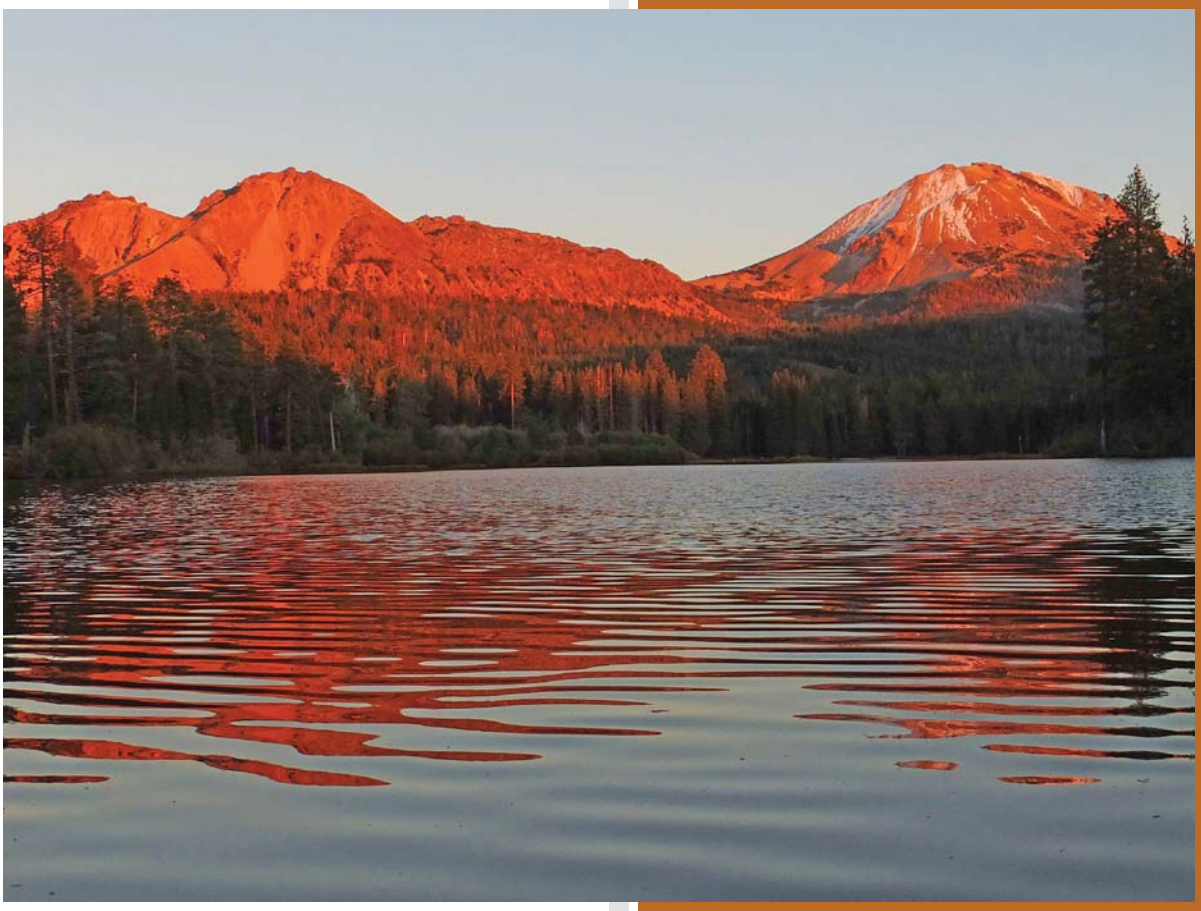
LAVO
WIP Report

NPS Retaining Wall Inventory Program
Lassen Volcanic National Park

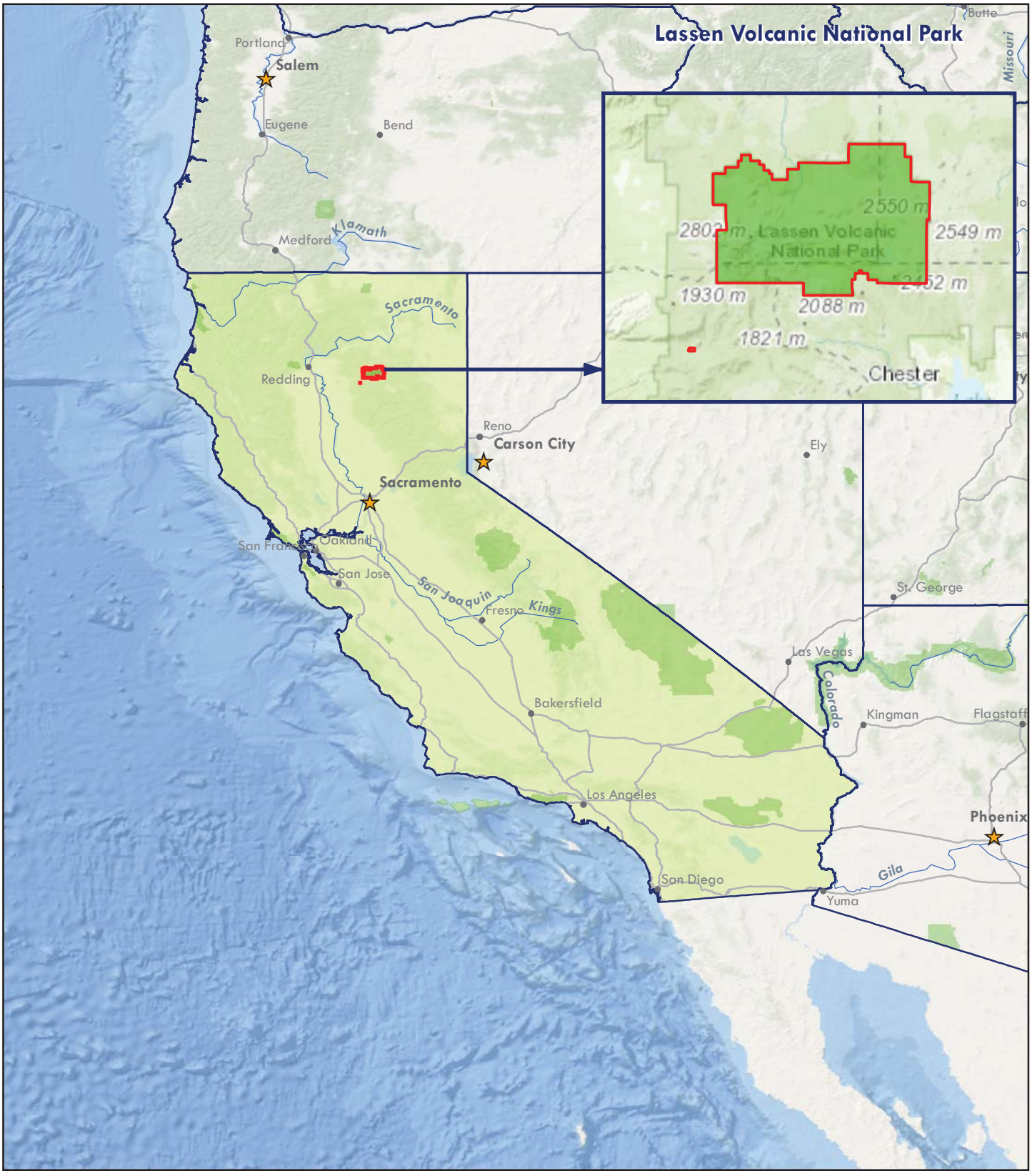


Federal Lands Highway
Road Inventory Program

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

Data Collection Date: August 2008
Report Date: October 2015

Lassen Volcanic National Park
in
California



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Introduction

Lassen Volcanic National Park

Federal Lands Highway
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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

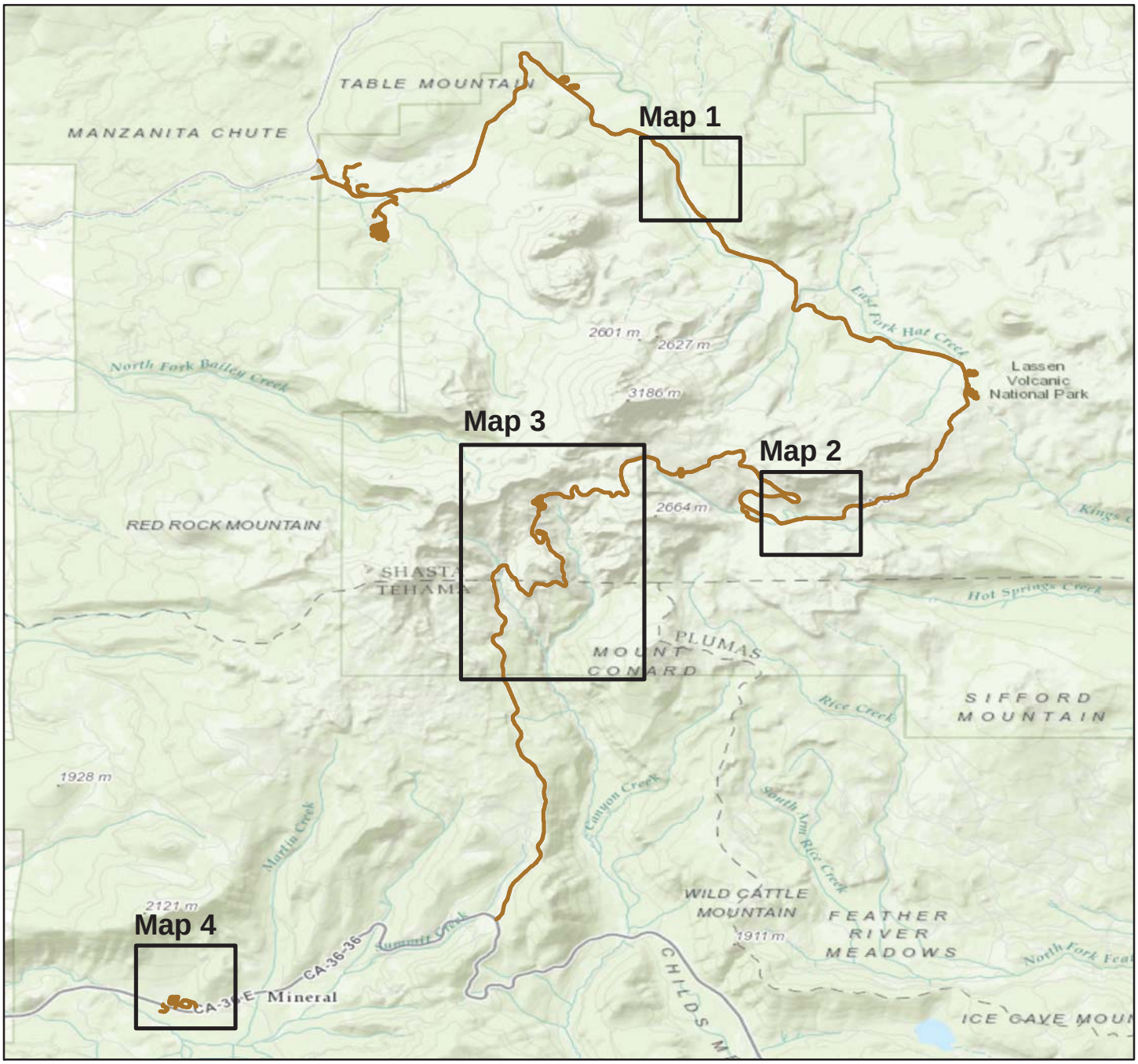
Lassen Volcanic National Park

Federal Lands Highway
Road Inventory Program

Lassen Volcanic National Park

WALL LOCATION MAP

Key Map



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RIP Collected Routes

Miles

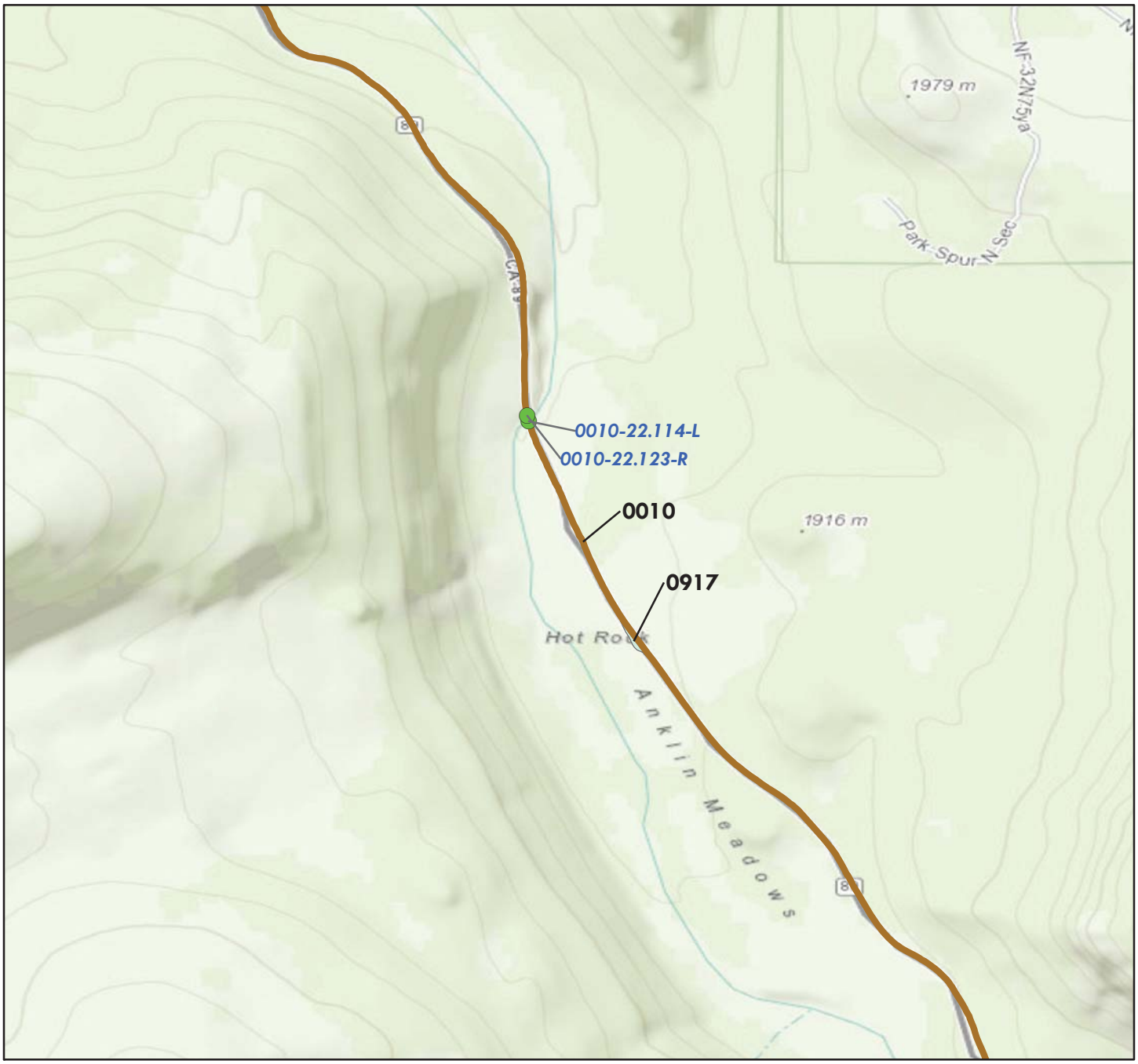
0 2 4

N

Lassen Volcanic National Park

WALL LOCATION MAP

Map 1



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Wall Locations

RIP Collected Routes

Miles

0 0.25 0.5

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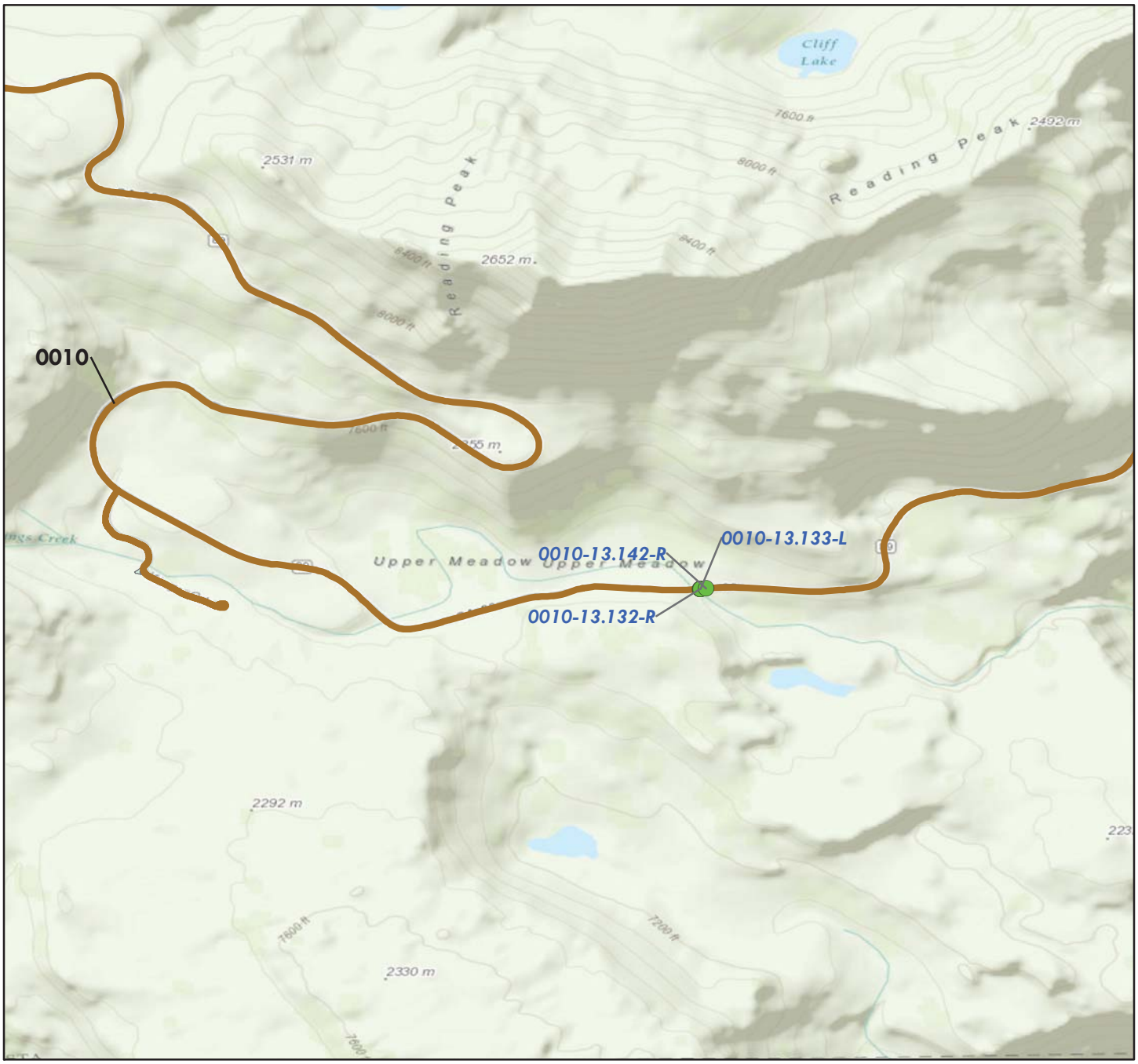
Lassen Volcanic National Park

WALL LOCATION MAP

Map 2



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Wall Locations

RIP Collected Routes

Miles

0 0.25 0.5

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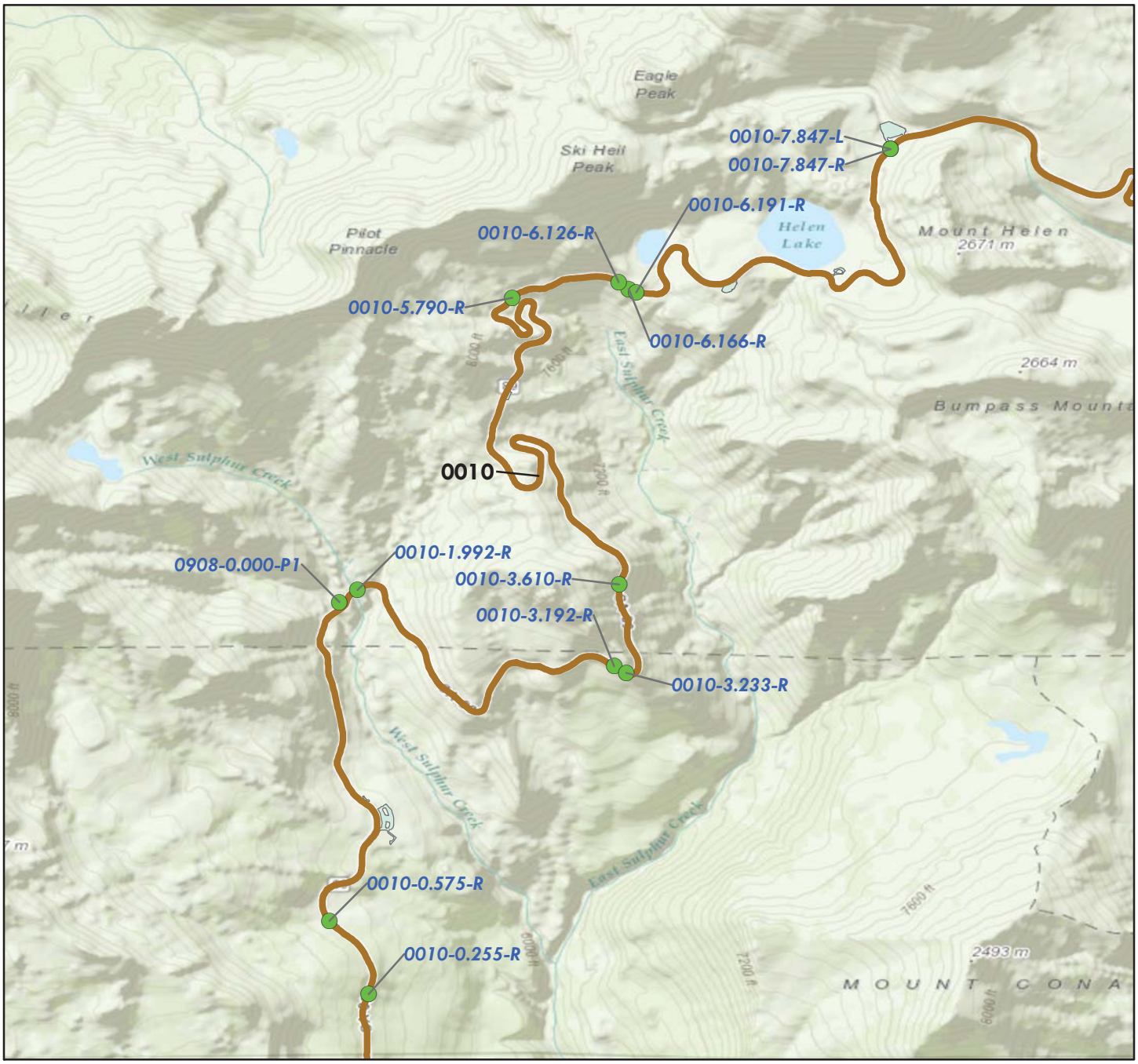
Lassen Volcanic National Park

WALL LOCATION MAP

Map 3



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Wall Locations

RIP Collected Routes

Miles

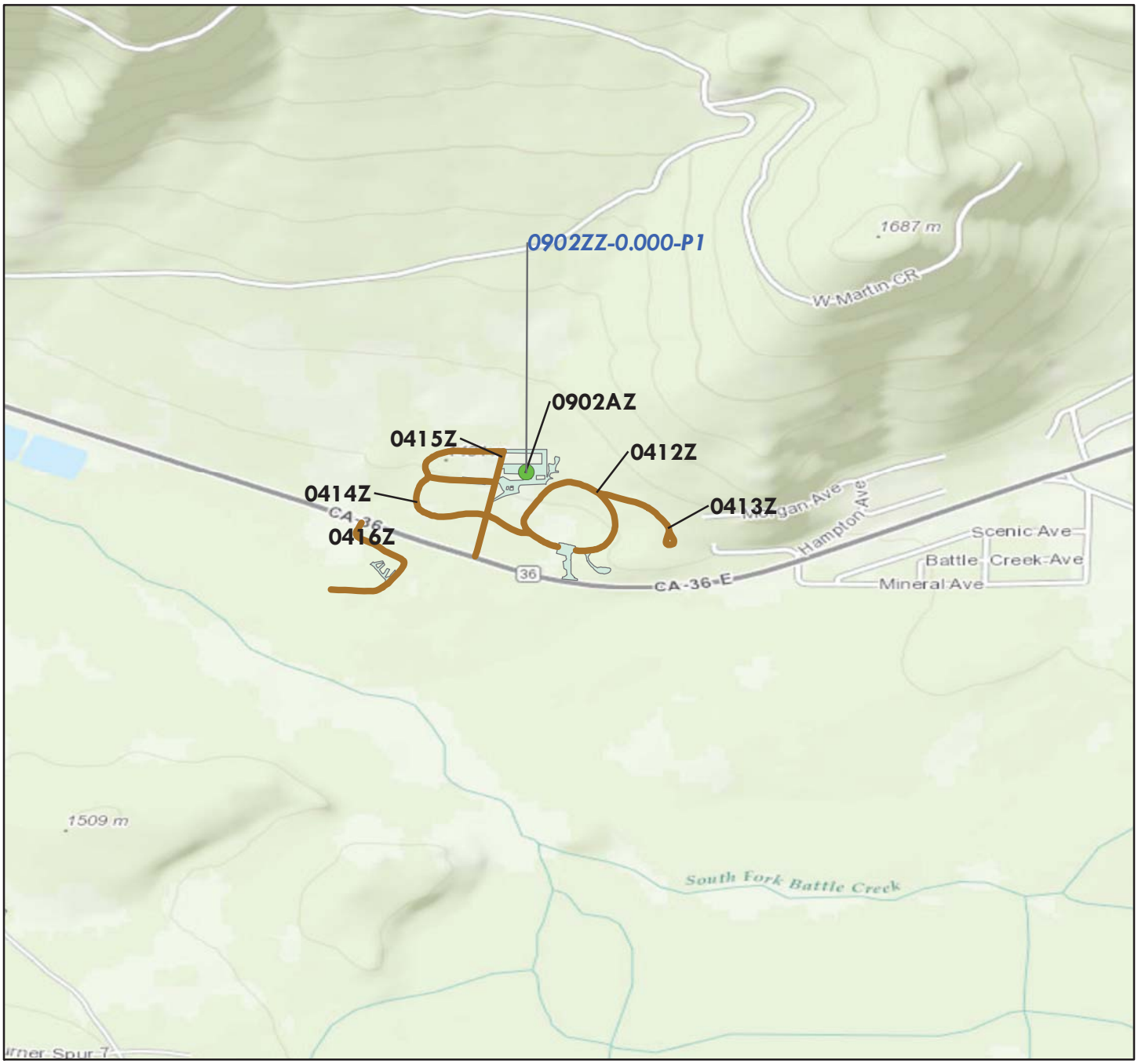
0 0.5 1

N

Lassen Volcanic National Park

WALL LOCATION MAP

Map 4



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Wall Locations

RIP Collected Routes

Miles

0 0.25 0.5

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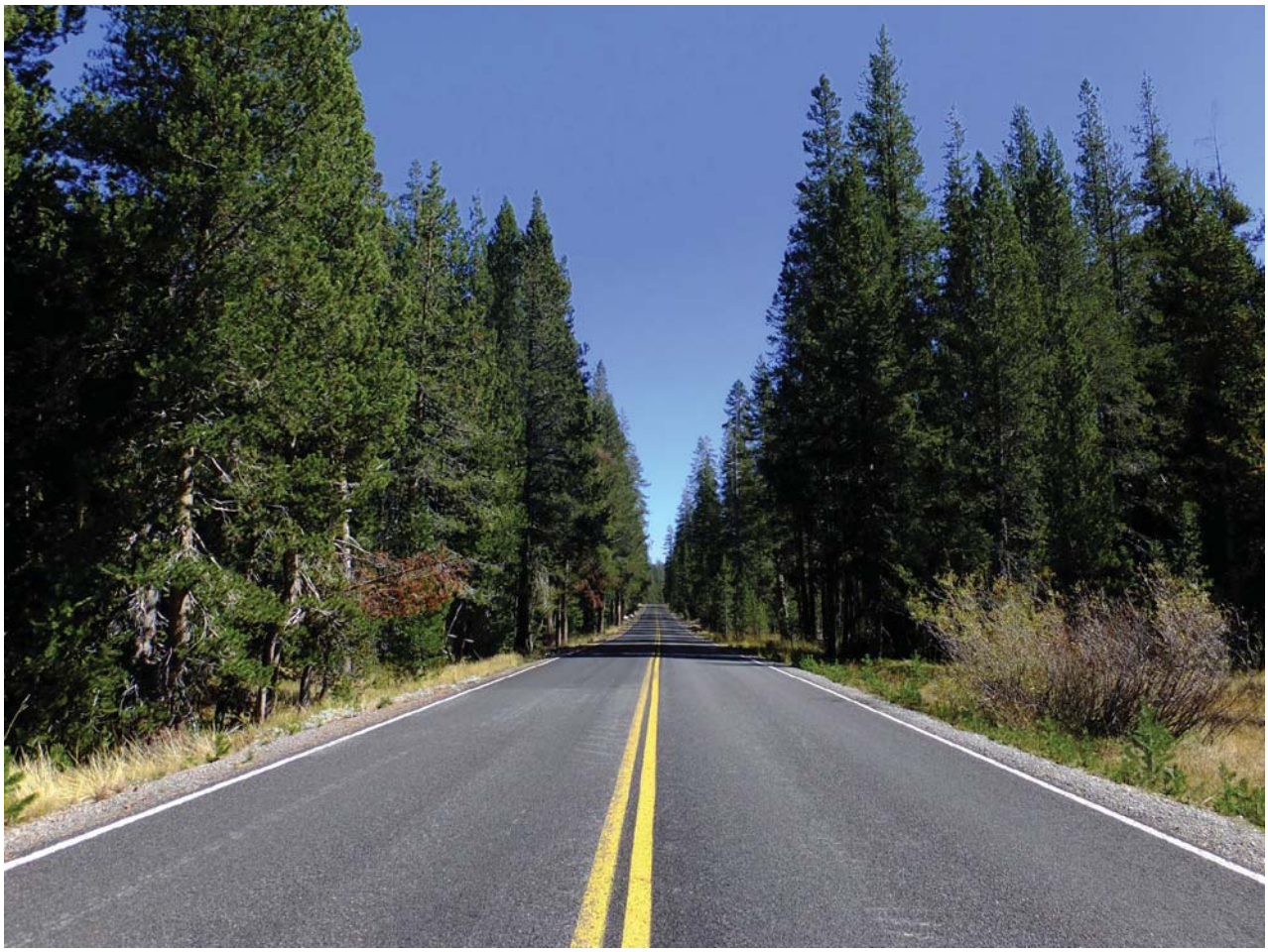
Tier 1
Park Retaining Wall Overview



Lassen Volcanic National Park

Federal Lands Highway
Road Inventory Program

Parkwide Summary: Lassen Volcanic National Park

Initial retaining wall inspections were conducted at Lassen Volcanic National Park in 2008, 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.

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, 19 walls were inventoried on the routes listed below.

Table 1: Number of Walls by Route

Route Number	Route Name	No. of Walls
0010	LASSEN PARK ROAD	17
0902ZZ	PARK HEADQUARTERS RANGER / MAINTENANCE PARKING AREAS	1
0908	SULPHUR WORKS PARKING	1

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	1
FW - Fill Wall	8
HW - Head Wall	7
SP - Slope Protection	3

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
CL, Cantilever - Concrete	4
GD, Gravity - Dry Stone	8
GG, Gravity - Gabion	1
GM, Gravity - Mortared Stone	5
GR, Other - Geogrid Reinforced Soil Slope	1

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

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

Recommended Action	2007 Repair Costs*	No. of Walls
No Action	$0	16
Monitor	$0	0
Maintenance	$2,475	3
Repair Elements	$0	0
Replace Elements	$0	0
Replace Wall	$0	0
Totals	**$2,475**	**19**

*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	16
$1 - $25,000	3
$25,001 - $50,000	0
$50,001 - $100,000	0
$100,001 - $250,000	0
$250,001 - $500,000	0
$500,001 - $1,000,000	0
$1,000,001 - $2,000,000	0
$2,000,001 - $3,000,000	0
$3,000,001 - $4,000,000	0
Total Number of Walls	**19**

*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 Lassen Volcanic 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 mortor 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 Lassen Volcanic 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)
No critically deficient walls.				

Notes: 1) Low consequence of failure and/or no recommended action may indicate repairs are not needed.
2) Wall ratings listed range from 0-49 (Poor/Critical).
3) Information was prepared for project planning purposes only. Actual repair work order scopes and actual costs will need to be evaluated based on current pay item unit prices for specific locations.
4) 2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Tier 2
Route Retaining Wall Overview

Lassen Volcanic National Park

Federal Lands Highway
Road Inventory Program

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK 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

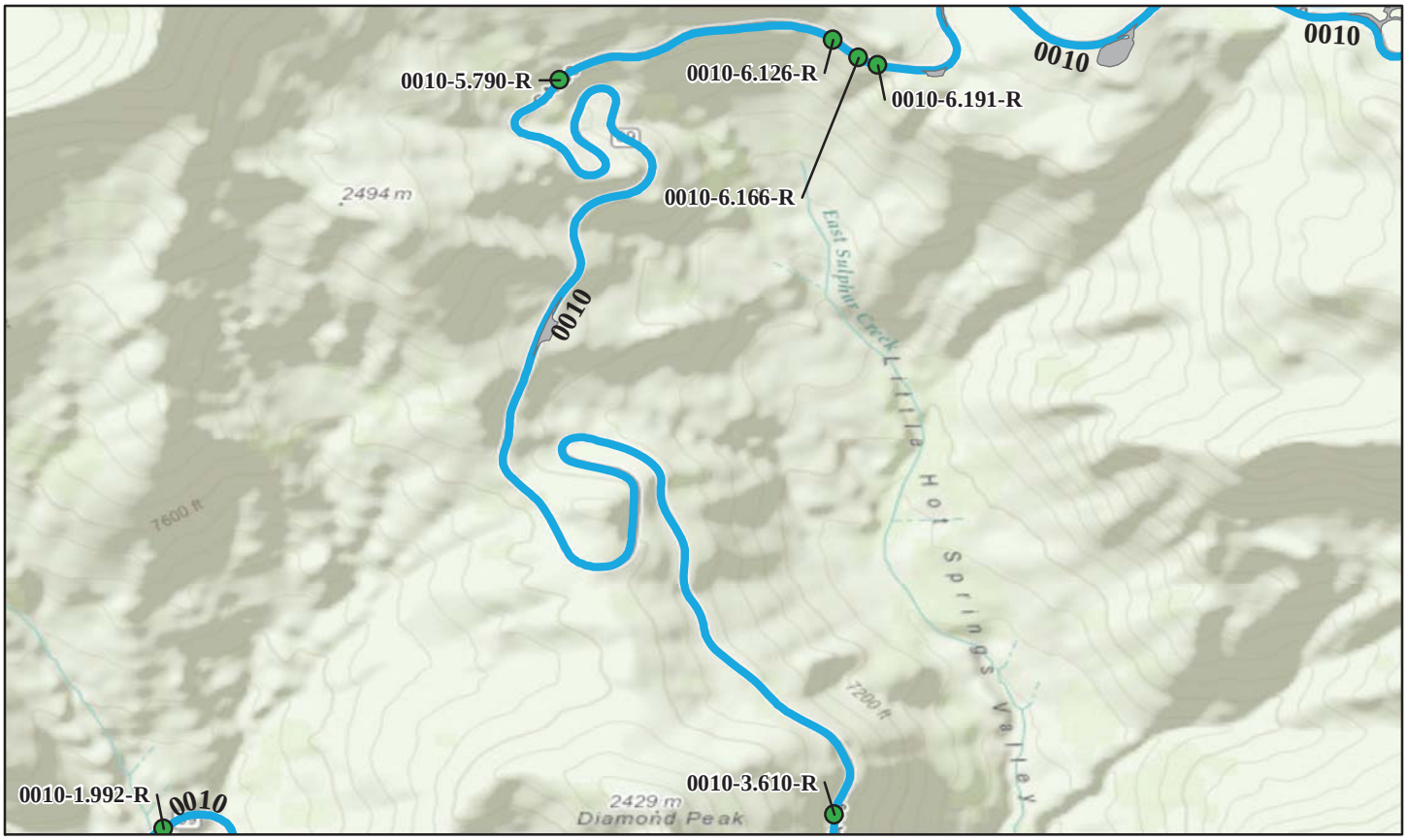
Critical / Poor (0 - 49)	Fair (50 - 69)	Good to Excellent (70 - 100)	No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
LAVO-0010-0.255-R 8/19/2008	1,410	282	Gravity - Dry Stone	Fill Wall	72	$1,375.00
LAVO-0010-0.575-R 8/19/2008	280	27	Gravity - Dry Stone	Head Wall	70	$0.00
LAVO-0010-1.992-R 8/19/2008	1,725	104	Gravity - Dry Stone	Fill Wall	90	$0.00
LAVO-0010-3.192-R 8/19/2008	4,000	189	Gravity - Dry Stone	Slope Protection	84	$0.00
LAVO-0010-3.233-R 8/19/2008	500	39	Gravity - Dry Stone	Slope Protection	84	$0.00

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

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD



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Retaining Wall Condition Legend – Wall Condition Rating

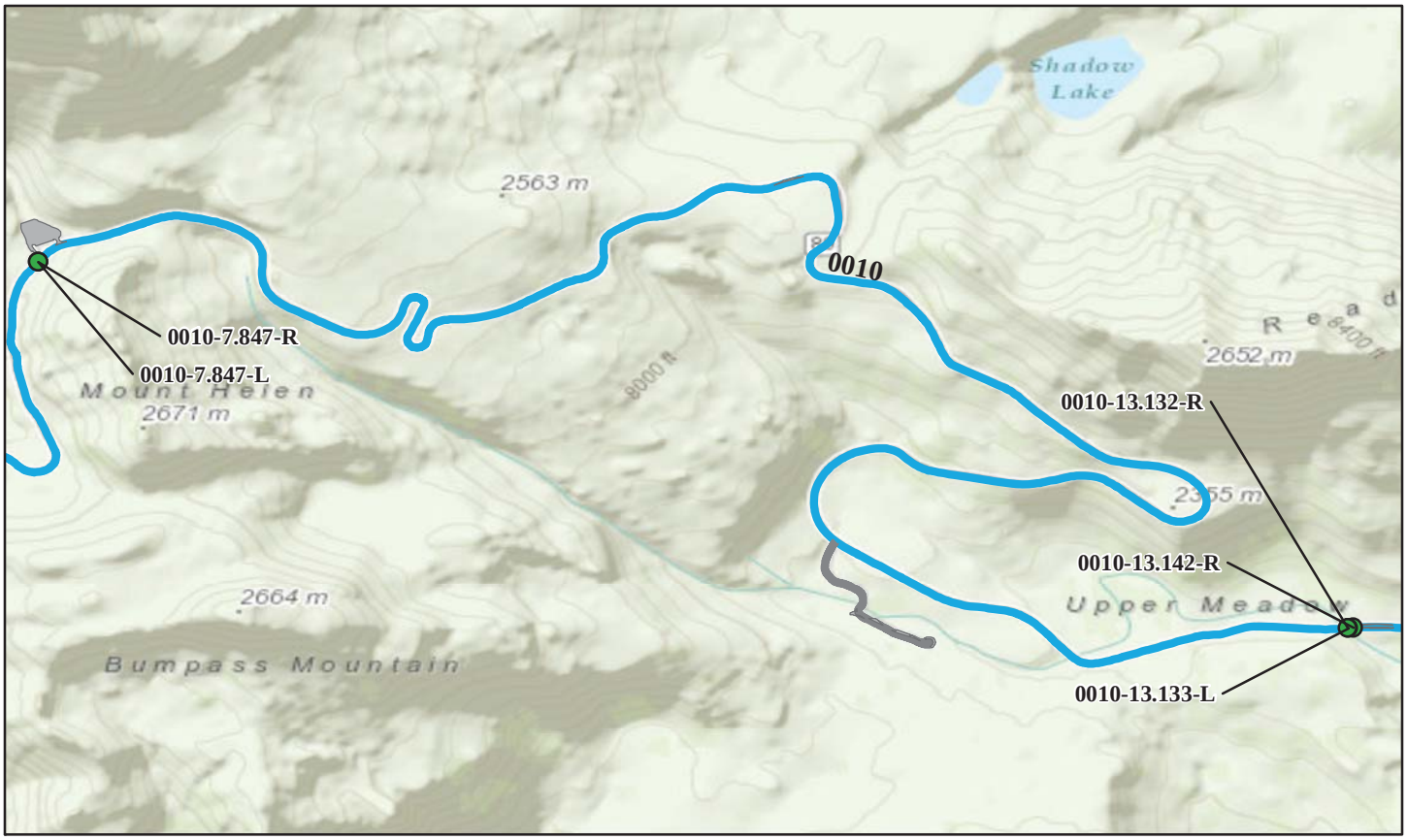
Critical / Poor (0 - 49)	Fair (50 - 69)	Good to Excellent (70 - 100)	No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
LAVO-0010-3.610-R 8/19/2008	371	53	Gravity - Gabion	Fill Wall	79	$0.00
LAVO-0010-5.790-R 8/19/2008	1,215	162	Other - Geogrid Reinforced Soil Slope	Fill Wall	86	$0.00
LAVO-0010-6.126-R 8/19/2008	2,215	211	Cantilever - Concrete	Fill Wall	93	$0.00
LAVO-0010-6.166-R 8/19/2008	920	72	Gravity - Dry Stone	Slope Protection	89	$0.00
LAVO-0010-6.191-R 8/19/2008	2,410	132	Gravity - Dry Stone	Fill Wall	84	$0.00

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

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD



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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
LAVO-0010-7.847-L 8/19/2008	155	32	Cantilever - Concrete	Head Wall	100	$0.00
LAVO-0010-7.847-R 8/19/2008	175	30	Cantilever - Concrete	Head Wall	100	$0.00
LAVO-0010-13.132-R 8/20/2008	290	34	Gravity - Mortared Stone	Head Wall	88	$0.00
LAVO-0010-13.133-L 8/20/2008	85	14	Gravity - Mortared Stone	Head Wall	87	$220.00
LAVO-0010-13.142-R 8/20/2008	490	147	Cantilever - Concrete	Fill Wall	100	$0.00

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

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK 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

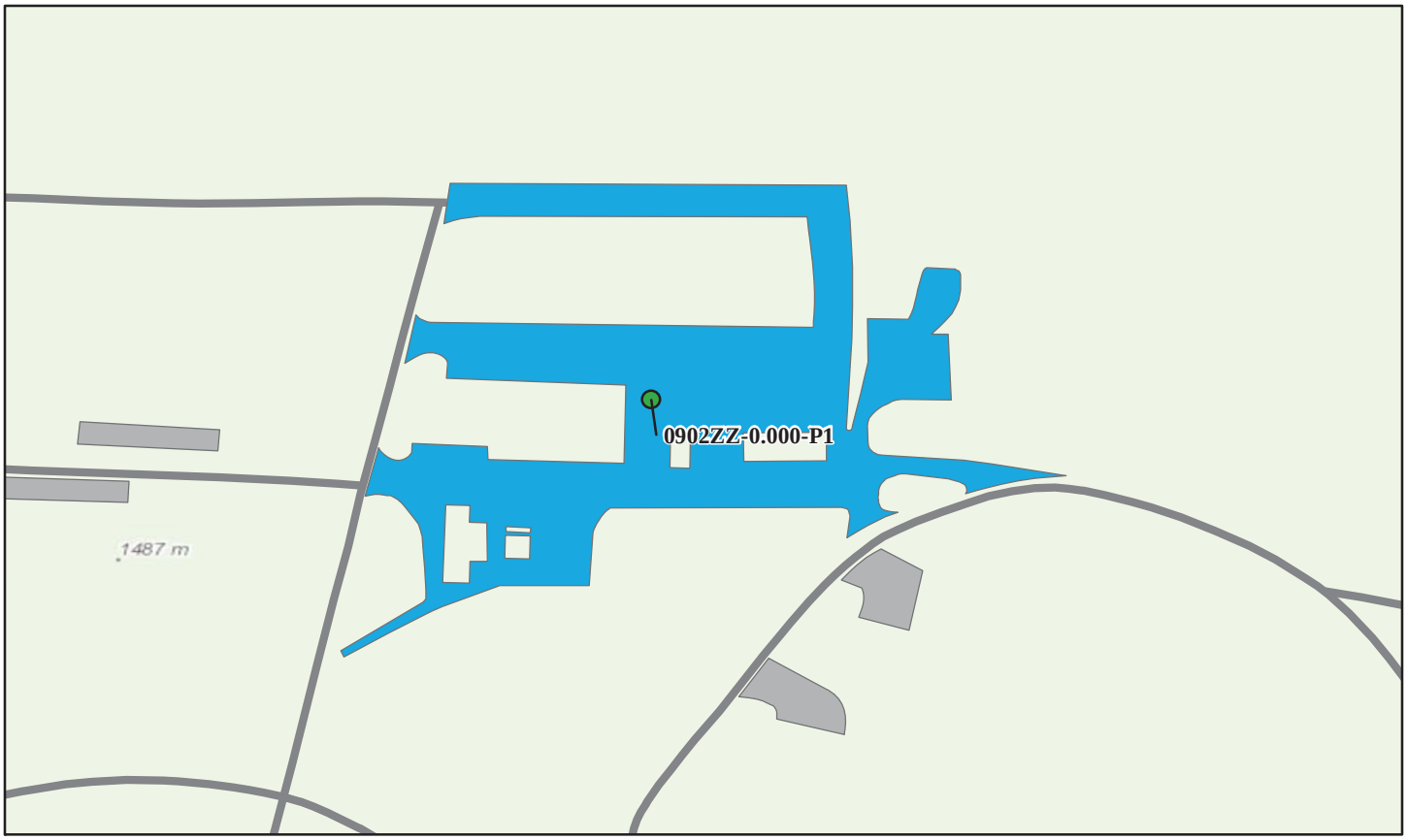
Critical / Poor (0 - 49)	Fair (50 - 69)	Good to Excellent (70 - 100)	No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
LAVO-0010-22.114-L 8/20/2008	350	56	Gravity - Mortared Stone	Head Wall	84	$0.00
LAVO-0010-22.123-R 8/20/2008	200	52	Gravity - Mortared Stone	Head Wall	80	$0.00

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

Lassen Volcanic National Park

ROUTE 0902ZZ: PARK HEADQUARTERS RANGER / MAINTENANCE PARKING AREAS



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Retaining Wall Condition Legend – Wall Condition Rating

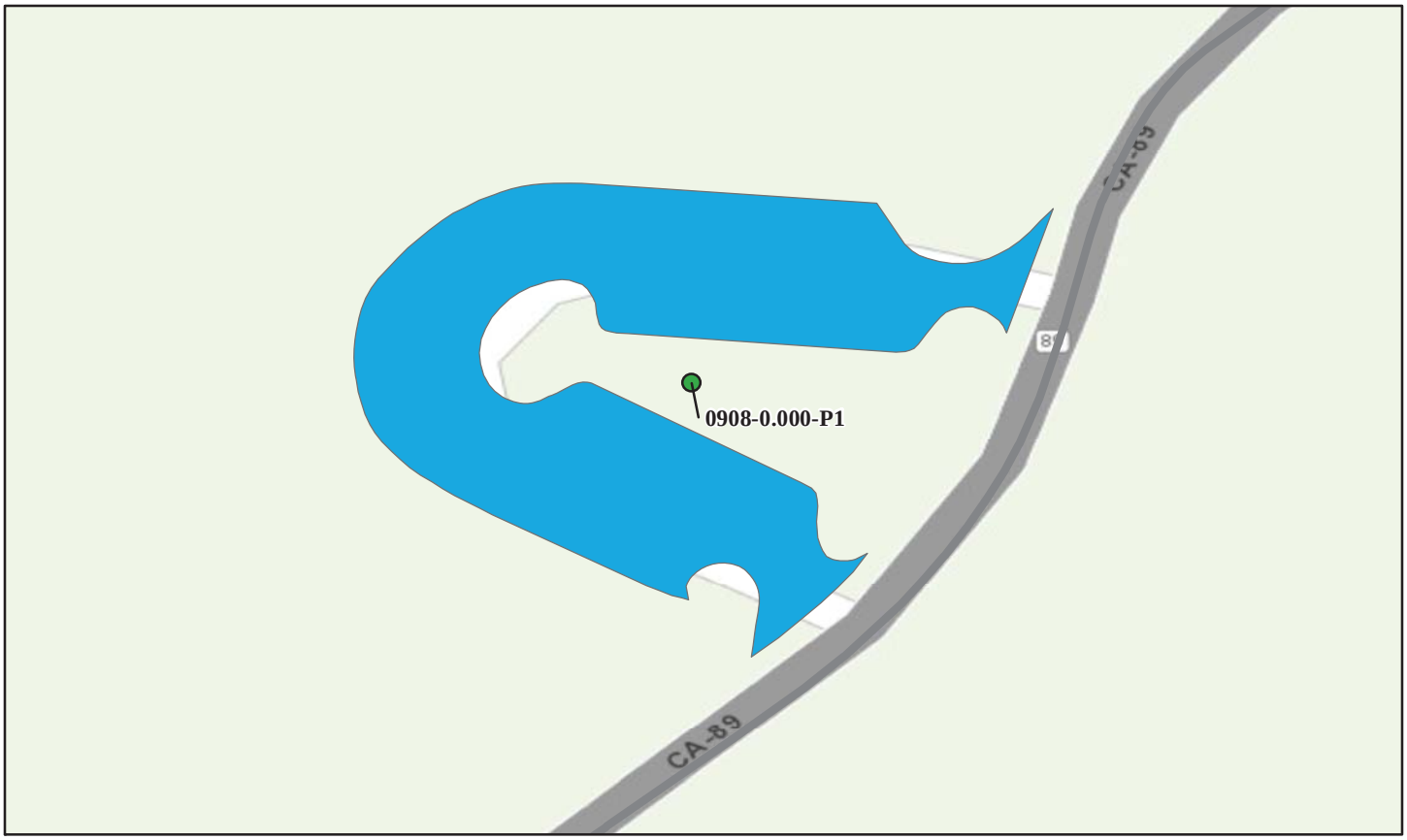
Critical / Poor (0 - 49)	Fair (50 - 69)	Good to Excellent (70 - 100)	No Data

Wall ID Inspection Date:	Wall Area (Sq. Ft.)	Wall Length (Ft.)	Wall Type	Wall Function	Overall Rating	Repair Cost
LAVO-0902ZZ-0.000-P1 8/19/2008	1680	280	Gravity - Dry Stone	Cut Wall	78	$880.00

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

Lassen Volcanic National Park

ROUTE 0908: SULPHUR WORKS PARKING



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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
LAVO-0908-0.000-P1 8/19/2008	890	235	Gravity - Mortared Stone	Fill Wall	93	$0.00

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

Tier 3
Retaining Wall Details

Lassen Volcanic National Park

Federal Lands Highway
Road Inventory Program

Wall ID:	**LAVO-0010-0.255-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	Unknown
***Wall Rating:**	72	**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 laid stone wall along outboard slope.		

Wall Measurements

Wall Length (ft.):	282	**Face Area (sq.):**	1410
Average Wall Height (ft.):	5	**Face Angle (deg.):**	60
Maximum Wall Height (ft.):	8	**Vertical Offset (ft.):**	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No signs of global instability, wall settlement, or structure deformation.	7
WALL FOUNDATION MATERIAL 8.00	Stable, but steep soil slope. No signs of slumping or erosion at toe of wall.	7
PLACED STONE 8.00	Large, hard, durable rock with minor weathering. Missing minor rocks - no impact to wall function or stability. Some silt filtering through and over wall face. No signs of sinkhole development at top of wall.	7
WALL DRAINS 0.50	Free draining wall. Minor silt migration through the face.	8
CURB/BERM/DITCH 0.50	Ditch line is stable, clear and functioning.	9
LATERAL SLOPE 0.50	Stable, vegetated side slopes. No signs of significant erosion.	9
ROAD/SIDEWALK/SHOULDER 0.50	No signs of wall-related distress.	9
UPSLOPE 0.50	Nearly flat top slope with no signs of settlement or erosion issues.	10
DOWNSLOPE 1.00	Steep, erosive, lightly vegetated slope. No signs of instability or significant erosion.	7

Repair Recommendations

Failure Consequence:	MODERATE
Recommendation Narrative:	Clear brush, bushes and small trees from wall face (leave brush/trees at wall toe). Labor: 25 hours @ $55/hr = $1,375
Repair Cost:	$1,375

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

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_0.255_R_1.jpg

LAVO_0010_0.255_R_2.jpg

Wall ID:	**LAVO-0010-0.575-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1972
***Wall Rating:**	70	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Head Wall	**Primary Wall Type:**	Gravity - Dry Stone
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	
General Description:	Dry laid, large stone wall above culvert outlet.		

Wall Measurements

Wall Length (ft.):	27	**Face Area (sq.):**	280
Average Wall Height (ft.):	10	**Face Angle (deg.):**	75
Maximum Wall Height (ft.):	14	**Vertical Offset (ft.):**	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No global distress. Minor rock displacement in face. No significant wall settlement observed.	7
WALL FOUNDATION MATERIAL 8.00	No signs of scour or settlement.	8
PLACED STONE 8.00	Large durable boulders, poorly placed, poorly chinked. Minor silt migration through wall. Missing/displaced stones in wall face.	6
DOWNSLOPE 0.50	Drainage channel is stable and vegetated, with some erosion along channel sidewalls.	8
VEGETATION 0.50	Minor vegetation in and above wall. Large brush growing at base of wall helps to stabilize lateral slopes.	8
WALL DRAINS 0.50	Free draining. Minor top slope erosion and some silt migration through wall face.	8
ROAD/SIDEWALK/SHOULDER 0.50	No wall-related distress.	9
UPSLOPE 1.00	Loose, erosive soils above wall to edge of roadway, though no significant erosion noted.	6
LATERAL SLOPE 1.00	Soft soils with 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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_0.575_R_1.jpg

Wall ID:	**LAVO-0010-1.992-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1965
***Wall Rating:**	90	**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 rockery fill wall.		

Wall Measurements

Wall Length (ft.):	104	**Face Area (sq.):**	1725
Average Wall Height (ft.):	16	**Face Angle (deg.):**	70
Maximum Wall Height (ft.):	22	**Vertical Offset (ft.):**	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No global distress indictaed or distress related to wall settlement or element displacement.	9
WALL FOUNDATION MATERIAL 8.00	Firm granular soil showing no signs of erosion or settlement.	10
PLACED STONE 8.00	Large, durable, hard boulders with some chinking. Minor boulders dislodged. No impact to wall function or stability.	8
DOWNSLOPE 0.50	Gentle, bare-soil downslope showing minor erosion.	9
LATERAL SLOPE 0.50	Bare-soil lateral slopes showing only very minor erosion.	9
ROAD/SIDEWALK/SHOULDER 0.50	Very minor curb/gutter cracking. No wall-related roadway distress.	9
TRAFFIC BARRIER/FENCE 0.50	Wooden fencing shows no sign of wall-related distress or deformation along the topline of the wall.	10
WALL DRAINS 1.00	None visible. Some migration of fill fines through 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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_1.992_R_1.jpg

LAVO_0010_1.992_R_2.jpg

Wall ID:	**LAVO-0010-3.192-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1972
***Wall Rating:**	84	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Slope Protection	**Primary Wall Type:**	Gravity - Dry Stone
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	
General Description:	Steep boulder fill acting as slope protection/retaining structure.		

Wall Measurements

Wall Length (ft.):	189	**Face Area (sq.):**	4000
Average Wall Height (ft.):	21	**Face Angle (deg.):**	50
Maximum Wall Height (ft.):	30	**Vertical Offset (ft.):**	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Bulging likely due to construction. No signs of road/shoulder settlement or displacement.	8
WALL FOUNDATION MATERIAL 8.00	Outcropping volcanic rock. Good foundation.	9
PLACED STONE 8.00	Large, hard durable boulders. Adequate construction. No significant rock displacement or missing elements.	8
VEGETATION 0.50	Minor bushes along wall face; no impact.	8
WALL DRAINS 0.50	None visible. Some soil migration through wall face and over top of wall.	8
DOWNSLOPE 0.50	Steep talus slope. Minor vegetation. Minor erosion to bedrock in some areas.	9
LATERAL SLOPE 0.50	Bedrock outcrop on one end. Stable talus/soil slope at other end.	9
ROAD/SIDEWALK/SHOULDER 0.50	No wall-related distress along paved roadway.	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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_3.192_R_1.jpg

LAVO_0010_3.192_R_2.jpg

Wall ID:	**LAVO-0010-3.233-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1972
***Wall Rating:**	84	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Slope Protection	**Primary Wall Type:**	Gravity - Dry Stone
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	
General Description:	Dry laid steep boulder slope protection.		

Wall Measurements

Wall Length (ft.):	39	**Face Area (sq.):**	500
Average Wall Height (ft.):	12	**Face Angle (deg.):**	53
Maximum Wall Height (ft.):	20	**Vertical Offset (ft.):**	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Apparent displacements likely due to construction. No signs of road or shoulder settlement or deformation.	8
WALL FOUNDATION MATERIAL 8.00	Outcropping rock abutments. Solid foundation. No erosion.	9
PLACED STONE 8.00	Large, hard, durable boulders, adequately placed. No visible rock displacement or missing elements.	8
VEGETATION 0.50	Minor bushes along wall face. No impact to wall.	8
WALL DRAINS 0.50	None visible. Some soil migration through wall face and over top of wall.	8
DOWNSLOPE 0.50	Steep talus slope with signs of minor water erosion. Very stable over bedrock.	9
LATERAL SLOPE 0.50	Bedrock outcrops on lateral slopes. Very stable.	9
ROAD/SIDEWALK/SHOULDER 0.50	No wall-related distress along paved roadway.	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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_3.233_R_1.jpg

Wall ID:	**LAVO-0010-3.610-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1982
***Wall Rating:**	79	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Fill Wall	**Primary Wall Type:**	Gravity - Gabion
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	
General Description:	Three tier gravity gabion wall with PVC-coated wire baskets.		

Wall Measurements

Wall Length (ft.):	53	**Face Area (sq.):**	371
Average Wall Height (ft.):	7	**Face Angle (deg.):**	50
Maximum Wall Height (ft.):	7	**Vertical Offset (ft.):**	-5

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Basket elements appear poorly constructed, but no global distress, foundation or roadway settlement evident.	9
WALL FOUNDATION MATERIAL 8.00	Rock fill; steep, but stable.	8
WIRE/GEOSYNTHETIC FACING 8.00	Bulging PVC-coated wire baskets (built that way). Minor corrosion on hog rings. Baskets are distorted, but stable.	7
ROAD/SIDEWALK/SHOULDER 0.50	No wall-related distress along roadway.	9
WALL DRAINS 0.50	None. Free draining. No signs of water distress.	9
LATERAL SLOPE 1.00	Steep fill. Bare slopes. Significant erosion at up-station end.	6
DOWNSLOPE 1.00	Steep rock fill with loose soil. Sparsely vegetated. Minor erosion downslope.	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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_3.610_R_1.jpg

LAVO_0010_3.610_R_2.jpg

Wall ID:	**LAVO-0010-5.790-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	2002
***Wall Rating:**	86	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Fill Wall	**Primary Wall Type:**	Other - Geogrid Reinforced Soi
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	
General Description:	Geogrid reinforced soil slope - 1:1 slope ratio.		

Wall Measurements

Wall Length (ft.):	162	**Face Area (sq.):**	1215
Average Wall Height (ft.):	7	**Face Angle (deg.):**	45
Maximum Wall Height (ft.):	9	**Vertical Offset (ft.):**	-1

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No global instability visible. Minor surficial erosion along slope face.	8
WALL FOUNDATION MATERIAL 8.00	Steep, bare-soil slope. No signs of slumping or settlement.	9
WIRE/GEOSYNTHETIC FACING 8.00	Geogrid extending from slope face is intact and appears to have been installed correctly. No torn/missing segments. Spacings are even and appropriate for slope. Functioning very well despite poor surface vegetation cover.	9
DOWNSLOPE 0.50	Steep, sparsely vegetated slope- though several large trees present. Very stable.	8
CURB/BERM/DITCH 0.50	Culvert pipe and riprap apron show no signs of erosion.	9
ROAD/SIDEWALK/SHOULDER 0.50	No signs of settlement or cracking along roadway or shoulder.	9
WALL DRAINS 1.00	None visible. Erosion rills down slope face from surface water roadway runoff (mostly sheet flow across superelevation at curve).	6
LATERAL SLOPE 1.00	Sparsley vegetated lateral slopes with minor surficial 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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_5.790_R_1.jpg

Wall ID:	**LAVO-0010-6.126-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	2002
***Wall Rating:**	93	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Fill Wall	**Primary Wall Type:**	Cantilever - Concrete
Surface Treatment:	Stain	**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	Sculpted Shotcrete
General Description:	Assumed concrete cantilever wall with sculpted shotcrete facing.		

Wall Measurements

Wall Length (ft.):	211	**Face Area (sq.):**	2215
Average Wall Height (ft.):	10	**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	No signs of global or settlement distress.	10
WALL FOUNDATION MATERIAL 8.00	Rock outcrops and stable placed rock fill. Very stable foundation.	9
CONCRETE 8.00	Concrete in this CL wall cannot be observed, but assumed no distress issues as no cracks are reflected in shotcrete facing or differential settlement along top of wall.	10
SHOTCRETE 8.00	Sculpted shotcrete is in excellent condition. Very minor cracking with minor efflorescence. No spalling.	10
LATERAL SLOPE 0.50	Placed rockfill and rock outcrops showing minor erosion.	8
DOWNSLOPE 0.50	Steep, rocky downslope. Very stable.	9
ROAD/SIDEWALK/SHOULDER 0.50	No wall-related distress. Very good condition.	9
TRAFFIC BARRIER/FENCE 0.50	No wall-related distress to movable guardwall on top of wall. No differential settlement observed.	9
ARCHITECTURAL FACING 0.50	Sculpted shotcrete looks near new. Stain is weathered. No spalling. Very minor cracking.	10

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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_6.126_R_1.jpg

LAVO_0010_6.126_R_2.jpg

Wall ID:	**LAVO-0010-6.166-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1960
***Wall Rating:**	89	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Slope Protection	**Primary Wall Type:**	Gravity - Dry Stone
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	
General Description:	Dry laid large boulder slope protection wall.		

Wall Measurements

Wall Length (ft.):	72	**Face Area (sq.):**	920
Average Wall Height (ft.):	12	**Face Angle (deg.):**	50
Maximum Wall Height (ft.):	17	**Vertical Offset (ft.):**	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Minor erosion along face. No global distress or signs of wall settlement or displacement.	9
WALL FOUNDATION MATERIAL 8.00	Rock outcrop, stable soils. Very stable foundation.	9
PLACED STONE 8.00	Large, intact, hard, durable boulders. Well placed. No missing elements.	9
WALL DRAINS 0.50	Free draining. Signs of silt migration through and over the top of the wall, though no sinkholing at top of wall evident.	8
LATERAL SLOPE 0.50	Retaining wall on one abutment. Rock outcrop on other abutment. Very stable.	9
ROAD/SIDEWALK/SHOULDER 0.50	No signs of wall-related distress.	9
TRAFFIC BARRIER/FENCE 0.50	No signs of wall-related distress.	9
VEGETATION 0.50	Very minor vegetation on wall face. No impact to wall.	9
DOWNSLOPE 1.00	Very steep, sparsely vegetated downslope with signs of minor surface 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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_6.166_R_1.jpg

Wall ID:	**LAVO-0010-6.191-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1960
***Wall Rating:**	84	**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 stone fill wall.		

Wall Measurements

Wall Length (ft.):	132	**Face Area (sq.):**	2410
Average Wall Height (ft.):	18	**Face Angle (deg.):**	65
Maximum Wall Height (ft.):	26	**Vertical Offset (ft.):**	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No signs of global distress or wall settlement. Minor bulging appears as constructed.	8
WALL FOUNDATION MATERIAL 8.00	Rock outcrop. Very stable.	9
PLACED STONE 8.00	Large, hard, durable boulders adequately placed. No significant missing stones.	8
DOWNSLOPE 0.50	Steep talus slope. No signs of slumping, sliding or erosion.	8
WALL DRAINS 0.50	None. Some soil migration over the top and through wall face. No significant water impacts to wall. No signs of sinkholing at top of wall.	8
LATERAL SLOPE 0.50	Rock outcrop on one end. Stable rock fill on other end.	9
ROAD/SIDEWALK/SHOULDER 0.50	No wall-related distress to roadway or shoulder.	9
VEGETATION 0.50	Minor vegetation in wall face. No impact to 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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_6.191_R_1.jpg

Wall ID:	**LAVO-0010-7.847-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	2008
***Wall Rating:**	100	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Head Wall	**Primary Wall Type:**	Cantilever - Concrete
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	Stone Veneer
General Description:	Mortared stone masonry faced culvert headwall. Under construction.		

Wall Measurements

Wall Length (ft.):	30	**Face Area (sq.):**	175
Average Wall Height (ft.):	5	**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	No distress.	10
WALL FOUNDATION MATERIAL 8.00	Rock fill, very stable.	10
CONCRETE 8.00	New, fresh.	10
MORTAR 8.00	New, fresh.	10
STONE MASONRY 8.00	Newly placed. Hard, durable, fresh.	10
ARCHITECTURAL FACING 0.50	Stone veneer is brand new.	10
CULVERT 0.50	Brand new, excellent condition.	10
DOWNSLOPE 0.50	Rockfill to gentle drainage.	10
LATERAL SLOPE 0.50	Rock fill and stable soils.	10

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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_7.847_R_1.jpg

Wall ID:	**LAVO-0010-7.847-L**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	2008
***Wall Rating:**	100	**Maintenance Action:**	No Action

Wall Description

Wall Function:	Head Wall	**Primary Wall Type:**	Cantilever - Concrete
Surface Treatment:		**Secondary Wall Type:**	
Secondary Surface Treatment:		**Architectural Facing:**	Stone Veneer
General Description:	Mortared stone masonry head wall with 5 foot diameter corrugated steel culvert.		

Wall Measurements

Wall Length (ft.):	32	**Face Area (sq.):**	155
Average Wall Height (ft.):	4	**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	No distress - new culvert.	10
WALL FOUNDATION MATERIAL 8.00	No signs of distress. Well founded on rock fill.	10
CONCRETE 8.00	New, fresh.	10
MORTAR 8.00	New, fresh.	10
STONE MASONRY 8.00	Newly placed. Hard, durable, fresh.	10
CULVERT 0.50	Brand new culvert. Excellent condition.	10
DOWNSLOPE 0.50	Asphalt paved inlet.	10
LATERAL SLOPE 0.50	Asphalt paved lateral slopes. Excellent condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	Newly paved. Excellent condition.	10

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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_7.847_L_1.jpg

Wall ID:	**LAVO-0010-13.132-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 20, 2008	**Approximate Year Built:**	Unknown
***Wall Rating:**	88	**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:	Mortared stone masonry headwall.		

Wall Measurements

Wall Length (ft.):	34	**Face Area (sq.):**	290
Average Wall Height (ft.):	8	**Face Angle (deg.):**	90
Maximum Wall Height (ft.):	11	**Vertical Offset (ft.):**	-2

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No signs of global distress or settlement deformation. No scour at wingwalls.	9
WALL FOUNDATION MATERIAL 8.00	Stable fill/colluvium. No signs of settlement or scour.	9
MORTAR 8.00	Hard, durable mortar, with minor cracking. Some minor sections of missing mortar. Generally intact and functioning very well.	8
STONE MASONRY 8.00	Strong, durable rock. Minor cracking in some blocks, but no significant spalling or weathering.	9
CULVERT 0.50	No signs of cracking or seepage around outlet. Could not see footing due to water flow.	9
DOWNSLOPE 0.50	Outlet channel is stable with no signs of erosion or downcutting toward culvert outlet.	9
VEGETATION 0.50	Minor vegetation at base of wall. No impact to wall performance.	9
LATERAL SLOPE 0.50	Recently graded throughout and armored with riprap on one end. Excellent condition.	10
ROAD/SIDEWALK/SHOULDER 0.50	Newly paved with graded shoulder. Excellent condition.	10

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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_13.132_R_1.jpg

Wall ID:	**LAVO-0010-13.133-L**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 20, 2008	**Approximate Year Built:**	Unknown
***Wall Rating:**	87	**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:	Mortared stone masonry headwall.		

Wall Measurements

Wall Length (ft.):	14	**Face Area (sq.):**	85
Average Wall Height (ft.):	6	**Face Angle (deg.):**	90
Maximum Wall Height (ft.):	6	**Vertical Offset (ft.):**	-1

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No signs of global distress or wall settlement.	9
WALL FOUNDATION MATERIAL 8.00	Stable colluvial/fill material. No scour/settlement indicated..	9
MORTAR 8.00	Minor cracking. Generally intact, hard, and durable.	8
STONE MASONRY 8.00	Hard, durable rock. No missing blocks.	9
CULVERT 0.50	No signs of seepage, headwall cracking or scour.	9
DOWNSLOPE 0.50	Stable inlet channel. No significant bank erosion.	9
LATERAL SLOPE 0.50	Well vegetated, gentle lateral slope. No signs of distress.	9
ROAD/SIDEWALK/SHOULDER 0.50	Newly paved. Excellent condition.	10
VEGETATION 1.00	Brush and one small tree growing at top of wall. Unchecked growth may impact wall in future.	5

Repair Recommendations

Failure Consequence:	HIGH
Recommendation Narrative:	Remove brush and small tree from top of headwall. Labor: 4 hours @ $55/hr = $220.00
Repair Cost:	$220

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

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_13.133_L_1.jpg

Wall ID:	**LAVO-0010-13.142-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 20, 2008	**Approximate Year Built:**	2008
***Wall Rating:**	100	**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 Veneer
General Description:	Mortared stone masonry faced cantilever wall. Recently constructed. 2 foot parapet above wall.		

Wall Measurements

Wall Length (ft.):	147	**Face Area (sq.):**	490
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	Excellent. No signs of global distress or structural distress.	10
WALL FOUNDATION MATERIAL 8.00	Firm soils, with no signs of settlement.	10
CONCRETE 8.00	New, fresh, strong, with no signs of construction quality issues.	10
MORTAR 8.00	Newly placed. Hard, durable, fresh.	10
STONE MASONRY 8.00	Newly placed. Hard, durable, fresh.	10
ARCHITECTURAL FACING 0.50	Stone veneer is brand new. No signs of distress.	10
CURB/BERM/DITCH 0.50	Curb shows no signs of settlement or cracking.	10
DOWNSLOPE 0.50	Gentle colluvial slope. Large trees below wall. Very stable.	10
LATERAL SLOPE 0.50	Gentle soil slopes. Recently graded. No signs of erosion. Riprap rundown at one end is new.	10

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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_13.142_R_1.jpg

LAVO_0010_13.142_R_2.jpg

Wall ID:	**LAVO-0010-22.114-L**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 20, 2008	**Approximate Year Built:**	Unknown
***Wall Rating:**	84	**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:	Mortared stone masonry headwall/wingwall at double-barrel concrete box culvert with 8 ft x 8 ft barrels. Secondary dry stack wing wall at one side above mortared wingwall.		

Wall Measurements

Wall Length (ft.):	56	**Face Area (sq.):**	350
Average Wall Height (ft.):	7	**Face Angle (deg.):**	90
Maximum Wall Height (ft.):	14	**Vertical Offset (ft.):**	-4

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No signs of global distress or settlement in the concrete boxes or wingwalls.	8
WALL FOUNDATION MATERIAL 8.00	Very stable soil/colluvium. No signs of scour or settlement.	9
MORTAR 8.00	Hard, durable mortar with minor cracking. Some seepage indicated by moss growth and minor staining.	8
PLACED STONE 8.00	Hard, durable, angular. Poorly placed, but locked together. No missing blocks.	8
STONE MASONRY 8.00	Hard, durable rock. No missing blocks.	9
ROAD/SIDEWALK/SHOULDER 0.50	No wall-related distress.	8
UPSLOPE 0.50	Gentle, bare-soil slope with no significant erosion.	8
CULVERT 0.50	8'x8' concrete boxes look near new. No distress.	9
DOWNSLOPE 0.50	Stable creek channel.	9

Repair Recommendations

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

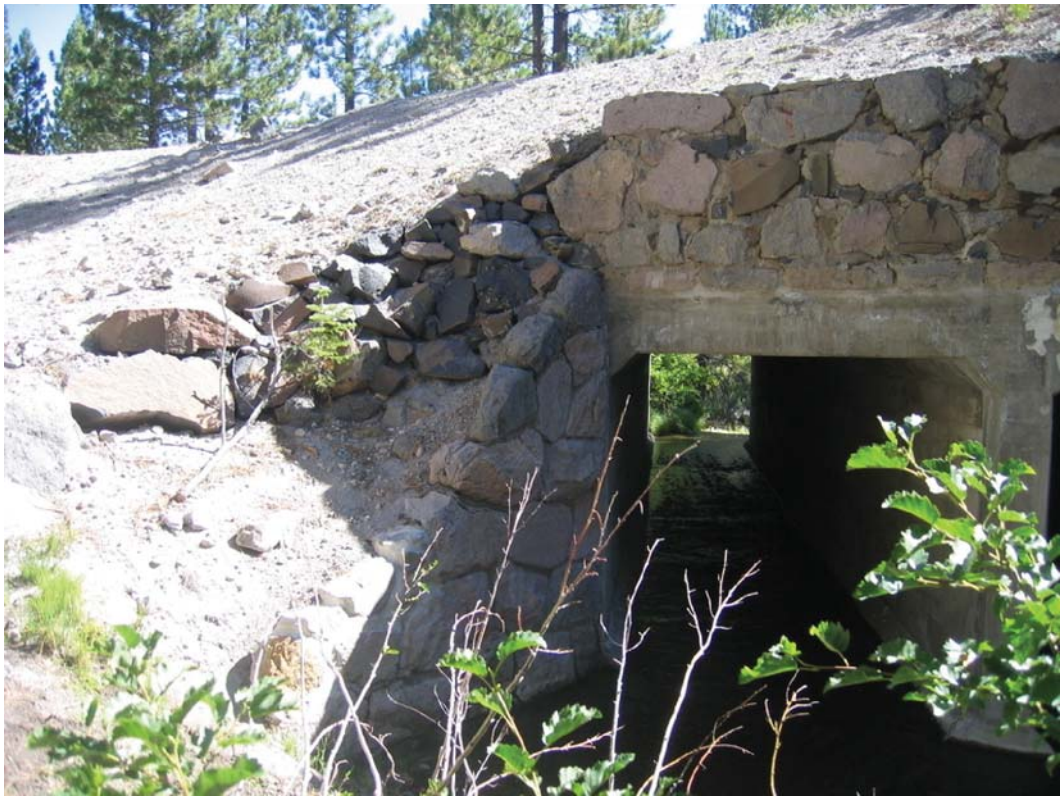
2007 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_22.114_L_1.jpg



LAVO_0010_22.114_L_2.jpg

Wall ID:	**LAVO-0010-22.123-R**		
Route Name:	LASSEN PARK ROAD		
Inspection Date:	August 20, 2008	**Approximate Year Built:**	Unknown
***Wall Rating:**	80	**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:	Mortared stone masonry headwall/wingwall at double-barrel concrete box culvert with 8x 8 barrels.		

Wall Measurements

Wall Length (ft.):	52	**Face Area (sq.):**	200
Average Wall Height (ft.):	3	**Face Angle (deg.):**	90
Maximum Wall Height (ft.):	12	**Vertical Offset (ft.):**	-6

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	No signs of global distress or settlement in the concrete boxes or wingwalls.	8
WALL FOUNDATION MATERIAL 8.00	Concrete box bottom extended beyond outlet, set on colluvial soils. Scouring below outlet apron is extensive, though it does not extend sufficiently deep to impacting head/wingwalls.	7
MORTAR 8.00	Hard, durable, intact mortar with only minor cracking. Minor seepage indicated by moderate moss growth and some staining.	8
STONE MASONRY 8.00	Hard, durable, no missing elements. No cracking or spalling.	9
DOWNSLOPE 0.50	Stable creek channel below outlet apron.	8
LATERAL SLOPE 0.50	Soft gentle slopes. Some hillside seepage, though well-vegetated and stable.	8
ROAD/SIDEWALK/SHOULDER 0.50	No settlement distress in roadway.	8
UPSLOPE 0.50	1.5H:1V non-vegetated soft soil, stable slope. No significant erosion.	8
CULVERT 0.50	8'x8' concrete boxes look near new. 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.

Lassen Volcanic National Park

ROUTE 0010: LASSEN PARK ROAD

Retaining Wall Condition Photos

LAVO_0010_22.123_R_1.jpg

LAVO_0010_22.123_R_2.jpg

Wall ID:	**LAVO-0902ZZ-0.000-P1**		
Route Name:	PARK HEADQUARTERS RANGER / MAINTENANCE PARKING AREAS		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1940
***Wall Rating:**	78	**Maintenance Action:**	Maintenance

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 stone wall.		

Wall Measurements

Wall Length (ft.):	280	**Face Area (sq.):**	1680
Average Wall Height (ft.):	6	**Face Angle (deg.):**	60
Maximum Wall Height (ft.):	7	**Vertical Offset (ft.):**	0

Assessed Elements

Element (Weighting Factor)	Narrative	Condition Rating (0 - 10)
PERFORMANCE 8.00	Minor rock displacement in face. No global movement. Minor toe bulging. No settlement.	7
WALL FOUNDATION MATERIAL 8.00	No signs of settlement or missing/eroded material. Ditch line at wall toe is fully functioning.	9
PLACED STONE 8.00	Hard, durable basalt rock. Minimal chinking with some silt migration through wall. No sinkholes at top of wall. Minor missing facing stones.	7
CURB/BERM/DITCH 0.50	Ditch line is stable, clear and functioning.	9
ROAD/SIDEWALK/SHOULDER 0.50	Roadway at toe has non-wall-related distress (patch work underway).	9
DOWNSLOPE 0.50	Ditch line at wall toe is stable. No signs of undercutting or scour.	10
LATERAL SLOPE 0.50	Minor side slopes with no signs of distress.	10
UPSLOPE 0.50	Nearly flat top slope with no signs of settlement or erosion issues.	10
VEGETATION 1.00	Substantial brush and a few small trees growing within on top and or below wall. Minor impacts. Needs clearing.	7

Repair Recommendations

Failure Consequence:	LOW
Recommendation Narrative:	Clear brush and small trees from wall face, ditch line, and along top of wall. Labor: 16 hours @ $55/hr. = $880.00
Repair Cost:	$880

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

Lassen Volcanic National Park

ROUTE 0902ZZ: PARK HEADQUARTERS RANGER / MAINTENANCE PARKING AREAS

Retaining Wall Condition Photos

LAVO_0902ZZ_0.000_P1_1.jpg

LAVO_0902ZZ_0.000_P1_2.jpg

Wall ID:	**LAVO-0908-0.000-P1**		
Route Name:	SULPHUR WORKS PARKING		
Inspection Date:	August 19, 2008	**Approximate Year Built:**	1965
***Wall Rating:**	93	**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:	Mortared stone masonry wall at parking area. Probably façade for concrete cantilever wall. Mortared stone guardwall parapet at top of wall.		

Wall Measurements

Wall Length (ft.):	235	**Face Area (sq.):**	890
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	No global or settlement issues. Minor full-height mortar cracking.	9
WALL FOUNDATION MATERIAL 8.00	Firm soil with excellent bearing. No displacement or significant settlement.	10
MORTAR 8.00	Minor shrinkage,/cracking. Generally hard, durable, and in-place.	9
STONE MASONRY 8.00	Minor cracked blocks. Some patching in the parapet. Very durable hard rock. No missing elements.	9
WALL DRAINS 0.50	Numerous weep holes along base of wall. Many are at soil line and partially filled, but still functioning well.	8
DOWNSLOPE 0.50	Moderate to gently dipping, stable soil slope. Modestly vegetated. No erosion.	9
TRAFFIC BARRIER/FENCE 0.50	Parapet shows no signs of wall-related distress. Minor patching due to weathering.	9
CULVERT 0.50	Culverts at bridge abutment are open, functioning as intended and show no signs of water-related distress.	10
LATERAL SLOPE 0.50	Bridge abutment at one end; very gentle, stable slope at other end.	10

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.

Lassen Volcanic National Park

ROUTE 0908: SULPHUR WORKS PARKING

Retaining Wall Condition Photos

LAVO_0908_0.000_P1_1.jpg

LAVO_0908_0.000_P1_2.jpg

Appendix A
Summary of WIP Definitions

Lassen Volcanic 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 ≥ 45˚ (≥ 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

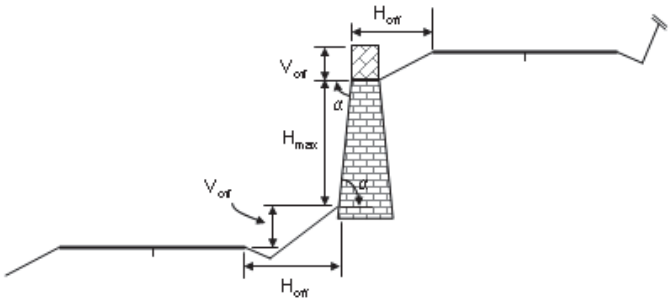
[**BV**] Brick Veneer	[**PF**] Planted Face	[**SS**] Simulated Stone
[**CO**] Cementitious Overlay	[**SC**] Sculpted Shotcrete	[**SV**] Stone Veneer
[**FF**] Fractured Fin Concrete	[**SH**] Shotcrete (nozzle finish)	[**TI**] Timber
[**FL**] Formlined Concrete	[**SM**] Steel/Metal	[**OT**] Other, User 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 *newly constructed or fabricated* 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.	**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.
		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.
		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.



H_{max}	Maximum exposed wall height, ft
V_{off}	Average vertical distance from pavement to cut wall toe or groundline at top of fill wall (+ above/ - below roadway), ft
H_{off}	Horizontal distance to wall face from edge of roadway, ft
α	Wall face angle measured from the horizontal, degrees
L	Maximum earth retaining length of the wall (excluding guardwalls). Wall length is the actual length of the structure, not simply the projected length along the roadway, ft