

# WICA WIP Report

## NPS Retaining Wall Inventory Program Wind Cave National Park



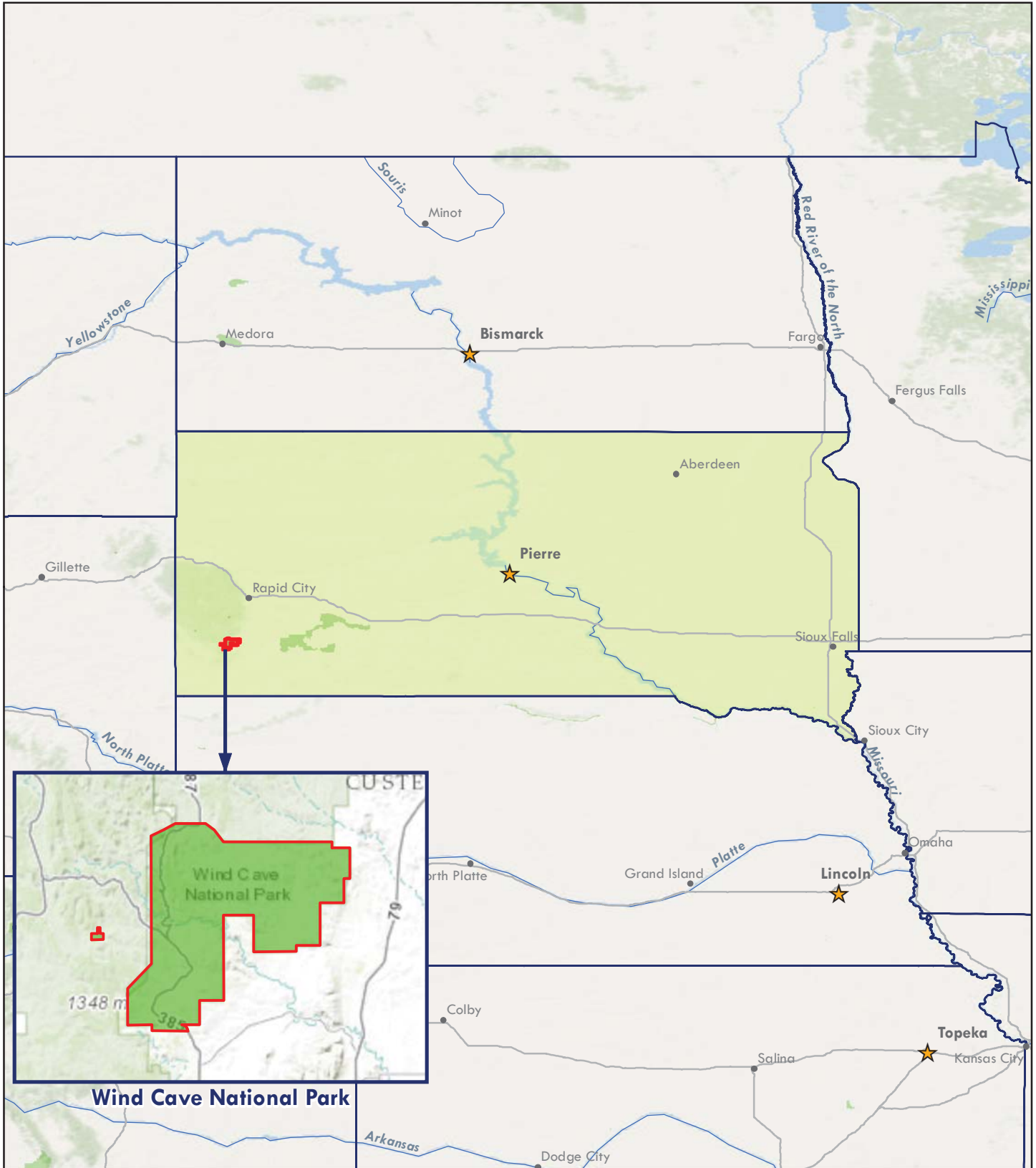
**Federal Lands Highway  
Road Inventory Program**

### Prepared By:

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

**Data Collection Date: November 2006  
Report Date: October 2015**

# Wind Cave National Park in South Dakota



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



## Wind Cave 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



Wind Cave National Park

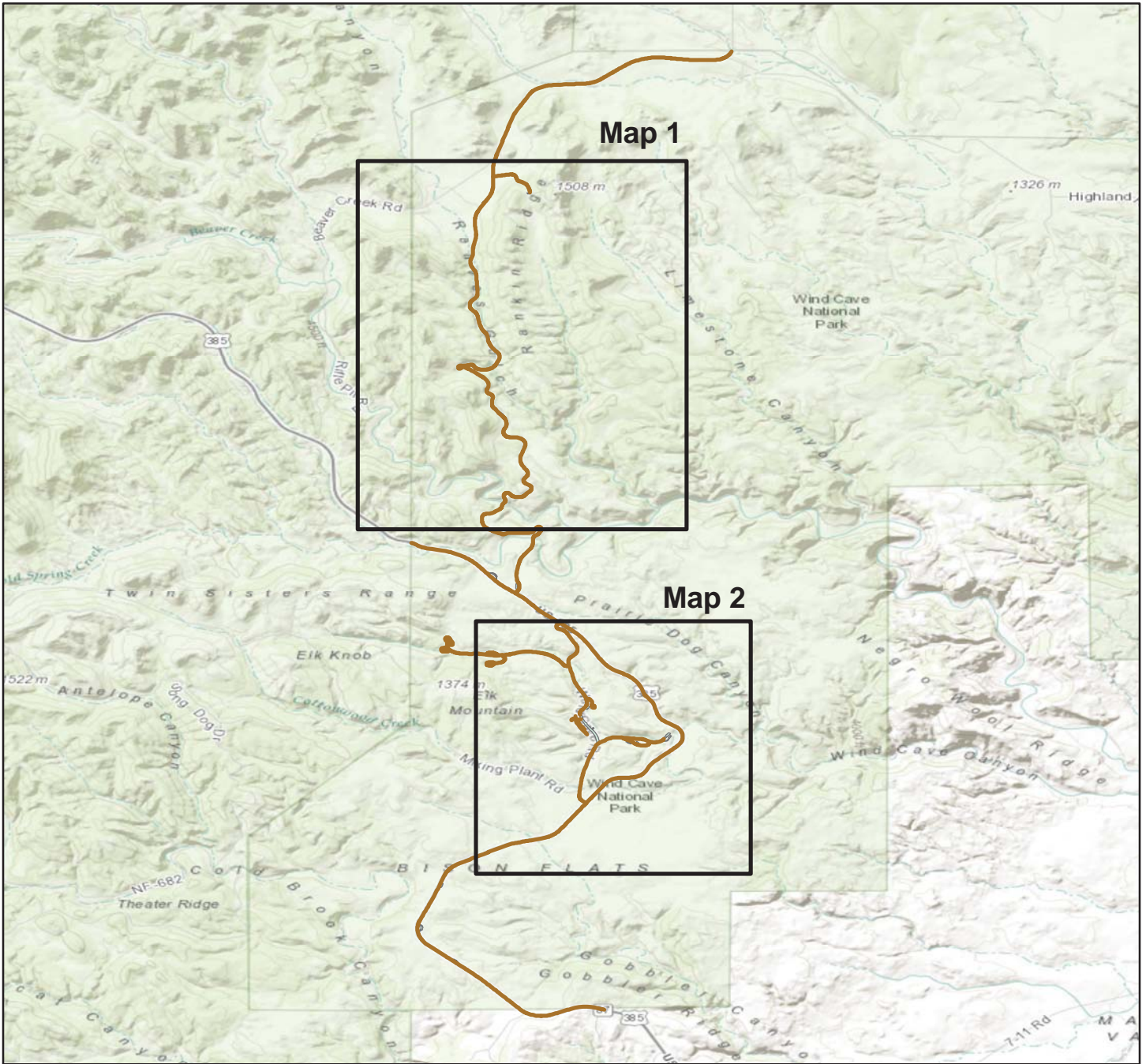


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# Wind Cave National Park

## 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



# Wind Cave National Park

## WALL LOCATION MAP

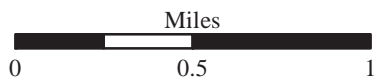
### Map 1



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

● Wall Locations

— RIP Collected Routes





# Wind Cave National Park

## WALL LOCATION MAP

### Map 2



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

- Wall Locations
- RIP Collected Routes



# Tier 1 Park Retaining Wall Overview



Wind Cave National Park



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## Parkwide Summary: Wind Cave National Park

Initial retaining wall inspections were conducted at Wind Cave National Park in 2006, and encompassed all known retaining wall structures associated with Park roadways - including structure's retaining cuts and fills, as well as qualifying headwalls at culverts. For the purposes of the assessment, walls must be a minimum of 4 feet in maximum height of retained earth and greater than 6 feet in maximum height for culvert headwalls. This does not include the height of parapet or guardwall above a retaining wall. In general, guardwall or parapets are not included in this assessment, but were inspected for Wind Cave 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, 11 walls were inventoried on the routes listed below.

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

<b>Route Number</b>	<b>Route Name</b>	<b>No. of Walls</b>
0011ZZ	VISITOR CENTER/CAVE ACCESS ROADS	4
0012	NORTH ENTRANCE ROAD (STATE HIGHWAY 87)	5
0900	VISITOR CENTER PARKING	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**

<b>Wall Function</b>	<b>No. of Walls</b>
BW - Bridge Wall	2
CW - Cut Wall	1
FW - Fill Wall	3
HW - Head Wall	5

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**

<b>Primary Wall Type</b>	<b>No. of Walls</b>
GC, Gravity - Mass Concrete	1
GD, Gravity - Dry Stone	7
GM, Gravity - Mortared Stone	3

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**

<b>Recommended Action</b>	<b>2007 Repair Costs*</b>	<b>No. of Walls</b>
No Action	\$0	3
Monitor	\$0	0
Maintenance	\$2,020	3
Repair Elements	\$60,575	4
Replace Elements	\$0	0
Replace Wall	\$19,125	1
<b>Totals</b>	<b>\$81,720</b>	<b>11</b>

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

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

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

<b>Cost Range*</b>	<b>No. of Walls</b>
\$0	3
\$1 - \$25,000	7
\$25,001 - \$50,000	1
\$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
<b>Total Number of Walls</b>	<b>11</b>

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

Routine inspection and performing the noted maintenance will greatly aid in the continued performance of all walls at Wind Cave 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 Wind Cave National Park that are on this list and have been elevated to the Park Regional Coordinators in a Regional Park Summary Memorandum. Generally, these are walls with major repair element recommendations that may be a priority for repair work in your park.

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

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

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

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

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

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

# Tier 2 Route Retaining Wall Overview



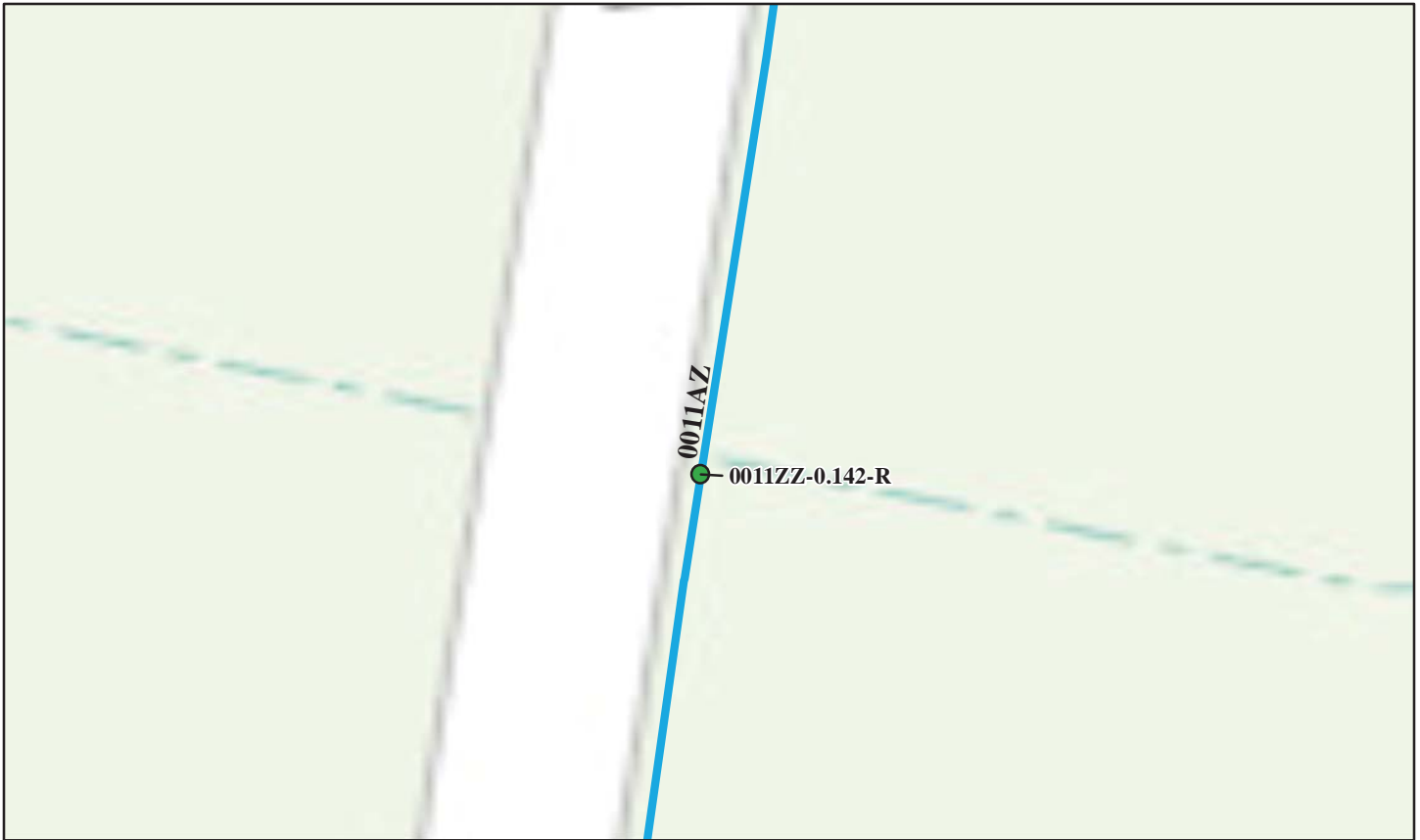
Wind Cave National Park



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# Wind Cave National Park

## ROUTE 0011ZZ: VISITOR CENTER/CAVE ACCESS ROADS



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
WICA-0011ZZ-0.142-R 11/15/2006	32	8	Gravity - Mortared Stone	Head Wall	84	\$1,020.00

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



# Wind Cave National Park

## ROUTE 0011ZZ: VISITOR CENTER/CAVE ACCESS ROADS



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
WICA-0011ZZ-0.025-R 11/14/2006	1,056	132	Gravity - Dry Stone	Fill Wall	52	\$45,000.00
WICA-0011ZZ-0.480-R 11/14/2006	32	8	Gravity - Mortared Stone	Head Wall	100	\$0.00
WICA-0011ZZ-0.676-R 11/13/2006	187	83	Gravity - Mortared Stone	Fill Wall	97	\$500.00

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

# Wind Cave National Park

## ROUTE 0012: NORTH ENTRANCE ROAD (STATE HIGHWAY 87)



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
WICA-0012-1.276-L 11/15/2006	37	12	Gravity - Dry Stone	Bridge Wall	91	\$800.00
WICA-0012-1.318-L 11/15/2006	110	11	Gravity - Dry Stone	Bridge Wall	94	\$0.00
WICA-0012-3.478-L 11/15/2006	136	39	Gravity - Dry Stone	Head Wall	69	\$11,175.00
WICA-0012-3.666-L 11/15/2006	255	85	Gravity - Dry Stone	Head Wall	60	\$19,125.00
WICA-0012-3.748-R 11/15/2006	52	13	Gravity - Dry Stone	Head Wall	94	\$500.00

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

# Wind Cave National Park

## ROUTE 0900: VISITOR CENTER PARKING



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

### 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
WICA-0900-0.000-P1  11/14/2006	160	64	Gravity - Mass Concrete	Cut Wall	97	\$0.00
WICA-0900-0.000-P2  11/14/2006	1282	135	Gravity - Dry Stone	Fill Wall	69	\$3,600.00

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

# Tier 3 Retaining Wall Details



Wind Cave National Park



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<b>Wall ID:</b>	WICA-0011ZZ-.025-R		
<b>Route Name:</b>	VISITOR CENTER/CAVE ACCESS ROADS		
<b>Inspection Date:</b>	November 14, 2006	<b>Approximate Year Built:</b>	1935
<b>*Wall Rating:</b>	52	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Wall repaired on south end in early 90s. Compound slope. Steeper at top below roadway. Flatter below. Lower wall acting as foundation for upper, steeper section.		

### Wall Measurements

<b>Wall Length (ft.):</b>	132	<b>Face Area (sq.):</b>	1056
<b>Average Wall Height (ft.):</b>	8	<b>Face Angle (deg.):</b>	50
<b>Maximum Wall Height (ft.):</b>	10	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Wall is failing but road supported by wall shows no distress. 15' section of wall failed and replaced in 1992.	5
WALL FOUNDATION MATERIAL 8.00	Lower wall section on steep, well vegetated foundation. Upper wall sections founded on lower wall which has raveled wall in several areas, causing undermining and loss of foundation support.	5
PLACED STONE 8.00	Loose overall. Failure in 3 areas, one of which was repaired. Existing areas 10'x20' and 8'x12'. Extensive raveling throughout.	4
DOWNSLOPE 0.50	in-place rock in some places. No distress.	10
LATERAL SLOPE 0.50	In-place rock	10
ROAD/SIDEWALK/SHOULDER 0.50	no distress	10
TRAFFIC BARRIER/FENCE 0.50	no distress	10
VEGETATION 0.50	Vegetation above upper wall (between wall and roadway) likely increasing stability by preventing erosion.	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Replace 2 failed wall sections. Use methods and materials similar to south end repair in 1992. Areas: 15x25 + 15x15 = 600sf. 600sf*\$75/sf = \$45,000 - used FHWA unit cost for rockery replacement.
<b>Repair Cost:</b>	\$45,000

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

# Wind Cave National Park

ROUTE 0011ZZ: VISITOR CENTER/CAVE ACCESS ROADS

## Retaining Wall Condition Photos



WICA\_0011ZZ\_0.025\_R\_1.jpg



WICA\_0011ZZ\_0.025\_R\_2.jpg

<b>Wall ID:</b>	WICA-0011ZZ-.142-R		
<b>Route Name:</b>	VISITOR CENTER/CAVE ACCESS ROADS		
<b>Inspection Date:</b>	November 15, 2006	<b>Approximate Year Built:</b>	1935
<b>*Wall Rating:</b>	84	<b>Maintenance Action:</b>	Maintenance

### Wall Description

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

### Wall Measurements

<b>Wall Length (ft.):</b>	8	<b>Face Area (sq.):</b>	32
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	9

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Overall in good condition.	8
WALL FOUNDATION MATERIAL 8.00	No distress	10
STONE MASONRY 8.00	Minor cracks in grout, stones intact. Minor grout loss.	8
CULVERT 0.50	2 culverts, one in headwall, both in good condition. Lower outlet partly blocked. Outlet erosion at upper culvert about 6-8" deep.	8
VEGETATION 0.50	Vegetation on and around wall - not impacting wall stability	8
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
LATERAL SLOPE 1.00	Erosion at side of wall caused by upper culvert outlet.	6

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Upper culvert outlet repair: Place 5cy armor stone at outlet for erosion control. 5cy*\$120/cy = \$620 - FHWA class 4 riprap unit cost. Repoint mortar: 32sf*\$6.5/sf = 240 - 2005 RSMMeans average unit cost. Veg Trim and clean culvert: 4 hrs misc labor
<b>Repair Cost:</b>	\$1,020

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

# Wind Cave National Park

ROUTE 0011ZZ: VISITOR CENTER/CAVE ACCESS ROADS

## Retaining Wall Condition Photos



WICA\_0011ZZ\_0.142\_R\_1.jpg



<b>Wall ID:</b>	WICA-0011ZZ--48-R		
<b>Route Name:</b>	VISITOR CENTER/CAVE ACCESS ROADS		
<b>Inspection Date:</b>	November 14, 2006	<b>Approximate Year Built:</b>	1935
<b>*Wall Rating:</b>	100	<b>Maintenance Action:</b>	No Action

### Wall Description

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

### Wall Measurements

<b>Wall Length (ft.):</b>	8	<b>Face Area (sq.):</b>	32
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	3

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Excellent condition.	10
WALL FOUNDATION MATERIAL 8.00	Good Condition	10
STONE MASONRY 8.00	Strong, unweathered rock, showing no signs of cracking or degradation. Mortar is sound, durable, and shows little or no signs of cracking or deterioration. Lower, older wall is sound and shows no signs of distress.	10
CULVERT 0.50	Good Condition	10
ROAD/SIDEWALK/SHOULDER 0.50	Good Condition	10

### Repair Recommendations

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

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

# Wind Cave National Park

ROUTE 0011ZZ: VISITOR CENTER/CAVE ACCESS ROADS

## Retaining Wall Condition Photos



WICA\_0011ZZ\_0.480\_R\_1.jpg

<b>Wall ID:</b>	WICA-0011ZZ--676-R		
<b>Route Name:</b>	VISITOR CENTER/CAVE ACCESS ROADS		
<b>Inspection Date:</b>	November 13, 2006	<b>Approximate Year Built:</b>	1935
<b>*Wall Rating:</b>	97	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Mortared Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	MP is for Route 11 intersection with unknown parking area immediately south of VC bldg. Retaining wall is on east side of this parking area.		

### Wall Measurements

<b>Wall Length (ft.):</b>	83	<b>Face Area (sq.):</b>	187
<b>Average Wall Height (ft.):</b>	2	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good.	10
WALL FOUNDATION MATERIAL 8.00	No distress	10
CONCRETE 8.00	Face is bulged and irregular but probably built that way. Two full height cracks that appear to penetrate through facing into concrete. Wall obscured by facing.	9
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
TRAFFIC BARRIER/FENCE 0.50	No deflection in fence above wall	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Seal 2 large full-height cracks with grout. Repoint smaller cracks as needed. 4 hrs*2crew*\$40/hr = \$320 - used CESS extra labor unit cost. NOTE: Default to minimum WO amount of \$500.
<b>Repair Cost:</b>	\$500

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

# Wind Cave National Park

ROUTE 0011ZZ: VISITOR CENTER/CAVE ACCESS ROADS

## Retaining Wall Condition Photos



WICA\_0011ZZ\_0.676\_R\_1.jpg

<b>Wall ID:</b>	WICA-0012-1.276-L		
<b>Route Name:</b>	NORTH ENTRANCE ROAD (STATE HIGHWAY 87)		
<b>Inspection Date:</b>	November 15, 2006	<b>Approximate Year Built:</b>	1929
<b>*Wall Rating:</b>	91	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Bridge Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Small wall on west side of south bridge abutment		

### Wall Measurements

<b>Wall Length (ft.):</b>	12	<b>Face Area (sq.):</b>	37
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	66
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Overall in very good condition.	10
WALL FOUNDATION MATERIAL 8.00	Erosion/void under high point of wall. Foundation slope steep, stable.	7
STONE MASONRY 8.00	Strong, unweathered rock, showing no signs of cracking or degradation. Mortar is sound, durable, and shows little or no signs of cracking or deterioration. Lower, older wall is sound and shows no signs of distress.	10
VEGETATION 0.50	Small shrub on wall	9
DOWNSLOPE 0.50	Stable fill	10
LATERAL SLOPE 0.50	Good Condition	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Dig out under wall, add large (2-3 man) foundation stones (1-3 stones) below wall high point. Trim vegetation on wall face. Use stones consistent with existing cultural fabric. Labor: 2 person crew for 8 hrs. Material cost unknown: Add 25% to labor cost
<b>Repair Cost:</b>	\$800

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

# Wind Cave National Park

ROUTE 0012: NORTH ENTRANCE ROAD (STATE HIGHWAY 87)

## Retaining Wall Condition Photos



WICA\_0012\_1.276\_L\_1.jpg

<b>Wall ID:</b>	WICA-0012-1.318-L		
<b>Route Name:</b>	NORTH ENTRANCE ROAD (STATE HIGHWAY 87)		
<b>Inspection Date:</b>	November 15, 2006	<b>Approximate Year Built:</b>	1929
<b>*Wall Rating:</b>	94	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Bridge Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Erosion protection for west side of north bridge abutment.		

### Wall Measurements

<b>Wall Length (ft.):</b>	11	<b>Face Area (sq.):</b>	110
<b>Average Wall Height (ft.):</b>	10	<b>Face Angle (deg.):</b>	50
<b>Maximum Wall Height (ft.):</b>	12	<b>Vertical Offset (ft.):</b>	4

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good condition and performance.	10
WALL FOUNDATION MATERIAL 8.00	Steep, erosion susceptible soil foundation. Probably shallow depth to bedrock	8
STONE MASONRY 8.00	Strong, unweathered rock, showing no signs of cracking or degradation. Mortar is sound, durable, and shows little or no signs of cracking or deterioration. Lower, older wall is sound and shows no signs of distress.	10
DOWNSLOPE 0.50	In-place rock	10
LATERAL SLOPE 0.50	In-place rock	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10

### Repair Recommendations

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

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

# Wind Cave National Park

ROUTE 0012: NORTH ENTRANCE ROAD (STATE HIGHWAY 87)

## Retaining Wall Condition Photos



WICA\_0012\_1.318\_L\_1.jpg



<b>Wall ID:</b>	WICA-0012-3.478-L		
<b>Route Name:</b>	NORTH ENTRANCE ROAD (STATE HIGHWAY 87)		
<b>Inspection Date:</b>	November 15, 2006	<b>Approximate Year Built:</b>	1935
<b>*Wall Rating:</b>	69	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Variable wall angle. Wall extends downgrade from headwall for approx 30 ft.		

### Wall Measurements

<b>Wall Length (ft.):</b>	39	<b>Face Area (sq.):</b>	136
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	3

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Likely repaired via stone replacement in the past. Poor wall condition not currently effecting roadway.	5
WALL FOUNDATION MATERIAL 8.00	Some foundation stones loose. Mostly in good condition.	9
PLACED STONE 8.00	Stones generally loose. Many missing/dislodged stones. Some slope erosion where stones are missing	6
CULVERT 0.50	Bottom and sides rusting out. Not adversely effecting wall.	8
VEGETATION 0.50	Vega on and in wall. Some adding to stability. Larger shrubs may be loosening wall stones	8
LATERAL SLOPE 0.50	Stable road fill	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
UPSLOPE 0.50	Stable, no distress.	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	North end of wall around culvert (headwall): Remove and replace 65sf of wall. Re-use existing stone. 65sf*\$75/sf = \$4875. South end of wall: Replace and reset stones as needed. Labor: 3 days for 2 person crew. Equipment: Backhoe 3 days, Possible dump truck
<b>Repair Cost:</b>	\$11,175

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

# Wind Cave National Park

ROUTE 0012: NORTH ENTRANCE ROAD (STATE HIGHWAY 87)

## Retaining Wall Condition Photos



WICA\_0012\_3.478\_L\_1.jpg



WICA\_0012\_3.478\_L\_2.jpg

<b>Wall ID:</b>	WICA-0012-3.666-L		
<b>Route Name:</b>	NORTH ENTRANCE ROAD (STATE HIGHWAY 87)		
<b>Inspection Date:</b>	November 15, 2006	<b>Approximate Year Built:</b>	1930
<b>*Wall Rating:</b>	60	<b>Maintenance Action:</b>	Replace Wall

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Variable face angle. Wall extends downgrade from headwall for approx 70 ft as fill support.		

### Wall Measurements

<b>Wall Length (ft.):</b>	85	<b>Face Area (sq.):</b>	255
<b>Average Wall Height (ft.):</b>	3	<b>Face Angle (deg.):</b>	80
<b>Maximum Wall Height (ft.):</b>	4	<b>Vertical Offset (ft.):</b>	2

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Wall failure impacting road edge and causing fill subsidence	4
WALL FOUNDATION MATERIAL 8.00	Erosion at culvert outlet causing minor undermining.	7
STONE MASONRY 8.00	Stones generally loose in wall face. Many stones missing. Animal traffic (Bison) causing stone loss.	6
CULVERT 0.50	Rusted, 1/2 to 2/3 full. Minimal effect on wall stability	9
LATERAL SLOPE 0.50	Stable road fill, settling slightly at road edge.	9
UPSLOPE 0.50	Stable, no distress.	10
VEGETATION 0.50	Vegetation on and above wall face. Likely adding to stability.	10
ROAD/SIDEWALK/SHOULDER 1.00	Over steepened shoulder/foreslope and pavement edge cracking along most of wall length.	7

### Repair Recommendations

<b>Failure Consequence:</b>	LOW
<b>Recommendation Narrative:</b>	Remove and replace wall salvaging all existing stone in the wall and nearby stone that has fallen from the face. Any new stone used should be similar in character to existing stone. Although not part of this WO, consider replacing the culvert at the sam
<b>Repair Cost:</b>	\$19,125

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

# Wind Cave National Park

ROUTE 0012: NORTH ENTRANCE ROAD (STATE HIGHWAY 87)

## Retaining Wall Condition Photos



WICA\_0012\_3.666\_L\_1.jpg



WICA\_0012\_3.666\_L\_2.jpg

<b>Wall ID:</b>	WICA-0012-3.748-R		
<b>Route Name:</b>	NORTH ENTRANCE ROAD (STATE HIGHWAY 87)		
<b>Inspection Date:</b>	November 15, 2006	<b>Approximate Year Built:</b>	1935
<b>*Wall Rating:</b>	94	<b>Maintenance Action:</b>	Maintenance

### Wall Description

<b>Wall Function:</b>	Head Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Granite pieces used in wall construction (unusual)		

### Wall Measurements

<b>Wall Length (ft.):</b>	13	<b>Face Area (sq.):</b>	52
<b>Average Wall Height (ft.):</b>	4	<b>Face Angle (deg.):</b>	65
<b>Maximum Wall Height (ft.):</b>	6	<b>Vertical Offset (ft.):</b>	5

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Good condition.	10
WALL FOUNDATION MATERIAL 8.00	No distress.	10
PLACED STONE 8.00	Minor voids in wall face	8
CULVERT 0.50	3.5'X5' elliptical. Minor rusting.	9
LATERAL SLOPE 0.50	Stable road fill	10
ROAD/SIDEWALK/SHOULDER 0.50	No distress	10
UPSLOPE 0.50	Good condition.	10

### Repair Recommendations

<b>Failure Consequence:</b>	LOW	
<b>Recommendation Narrative:</b>	Place chinking stones in minor voids in wall face as needed. Use stones salvaged on site. Labor: 6hrs*1crew = 6hrs. Material: Incidental to labor. 6hrs*\$40/hr = \$240 Used CESS extra labor cost. Use \$500 minimum WO cost	
<b>Repair Cost:</b>	\$500	

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

# Wind Cave National Park

ROUTE 0012: NORTH ENTRANCE ROAD (STATE HIGHWAY 87)

## Retaining Wall Condition Photos



WICA\_0012\_3.748\_R\_1.jpg

<b>Wall ID:</b>	WICA-0900-0-P1		
<b>Route Name:</b>	VISITOR CENTER PARKING		
<b>Inspection Date:</b>	November 14, 2006	<b>Approximate Year Built:</b>	1979
<b>*Wall Rating:</b>	97	<b>Maintenance Action:</b>	No Action

### Wall Description

<b>Wall Function:</b>	Cut Wall	<b>Primary Wall Type:</b>	Gravity - Mass Concrete
<b>Surface Treatment:</b>	Other - Colored grout over mesh	<b>Secondary Wall Type:</b>	
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	MP is for intersection with unknown parking area immediately south of the VC bldg. Wall is on west side of parking area.		

### Wall Measurements

<b>Wall Length (ft.):</b>	64	<b>Face Area (sq.):</b>	160
<b>Average Wall Height (ft.):</b>	2	<b>Face Angle (deg.):</b>	90
<b>Maximum Wall Height (ft.):</b>	5	<b>Vertical Offset (ft.):</b>	1

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Very good condition.	10
WALL FOUNDATION MATERIAL 8.00	No distress	10
CONCRETE 8.00	Bulged and irregular face but probably built that way (virtually no other distress that would indicate post construction distortion). Two full height cracks in surface grout that appear to penetrate into wall.	9
ROAD/SIDEWALK/SHOULDER 0.50	no distress	10
TRAFFIC BARRIER/FENCE 0.50	No deflection	10

### Repair Recommendations

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

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

**Wind Cave National Park**  
**ROUTE 0900: VISITOR CENTER PARKING**

**Retaining Wall Condition Photos**



**WICA\_0900\_0.000\_P1\_1.jpg**



<b>Wall ID:</b>	WICA-0900-0-P2		
<b>Route Name:</b>	VISITOR CENTER PARKING		
<b>Inspection Date:</b>	November 14, 2006	<b>Approximate Year Built:</b>	1935
<b>*Wall Rating:</b>	69	<b>Maintenance Action:</b>	Repair Elements

### Wall Description

<b>Wall Function:</b>	Fill Wall	<b>Primary Wall Type:</b>	Gravity - Dry Stone
<b>Surface Treatment:</b>		<b>Secondary Wall Type:</b>	Gravity - Mortared Stone
<b>Secondary Surface Treatment:</b>		<b>Architectural Facing:</b>	
<b>General Description:</b>	Route 11 parallels PA 900C. Milepost are referenced to route 11 but wall is in 900C. Face angle is highly variable and compound in several portions of the wall.		

### Wall Measurements

<b>Wall Length (ft.):</b>	135	<b>Face Area (sq.):</b>	1282
<b>Average Wall Height (ft.):</b>	10	<b>Face Angle (deg.):</b>	60
<b>Maximum Wall Height (ft.):</b>	17	<b>Vertical Offset (ft.):</b>	0

### Assessed Elements

<b>Element (Weighting Factor)</b>	<b>Narrative</b>	<b>Condition Rating (0 - 10)</b>
PERFORMANCE 8.00	Evidence of repair to foundation, upper wall, culvert and spillway.	7
WALL FOUNDATION MATERIAL 8.00	Previous sloughing likely. Evidence of concrete repairs. Toe is steep.	7
STONE MASONRY 8.00	Large voids in grout in several areas. Missing chinking in dry laid portions of wall. Face bulged near 12" culvert in upper portion of south end of wall.	7
DOWNSLOPE 0.50	No distress. Steep but well vegetated	8
WALL DRAINS 0.50	6" pipe drains present. 12" culvert w/concrete spillway. Drains in good condition, spillway breaking up but currently functional.	8
ROAD/SIDEWALK/SHOULDER 0.50	7.5 ft concrete sidewalk in good condition	10
VEGETATION 1.00	Small juniper and other brush growing from wall face. Beginning to dislodge wall stones	6

### Repair Recommendations

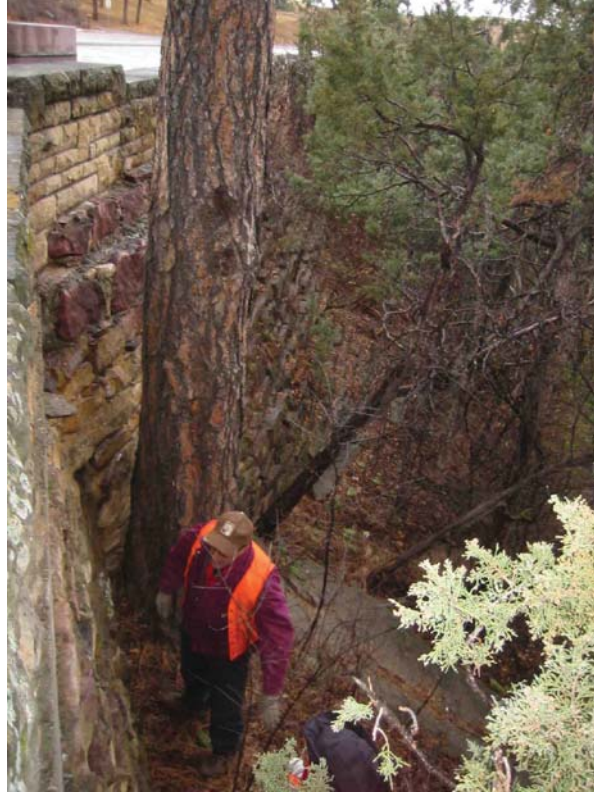
<b>Failure Consequence:</b>	MODERATE
<b>Recommendation Narrative:</b>	Remove vegetation from wall face. Rechink large voids in dry laid stone. Repoint/fill large voids in mortared stone. Use stone chinking material consistent with existing stone face. Masonry labor: 2 person crew for 4 days = 64hrs.
<b>Repair Cost:</b>	\$3,600

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

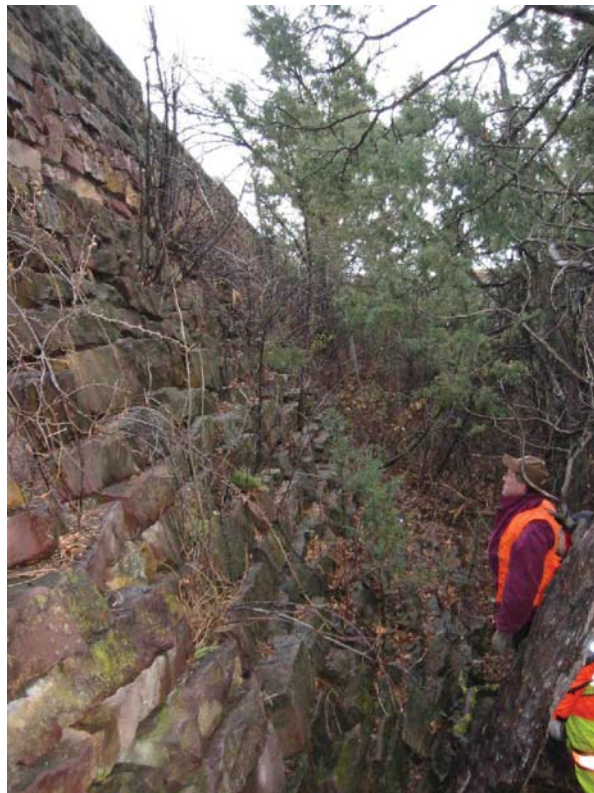
# Wind Cave National Park

## ROUTE 0900: VISITOR CENTER PARKING

### Retaining Wall Condition Photos



WICA\_0900\_0.000\_P2\_1.jpg



WICA\_0900\_0.000\_P2\_2.jpg

# Appendix A

## Summary of WIP Definitions



Wind Cave National Park



**Federal Lands Highway  
Road Inventory Program**

# **Appendix A**

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

## **Wall Naming Convention**

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

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

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

**Retaining Wall Acceptance Criteria**

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

**Definitions**

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

**Wall Function Codes**

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

**Wall Type Codes**

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

**Architectural Facing Type Codes**

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

**Surface Treatment Codes**

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

**Condition Ratings**

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

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

**Wall Performance Condition Ratings**

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

