8.00	Hard durable angular stones to 3 ft. max. About 20 % of the upper layer(s) of rock have stones missing or need to be reset.	7
DOWNSLOPE 0.50	Toe of the wall is in McDonald Creek for almost the entire length. Scour damage appears minimal except at the start of the wall. Wall needs to be extended or rip raped at the start.	8
WALL DRAINS 0.50	No wall drains. No evidence of internal drainage distress but difficult to view from above.	9
LATERAL SLOPE 1.00	At the start, the lateral slope is scoured by the creek below and eroded from the shoulder above. The wall needs to be either extended or rip raped for a length of about 20 ft. in this direction. At the end, the fill and natural slope is steep but well	5
ROAD/SIDEWALK/SHOULDER 1.00	No evidence of pavement distress. Shoulder is eroded from runoff at the start of the wall.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	1. Reset existing or replace missing stones in the top layer(s) for about 20 % of the length, use local materials. Excavator 16 hr. x \$150/hr. = \$2400. 2 Laborers x 16 hr. x \$55/hr. = \$1760. Subtotal = \$4160. 2. Riprap a 20 ft. length of lateral slope
Repair Cost:	\$9,160

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_17.146_L_1.jpg

Wall ID:	GLAC-0010W-17.312-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 12, 2007	Approximate Year Built:	Unknown
*Wall Rating:	77	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry-place stone supporting fill at turnout. Appears to have been dumped rather than place. Performing well but need to have piping voids filled behind the top stones.		

Wall Measurements

Wall Length (ft.):	106	Face Area (sq.):	1477
Average Wall Height (ft.):	13	Face Angle (deg.):	71
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	-11

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but need to have piping voids filled at the top of the wall.	8
WALL FOUNDATION MATERIAL 8.00	Bedrock and gravelly streambed with cobbles. No apparent scour distress.	8
PLACED STONE 8.00	Hard durable stones from 1 ft. to 5 ft. max. Poorly interlocked appears to be dumped or machine placed.	7
DOWNSLOPE 0.50	Bedrock or gravelly streambed. No apparent scour distress. Seasonally high water at base o wall.	8
ROAD/SIDEWALK/SHOULDER 0.50	Pavement and shoulder show distress caused by extreme runoff from the road surface. does not appear to be related to the function of the wall. Wall was probably recently constructed to repair this damage.	8
LATERAL SLOPE 0.50	Bedrock with vegetated soil mantle at start, Concrete wall at end.	9
WALL DRAINS 0.50	No drains and no apparent internal drainage distress.	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Fill piping voids at top of wall, use local materials. 2 Laborers x 8 hr/ x \$55/hr. = \$880. Loader 8hr. x \$170/hr. = \$1360. Dump Truck 8 hr. x \$120/hr. = \$960. Total = \$3200
Repair Cost:	\$3,200

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_17.312_L_1.jpg

Wall ID:	GLAC-0010W-17.335-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 12, 2007	Approximate Year Built:	Unknown
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mass Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Concrete gravity wall supporting fill slope. Performing well, no action necessary.		

Wall Measurements

Wall Length (ft.):	31	Face Area (sq.):	384
Average Wall Height (ft.):	12	Face Angle (deg.):	86
Maximum Wall Height (ft.):	22	Vertical Offset (ft.):	-12

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well. No action is required	9
WALL FOUNDATION MATERIAL 8.00	Founded on exposed stable bedrock. No scour or undermining.	9
CONCRETE 8.00	No evidence of distress except for a section at the end where a wedge-shaped 5 ft. on top extending down 3 ft. on side is broken off with a small amount of rebar showing, does not appear to be affecting the function of the wall.	8
DOWNSLOPE 0.50	Toe of the wall is inundated during high stream flow. No evidence of scour distress or undermining.	8
LATERAL SLOPE 0.50	GD wall at start. Steep bedrock slope and start of a GM wall at end.	8
WALL DRAINS 0.50	No wall drains and no evidence of internal drainage distress.	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_17.335_L_1.jpg

Wall ID:	GLAC-0010W-17.340-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 12, 2007	Approximate Year Built:	Unknown
*Wall Rating:	72	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall is generally performing well but needs mortar maintenance. Vertical crack about 10 ft. from the start of the wall needs to be monitored for displacement.		

Wall Measurements

Wall Length (ft.):	105	Face Area (sq.):	1327
Average Wall Height (ft.):	12	Face Angle (deg.):	81
Maximum Wall Height (ft.):	23	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs mortar maintenance and replacement of a few missing stones at the base. Vertical crack at start of wall needs to be monitored.	8
WALL FOUNDATION MATERIAL 8.00	Founded on stable massive bedrock sloping about 25 degrees toward the stream. No severe scour noted, but some stones loose or missing at the base. See note above, the cracking may be foundation related.	7
MORTAR 8.00	Only minor weathering and spalling, but considerable debonding throughout (about 60 % of the wall).	7
STONE MASONRY 8.00	Hard durable angular stones to 2 ft. max. Interlock is only fair with some joints to 4 inches. About 10 ft. from the start is a vertical crack with about a 1 in. opening in the guardwall and extending down into the wingwall. No lateral or vertical disp	7
DOWNSLOPE 0.50	Exposed sloping bedrock in streambed. No major scour distress.	8
LATERAL SLOPE 0.50	Concrete wall at start. Steep stable bedrock with sparse vegetation at end.	8
WALL DRAINS 0.50	There is an arch drain at the base in the highest section of the wall. No evidence of internal drainage distress.	9
ROAD/SIDEWALK/SHOULDER 1.00	No evidence of pavement distress. Shoulder is paved to the guardwall which has the crack noted above.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	1. Replace and regrout missing stones at the base, use local stones. 2. Laborers x 16 hr. x \$55/hr. = \$1760. Materials = \$40. Subtotal = \$1800. 2. Repoint mortar in about 60 % of the wall surface area. Repoint mortar (0.60 x ((105 ft. x 1.5 ft.) + 1327 sq
Repair Cost:	\$68,600

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_17.340_L_1.jpg

Wall ID:	GLAC-0010W-17.404-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 12, 2007	Approximate Year Built:	Unknown
*Wall Rating:	68	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall still performing but has considerable mortar degradation. Possible vertical bulging displacement needs to be monitored.		

Wall Measurements

Wall Length (ft.):	113	Face Area (sq.):	695
Average Wall Height (ft.):	6	Face Angle (deg.):	76
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is still performing but needs mortar maintenance. Possible vertical bulging needs to be monitored.	7
WALL FOUNDATION MATERIAL 8.00	Either in place rock sloping toward the stream or sandy soil. No evidence of undermining or scour but toe is inundated and sand probably deposited during high water.	8
MORTAR 8.00	Mortar has considerable debonding over about 60 % of wall and deep spalling over about 30 %. Only about 10 % of the wall has good mortar.	5
STONE MASONRY 8.00	Mostly hard durable stones well interlocked with even grout lines. A few broken stones. Evidence of vertical bulging about 64 ft. from the start of the wall.	7
DOWNSLOPE 0.50	Bedrock sloping toward the stream. Toe is inundated during high water.	8
LATERAL SLOPE 0.50	Moderately sloping shallow bedrock on both sides.	8
WALL DRAINS 1.00	No drains installed. Some evidence of internal drainage distress with seepage stains at grout lines.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint mortar for about 90 % of the wall area. Repoint mortar (0.90 x 695 sq. ft.) x \$75/sq.ft. = \$46,910
Repair Cost:	\$46,910

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_17.404_L_1.jpg

Wall ID:	GLAC-0010W-18.748-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 13, 2007	Approximate Year Built:	Unknown
*Wall Rating:	63	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at inlet to twin 5 ft x 5 ft box culverts. Channel is dry, inlet recently cleared of debris. Wall is performing well but is in need of major repointing and resetting of stones. Monitor for settlement.		

Wall Measurements

Wall Length (ft.):	41	Face Area (sq.):	135
Average Wall Height (ft.):	3	Face Angle (deg.):	90
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	-4

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is still performing well but is in need of mortar maintenance and some stone resetting or replacement on its entire surface area. Possible settlement and batter displacement needs to be monitored.	6
WALL FOUNDATION MATERIAL 8.00	Stream channel is currently dry and recently cleared of debris. Evidence of settlement and batter distress possibly caused by earlier scour.	7
MORTAR 8.00	Major debonding for the entire wall including the guardwall above the culverts. Cracking, spalling and weathering is also moderate.	5
STONE MASONRY 8.00	Hard durable angular stones to 2 ft. max. Zones not well interlocked with joints to 3 in. Top stones are missing.	7
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Shoulder at end had been eroded and gully recently filled with rock.	8
LATERAL SLOPE 0.50	Gentle grassy fill slopes and brush and tree covered natural slopes.	9
WALL DRAINS 1.00	No drains installed. Some evidence of damage from runoff infiltration behind wall and seepage from grout lines below. Mortar missing and stones loose at these locations.	5
UPSLOPE 1.00	Stream channel had been filled with debris and recently cleaned. some evidence of wall settlement may have been caused by previous scour distress and undermining.	6

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	1. Replace or reset surface stones, use local stones. 2 Laborers x 12 hr. x \$55/hr. = \$1320. 2. Repoint mortar for stones above culverts and entire wall face area. Repoint mortar ((18 ft. x 1.5 ft.) + 135 sq. ft.) x \$75/sq.ft. = \$12,150. Total = \$13,470
Repair Cost:	\$13,470

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_18.748_R_1.jpg

Wall ID:	GLAC-0010W-18.750-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 13, 2007	Approximate Year Built:	Unknown
*Wall Rating:	79	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at outlet of twin 5 ft x 5 ft box culverts. Performing well need to replace/reset a few stones at both the beginning and end of the wall. Monitor for settlement at the end.		

Wall Measurements

Wall Length (ft.):	26	Face Area (sq.):	37
Average Wall Height (ft.):	1	Face Angle (deg.):	90
Maximum Wall Height (ft.):	4	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs to have stones replaced/reset at both ends of the wall. Settlement of the pavement at both ends of the wall needs to be monitored.	8
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed. No scour distress.	9
STONE MASONRY 8.00	Hard durable angular stones, well interlocked. Stones are loose or missing at both ends of the wall.	7
MORTAR 8.00	Mortar is in good condition with only minor weathering, spalling and debonding degradation.	8
DOWNSLOPE 0.50	Gravelly streambed on gentle gradient. No scour distress noted.	8
LATERAL SLOPE 0.50	Gentle natural slopes, well vegetated. gravel overburden adjacent to each side.	8
WALL DRAINS 0.50	No drains installed. Some minor evidence of seepage from grout lines.	8
ROAD/SIDEWALK/SHOULDER 1.00	Pavement shows evidence of settlement of subgrade at both ends of the wall. Wall does not show any displacement and may not be affected.	6
CULVERT 1.00	Surface of concrete culverts is degrading and spalling, exposing rebar. Will eventually contribute to degradation of the adjacent wall.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Replace/reset stones at both ends of wall, use local stones. 2 Laborers x 4 hr. x \$55/hr. = \$440
Repair Cost:	\$440

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_18.750_L_1.jpg

Wall ID:	GLAC-0010W-19.590-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 13, 2007	Approximate Year Built:	Unknown
*Wall Rating:	68	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at outlet for 17 ft x 3 ft bridge. Performing well but needs mortar maintenance.		

Wall Measurements

Wall Length (ft.):	31	Face Area (sq.):	118
Average Wall Height (ft.):	3	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Headwall is performing well but is need of mortar maintenance.	7
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed, stable with no evidence of scour or undermining.	8
MORTAR 8.00	Mortar is missing, loose, or debonded on about 50 % of wall face.	5
STONE MASONRY 8.00	Hard durable angular to round stones to 1 ft. max. Poorly interlocked with uneven joint lines. Some stones are weathering and minor spalling. No batter or bulging distress noted.	7
DOWNSLOPE 0.50	Gravelly streambed. No evidence of scour distress. Flood debris scattered along stream banks.	8
LATERAL SLOPE 0.50	Gentle grassy fill slopes to tree covered flood plain.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement, shoulder, or guardwall distress.	9
WALL DRAINS 1.00	No drains installed. Considerable evidence of seepage from grout lines probably contributing to mortar degradation..	6

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Repoint and fill mortar voids for about 50 % of wall surface area. Repoint mortar (0.50 x ((31 ft. x 2 ft.) + 118 sq. ft.)) x \$75/sq.ft. = \$6750
Repair Cost:	\$6,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_19.590_L_1.jpg

Wall ID:	GLAC-0010W-19.590-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 13, 2007	Approximate Year Built:	Unknown
*Wall Rating:	82	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at inlet to 17 ft x 3 ft concrete bridge. Performing well. Stones are not as good quality as walls downstream and need to be monitored for degradation.		

Wall Measurements

Wall Length (ft.):	32	Face Area (sq.):	83
Average Wall Height (ft.):	2	Face Angle (deg.):	90
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well. No maintenance necessary at this time. Monitor stone degradation and road rutting.	8
WALL FOUNDATION MATERIAL 8.00	Stable gravelly streambed. No evidence of scour distress or undermining.	9
MORTAR 8.00	Mortar is in good condition with less than 10 % of the area showing debonding and spalling distress.	8
STONE MASONRY 8.00	Mostly hard durable stones but range from angular to round. Poorly interlocked with uneven grout lines. No evidence of batter distress.	8
DOWNSLOPE 0.50	Gently sloping gravelly streambed. No evidence of scour distress.	8
LATERAL SLOPE 0.50	Gently sloping terrain.	9
ROAD/SIDEWALK/SHOULDER 1.00	Pavement is rutted at bridge location. No shoulder or guardwall distress noted.	6
WALL DRAINS 1.00	No drains installed. Some evidence of seepage at grout lines.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_19.590_R_1.jpg

Wall ID:	GLAC-0010W-19.591-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	July 13, 2007	Approximate Year Built:	Unknown
*Wall Rating:	68	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at outlet for 17 ft x 3 ft bridge. Performing well but needs mortar maintenance.		

Wall Measurements

Wall Length (ft.):	31	Face Area (sq.):	118
Average Wall Height (ft.):	3	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Headwall is performing well but is need of mortar maintenance.	7
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed, stable with no evidence of scour or undermining.	8
MORTAR 8.00	Mortar is missing, loose, or debonded on about 50 % of wall face.	5
STONE MASONRY 8.00	Hard durable angular to round stones to 1 ft. max. Poorly interlocked with uneven joint lines. Some stones are weathering and minor spalling. No batter or bulging distress noted.	7
DOWNSLOPE 0.50	Gravelly streambed. No evidence of scour distress. Flood debris scattered along stream banks.	8
LATERAL SLOPE 0.50	Gentle grassy fill slopes to tree covered flood plain.	9
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement, shoulder, or guardwall distress.	9
WALL DRAINS 1.00	No drains installed. Considerable evidence of seepage from grout lines probably contributing to mortar degradation..	6

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Reoint and fill mortar voids for about 50 % of wall surface area. Repoint mortar (0.50 x ((31 ft. x 2 ft.) + 118 sq. ft.) x \$75/sq.ft. = \$6750
Repair Cost:	\$6,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos

Condition photos are not available for GLAC-0010W-19.591-L.

Wall ID:	GLAC-0010W-22.347-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Outlet stone masonry headwall at lower crossing of Granite (Alder) Creek		

Wall Measurements

Wall Length (ft.):	37	Face Area (sq.):	210
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	-6

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, monitor separation between headwall and box culvert	8
WALL FOUNDATION MATERIAL 8.00	Concrete footing, no distress	8
MORTAR 8.00	Cracking and debonding of mortar at top of wall; 1-1/2" gap between rock and culvert	7
STONE MASONRY 8.00	Semi-angular rock, good condition, lots of efflorescence	8
CULVERT 0.50	8'x10' concrete box culvert, no distress	8
DOWNSLOPE 0.50	Rocky, coarse streambed material	8
LATERAL SLOPE 0.50	Gentle, heavily vegetated slope	8
WALL DRAINS 0.50	No distress noted	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_22.347_L_1.jpg

Wall ID:	GLAC-0010W-22.354-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	77	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet headwall for 2 cip box culverts (8 ft x 9.5 ft & 4 ft x 6 ft) at lower crossing of Granite (Alder) Creek		

Wall Measurements

Wall Length (ft.):	37	Face Area (sq.):	200
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	-1

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Coarse talus, firm, no distress	9
MORTAR 8.00	Minor debonding overall, total mortar loss in lower 4 feet of wall for 20% of wall, mortar loss at headwall/box culvert interface	6
STONE MASONRY 8.00	No distress	9
WALL DRAINS 0.50	None, no distress	9
CULVERT 1.00	Some cracking in concrete of 8'x9.5' box culvert; abrasion at concrete floor exposing steel reinforcement; roof cracks have been patched	7
DOWNSLOPE 1.00	Creek bed, boulder, some scour at inlet up to 1 foot deep	7
LATERAL SLOPE 1.00	Steep to vertical, some erosion from creek; bouldery, some erosion behind wing wall	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 20% of lower 4 feet of wall (40 sqft), patch culvert slab at inlet (1 cyd). Repoint: 40 sqft x \$75/sqft = \$3000. Concrete patch: 1 cyd x \$1500 = \$1,500. Total=\$4,500
Repair Cost:	\$4,500

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_22.354_R_1.jpg

Wall ID:	GLAC-0010W-22.360-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	66	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Outlet stone masonry headwall to lower crossing of Granite (Alder) Creek, 4 ft x 6 ft		

Wall Measurements

Wall Length (ft.):	21	Face Area (sq.):	60
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	-6

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No distress	7
WALL FOUNDATION MATERIAL 8.00	Soil, stable	7
MORTAR 8.00	Isolated cracking and debonding, some deterioration	6
STONE MASONRY 8.00	Smaller and medium sized stones, efflorescence staining, some weathering and fractures on stone	6
LATERAL SLOPE 0.50	Soil and vegetation, stable	8
WALL DRAINS 0.50	None	9
CULVERT 1.00	4'x6' cip box culvert, no distress	7
VEGETATION 1.00	Heavy vegetation growth over top of wall face	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_22.360_L_1.jpg

Wall ID:	GLAC-0010W-22.855-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Fill wall, 3 foot high concrete wall with additional 1 foot thick concrete footing sitting on 2 foot high dry stack wall, no shoulder		

Wall Measurements

Wall Length (ft.):	133	Face Area (sq.):	665
Average Wall Height (ft.):	5	Face Angle (deg.):	90
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, some slight tilting	7
WALL FOUNDATION MATERIAL 8.00	Talus/shot rock, slightly settling; up to 30' length of concrete footing is undermined	7
CONCRETE 8.00	CIP concrete wall, leaning out slightly in middle	8
OTHER PRIMARY ELEMENT 8.00	Dry stack wall, 2' high, slight settling	8
LATERAL SLOPE 0.50	Steep, loose talus slope, wooded, minor raveling; another wall located at end of wall	8
WALL DRAINS 0.50	4" pvc drains at base of wall	8
DOWNSLOPE 1.00	Steep, loose talus/shot rock, minor raveling, wooded	7
ROAD/SIDEWALK/SHOULDER 1.00	Wall parallel cracking in road lane, up to 1 inch cracks, up to 1" settlement in road	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Patch undermining beneath concrete footing, 30'x3'x1' Concrete: 3 cyd x \$1,500=\$4,500 Total=\$4,500
Repair Cost:	\$4,500

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

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_22.855_L_1.jpg

Wall ID:	GLAC-0010W-22.880-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	65	Maintenance Action:	Replace Wall

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Gravity - Dry Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall with short section of dry laid wall under stone masonry guardwall.		

Wall Measurements

Wall Length (ft.):	156	Face Area (sq.):	680
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry section performing, dry laid section is not	6
WALL FOUNDATION MATERIAL 8.00	Bedrock, soil	8
PLACED STONE 8.00	Significant bulging and dislodged stones at station 20, localized failure of dry laid wall	4
MORTAR 8.00	Minor cracking and debonding, no significant voids	7
STONE MASONRY 8.00	Weathered, minor fractures otherwise no distress	7
DOWNSLOPE 0.50	Steep, vegetated talus and bedrock slope	8
LATERAL SLOPE 0.50	Adjacent wall at beginning	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Replace dry laid wall section (70 sqft) Replace dry stone gravity wall: \$50 sqft x 70 sqft = \$3,500 Total=\$3,500
Repair Cost:	\$3,500

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_22.880_L_1.jpg

Wall ID:	GLAC-0010W-22.913-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	91	Face Area (sq.):	635
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	13	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Moderate weathering, moderate debonding over 30% of wall	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Steep, loose talus over bedrock, minor raveling	8
LATERAL SLOPE 0.50	Steep, bedrock, no distress	9
WALL DRAINS 0.50	3" diameter wall drain tile near base of wall outlets through face, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Lateral cracks running parallel to wall previously patched	7

Repair Recommendations

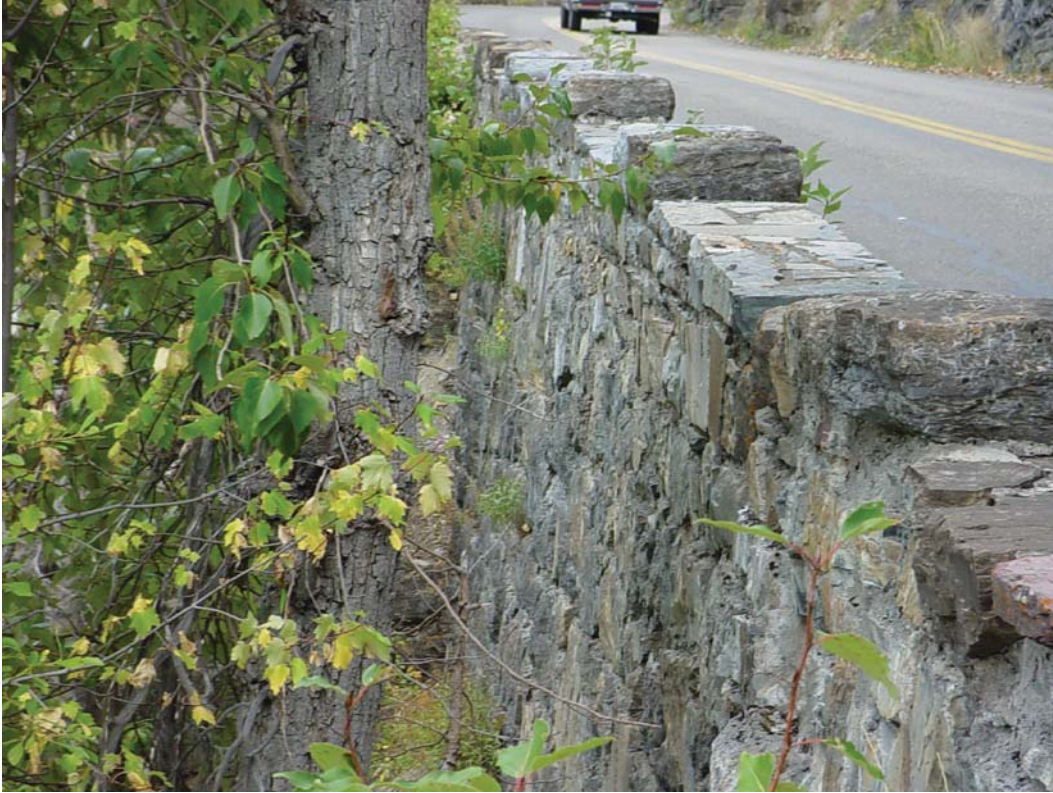
Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 30% of wall face (190 sqft) Repoint: 190 sqft x \$75/sqft = \$14,250 Total=\$14,250
Repair Cost:	\$14,250

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_22.913_L_1.jpg

Wall ID:	GLAC-0010W-22.962-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	72	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	76	Face Area (sq.):	450
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall stable	8
WALL FOUNDATION MATERIAL 8.00	Soil, firm, stable	8
MORTAR 8.00	20% of mortar shows voids, debonding, cracking	6
STONE MASONRY 8.00	Heavy efflorescence staining on 5% of wall face, stone angular, weathered	7
DOWNSLOPE 0.50	Soil, firm, stable	8
LATERAL SLOPE 0.50	Bedrock and soil, stable	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 1.00	Areas of stone separation in guardwall, cracking in mortar; 20' total	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 20% of wall face (90 sqft) Repoint: 130 sqft x \$75/sqft = \$9,750 Total: \$9,750
Repair Cost:	\$9,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_22.962_L_1.jpg

Wall ID:	GLAC-0010W-23.052-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 16, 2007	Approximate Year Built:	1930
*Wall Rating:	70	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	82	Face Area (sq.):	750
Average Wall Height (ft.):	9	Face Angle (deg.):	85
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	-7

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stable, no distress	8
WALL FOUNDATION MATERIAL 8.00	Soil, talus, 5' undermining at station 20	6
MORTAR 8.00	30% of wall face mortar has voids, debonded	6
STONE MASONRY 8.00	Large blocks, no distress	8
WALL DRAINS 0.50	None	8
CULVERT 1.00	24" cmp at station 30, minor damage to outlet	7
DOWNSLOPE 1.00	Talus, minor erosion	7
LATERAL SLOPE 1.00	Soil and talus, minor erosion	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint 30% of wall face (225 sqft) Repoint: 225 sqft x \$75/sqft = \$16,875 Total = \$16,875
Repair Cost:	\$16,875

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.052_L_1.jpg

Wall ID:	GLAC-0010W-23.445-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	90	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall at uphill end of west tunnel		

Wall Measurements

Wall Length (ft.):	78	Face Area (sq.):	515
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	15	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	No distress in wall	9
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Steep, talus and bedrock, minor raveling of talus	8
ROAD/SIDEWALK/SHOULDER 0.50	Some cracks, unevenness and impact damage in road surface (asphalt & concrete), likely not wall related	8
TRAFFIC BARRIER/FENCE 0.50	Minor debonding of mortar at guardwall	8
CULVERT 0.50	Storm drain outlet at beginning of wall, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.445_L_1.jpg

Wall ID:	GLAC-0010W-23.494-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall rehabilitated in 2000		

Wall Measurements

Wall Length (ft.):	51	Face Area (sq.):	200
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No distress	8
WALL FOUNDATION MATERIAL 8.00	90% of wall is on soil, from cmp culvert to wall end shows minor undermining (4' length)	7
MORTAR 8.00	Minor cracking and debonding otherwise no distress	8
STONE MASONRY 8.00	Irregularly sized, angular blocks, no distress	8
CULVERT 0.50	24" cmp	8
DOWNSLOPE 0.50	Talus, soil, stable	8
LATERAL SLOPE 0.50	Talus, soil, stable	8
WALL DRAINS 0.50	No distress	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.494_L_1.jpg

Wall ID:	GLAC-0010W-23.505-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	73	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	61	Face Area (sq.):	400
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	13	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, however significant mortar loss threatens future performance	7
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	30% of mortar moderate to severe debonding with mortar loss over 10% of wall creating voids of 6" into face of wall	6
STONE MASONRY 8.00	Stone blocks are highly jointed along bedding planes; 30% of blocks are spalling	7
LATERAL SLOPE 0.50	Talus over shallow bedrock, mild raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	Minor impact damage in overlay	8
DOWNSLOPE 0.50	Shallow bedrock, no distress	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 40% of wall face (160 sqft) Repoint: 160 sqft x \$75 = \$12,000
Repair Cost:	\$12,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.505_L_1.jpg

Wall ID:	GLAC-0010W-23.535-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	79	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	44	Face Area (sq.):	150
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No distress	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Tight mortar with isolated small voids	8
STONE MASONRY 8.00	Smaller rectangular blocks	8
WALL DRAINS 0.50	4" pvc drain at station 14	8
DOWNSLOPE 1.00	Steep, bedrock with talus	7
LATERAL SLOPE 1.00	Steep, bedrock with talus	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.535_L_1.jpg

Wall ID:	GLAC-0010W-23.554-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	72	Maintenance Action:	Replace Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	300	Face Area (sq.):	800
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Bulging at station 14 for length of 10', otherwise performing as intended	7
WALL FOUNDATION MATERIAL 8.00	Talus, soil, no erosion	8
MORTAR 8.00	Cracked and separated mortar at station 14, otherwise no distress	7
STONE MASONRY 8.00	Area of bulging at station 14, other sections show no distress	7
WALL DRAINS 0.50	None	8
DOWNSLOPE 1.00	Soil, talus, minor erosion	7
LATERAL SLOPE 1.00	Soil, talus	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Rebuild bulged wall section, 4'x10' Rebuild: 40 sqft x \$160/sqft = \$6,400
Repair Cost:	\$6,400

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

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.554_L_1.jpg

Wall ID:	GLAC-0010W-23.692-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	71	Maintenance Action:	Replace Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall with stone masonry guardwall		

Wall Measurements

Wall Length (ft.):	87	Face Area (sq.):	1055
Average Wall Height (ft.):	12	Face Angle (deg.):	60
Maximum Wall Height (ft.):	21	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended for most of wall, isolated area of failure at beginning of wall	7
WALL FOUNDATION MATERIAL 8.00	Coarse talus or bedrock or riprap; mild to minor raveling	7
PLACED STONE 8.00	Majority of wall has no distress, first 10' of wall has failed and needs to be rebuilt	7
TRAFFIC BARRIER/FENCE 0.50	Guardwall under construction at time of inspection	9
WALL DRAINS 0.50	None, no distress	9
DOWNSLOPE 1.00	Loose talus and rip rap over shallow bedrock, moderate raveling	7
LATERAL SLOPE 1.00	Steep, loose talus over shallow bedrock, moderate raveling	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Rebuild beginning 10' length of wall (70 sqft) Replace, gravity, dry stone: 70 sqft x \$50/sqft = \$3,500
Repair Cost:	\$3,500

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.692_L_1.jpg

Wall ID:	GLAC-0010W-23.708-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	77	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	27	Face Area (sq.):	210
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, soil, stable	8
MORTAR 8.00	Voids in grout, minor debonding, separations in guardwall grout	7
STONE MASONRY 8.00	Rectangular blocks, no distress	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	None	8
DOWNSLOPE 1.00	Steep, talus, soil, stable	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.708_L_1.jpg

Wall ID:	GLAC-0010W-23.720-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 16, 2007	Approximate Year Built:	1930
*Wall Rating:	71	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall - rehabilitated in 2001		

Wall Measurements

Wall Length (ft.):	152	Face Area (sq.):	840
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, stable, minor undermining beneath newer wall section, 10' length	6
MORTAR 8.00	Last 50' of wall shows voids, debonding of mortar, 30% of face	6
STONE MASONRY 8.00	Station 0 to station 29 constructed in 2001, remainder is original, no distress	8
CULVERT 0.50	30" cmp at station 14	8
DOWNSLOPE 0.50	Soil, talus, stable	8
LATERAL SLOPE 0.50	Soil, talus, vegetated	8
WALL DRAINS 0.50	PVC underdrain	8
TRAFFIC BARRIER/FENCE 0.50	New guardwall being constructed on initial 30' of wall	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.720_L_1.jpg

Wall ID:	GLAC-0010W-23.753-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 16, 2007	Approximate Year Built:	1930
*Wall Rating:	77	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall		

Wall Measurements

Wall Length (ft.):	56	Face Area (sq.):	160
Average Wall Height (ft.):	2	Face Angle (deg.):	70
Maximum Wall Height (ft.):	4	Vertical Offset (ft.):	-4

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, talus, stable	8
PLACED STONE 8.00	Medium angular blocks, no distress	7
CULVERT 0.50	18" cmp at beginning of wall	8
DOWNSLOPE 0.50	Talus, soil, stable	8
LATERAL SLOPE 0.50	Soil, talus	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.753_L_1.jpg

Wall ID:	GLAC-0010W-23.805-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	2000
*Wall Rating:	90	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	53	Face Area (sq.):	185
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Coarse fill or bedrock, no distress	9
MORTAR 8.00	No distress	9
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Steep, loose talus over bedrock, minor raveling	8
LATERAL SLOPE 0.50	Steep, talus, mild raveling	8
CULVERT 0.50	18" cmp, tar coated, outlets below wall, no distress	9
WALL DRAINS 0.50	No distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_23.805_L_1.jpg

Wall ID:	GLAC-0010W-24.003-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Large dry laid fill wall at The Loop. Rehabed in 2000 by placing rock buttress in eroded crevice area at toe of north end of wall, and grouting and anchoring much of the north wall stone.		

Wall Measurements

Wall Length (ft.):	135	Face Area (sq.):	4600
Average Wall Height (ft.):	34	Face Angle (deg.):	45
Maximum Wall Height (ft.):	54	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Some bulging at base of wall, performing as intended	8
WALL FOUNDATION MATERIAL 8.00	Coarse talus or weathered rock, minor undermining over 4 feet at base of wall at hand placed concrete section	7
PLACED STONE 8.00	Large rectangular blocks, no distress	7
ANCHOR HEADS 8.00	Not visible, installed in 2000, no apparent distress	9
CONCRETE 8.00	Some concrete hand placed at toe of wall, no distress	9
LATERAL SLOPE 0.50	Steep, minor cracking	8
DOWNSLOPE 0.50	Steep, bedrock, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
TRAFFIC BARRIER/FENCE 0.50	New, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.003_L_1.jpg

Wall ID:	GLAC-0010W-24.362-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	2007
*Wall Rating:	90	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	MSE - Welded Wire Face
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	MSE fill wall with stone facing still under construction (2007)		

Wall Measurements

Wall Length (ft.):	91	Face Area (sq.):	510
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No finished yet with construction	9
WALL FOUNDATION MATERIAL 8.00	No distress	9
WIRE/GEOSYNTHETIC FACING 8.00	No distress, under construction, but wire face exposed at time of inspection	9
DOWNSLOPE 0.50	Steep, talus, stable	8
LATERAL SLOPE 0.50	Talus, vegetated, stable	8
ARCHITECTURAL FACING 0.50	Not applied yet	9
TRAFFIC BARRIER/FENCE 0.50	Not constructed yet	9
WALL DRAINS 0.50	3@ 6" pvc drains beneath wall footing	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.362_R_1.jpg

Wall ID:	GLAC-0010W-24.400-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	38	Face Area (sq.):	170
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Likely shallow bedrock, no distress	9
MORTAR 8.00	Minor debonding, 70% repointed	8
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Talus and side cast fill over shallow bedrock, minor raveling	8
LATERAL SLOPE 0.50	Talus and side cast fill over shallow bedrock, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
WALL DRAINS 0.50	No distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.400_R_1.jpg

Wall ID:	GLAC-0010W-24.445-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	2007
*Wall Rating:	90	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	MSE - Welded Wire Face
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	New MSE fill wall under construction at time of inspection.		

Wall Measurements

Wall Length (ft.):	106	Face Area (sq.):	640
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	New wall under construction, no distress noted	9
WALL FOUNDATION MATERIAL 8.00	No distress noted	9
MORTAR 8.00	New wall under construction, no distress noted	9
WIRE/GEOSYNTHETIC FACING 8.00	New wall under construction, no distress noted	9
DOWNSLOPE 0.50	Soil and talus, stable	8
LATERAL SLOPE 0.50	Soil, talus, vegetated, no distress	8
WALL DRAINS 0.50	No distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.445_R_1.jpg

Wall ID:	GLAC-0010W-24.510-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	2007
*Wall Rating:	87	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	MSE - Welded Wire Face
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	New MSE fill wall with stone facing still under construction		

Wall Measurements

Wall Length (ft.):	114	Face Area (sq.):	570
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Still under construction	9
WALL FOUNDATION MATERIAL 8.00	Talus and soil, stable	8
WIRE/GEOSYNTHETIC FACING 8.00	New wall still under construction, no distress	9
DOWNSLOPE 0.50	Talus, soil, stable	8
LATERAL SLOPE 0.50	Talus, vegetated	8
ARCHITECTURAL FACING 0.50	Stone facing not applied yet	9
WALL DRAINS 0.50	No distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.510_R_1.jpg

Wall ID:	GLAC-0010W-24.532-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	90	Face Area (sq.):	1100
Average Wall Height (ft.):	12	Face Angle (deg.):	85
Maximum Wall Height (ft.):	17	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock and soil	8
MORTAR 8.00	70% of face repointed in 2007	9
STONE MASONRY 8.00	Angular blocks, no distress	9
DOWNSLOPE 0.50	Bedrock, cliff	8
LATERAL SLOPE 0.50	Bedrock, soil, stable	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.532_R_1.jpg

Wall ID:	GLAC-0010W-24.600-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	23	Face Area (sq.):	140
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Minor debonding, recently repointed	8
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress in overlay	9
TRAFFIC BARRIER/FENCE 0.50	Guardwall, no distress	9
WALL DRAINS 0.50	1 @ 3" drain tile outlets through face, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.600_R_1.jpg

Wall ID:	GLAC-0010W-24.606-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	70	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	227	Face Area (sq.):	2040
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	30% of wall face has debonded mortar, cracks	6
STONE MASONRY 8.00	Large angular blocks, minor fractures in wall stone	7
DOWNSLOPE 0.50	Bedrock, cliff	8
LATERAL SLOPE 0.50	Bedrock, no distress	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.606_R_1.jpg

Wall ID:	GLAC-0010W-24.650-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	83	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry head wall for Crystal Point Arch		

Wall Measurements

Wall Length (ft.):	74	Face Area (sq.):	735
Average Wall Height (ft.):	9	Face Angle (deg.):	85
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Moderate debonding over 50% of wall with missing mortar	7
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	Newer 24" cmp culvert outlets in newer inset wall below arch, no distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Same	9
WALL DRAINS 0.50	Several 6" diameter pvc wall drains outlet and inset stone masonry wall adjacent to culvert outlet, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Minor shoulder cracking and settling	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 50% of wall (370 sqft) Repoint: 370 sqft x \$75 = \$27,750 Total=\$27,750
Repair Cost:	\$27,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.650_R_1.jpg

Wall ID:	GLAC-0010W-24.678-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	68	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	54	Face Area (sq.):	130
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Bedrock - 5' of undermined wall toe at beginning of wall	6
MORTAR 8.00	Isolated cracking and debonding of face <10%	7
STONE MASONRY 8.00	Minor fractures < 1% of stone	7
DOWNSLOPE 0.50	Bedrock, cliff	8
LATERAL SLOPE 0.50	Bedrock, cliff	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repair undermining, 5' length Underpinning/stabilization: 5 feet x 1 foot x \$200/sqft = \$1,000 Total=\$1,000
Repair Cost:	\$1,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.678_R_1.jpg

Wall ID:	GLAC-0010W-24.700-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	30	Face Area (sq.):	200
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Isolated cracking, voids <10% of face	7
STONE MASONRY 8.00	No distress	8
DOWNSLOPE 0.50	Bedrock cliff	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.700_R_1.jpg

Wall ID:	GLAC-0010W-24.718-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Cantilever - Concrete
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone masonry fill wall with cantilevered wall with stone and mortar arch facing for center 50 ft of wall.		

Wall Measurements

Wall Length (ft.):	150	Face Area (sq.):	1800
Average Wall Height (ft.):	12	Face Angle (deg.):	85
Maximum Wall Height (ft.):	19	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Stone masonry wall is performing as intended; arch facing on concrete wall has failed	7
WALL FOUNDATION MATERIAL 8.00	Likely bedrock	9
CONCRETE 8.00	Vertical cracks (up to 0.5" diam) through concrete wall	7
MORTAR 8.00	Minor debonding of mortar at stone masonry portion of wall, moderate efflorescence.	8
STONE MASONRY 8.00	No distress	9
ARCHITECTURAL FACING 1.00	Most of facing has debonded and fallen away from concrete wall	4
DOWNSLOPE 0.50	Steep, partially wooded, bedrock or thin talus over bedrock, no distress	8
LATERAL SLOPE 0.50	Steep, partially wooded, bedrock or thin talus over bedrock, no distress	8
CULVERT 0.50	24" cmp culvert outlets through face of wall near start, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repair stone facing, 750 sqft Remove and reset stone facing: 750 sqft x \$45/sqft = \$33,750 Total=\$33,750
Repair Cost:	\$33,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.718_R_1.jpg

Wall ID:	GLAC-0010W-24.758-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	77	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall		

Wall Measurements

Wall Length (ft.):	32	Face Area (sq.):	160
Average Wall Height (ft.):	5	Face Angle (deg.):	65
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, stable	8
PLACED STONE 8.00	Large rectangular blocks, minor voids	7
DOWNSLOPE 0.50	Soil	8
LATERAL SLOPE 0.50	Bedrock and soil	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.758_R_1.jpg

Wall ID:	GLAC-0010W-24.782-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	80	Face Area (sq.):	470
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No distress	8
WALL FOUNDATION MATERIAL 8.00	Soil, stable	8
STONE MASONRY 8.00	Minor fractures, no distress	8
MORTAR 8.00	70% of wall face repointed in 2001	9
DOWNSLOPE 0.50	Soil, talus, stable	8
LATERAL SLOPE 0.50	Soil, talus, stable	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.782_R_1.jpg

Wall ID:	GLAC-0010W-24.840-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	70	Face Area (sq.):	460
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Minor voids, debonding < 5% of face	8
STONE MASONRY 8.00	No distress	8
DOWNSLOPE 0.50	Bedrock	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.840_R_1.jpg

Wall ID:	GLAC-0010W-24.872-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	90	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	43	Face Area (sq.):	170
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	No distress	9
STONE MASONRY 8.00	No distress	9
ROAD/SIDEWALK/SHOULDER 0.50	Mild undulating roadway, rock fall impact damage, patches	8
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
TRAFFIC BARRIER/FENCE 0.50	No distress - guardwall	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.872_R_1.jpg

Wall ID:	GLAC-0010W-24.900-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	99	Face Area (sq.):	1160
Average Wall Height (ft.):	11	Face Angle (deg.):	85
Maximum Wall Height (ft.):	17	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	minor, moderate debonding	7
STONE MASONRY 8.00	Minor spalling on 5% of stone blocks	8
CULVERT 0.50	12" concrete culvert pipe outlets through face near wall start, no distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
WALL DRAINS 0.50	None, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Lateral cracking along asphalt shoulder	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.900_R_1.jpg

Wall ID:	GLAC-0010W-24.920-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	75	Face Area (sq.):	360
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, bedrock, minor erosion beneath end toe section	6
STONE MASONRY 8.00	No distress	8
MORTAR 8.00	Tight, good workmanship	9
DOWNSLOPE 0.50	Bedrock, talus, stable	8
LATERAL SLOPE 0.50	Bedrock, stable	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.920_R_1.jpg

Wall ID:	GLAC-0010W-24.936-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	48	Face Area (sq.):	108
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	4	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Minor debonding	7
STONE MASONRY 8.00	Minor spalling on 2% of stones	8
ROAD/SIDEWALK/SHOULDER 0.50	Multiple patched sections, no distress in current overlays	8
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
WALL DRAINS 0.50	None, no distress	9
TRAFFIC BARRIER/FENCE 1.00	First 8 feet of guardwall is totally destroyed due to impact damage	6

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.936_R_1.jpg

Wall ID:	GLAC-0010W-24.997-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1980
*Wall Rating:	67	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Reinforced concrete fill wall		

Wall Measurements

Wall Length (ft.):	35	Face Area (sq.):	310
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Soil, talus	7
CONCRETE 8.00	Concrete spalling under first 10' section of guardwall stone and beneath culvert outlet	6
CULVERT 0.50	24" concrete pipe outlets through wall face at station 20	8
WALL DRAINS 0.50	None	8
LATERAL SLOPE 1.00	Undermining of guardwall adjacent to wall (beginning and ending)	6
DOWNSLOPE 1.00	Talus, soil, stable	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Patch concrete spalling, 45 sqft. Remove deteriorated concrete: 2 man-days @ \$350/day = \$700. Place concrete: 2 cyd @ \$1,500/cyd = \$3,000. Total= \$3,700
Repair Cost:	\$3,700

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_24.997_R_1.jpg

Wall ID:	GLAC-0010W-25.086-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	83	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	55	Face Area (sq.):	360
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Mild to moderate debonding over 20% of wall	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
TRAFFIC BARRIER/FENCE 0.50	No distress	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.086_R_1.jpg

Wall ID:	GLAC-0010W-25.102-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	89	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	43	Face Area (sq.):	325
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	No distress, 40% repointed	9
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	12" cmp cross drain culvert outlets beneath guardwall at end of wall, no distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
TRAFFIC BARRIER/FENCE 0.50	No distress in guardwall	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.102_R_1.jpg

Wall ID:	GLAC-0010W-25.388-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	169	Face Area (sq.):	670
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Mild debonding over 50% of wall	8
STONE MASONRY 8.00	No distress	9
ROAD/SIDEWALK/SHOULDER 0.50	Very minor cracking in overlay	8
CULVERT 0.50	18" cmp culvert outlets below wall, no distress	9
DOWNSLOPE 0.50	Steep bedrock cliff, no distress	9
LATERAL SLOPE 0.50	Steep bedrock cliff, no distress	9
WALL DRAINS 0.50	1 @ 3" drain tile outlets through face, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.388_R_1.jpg

Wall ID:	GLAC-0010W-25.420-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	24	Face Area (sq.):	110
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, stable	8
MORTAR 8.00	No distress	8
STONE MASONRY 8.00	Regular, rectangular blocks, no distress	8
DOWNSLOPE 0.50	Bedrock, stable	8
LATERAL SLOPE 0.50	Bedrock, stable	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.420_R_1.jpg

Wall ID:	GLAC-0010W-25.425-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	65	Face Area (sq.):	300
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	8
MORTAR 8.00	Isolated voids, otherwise no distress	7
STONE MASONRY 8.00	No distress	8
DOWNSLOPE 0.50	Very steep, stable	8
LATERAL SLOPE 0.50	Bedrock, steep	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.425_R_1.jpg

Wall ID:	GLAC-0010W-25.437-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	87	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	62	Face Area (sq.):	720
Average Wall Height (ft.):	11	Face Angle (deg.):	85
Maximum Wall Height (ft.):	19	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Top 5-10 feet appear to be leaning slightly, road settled 2-3 inches at this location, recently repointed	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Recently repointed, no distress	9
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Bedrock cliff, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
TRAFFIC BARRIER/FENCE 0.50	Recently repointed guardwall, no distress	9
WALL DRAINS 0.50	None, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Lateral cracks along traffic lane and narrow asphalt shoulder; shoulder appears to have settled 2-3 inches	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.437_R_1.jpg

Wall ID:	GLAC-0010W-25.453-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	81	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	113	Face Area (sq.):	1150
Average Wall Height (ft.):	10	Face Angle (deg.):	85
Maximum Wall Height (ft.):	22	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is functioning as intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, soil, talus	8
STONE MASONRY 8.00	Large square and rectangular blocks, no distress	8
MORTAR 8.00	High quality, good workmanship	9
CULVERT 0.50	24" cmp in roadway embankment, small arch opening in stone masonry wall	8
LATERAL SLOPE 0.50	Bedrock and soil	8
ROAD/SIDEWALK/SHOULDER 1.00	40' length of guardwall destroyed as wall is in avalanche chute.	4
WALL DRAINS 0.50	2" clay pipe	8
DOWNSLOPE 1.00	Talus with erosion pockets	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Rebuild guardwall 40' - Candidate for avalanche resistant guardwall Barrier Replacement, stone masonry unreinforced - \$2900/lnft x 40lnft= \$116,000
Repair Cost:	\$116,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.453_R_1.jpg

Wall ID:	GLAC-0010W-25.465-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 12, 2007	Approximate Year Built:	1930
*Wall Rating:	79	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry inlet headwall. Culvert buried by debris, located in avalanche chute, entire area periodically covered by debris		

Wall Measurements

Wall Length (ft.):	22	Face Area (sq.):	80
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall performing, culvert and basin need clean out	7
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	Moderate debonding, mortar covered by dirt, some mortar loss	7
STONE MASONRY 8.00	No distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	8
WALL DRAINS 0.50	None, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Missing mortar, loose cap stones, missing 1-2 stones in guardwall	6
CULVERT 1.00	24" cmp culvert; completely buried by debris, likely filled/clogged	7
ROAD/SIDEWALK/SHOULDER 1.00	Cracked asphalt, impact damage	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint wall (80 sqft) and clean out culvert. Repoint: \$75/sqft x 80 sqft = \$6,000. Clean out basin and culvert = 2 man-days x \$350/day = \$700. Total=\$6,700
Repair Cost:	\$6,700

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.465_L_1.jpg

Wall ID:	GLAC-0010W-25.680-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	83	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	84	Face Area (sq.):	860
Average Wall Height (ft.):	10	Face Angle (deg.):	85
Maximum Wall Height (ft.):	19	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Minor debonding, very small voids over 2% of wall	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Thin loose talus over bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress in overlay	9
WALL DRAINS 0.50	1 @ 3" diameter drain tile outlets through face of wall near base, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.680_R_1.jpg

Wall ID:	GLAC-0010W-25.707-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	52	Face Area (sq.):	420
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	20	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil and bedrock	8
MORTAR 8.00	50% of wall face mortar is debonded, separated from stones	6
STONE MASONRY 8.00	Large ashlar blocks, no distress	8
WALL DRAINS 0.50	None	8
DOWNSLOPE 1.00	Steep soil, talus, bedrock, no distress	7
LATERAL SLOPE 1.00	Soil, talus, bedrock, stable	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 50% of wall face (210 sqft) Repoint: 210 sqft x \$75/sqft = \$15,750 Total=\$15,750
Repair Cost:	\$15,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.707_R_1.jpg

Wall ID:	GLAC-0010W-25.725-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	45	Face Area (sq.):	380
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	17	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Performing as intended with some deficiencies noted above	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	25% of mortar is debonded, voids between stones where mortar is missing	7
STONE MASONRY 8.00	Slight weathering of stones, minor spalling of rocks	7
DOWNSLOPE 0.50	Very steep slope, no vegetation	8
LATERAL SLOPE 0.50	Beginning - bedrock, end - bedrock covered in soil	8
ROAD/SIDEWALK/SHOULDER 0.50	Road is in good condition, no distress	8
WALL DRAINS 0.50	No distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.725_R_1.jpg

Wall ID:	GLAC-0010W-25.737-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	74	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	121	Face Area (sq.):	900
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	13	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, talus, bedrock, steep	7
MORTAR 8.00	Isolated debonding, cracking in mortar	7
STONE MASONRY 8.00	Large ashlar blocks, no distress	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 1.00	Last 40' of guardwall shows impact damage, broken stones, cracked mortar	5
DOWNSLOPE 1.00	Talus, steep	7
LATERAL SLOPE 1.00	Talus, soil, bedrock, steep	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repair 40' length of guardwall Barrier replacement, stone masonry unreinforced: \$2,900/lnft x 40 lnft = \$116,000 Total=\$116,000
Repair Cost:	\$116,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.737_R_1.jpg

Wall ID:	GLAC-0010W-25.760-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall with arch opening for upper crossing of Granite (Alder) Creek		

Wall Measurements

Wall Length (ft.):	104	Face Area (sq.):	1385
Average Wall Height (ft.):	13	Face Angle (deg.):	85
Maximum Wall Height (ft.):	22	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall performing as intended	7
WALL FOUNDATION MATERIAL 8.00	Bedrock mostly, one 20' section may be built on coarse fill where a 5' section is being undermined slightly by creek erosion	8
MORTAR 8.00	Minor debonding over entire wall, moderate debonding over 40% of wall including severe debonding and small voids over 5%	7
STONE MASONRY 8.00	Minor spalling on 5% of stone blocks, not critical	8
CULVERT 0.50	7'x9' arched stone and mortar culvert; some efflorescence, debonding and mortar loss	8
DOWNSLOPE 0.50	Steep, bedrock and creek bed	8
LATERAL SLOPE 0.50	Bedrock at beginning, steep slope with soil and dry stack wall at end	8
WALL DRAINS 0.50	1 @ 3" diameter drain tile outlets through face, no distress. 1 @ 3" diameter drain tile outlets at base of wall	9
TRAFFIC BARRIER/FENCE 1.00	Severe guardwall damage (impact) at wall start and moderate impact damage along remaining length	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 40% of wall (550 sqft), patch minor undermining along toe (5' x 1'). Repoint: 550 sqft x \$75/sqft = \$41,250. Underpinning/stabilization: 5 sqft x \$200/sqft = \$1,000. Total = \$42,250
Repair Cost:	\$42,250

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.760_R_1.jpg

Wall ID:	GLAC-0010W-25.778-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet stone masonry headwall at upper crossing of Granite (Alder) Creek		

Wall Measurements

Wall Length (ft.):	48	Face Area (sq.):	360
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Widespread debonding of mortar in top 8' of headwall	6
STONE MASONRY 8.00	Large blocks, no distress	8
CULVERT 0.50	7' x 10' high stone masonry arch	8
LATERAL SLOPE 0.50	Bedrock, stable	8
UPSLOPE 0.50	Solid bedrock channel, very little debris flow	8
WALL DRAINS 0.50	None	9
TRAFFIC BARRIER/FENCE 1.00	First 15' of guardwall damaged by impact	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint top 8' of wall (400 sqft), Rebuild 15' of guardwall. Repoint: 400 sqft x \$75/sqft = \$30,000. Barrier rebuild, stone masonry: 15 lnft x \$2900/lnft = \$43,500. Total=\$73,500
Repair Cost:	\$73,500

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.778_L_1.jpg

Wall ID:	GLAC-0010W-25.788-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	83	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall/slope protection on steep slope below pullout		

Wall Measurements

Wall Length (ft.):	25	Face Area (sq.):	300
Average Wall Height (ft.):	12	Face Angle (deg.):	50
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	-5

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Coarse talus/fill, very minor creep	8
PLACED STONE 8.00	Large blocks, 1'-3' in diameter, no distress	9
DOWNSLOPE 0.50	Steep, loose, coarse talus/fill, minor raveling	8
LATERAL SLOPE 0.50	Steep, dense, coarse talus/fill, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.788_R_1.jpg

Wall ID:	GLAC-0010W-25.960-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	83	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Gravity - Dry Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet stone masonry and dry laid headwall		

Wall Measurements

Wall Length (ft.):	24	Face Area (sq.):	290
Average Wall Height (ft.):	12	Face Angle (deg.):	85
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, monitor mortar	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Minor debonding over entire wall, moderate debonding and mortar loss over 20% of wall (scour)	7
PLACED STONE 8.00	Vertical cracks in dry laid blocks over 5% of wall	8
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	4' diameter arched stone and mortar culvert, bedrock floor, minor debonding and efflorescence	8
CURB/BERM/DITCH 0.50	Ditch outlets at far end of headwall, no distress	9
DOWNSLOPE 0.50	Bedrock channel, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.960_L_1.jpg

Wall ID:	GLAC-0010W-25.961-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Outlet stone masonry headwall		

Wall Measurements

Wall Length (ft.):	16	Face Area (sq.):	65
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	19

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, bedrock	8
MORTAR 8.00	Mortar cracked and debonded through 40% of wall face	7
STONE MASONRY 8.00	One stone missing, otherwise no distress	7
CULVERT 0.50	4' x 4' stone masonry culvert	8
DOWNSLOPE 0.50	Bedrock channel with soil side slopes, no distress	8
LATERAL SLOPE 0.50	Soil, stable	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Repoint 40% of wall face (25 sqft) Repoint: 25 sqft x \$75/sqft = \$1,875 Total=\$1,875
Repair Cost:	\$1,875

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_25.961_R_1.jpg

Wall ID:	GLAC-0010W-26.796-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	153	Face Area (sq.):	764
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	Minor debonding over 50% of wall, moderate debonding and mortar loss over 10% of wall	7
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Steep, thin layer of talus over bedrock, minor raveling	8
LATERAL SLOPE 0.50	Bedrock or talus over bedrock, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	Lateral cracking along overlay shoulder	8
TRAFFIC BARRIER/FENCE 0.50	Some impact damage at guardwall	8
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint 10% of wall (75 sqft). Repoint: 75 sqft x \$75/sqft = \$5,625. Total=\$5,625
Repair Cost:	\$5,625

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_26.796_R_1.jpg

Wall ID:	GLAC-0010W-26.844-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall prior to bird woman falls		

Wall Measurements

Wall Length (ft.):	213	Face Area (sq.):	1170
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, soil	8
MORTAR 8.00	Debonding and cracking through 20% of wall face, isolated voids	7
STONE MASONRY 8.00	Large rectangular blocks, no distress noted	8
DOWNSLOPE 0.50	Steep, soil, bedrock	8
LATERAL SLOPE 0.50	Bedrock, talus	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_26.844_R_1.jpg

Wall ID:	GLAC-0010W-26.903-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	165	Face Area (sq.):	1570
Average Wall Height (ft.):	9	Face Angle (deg.):	85
Maximum Wall Height (ft.):	27	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall may be leaning out slightly at top at beginning and end of wall	7
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Moderate debonding with some mortar loss over 50% of wall	7
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	18" cmp culvert outlets through wall face near top of wall, no distress	9
DOWNSLOPE 0.50	Bedrock cliff, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
WALL DRAINS 0.50	None observed, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Impact damage to guardwall, leaning slightly last half of wall due to movement of road fill	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 50% of wall (800 sqft) Repoint: 800 sqft x \$75/sqft = \$60,000 Total = \$60,000
Repair Cost:	\$60,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_26.903_R_1.jpg

Wall ID:	GLAC-0010W-26.952-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	74	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	146	Face Area (sq.):	1400
Average Wall Height (ft.):	9	Face Angle (deg.):	85
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Bedrock, talus	8
MORTAR 8.00	Minor cracking and debonding of mortar, 10% of face	7
STONE MASONRY 8.00	Large stone, no distress noted	8
DOWNSLOPE 0.50	Very steep bedrock	8
LATERAL SLOPE 0.50	Bedrock and talus	8
TRAFFIC BARRIER/FENCE 1.00	50' section of guardwall missing, protected by jersey barrier	4
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Replace 50' of guardwall Barrier replacement, stone masonry: 50 lnft x \$2900/lnft = \$145,000
Repair Cost:	\$145,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_26.952_R_1.jpg

Wall ID:	GLAC-0010W-26.993-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	70	Face Area (sq.):	370
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, leaning out slightly	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	9
MORTAR 8.00	No distress noted	8
PLACED STONE 8.00	No distress noted	8
DOWNSLOPE 0.50	Very steep, bedrock	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	No distress noted	9
ROAD/SIDEWALK/SHOULDER 1.00	Shoulder is cracked parallel to wall up to 3" and settled up to 3"	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_26.993_R_1.jpg

Wall ID:	GLAC-0010W-27.010-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1980
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Concrete fill wall with stone facing		

Wall Measurements

Wall Length (ft.):	60	Face Area (sq.):	500
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	15	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No distress	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, soil	8
CONCRETE 8.00	No distress	9
MORTAR 8.00	Tight, good workmanship, no distress	9
ARCHITECTURAL FACING 0.50	Minor irregularities in profile of wall stone face, no distress	8
CULVERT 0.50	18" cmp culvert at station 35, cross drain at station 60	8
DOWNSLOPE 0.50	Talus, bedrock	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.010_R_1.jpg

Wall ID:	GLAC-0010W-27.060-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1980
*Wall Rating:	87	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Concrete fill wall with stone facing, rehabed in 2003		

Wall Measurements

Wall Length (ft.):	169	Face Area (sq.):	1300
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	16	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Mostly new, no distress, old section of mortar at older facing shows significant efflorescence	8
CONCRETE 8.00	Not visible, no apparent distress	9
DOWNSLOPE 0.50	Bedrock with thin layer of side-cast sand and gravel, minor raveling	8
LATERAL SLOPE 0.50	Steep, coarse talus and side cast material, minor raveling	8
ARCHITECTURAL FACING 0.50	6" stone blocks, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
TRAFFIC BARRIER/FENCE 0.50	New removable guardwall, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.060_R_1.jpg

Wall ID:	GLAC-0010W-27.111-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1980
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone faced concrete fill wall just prior to Haystack Arch		

Wall Measurements

Wall Length (ft.):	119	Face Area (sq.):	750
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	No distress	8
CONCRETE 8.00	No apparent distress	8
MORTAR 8.00	Good workmanship, no distress	9
CULVERT 0.50	18" cmp culvert at station 35, cross drain at station 60	8
DOWNSLOPE 0.50	Bedrock and talus	8
LATERAL SLOPE 0.50	Bedrock and talus	8
WALL DRAINS 0.50	Openings in stone face above footing	8
ARCHITECTURAL FACING 0.50	Large section of wall newly faced in 2005	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.111_R_1.jpg

Wall ID:	GLAC-0010W-27.128-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1980
*Wall Rating:	89	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone faced concrete fill wall with arch culvert opening for Haystack Creek		

Wall Measurements

Wall Length (ft.):	121	Face Area (sq.):	920
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	15	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Bedrock, No distress	9
CONCRETE 8.00	None visible, no apparent distress	9
MORTAR 8.00	No distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Retaining walls at wall start/end, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
TRAFFIC BARRIER/FENCE 0.50	Removable guardwall, no distress	9
WALL DRAINS 0.50	Several 3" diameter wall drains (pvc) outlet through face, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.128_R_1.jpg

Wall ID:	GLAC-0010W-27.131-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	61	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet stone masonry headwall at Haystack Creek		

Wall Measurements

Wall Length (ft.):	25	Face Area (sq.):	80
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Performing, but could suffer localized failure without corrective action	6
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
STONE MASONRY 8.00	25 sqft of wall stone missing at base of wall end	4
MORTAR 8.00	Cracked and debonded mortar on 30% of wall face	6
WALL DRAINS 0.50	None	8
LATERAL SLOPE 0.50	Bedrock	9
UPSLOPE 0.50	Bedrock channel	9
CULVERT 1.00	16' x 8' arch (reinforced concrete slab bridge) with stone masonry facing on interior wall which are in need of repointing	6
TRAFFIC BARRIER/FENCE 1.00	Some stones missing from top of guardwall	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repair lost wall stone (25 sqft), Repoint (25 sqft). Replace lost stone in guardwall (20 sqft). Repair wall stone: 25 sqft x \$200/sqft = \$5,000. Repoint: 25 sqft x \$75/sqft = \$1,875. Guardwall repair: 20 sqft x \$200/sqft = \$4,000. Total=\$10,875.
Repair Cost:	\$10,875

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.131_L_1.jpg

Wall ID:	GLAC-0010W-27.156-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1980
*Wall Rating:	89	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone faced concrete fill wall		

Wall Measurements

Wall Length (ft.):	56	Face Area (sq.):	400
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
CONCRETE 8.00	Concrete not visible, no apparent distress	9
MORTAR 8.00	No distress	9
DOWNSLOPE 0.50	Side cast fill over bedrock, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	10' long, 1/4" diameter crack in roadway parallel to wall, no other distress	8
ARCHITECTURAL FACING 0.50	Stone and mortar, no distress	9
LATERAL SLOPE 0.50	Other walls, no distress	9
TRAFFIC BARRIER/FENCE 0.50	Removable guardwall, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.156_R_1.jpg

Wall ID:	GLAC-0010W-27.165-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1980
*Wall Rating:	83	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stoned faced concrete fill wall		

Wall Measurements

Wall Length (ft.):	175	Face Area (sq.):	1070
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock and soil	8
MORTAR 8.00	Top 4' of wall refaced in 2005	8
CONCRETE 8.00	Covered by stone	9
ARCHITECTURAL FACING 0.50	Top 4' of wall refaced in 2005	8
DOWNSLOPE 0.50	Steep, bedrock and soil	8
LATERAL SLOPE 0.50	Bedrock, adjacent wall	8
CULVERT 0.50	18" cmp culvert at station 170	9
TRAFFIC BARRIER/FENCE 0.50	New removable guardwall added in 2005	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.165_R_1.jpg

Wall ID:	GLAC-0010W-27.197-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	41	Face Area (sq.):	360
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	15	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Minor debonding	8
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Steep, channel, side cast fill soil over shallow bedrock, minor raveling	8
LATERAL SLOPE 0.50	Another wall locate at wall start. Steep side cast fill over bedrock at wall end, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
WALL DRAINS 0.50	None, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Sever impact damage of 6' section of guardwall	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.197_R_1.jpg

Wall ID:	GLAC-0010W-27.577-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	86	Face Area (sq.):	730
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	Very minor debonding	8
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Steep, side cast fill and talus over bedrock, minor raveling	8
LATERAL SLOPE 0.50	Steep, side cast fill and talus over shallow bedrock, minor raveling	8
CULVERT 0.50	24" cmp culvert outlet at base of wall, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
TRAFFIC BARRIER/FENCE 0.50	No distress, removable guardwall	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.577_R_1.jpg

Wall ID:	GLAC-0010W-27.678-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	64	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall with avalanche resistant guardwall		

Wall Measurements

Wall Length (ft.):	172	Face Area (sq.):	2130
Average Wall Height (ft.):	12	Face Angle (deg.):	85
Maximum Wall Height (ft.):	34	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Bedrock, talus	8
MORTAR 8.00	75% of mortar is weathered, voided and debonded	4
STONE MASONRY 8.00	Highly weathered	6
CULVERT 0.50	4'x3' stone arch at toe with 3' cmp in roadway fill	8
DOWNSLOPE 0.50	Talus, bedrock	8
LATERAL SLOPE 0.50	Bedrock and soil, no distress	8
WALL DRAINS 0.50	2" drains at footing	8
TRAFFIC BARRIER/FENCE 0.50	Avalanche resistant guardwall installed in 2003	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 75% of face (1,600 sqft) Repoint: 1600 sqft x \$75/sqft = \$120,000 Total=\$120,000
Repair Cost:	\$120,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.678_R_1.jpg

Wall ID:	GLAC-0010W-27.697-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Gravity - Dry Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall with a dry laid wing wall		

Wall Measurements

Wall Length (ft.):	37	Face Area (sq.):	240
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	11	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Debonding of mortar, 1/2" spacing in isolated areas	7
STONE MASONRY 8.00	Vertical cracks in stones, impact damage to stones	7
PLACED STONE 8.00	3' minus boulders used as wing wall, well interlocked, minimal voids	8
CULVERT 0.50	36" cmp culvert	8
LATERAL SLOPE 0.50	Beginning - bedrock, end - dry laid wall	8
ROAD/SIDEWALK/SHOULDER 0.50	Concrete slab for an avalanche resistant guardwall	8
TRAFFIC BARRIER/FENCE 0.50	Avalanche resistant guardwall	8

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.697_L_1.jpg

Wall ID:	GLAC-0010W-27.786-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	73	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	150	Face Area (sq.):	1300
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	17	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, 10' of undermining of wall base at start of wall	7
MORTAR 8.00	50% or mortar moderately debonded, some lost mortar with 2"-3" diameter voids	7
STONE MASONRY 8.00	Minor spalling on 10% of stone blocks	8
DOWNSLOPE 0.50	Steep, talus and side cast material, mild raveling	8
LATERAL SLOPE 0.50	Steep, talus and side cast material, mild raveling	8
CULVERT 0.50	30" cmp culvert outlets through wall at station 97, no distress; 1'x1.5' cross drain and 12" roadway drain outlets at top of wall near station 56	9
WALL DRAINS 0.50	None, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Several lateral cracks in road and shoulder parallel to wall, settlement at shoulder up to 2", some impact damage	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 50% of face (650 sqft), place concrete under undermined footing at wall start (10 sqft). Repoint: 650 sqft x \$75/sqft = \$48,750. Underpinning/stabilization= 10 sqft x \$200/sqft = \$2,000. Total=\$50,750
Repair Cost:	\$50,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.786_R_1.jpg

Wall ID:	GLAC-0010W-27.839-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	73	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall		

Wall Measurements

Wall Length (ft.):	35	Face Area (sq.):	150
Average Wall Height (ft.):	4	Face Angle (deg.):	80
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	-6

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Soil, no erosion, steep	7
PLACED STONE 8.00	Rectangular blocks, no distress	8
WALL DRAINS 0.50	None	9
DOWNSLOPE 1.00	Steep avalanche chute	7
LATERAL SLOPE 1.00	Soil, minor erosion	7
TRAFFIC BARRIER/FENCE 1.00	Removable guardwall (old style) not connected to dry laid	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.839_R_1.jpg

Wall ID:	GLAC-0010W-27.851-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall/slope protection		

Wall Measurements

Wall Length (ft.):	69	Face Area (sq.):	480
Average Wall Height (ft.):	6	Face Angle (deg.):	55
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	-1

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Talus or side cast fill, no apparent distress	9
PLACED STONE 8.00	0.5' to 1' angular blocks, scattered small voids, partly vegetated, no distress	9
DOWNSLOPE 0.50	Steep, vegetated, minor raveling	8
LATERAL SLOPE 0.50	Steep, vegetated, minor raveling	8
WALL DRAINS 0.50	None, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Lateral cracks, settlement to 2"	7
TRAFFIC BARRIER/FENCE 1.00	Impact damage to guardwall, leaning, settling	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.851_R_1.jpg

Wall ID:	GLAC-0010W-27.933-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 13, 2007	Approximate Year Built:	1930
*Wall Rating:	70	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall		

Wall Measurements

Wall Length (ft.):	82	Face Area (sq.):	830
Average Wall Height (ft.):	10	Face Angle (deg.):	55
Maximum Wall Height (ft.):	15	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Soil, bedrock, stable	7
PLACED STONE 8.00	1'-2' angular voids with several voids; partially vegetated face	7
TRAFFIC BARRIER/FENCE 0.50	Stone masonry guard wall	8
WALL DRAINS 0.50	None, no distress	8
DOWNSLOPE 1.00	Steep soil, talus, avalanche chute	7
LATERAL SLOPE 1.00	Vegetated, soil and talus	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_27.933_R_1.jpg

Wall ID:	GLAC-0010W-28.270-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1980
*Wall Rating:	87	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone faced concrete fill wall		

Wall Measurements

Wall Length (ft.):	44	Face Area (sq.):	110
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall performing as intended, facing needs repair	8
WALL FOUNDATION MATERIAL 8.00	Likely shallow bedrock or coarse fill, no distress	9
CONCRETE 8.00	Cast in place concrete wall not visible, no apparent distress	9
MORTAR 8.00	No distress	9
STONE MASONRY 8.00	No distress	9
DOWNSLOPE 0.50	Steep, talus and side cast fill over shallow bedrock, minor raveling	8
LATERAL SLOPE 0.50	Steep, talus and side cast fill over shallow bedrock, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress in overlay	9
TRAFFIC BARRIER/FENCE 0.50	Removable guard wall, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repair facing (55 sqft) Stone facing repair: 55 sqft x 50 sqft = \$2,750 Total=\$2,750
Repair Cost:	\$2,750

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.270_R_1.jpg

Wall ID:	GLAC-0010W-28.330-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1980
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone faced concrete fill wall		

Wall Measurements

Wall Length (ft.):	14	Face Area (sq.):	45
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	4	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Wall footing exposed, founded on soil	8
CONCRETE 8.00	Not visible, no distress	8
DOWNSLOPE 0.50	Soil, steep, no distress	8
LATERAL SLOPE 0.50	Soil, stable	8
ROAD/SIDEWALK/SHOULDER 0.50	Removable guardwall on top of wall	8
WALL DRAINS 0.50	None, no distress	8
ARCHITECTURAL FACING 1.00	Minor gap at top of stone facing, no distress	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.330_R_1.jpg

Wall ID:	GLAC-0010W-28.610-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall/slope protection		

Wall Measurements

Wall Length (ft.):	70	Face Area (sq.):	1100
Average Wall Height (ft.):	15	Face Angle (deg.):	55
Maximum Wall Height (ft.):	23	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock or talus over bedrock, minor settlement	8
PLACED STONE 8.00	1' to 5' diameter irregular stones, large voids, minor settlement	8
DOWNSLOPE 0.50	Steep, talus and side cast fill over shallow bedrock, minor raveling	8
LATERAL SLOPE 0.50	Steep, talus and side cast fill over shallow bedrock, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	Minor cracking in overlay	8
TRAFFIC BARRIER/FENCE 0.50	Removable guardwall, no distress	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.610_R_1.jpg

Wall ID:	GLAC-0010W-28.640-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	56	Maintenance Action:	Replace Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	77	Face Area (sq.):	640
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	19	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Performing satisfactorily at present but localized failures are eminent with corrective action	6
WALL FOUNDATION MATERIAL 8.00	Talus, soil, steep	7
MORTAR 8.00	90% of mortar deteriorated or missing at and beneath arch opening	4
STONE MASONRY 8.00	Angular blocks, no cracking. Several stones missing beneath first 10' of wall, could result in local failure	5
WALL DRAINS 0.50	None, no distress	8
ROAD/SIDEWALK/SHOULDER 1.00	Patching of overlay heavy at cross drain	5
TRAFFIC BARRIER/FENCE 1.00	Crenellations of stone masonry guardwall are moderately to severely damaged	5
DOWNSLOPE 1.00	Steep, eroded channel beneath drainage features; soil and talus	6
CULVERT 1.00	18" squash pipe at station 6, cross drain and arch opening (with 24" cmp) at station 48	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Replace beginning of wall (50 sqft), repoint under arch opening (80 sqft). Replace stone masonry wall: 50 sqft x \$160/sqft = \$8,000. Repoint: 80 sqft x \$75/sqft = \$6,000. Total=\$14,000
Repair Cost:	\$14,000

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

Glacier National Park
ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.640_R_1.jpg

Wall ID:	GLAC-0010W-28.660-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall with stone masonry guardwall		

Wall Measurements

Wall Length (ft.):	33	Face Area (sq.):	215
Average Wall Height (ft.):	6	Face Angle (deg.):	52
Maximum Wall Height (ft.):	13	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Firm soil, vegetated	8
PLACED STONE 8.00	Large semi-angular stone, well interlocked, minimal voids	8
DOWNSLOPE 0.50	Steep, vegetated slope	8
LATERAL SLOPE 0.50	Steep, vegetated slope at both ends	8
WALL DRAINS 0.50	No distress noted	9
ROAD/SIDEWALK/SHOULDER 1.00	Cracking located 5' out from guardwall runs parallel to wall	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.660_R_1.jpg

Wall ID:	GLAC-0010W-28.770-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	88	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall/slope protection at weeping wall		

Wall Measurements

Wall Length (ft.):	67	Face Area (sq.):	930
Average Wall Height (ft.):	13	Face Angle (deg.):	52
Maximum Wall Height (ft.):	20	Vertical Offset (ft.):	-1

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Bedrock or talus over shallow bedrock, no apparent distress	9
PLACED STONE 8.00	1' to 3' tabular stones, small to medium voids, some animal burrows, no distress	9
DOWNSLOPE 0.50	Steep, talus, minor raveling	8
LATERAL SLOPE 0.50	Steep, talus, minor raveling	8
WALL DRAINS 0.50	None, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Impact resistant guardwall, severe impact damage to stone and mortar	6
ROAD/SIDEWALK/SHOULDER 1.00	Up to 2" wide cracks and up to 2" settlement due to differential settlement between asphalt and concrete roadway sections	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.770_R_1.jpg

Wall ID:	GLAC-0010W-28.806-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	61	Maintenance Action:	Replace Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	210	Face Area (sq.):	1600
Average Wall Height (ft.):	7	Face Angle (deg.):	88
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Overall performing as intended; potential for localized failure near station 130	6
WALL FOUNDATION MATERIAL 8.00	Station 75 shows undermining; footing (or footing repair) exposed from station 0 to 55	6
STONE MASONRY 8.00	Localize loss of stone at station 130, adjacent to concrete pipe (4' x 4' loss), remainder of wall stones show minor cracking, weathering	5
MORTAR 8.00	Minor debonding, cracking in mortar	7
CULVERT 1.00	18" concrete pipe at station 130, 3' length is broken away from remainder	4
WALL DRAINS 0.50	2" drains near station 75	8
DOWNSLOPE 1.00	Soil, talus, erodible	7
LATERAL SLOPE 1.00	Soil, talus, minor vegetation	7
TRAFFIC BARRIER/FENCE 1.00	Stone masonry guardwall shows some tipping/rotation; first 65' of guardwall is newer, remainder shows crenellation stone loss in isolated areas	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Replace loss of wall stone adjacent to concrete pipe (16 sqft) Stone masonry replacement: 16 sqft x \$160/sqft = \$2,560 Total=\$2,560
Repair Cost:	\$2,560

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.806_R_1.jpg

Wall ID:	GLAC-0010W-28.852-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	84	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	80	Face Area (sq.):	570
Average Wall Height (ft.):	7	Face Angle (deg.):	85
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Likely shallow bedrock, no distress	9
MORTAR 8.00	Mild debonding	8
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	24" cmp culvert outlets at base; partially filled with debris	8
DOWNSLOPE 0.50	Steep, talus and side cast fill, minor raveling	8
LATERAL SLOPE 0.50	Steep, talus and side cast fill, minor raveling	8
ROAD/SIDEWALK/SHOULDER 0.50	Minor cracking in roadway	8
WALL DRAINS 0.50	Possibly one drain outlet at base, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_28.852_R_1.jpg

Wall ID:	GLAC-0010W-29.160-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	74	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	Gravity - Mortared Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid and stone masonry fill wall		

Wall Measurements

Wall Length (ft.):	60	Face Area (sq.):	350
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Minor bulging of dry laid, no dislodged stones	7
WALL FOUNDATION MATERIAL 8.00	Soil and bedrock, no erosion	8
PLACED STONE 8.00	Dry stacked has vegetation growth, minor movement evident	6
MORTAR 8.00	No distress in stone masonry section	8
STONE MASONRY 8.00	Angular blocks, no distress	8
TRAFFIC BARRIER/FENCE 0.50	Stone masonry guardwall on top of dry laid and stone masonry wall.	8
WALL DRAINS 0.50	None	8
ROAD/SIDEWALK/SHOULDER 1.00	Roadway shows settlement, longitudinal cracks	6
DOWNSLOPE 1.00	Steep, bedrock and soil, stable	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.160_R_1.jpg

Wall ID:	GLAC-0010W-29.553-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	72	Maintenance Action:	Replace Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	115	Face Area (sq.):	820
Average Wall Height (ft.):	7	Face Angle (deg.):	90
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall has impact damage to structure	6
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	Mild to moderate debonding over 50% of wall and cracking through entire wall structure; likely due to avalanche impacts	6
STONE MASONRY 8.00	Minor cracking of blocks due to avalanche impact; blocks displaced by 1" - 4" along horizontal line 10 feet below top of wall	8
DOWNSLOPE 0.50	Steep, talus/colluvium/avalanche debris over shallow bedrock, minor raveling	8
LATERAL SLOPE 0.50	Steep, talus/colluvium/avalanche debris over shallow bedrock, minor raveling	8
WALL DRAINS 0.50	None, no distress	9
CURB/BERM/DITCH 1.00	Ditch outlets into 18" cmp at wall start, pipe has failed and first 8 feet of wall is settling and failing	6
ROAD/SIDEWALK/SHOULDER 1.00	Lateral cracking (up to 2" wide) and settling at shoulder up to 4"	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Replace top 10 feet of wall (1150 sqft) with avalanche resistant guardwall design, repair wall around culvert (20 sqft), repair 18" culvert. Replace stone masonry wall: 1150 sqft x \$160/sqft = \$184,000. Repair wall around culvert: 20 sqft x \$620/sqft = \$12,400.
Repair Cost:	\$200,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.553_R_1.jpg

Wall ID:	GLAC-0010W-29.587-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	79	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall		

Wall Measurements

Wall Length (ft.):	42	Face Area (sq.):	535
Average Wall Height (ft.):	12	Face Angle (deg.):	45
Maximum Wall Height (ft.):	20	Vertical Offset (ft.):	-5

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended with minor voids	8
WALL FOUNDATION MATERIAL 8.00	Talus over shallow bedrock	8
PLACED STONE 8.00	Large semi-angular stones well interlocked with minimal voids	8
CULVERT 0.50	12" concrete culvert 10' from start, 4' below top of wall	8
DOWNSLOPE 0.50	Steep talus slope with vegetation	8
LATERAL SLOPE 0.50	Steep talus slope with vegetation	8
WALL DRAINS 0.50	No distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Cracking along shoulder, settled up to 2"	6
TRAFFIC BARRIER/FENCE 1.00	Guardwall is displaced and has been moved approximately 7"	6

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.587_R_1.jpg

Wall ID:	GLAC-0010W-29.661-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	79	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	35	Face Area (sq.):	140
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No distress	8
WALL FOUNDATION MATERIAL 8.00	Stable, no distress	8
MORTAR 8.00	Tight, good workmanship, no distress	8
PLACED STONE 8.00	Rectangular stone, no distress	8
CULVERT 0.50	3' x 2.5' arch opening with 24" cmp	8
LATERAL SLOPE 0.50	Bedrock, talus	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 1.00	Cracking of mortar and stone loss in guardwall section	6
DOWNSLOPE 1.00	Talus over bedrock	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.661_R_1.jpg

Wall ID:	GLAC-0010W-29.782-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1980
*Wall Rating:	80	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	Gravity - Mortared Stone
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Concrete fill wall, avalanched resistant guardwall sitting on a stone masonry wall foundation		

Wall Measurements

Wall Length (ft.):	57	Face Area (sq.):	171
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Stone masonry wall sitting on bedrock, approx 35% of stone masonry wall is undermined	7
MORTAR 8.00	Debonding of mortar and minor cracking	8
STONE MASONRY 8.00	Slight weathering	8
CONCRETE 8.00	No distress noted in concrete	9
DOWNSLOPE 0.50	Very steep, bedrock	8
LATERAL SLOPE 0.50	Very steep, bedrock	8
ROAD/SIDEWALK/SHOULDER 0.50	Avalanche resistant guard wall and roadway slab, minor cracking	8
WALL DRAINS 0.50	None noted, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repair foundation undermining, 15' length x 1' high Underpinning/stabilization: 15 sqft x \$200/sqft = \$3,000 Total=\$3,000
Repair Cost:	\$3,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.782_R_1.jpg

Wall ID:	GLAC-0010W-29.798-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1980
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	Stone
General Description:	Stone faced concrete fill wall with reinforced tiebacks		

Wall Measurements

Wall Length (ft.):	342	Face Area (sq.):	3930
Average Wall Height (ft.):	11	Face Angle (deg.):	85
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
ANCHOR HEADS 8.00	Not visible, patched with concrete, minor efflorescence from patch	8
CONCRETE 8.00	Cast in place concrete, no distress, partially covered by stone facing	9
OTHER PRIMARY ELEMENT 8.00	Concrete footing at bottom 1-2' of wall, no distress	9
TRAFFIC BARRIER/FENCE 0.50	Concrete guardwall, no facing, minor impact damage	8
DOWNSLOPE 0.50	Bedrock cliffs, no distress	9
LATERAL SLOPE 0.50	Bedrock cliffs, no distress	9
WALL DRAINS 1.00	3" pvc wall drains spaced every 8 feet, minor to severe efflorescence has partially to completely blocked drains	6

Repair Recommendations

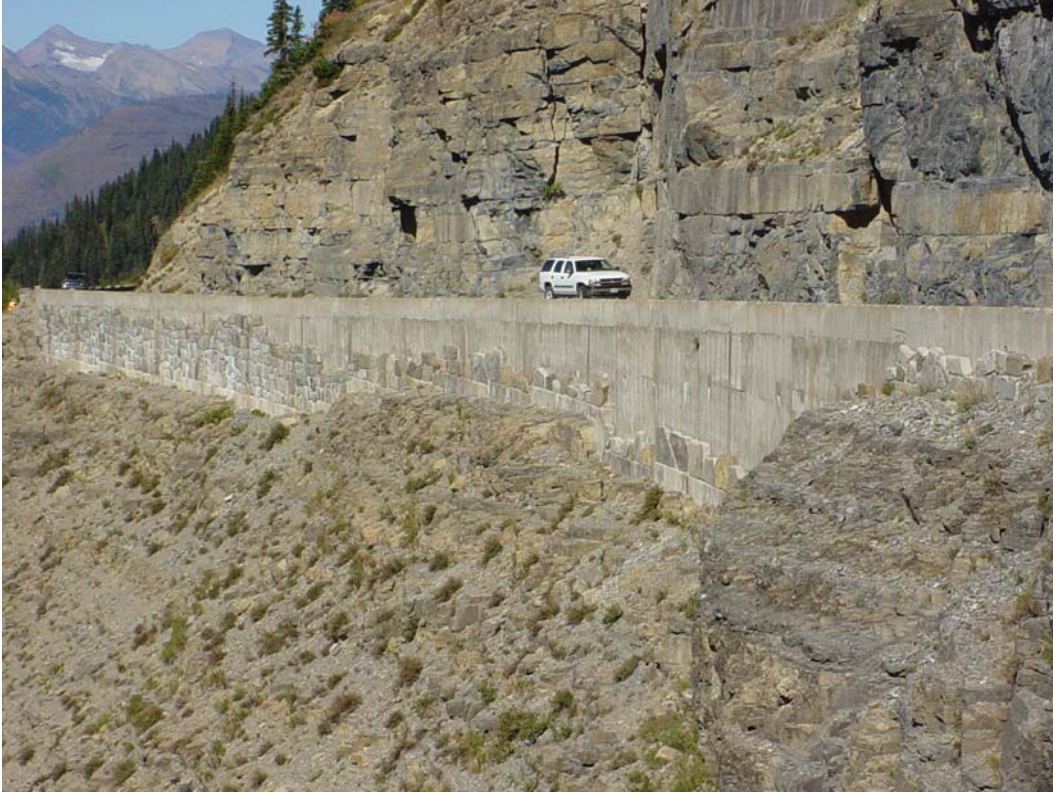
Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.798_R_1.jpg

Wall ID:	GLAC-0010W-29.887-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	78	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall just prior to Triple Arches		

Wall Measurements

Wall Length (ft.):	85	Face Area (sq.):	590
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	8
MORTAR 8.00	Minor cracking and debonding otherwise no distress	7
STONE MASONRY 8.00	Angular blocks, no distress	8
DOWNSLOPE 0.50	Bedrock cliff	8
LATERAL SLOPE 0.50	Bedrock cliff	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 0.50	New removable guardwall installed	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.887_R_1.jpg

Wall ID:	GLAC-0010W-29.900-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall and arch structures - Triple Arches		

Wall Measurements

Wall Length (ft.):	89	Face Area (sq.):	760
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, recently completed stabilization efforts	8
MORTAR 8.00	Isolated cracking and debonding otherwise no apparent distress	7
STONE MASONRY 8.00	Angular blocks with minor cracking, no apparent distress	7
DOWNSLOPE 0.50	Bedrock cliff	8
LATERAL SLOPE 0.50	Bedrock cliff	8
WALL DRAINS 0.50	None noted	8
TRAFFIC BARRIER/FENCE 1.00	Minor loss to stone guardwall	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.900_R_1.jpg

Wall ID:	GLAC-0010W-29.925-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	82	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	128	Face Area (sq.):	1210
Average Wall Height (ft.):	9	Face Angle (deg.):	85
Maximum Wall Height (ft.):	30	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Poor access, 20% of wall has moderate debonding; 2% of wall with mortar loss	7
STONE MASONRY 8.00	Poor access, no distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
WALL DRAINS 0.50	None, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Up to 1/2" lateral cracks along paved shoulder, some settling at shoulder to 1"	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Repoint 20% of wall (240 sqft) Repoint: 240 sqft x \$75/sqft = 18,000 Total=\$18,000
Repair Cost:	\$18,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.925_R_1.jpg

Wall ID:	GLAC-0010W-29.948-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	28	Face Area (sq.):	90
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, bedrock	8
MORTAR 8.00	No distress	8
STONE MASONRY 8.00	Angular blocks, no distress	8
DOWNSLOPE 0.50	Bedrock, cliff	8
LATERAL SLOPE 0.50	Bedrock, cliff	8
WALL DRAINS 0.50	None, no distress	8

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.948_R_1.jpg

Wall ID:	GLAC-0010W-29.959-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	80	Face Area (sq.):	1200
Average Wall Height (ft.):	15	Face Angle (deg.):	85
Maximum Wall Height (ft.):	30	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	9
MORTAR 8.00	Moderate cracking of mortar, some mortar loss	7
STONE MASONRY 8.00	No distress noted	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress noted	8
DOWNSLOPE 0.50	Bedrock	9
LATERAL SLOPE 0.50	Bedrock	9
WALL DRAINS 0.50	No distress noted	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.959_R_1.jpg

Wall ID:	GLAC-0010W-29.976-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	Repair Elements

Wall Description

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

Wall Measurements

Wall Length (ft.):	54	Face Area (sq.):	490
Average Wall Height (ft.):	9	Face Angle (deg.):	85
Maximum Wall Height (ft.):	21	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Cracking and debonding of mortar through 40% of wall face	6
STONE MASONRY 8.00	Large angular blocks with no distress	8
DOWNSLOPE 0.50	Bedrock, steep	8
LATERAL SLOPE 0.50	Bedrock and soil	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 1.00	Cracking and broken stones in 20' length of stone guardwall	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repoint 40% of wall face (200 sqft) Repoint: 200 sqft x \$75/sqft = \$15,000 Total=\$15,000
Repair Cost:	\$15,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_29.976_R_1.jpg

Wall ID:	GLAC-0010W-30.004-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1980
*Wall Rating:	87	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Cantilever - Concrete
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Concrete fill wall (no facing) with avalanche resistant guardwall		

Wall Measurements

Wall Length (ft.):	46	Face Area (sq.):	130
Average Wall Height (ft.):	2	Face Angle (deg.):	85
Maximum Wall Height (ft.):	4	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock covered in talus	9
CONCRETE 8.00	No distress noted	9
DOWNSLOPE 0.50	Steep bedrock covered in talus	8
LATERAL SLOPE 0.50	Steep bedrock covered in talus	8
ROAD/SIDEWALK/SHOULDER 0.50	Avalanche resistant road slab and guardwall	9
WALL DRAINS 0.50	No distress	9

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_30.004_R_1.jpg

Wall ID:	GLAC-0010W-30.144-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	106	Face Area (sq.):	1500
Average Wall Height (ft.):	14	Face Angle (deg.):	85
Maximum Wall Height (ft.):	30	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Likely bedrock, no distress	9
MORTAR 8.00	Mild debonding in older part of wall; moss covered below culvert outlet	8
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	6'x6' concrete box culvert; minor scour of concrete floor slab	8
DOWNSLOPE 0.50	Steep side cast fill and talus over shallow bedrock, minor raveling/creep	8
LATERAL SLOPE 0.50	Steep side cast fill and talus over shallow bedrock	8
ROAD/SIDEWALK/SHOULDER 0.50	Newer concrete slab, no distress	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_30.144_R_1.jpg

Wall ID:	GLAC-0010W-30.151-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	2000
*Wall Rating:	77	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Inlet stone masonry head wall in avalanche chute		

Wall Measurements

Wall Length (ft.):	20	Face Area (sq.):	110
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Good workmanship, no distress	9
STONE MASONRY 8.00	Wall reconstructed in 2001	9
CULVERT 0.50	6'x6' concrete box	8
LATERAL SLOPE 0.50	Bedrock	8
UPSLOPE 0.50	Bedrock channel	8
WALL DRAINS 0.50	None	9
TRAFFIC BARRIER/FENCE 5.00	Stone guardwall destroyed due to avalanche	2

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repair guardwall (20 lnft) Barrier replacement, stone masonry with concrete core: 20 lnft x \$2000/lnft = \$40,000 Total=\$40,000
Repair Cost:	\$40,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_30.151_L_1.jpg

Wall ID:	GLAC-0010W-30.388-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	50	Face Area (sq.):	330
Average Wall Height (ft.):	6	Face Angle (deg.):	85
Maximum Wall Height (ft.):	9	Vertical Offset (ft.):	35

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock covered in talus	8
MORTAR 8.00	Minimal debonding and weathering	8
STONE MASONRY 8.00	No distress noted	8
CULVERT 0.50	24" cmp culvert	8
DOWNSLOPE 0.50	Steep, bedrock covered in talus	8
LATERAL SLOPE 0.50	Steep, bedrock covered in talus	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress noted	9
WALL DRAINS 0.50	No distress noted	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_30.388_R_1.jpg

Wall ID:	GLAC-0010W-30.455-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	89	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall/slope protection		

Wall Measurements

Wall Length (ft.):	62	Face Area (sq.):	450
Average Wall Height (ft.):	7	Face Angle (deg.):	55
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	-10

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	9
WALL FOUNDATION MATERIAL 8.00	Talus, no distress	9
PLACED STONE 8.00	1' - 3' diameter irregular stones, no distress	9
DOWNSLOPE 0.50	Steep, loose, talus, storm water channel, minor creep and raveling	8
LATERAL SLOPE 0.50	Steep, loose talus and end dumped debris, minor to moderate creep and raveling	8
UPSLOPE 0.50	Steep, talus/fill, mild raveling	8
CULVERT 0.50	24" cmp culvert outlet, no distress	9
WALL DRAINS 0.50	None, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Recently cold patched cracks along shoulder	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_30.455_R_1.jpg

Wall ID:	GLAC-0010W-30.760-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	109	Face Area (sq.):	400
Average Wall Height (ft.):	3	Face Angle (deg.):	85
Maximum Wall Height (ft.):	14	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, 10' section of newly replaced wall settled up to 1 inch, cracking through mortar - monitor	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Mild debonding	8
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	18" cmp culvert and 12" cross drain, no distress	9
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	9
WALL DRAINS 0.50	None, no distress	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_30.760_R_1.jpg

Wall ID:	GLAC-0010W-30.803-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	70	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	Cantilever - Concrete
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall with concrete wall section at beginning		

Wall Measurements

Wall Length (ft.):	122	Face Area (sq.):	650
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	15' length of undermining beneath start of stone masonry section (sta 34), bedrock	5
MORTAR 8.00	Isolated cracking and debonding < 5% of face	7
PLACED STONE 8.00	Minor cracking in isolated stones otherwise no distress	7
CONCRETE 8.00	No distress, not faced	8
LATERAL SLOPE 0.50	Bedrock and talus	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 1.00	15' length of guardwall damaged/ missing (station 30)	6
DOWNSLOPE 1.00	Talus, steep	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Repair undermining (15 sqft), repair guardwall (15 lnft). Underpinning/stabilization: 15 sqft x \$200/sqft = \$3,000. Barrier replacement, stone masonry: 15 lnft x \$2900/lnft = \$43,500. Total=\$46,500
Repair Cost:	\$46,500

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_30.803_R_1.jpg

Wall ID:	GLAC-0010W-31.156-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	85	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	70	Face Area (sq.):	280
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	10	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress	9
MORTAR 8.00	Mild debonding (poor access)	8
STONE MASONRY 8.00	No distress (poor access)	9
TRAFFIC BARRIER/FENCE 0.50	Mild to moderate debonding; minor impact damage to guardwall	8
DOWNSLOPE 0.50	Bedrock, no distress	9
LATERAL SLOPE 0.50	Bedrock, no distress	9
WALL DRAINS 0.50	None, no distress	9
ROAD/SIDEWALK/SHOULDER 1.00	Lateral cracking along road shoulder	7

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_31.156_R_1.jpg

Wall ID:	GLAC-0010W-31.183-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	50	Face Area (sq.):	430
Average Wall Height (ft.):	8	Face Angle (deg.):	85
Maximum Wall Height (ft.):	18	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Bedrock	8
MORTAR 8.00	Random cracking and debonding of 10% of wall mortar	7
STONE MASONRY 8.00	Large angular stones, no observed distress	7
DOWNSLOPE 0.50	Bedrock cliff	8
LATERAL SLOPE 0.50	Bedrock	8
WALL DRAINS 0.50	None	8
ROAD/SIDEWALK/SHOULDER 1.00	Separation of wall top (guardwall) from road surface - 8" max	6

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos

Condition photos are not available for GLAC-0010W-31.183-R.

Wall ID:	GLAC-0010W-31.195-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

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

Wall Measurements

Wall Length (ft.):	77	Face Area (sq.):	250
Average Wall Height (ft.):	3	Face Angle (deg.):	80
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended, new section good, old section has minor deficiencies	8
WALL FOUNDATION MATERIAL 8.00	Bedrock, no distress. Old section of wall has minor undermining	8
MORTAR 8.00	No distress noted in new sections of wall; old sections have some weathering and cracking	8
STONE MASONRY 8.00	New areas are good, old section of wall is deteriorating	8
DOWNSLOPE 0.50	Very steep bedrock	8
LATERAL SLOPE 0.50	Very steep bedrock	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress noted	8
WALL DRAINS 0.50	One drain, no distress	8

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos

Condition photos are not available for GLAC-0010W-31.195-R.

Wall ID:	GLAC-0010W-31.239-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 14, 2007	Approximate Year Built:	1930
*Wall Rating:	70	Maintenance Action:	Replace Wall

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Short stone masonry fill wall prior stabilization work included shotcrete toe repairs		

Wall Measurements

Wall Length (ft.):	61	Face Area (sq.):	122
Average Wall Height (ft.):	2	Face Angle (deg.):	90
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Continued stability problems expected due to erodible foundation material	6
WALL FOUNDATION MATERIAL 8.00	Loose talus and avalanche debris; moderate to severe creep/slump	6
MORTAR 8.00	Minor to moderate debonding	7
STONE MASONRY 8.00	No distress	9
WALL DRAINS 0.50	None, no distress	9
DOWNSLOPE 1.00	Steep loose talus, moderate creep	7
LATERAL SLOPE 1.00	Steep loose talus, moderate creep	7
ROAD/SIDEWALK/SHOULDER 1.00	Separation, cracks in pavement along shoulder	7
TRAFFIC BARRIER/FENCE 1.00	Leaning	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Replace entire wall due to stability issues; excavate down to bedrock (10') and rebuild wall (900 sqft) Replace wall founded on bedrock, mse with stone facing: 900 sqft x \$200/sqft = \$180,000 Total=\$180,000
Repair Cost:	\$180,000

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_31.239_R_1.jpg

Wall ID:	GLAC-0010W-31.440-R		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1995
*Wall Rating:	82	Maintenance Action:	No Action

Wall Description

Wall Function:	Cut Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry cut wall at Oberlin Bend parking		

Wall Measurements

Wall Length (ft.):	168	Face Area (sq.):	710
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	5	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Sidewalk in front of wall, stable, no distress	9
MORTAR 8.00	No distress	8
STONE MASONRY 8.00	Large angular blocks, no distress	8
LATERAL SLOPE 0.50	Soil, stable	8
UPSLOPE 0.50	Soil, gentle slope, no erosion	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_31.440_R_1.jpg

Wall ID:	GLAC-0010W-31.459-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1930
*Wall Rating:	80	Maintenance Action:	No Action

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Dry Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Dry laid fill wall inside turn of Oberlin Bend		

Wall Measurements

Wall Length (ft.):	53	Face Area (sq.):	190
Average Wall Height (ft.):	3	Face Angle (deg.):	75
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	-1

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, stable, flat	8
PLACED STONE 8.00	Large angular blocks, no distress	8
CULVERT 0.50	24" cmp culvert	8
DOWNSLOPE 0.50	Flat meadow, minor drainage	8
LATERAL SLOPE 0.50	Soil, flat	8
WALL DRAINS 0.50	None	8

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_31.459_L_1.jpg

Wall ID:	GLAC-0010W-31.514-L		
Route Name:	GOING TO THE SUN ROAD WEST		
Inspection Date:	September 15, 2007	Approximate Year Built:	1960
*Wall Rating:	84	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall for 4 ft x 6 ft box culvert in Oberlin Bend area		

Wall Measurements

Wall Length (ft.):	18	Face Area (sq.):	90
Average Wall Height (ft.):	5	Face Angle (deg.):	85
Maximum Wall Height (ft.):	7	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended but in need of minor maintenance, repair	8
WALL FOUNDATION MATERIAL 8.00	Firm, coarse sand and gravel, no distress	9
MORTAR 8.00	2 stones dislodged at top of wall due to impact damage	8
STONE MASONRY 8.00	No distress	9
CULVERT 0.50	6' x 4' concrete box culvert, no distress	9
DOWNSLOPE 0.50	Creek bed, cobbles and boulders, no distress	9
WALL DRAINS 0.50	None, no distress	9
LATERAL SLOPE 1.00	Riprap or coarse road fill, minor erosion at wall end due to surface runoff	7
ROAD/SIDEWALK/SHOULDER 1.00	Gravel shoulder, minor surface erosion due to storm runoff	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Reset 2 stone blocks Reset blocks (material on-site): 1 man-day x \$350/day=\$350 Total=\$350
Repair Cost:	\$350

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

Glacier National Park

ROUTE 0010W: GOING TO THE SUN ROAD WEST

Retaining Wall Condition Photos



GLAC_0010W_31.514_L_1.jpg

Wall ID:	GLAC-0014-9.020-R		
Route Name:	MANY GLACIER ROAD		
Inspection Date:	July 10, 2007	Approximate Year Built:	Unknown
*Wall Rating:	71	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at inlet for Windy Creek Bridge (triple arches - two 9 ft x 5 ft and one 14 ft x 4 ft). Performing well but cap and end stones need to be reset. Mortar also needs maintenance.		

Wall Measurements

Wall Length (ft.):	67	Face Area (sq.):	140
Average Wall Height (ft.):	2	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs to have cap and end stones replaced/reset. Mortar needs maintenance. Lateral slopes may be scouring under extreme flood conditions and need to be monitored.	8
WALL FOUNDATION MATERIAL 8.00	Silty sand and cobbles with evidence of channel instability and scour.	8
MORTAR 8.00	Mortar shows debonding and voids over about 60 % of the surface.	6
STONE MASONRY 8.00	Hard durable angular rock well interlocked with even grout lines. Several cap and end stones are loose or missing.	7
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement distress. Roadway drain installed next to bridge. No shoulder distress.	9
WALL DRAINS 0.50	No drains installed. No evidence of internal drainage distress.	9
UPSLOPE 1.00	Cobbly streambed with evidence of channel instability with cobbles being moved during high flow and striking the wall.	6
LATERAL SLOPE 1.00	Gently slopes. Evidence that during high flows lateral slopes may have scour distress impacting the ends of the wall. Currently protected by boulders but need to be monitored.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	1. Reset/Replace cap and end stones, use local stones. 2 laborers x 8 hr. x \$55/hr. = \$880. Materials = \$120. Subtotal = \$1000. 2. Repoint mortar on about 60 % of the wall face. Repoint mortar (0.60 x 140 sqft.) x \$75/sq.ft = \$6300. Total = \$7300.
Repair Cost:	\$7,300

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

Glacier National Park
ROUTE 0014: MANY GLACIER ROAD

Retaining Wall Condition Photos



GLAC_0014_9.020_R_1.jpg

Wall ID:	GLAC-0014-9.023-L		
Route Name:	MANY GLACIER ROAD		
Inspection Date:	July 10, 2007	Approximate Year Built:	Unknown
*Wall Rating:	80	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at outlet for Windy Creek Bridge (Triple arches - two 9 ft x 5 ft and one 14 ft x 4 ft). Performing well but needs to have cap and end stones reset/replaced and mortar maintenance.		

Wall Measurements

Wall Length (ft.):	68	Face Area (sq.):	123
Average Wall Height (ft.):	1	Face Angle (deg.):	90
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs some maintenance to reset cap and end stones and repoint mortar.	8
WALL FOUNDATION MATERIAL 8.00	Gravelly stable firm soil on wingwalls. Concrete arches show no scour distress and have flood debris at outlet.	8
MORTAR 8.00	Mortar has much cracking and debonding adjacent to the concrete arches (about 30 % of the wall area). Several cap and end stones are loose or missing due to mortar degradation.	7
STONE MASONRY 8.00	Hard durable angular stones to 2 ft. max. Well interlocked with even grout lines. No degradation and batter distress noted.	9
DOWNSLOPE 0.50	Gravelly stable floodplain with small trees and grass. channel is currently dry.	9
LATERAL SLOPE 0.50	Gentle natural slopes, gravelly and grass covered on both sides.	9
WALL DRAINS 0.50	No drains installed and no evidence of internal drainage distress.	9
ROAD/SIDEWALK/SHOULDER 1.00	No evidence of pavement distress and no batter distress on guardwall. Stones in top layer of guardwall needs to be reset.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	1. Reset/Replace several cap and end stones, use local stones. 2 Laborers x 8 hr. x \$55/hr. = \$880, Materials = \$120, Subtotal = \$1000. 2. Repoint mortar for about 30 % of the wall area. Repoint mortar (0.30 x 123 sqft.) x \$75/sq.ft. = \$2770. Total = \$3770
Repair Cost:	\$3,770

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

Glacier National Park
ROUTE 0014: MANY GLACIER ROAD

Retaining Wall Condition Photos



GLAC_0014_9.023_L_1.jpg

Wall ID:	GLAC-0014-10.443-L		
Route Name:	MANY GLACIER ROAD		
Inspection Date:	July 10, 2007	Approximate Year Built:	Unknown
*Wall Rating:	78	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall at outlet of triple box culvert (two 9 ft x 7 ft and One 14 ft x 7 ft). Performing well but needs to have cap and end stones replaced/reset and mortar maintenance.		

Wall Measurements

Wall Length (ft.):	70	Face Area (sq.):	138
Average Wall Height (ft.):	1	Face Angle (deg.):	90
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs to have cap and end stones reset/replaced and some local mortar maintenance.	8
WALL FOUNDATION MATERIAL 8.00	Gravelly stable firm soil at outlet. No scour, undermining, or batter distress noted.	8
MORTAR 8.00	Mortar is generally in good condition except at cap and end stones and adjacent to the concrete culverts (about 20 % of wall face area needs repointing.	7
STONE MASONRY 8.00	Hard durable angular stones to 2 ft. max. Well interlocked with even grout lines. Only minor weathering and spalling noted.	8
DOWNSLOPE 0.50	Gravelly stable floodplain with small trees and grass. No scour distress noted. Water only running through the west culvert.	9
LATERAL SLOPE 0.50	Gently sloped grass covered natural slopes on both ends. No erosion distress noted.	9
WALL DRAINS 0.50	No drains installed and evidence of internal drainage distress.	9
ROAD/SIDEWALK/SHOULDER 1.00	No pavement or guardwall batter distress noted. Top layer of guardwall stones need to be reset/replaced.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	1. Reset/Replace cap and end stones, use local stones. 2 Laborers x 8hr. x \$55/hr. = \$880. Materials = \$120. Subtotal = \$1000. 2. Repoint mortar for about 20 % of the wall area, especially adjacent to the concrete culverts. Repoint mortar
Repair Cost:	\$3,070

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

Glacier National Park
ROUTE 0014: MANY GLACIER ROAD

Retaining Wall Condition Photos



GLAC_0014_10.443_L_1.jpg

Wall ID:	GLAC-0014-10.445-R		
Route Name:	MANY GLACIER ROAD		
Inspection Date:	July 10, 2007	Approximate Year Built:	Unknown
*Wall Rating:	80	Maintenance Action:	Maintenance

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall for inlet of triple box culvert bridge (Two 9 ft x 7 ft and One 14 ft x 7 ft). Performing well but needs to have cap and end stones reset/replaced and mortar maintenance.		

Wall Measurements

Wall Length (ft.):	68	Face Area (sq.):	135
Average Wall Height (ft.):	1	Face Angle (deg.):	90
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is performing well but needs to have cap and end stones reset/replaced and some mortar maintenance. Concrete in culverts is degrading and spalling with rebar showing and needs monitoring.	8
WALL FOUNDATION MATERIAL 8.00	Cobbly streambed, no scour degradation.	8
MORTAR 8.00	Mortar is generally in good condition except for about 30 % of wall which is has debonding degradation. Some debonding several inches deep.	7
STONE MASONRY 8.00	Hard durable angular stones, well interlocked with even grout lines.	9
LATERAL SLOPE 0.50	Gentle natural slopes on both sides, no evidence of erosion or scour distress.	8
ROAD/SIDEWALK/SHOULDER 0.50	Two shoulder drains next to guardwall. Pavement shows minor repairs were made at the start of the bridge.	8
UPSLOPE 0.50	Cobbly streambed that shows evidence of cobbles moving during seasonal flooding.	8
WALL DRAINS 0.50	No drains installed and no evidence of internal drainage distress.	8

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	1. Reset/Replace cap and end stones. 2 Laborers x 8hr. x \$55/hr. = \$880. Materials = \$120. Subtotal = \$1000. 2. Repoint mortar in about 30 % of the wall face area. Repoint mortar (0.30 x 135 sqft.) x \$75/sq.ft. = \$3040. Total = \$4040
Repair Cost:	\$4,040

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

Glacier National Park
ROUTE 0014: MANY GLACIER ROAD

Retaining Wall Condition Photos



GLAC_0014_10.445_R_1.jpg

Wall ID:	GLAC-0014-10.972-L		
Route Name:	MANY GLACIER ROAD		
Inspection Date:	July 10, 2007	Approximate Year Built:	Unknown
*Wall Rating:	48	Maintenance Action:	Replace Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall for 6 ft x 4 ft box culvert. Wall has flood -damaged failed sections at both ends and needs to be rebuilt.		

Wall Measurements

Wall Length (ft.):	31	Face Area (sq.):	222
Average Wall Height (ft.):	7	Face Angle (deg.):	90
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall was badly damaged in last flood with about an 8 ft. section at each end cracked away and displaced. These sections need to be completely rebuilt.	5
WALL FOUNDATION MATERIAL 8.00	The outlet of the culvert has severe scour undermining at least 2 ft. under the pipe at the outlet and extending under the failed wall sections.	3
STONE MASONRY 8.00	Hard durable angular stones in the unfailed center section adjacent to the culvert. About an 8 ft. long section of the wall at each end has cracked for the full vertical height and has displaced vertically toward the stream.	4
MORTAR 8.00	Mortar in middle section that has not failed has only minor degradation and may not require maintenance.	7
DOWNSLOPE 1.00	Deeply scoured gravelly streambed.	4
LATERAL SLOPE 0.50	Gentle gravelly natural slope, brush covered.	8
ROAD/SIDEWALK/SHOULDER 1.00	No evidence of pavement distress. Should at the start is eroded to the edge of the pavement and under the beginning failed section with voids to 3 ft. deep extending back under this section.	4
WALL DRAINS 0.50	No drains and no evidence of internal drainage distress.	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	1. Remove existing failed end sections (two sections: about 60 sqft at start and 48 sq. ft. at end) and rebuilt GM wall(s). 2 Laborers x 8 hr. x \$55/hr. = \$880. Excavator 8 hr. x \$150/hr. = \$1200. Dump Truck 8 hr. x \$120/hr. = \$960. Rebuild GM wall section
Repair Cost:	\$26,920

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

Glacier National Park
ROUTE 0014: MANY GLACIER ROAD

Retaining Wall Condition Photos



GLAC_0014_10.972_L_1.jpg

Wall ID:	GLAC-0014-10.973-L		
Route Name:	MANY GLACIER ROAD		
Inspection Date:	July 10, 2007	Approximate Year Built:	Unknown
*Wall Rating:	48	Maintenance Action:	Replace Elements

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry headwall for 6 ft x 4 ft box culvert. Wall has flood -damaged failed sections at both ends and needs to be rebuilt.		

Wall Measurements

Wall Length (ft.):	31	Face Area (sq.):	222
Average Wall Height (ft.):	7	Face Angle (deg.):	90
Maximum Wall Height (ft.):	12	Vertical Offset (ft.):	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall was badly damaged in last flood with about an 8 ft. section at each end cracked away and displaced. These sections need to be completely rebuilt.	5
WALL FOUNDATION MATERIAL 8.00	The outlet of the culvert has severe scour undermining at least 2 ft. under the pipe at the outlet and extending under the failed wall sections.	3
STONE MASONRY 8.00	Hard durable angular stones in the unfailed center section adjacent to the culvert. About an 8 ft. long section of the wall at each end has cracked for the full vertical height and has displaced vertically toward the stream.	4
MORTAR 8.00	Mortar in middle section that has not failed has only minor degradation and may not require maintenance.	7
DOWNSLOPE 1.00	Deeply scoured gravelly streambed.	4
LATERAL SLOPE 0.50	Gentle gravelly natural slope, brush covered.	8
ROAD/SIDEWALK/SHOULDER 1.00	No evidence of pavement distress. Should at the start is eroded to the edge of the pavement and under the beginning failed section with voids to 3 ft. deep extending back under this section.	4
WALL DRAINS 0.50	No drains and no evidence of internal drainage distress.	9

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	1. Remove existing failed end sections (two sections: about 60 sq.ft at start and 48 sq. ft. at end) and rebuilt GM wall(s). 2 Laborers x 8 hr. x \$55/hr. = \$880. Excavator 8 hr. x \$150/hr. = \$1200. Dump Truck 8 hr. x \$120/hr. = \$960. Rebuild GM wall section
Repair Cost:	\$26,920

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

Glacier National Park
ROUTE 0014: MANY GLACIER ROAD

Retaining Wall Condition Photos



GLAC_0014_10.973_L_1.jpg

Wall ID:	GLAC-0014-10.973-R		
Route Name:	MANY GLACIER ROAD		
Inspection Date:	July 10, 2007	Approximate Year Built:	Unknown
*Wall Rating:	71	Maintenance Action:	No Action

Wall Description

Wall Function:	Head Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry wall at inlet to 6 ft x 4 ft box culvert. Still performing well but has a vertical crack near the start of the wall which needs to be monitored for displacement.		

Wall Measurements

Wall Length (ft.):	31	Face Area (sq.):	140
Average Wall Height (ft.):	4	Face Angle (deg.):	90
Maximum Wall Height (ft.):	8	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Wall is still performing well. Of concern is a vertical crack about 7 ft. from the start of the wall which extends the full 7 ft. height of the wall. No displacement of the crack at this time but this crack should be monitored.	7
WALL FOUNDATION MATERIAL 8.00	Gravelly streambed with evidence of scour distress and undermining. Note crack in wall about 7 ft. from the start in undermined section.	6
STONE MASONRY 8.00	Generally hard durable angular stones well interlocked. One stone is cracked at a vertical crack in the wall about 7 ft. from the start of the wall which extends the entire 7 ft. vertical depth. No displacement at the crack at this time but needs to be	7
MORTAR 8.00	Less than 10 % debonding in the wall. Cap stones in guardwall have about 30 % debonding but only slightly weathered.	8
LATERAL SLOPE 0.50	Very steep slope at the start with some soil erosion. Gentle well vegetated slope at the end.	8
ROAD/SIDEWALK/SHOULDER 0.50	No evidence of pavement or shoulder distress.	8
WALL DRAINS 0.50	No drains installed and no evidence of internal drainage distress.	9
UPSLOPE 1.00	Gravelly streambed with cobbles. Evidence of scour distress.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	None
Repair Cost:	\$0

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

Glacier National Park
ROUTE 0014: MANY GLACIER ROAD

Retaining Wall Condition Photos



GLAC_0014_10.973_R_1.jpg

Wall ID:	GLAC-0948A-0.000-P1		
Route Name:	SUN POINT PICNIC AREA A		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	77	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Cut Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry cut wall at Sun Point Picnic Area		

Wall Measurements

Wall Length (ft.):	122	Face Area (sq.):	600
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, no distress	8
MORTAR 8.00	Minor cracking and debonding of mortar	7
STONE MASONRY 8.00	Rectangular blocks, no distress	8
DOWNSLOPE 0.50	Parking lot	8
LATERAL SLOPE 0.50	Parking lot	8
WALL DRAINS 0.50	None	9
TRAFFIC BARRIER/FENCE 1.00	Minor, isolated impact damage to guardwall, 10' length	6

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Repair guardwall 10 lnft Stone masonry guardwall repair: 10 lnft x \$200/lnft = \$2,000 Total = \$2,000
Repair Cost:	\$2,000

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

Glacier National Park
ROUTE 0948A: SUN POINT PICNIC AREA A

Retaining Wall Condition Photos



GLAC_0948A_0.000_P1_1.jpg

Wall ID:	GLAC-0948B-0.000-P1		
Route Name:	SUN POINT PICNIC AREA B		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	75	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall in Sun Point Picnic Area parking lot		

Wall Measurements

Wall Length (ft.):	136	Face Area (sq.):	580
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	4	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	7
WALL FOUNDATION MATERIAL 8.00	Firm soil, no distress	9
MORTAR 8.00	50% of mortar has minor to severe debonding, several vertical cracks through mortar	6
STONE MASONRY 8.00	Several blocks have cracked (spalled), 4-5 missing blocks at guardwall	8
DOWNSLOPE 0.50	Flat gravel parking lot, no distress	9
LATERAL SLOPE 0.50	Flat gravel parking lot, no distress	9
ROAD/SIDEWALK/SHOULDER 0.50	Flat gravel parking lot, no distress	9
WALL DRAINS 0.50	None, no distress	9
TRAFFIC BARRIER/FENCE 1.00	Guardwall has impact damage from cars, cracked mortar, 4-5 missing blocks	6

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Repoint 50% of wall (290 sqft) Repoint: 290 sqft x \$75/sqft = \$21,750 Total = \$21,750
Repair Cost:	\$21,750

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

Glacier National Park
ROUTE 0948B: SUN POINT PICNIC AREA B

Retaining Wall Condition Photos



GLAC_0948B_0.000_P1_1.jpg

Wall ID:	GLAC-0948B-0.000-P2		
Route Name:	SUN POINT PICNIC AREA B		
Inspection Date:	September 11, 2007	Approximate Year Built:	1930
*Wall Rating:	79	Maintenance Action:	Repair Elements

Wall Description

Wall Function:	Fill Wall	Primary Wall Type:	Gravity - Mortared Stone
Surface Treatment:		Secondary Wall Type:	
Secondary Surface Treatment:		Architectural Facing:	
General Description:	Stone masonry fill wall at Sun Point Picnic Area parking lot		

Wall Measurements

Wall Length (ft.):	78	Face Area (sq.):	320
Average Wall Height (ft.):	4	Face Angle (deg.):	85
Maximum Wall Height (ft.):	6	Vertical Offset (ft.):	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	As intended	8
WALL FOUNDATION MATERIAL 8.00	Soil, stable	8
MORTAR 8.00	No distress	8
STONE MASONRY 8.00	No distress	8
DOWNSLOPE 0.50	Construction staging area, soil, flat	8
LATERAL SLOPE 0.50	Parking lot	8
WALL DRAINS 0.50	None	8
TRAFFIC BARRIER/FENCE 1.00	Heavy cracking, debonding of guardwall section with isolated stone loss	5

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Repair guardwall 40 lnft Stone masonry guardwall repair: 40 lnft x \$2000/lnft = \$80,000 Total=\$80,000
Repair Cost:	\$80,000

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

Glacier National Park
ROUTE 0948B: SUN POINT PICNIC AREA B

Retaining Wall Condition Photos



GLAC_0948B_0.000_P2_1.jpg

Appendix A

Summary of WIP Definitions



Glacier 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 ≥ 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

Design Criteria	Measure of how well current design criteria are satisfied: None - Does not meet any known standards. Non-AASHTO - Does not meet AASHTO, but is consistent with other structures of its type/period with good performance. AASHTO - Apparently meets current AASHTO Geometric, Design, Materials, and Construction Standards.
Consequence of Failure	Low - No loss of roadway, no to low public risk, no impact to traffic during wall repair/replacement Moderate - Hourly to short-term closure of roadway, low-to-moderate public risk, multiple alternate routes available High - Seasonal to long-term loss of roadway, substantial loss-of-life risk, no alternate routes available
Action	Select from: No Action, Monitor, Maintenance, Repair Elements, Replace Elements, and Replace Wall
Weighting Factor	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.
Data Reliability	Estimate of how well observed conditions represent wall performance, and if additional investigations may be warranted. 1-Poor 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. 2-Good Observed conditions are sufficient to rate the conditions of wall element(s); however, additional investigations would be useful to better understand element performance. 3-Very Good 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.

9-10 (Excellent)	-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.
7-8 (Good)	-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.
5-6 (Fair)	-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.
3-4 (Poor)	-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.
1-2 (Critical)	-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

Performance	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>Good to Excellent - 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>Fair - 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>Poor to Critical - 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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