

CHAPTER 2 – DATA COLLECTION PROCESS AND PROCEDURES

As previously mentioned, the Wall Inventory Program has aspects resident within both the FHWA Federal Lands Highway program and the National Park Service. FLH is responsible for collecting, documenting, storing and transmitting wall assessment data to the NPS who, in turn, is responsible for incorporating the information within the FMSS asset management system. With that in mind, this chapter is devoted to describing FLH data management processes and procedures; NPS FMSS processes and procedures are beyond the scope of this Procedures Manual, and are documented elsewhere. The following subsections outline the standards for performing wall inventory tasks, and are broken into four primary categories: (1) pre-field activities, (2) field assessment activities, (3) post-field activities, and (4) data management activities.

2.1 GENERAL INVENTORY AND ASSESSMENT PROCESS

Figure 4 identifies the four primary categories of activities comprising the Wall Inventory Program, and lists specific activities under each.

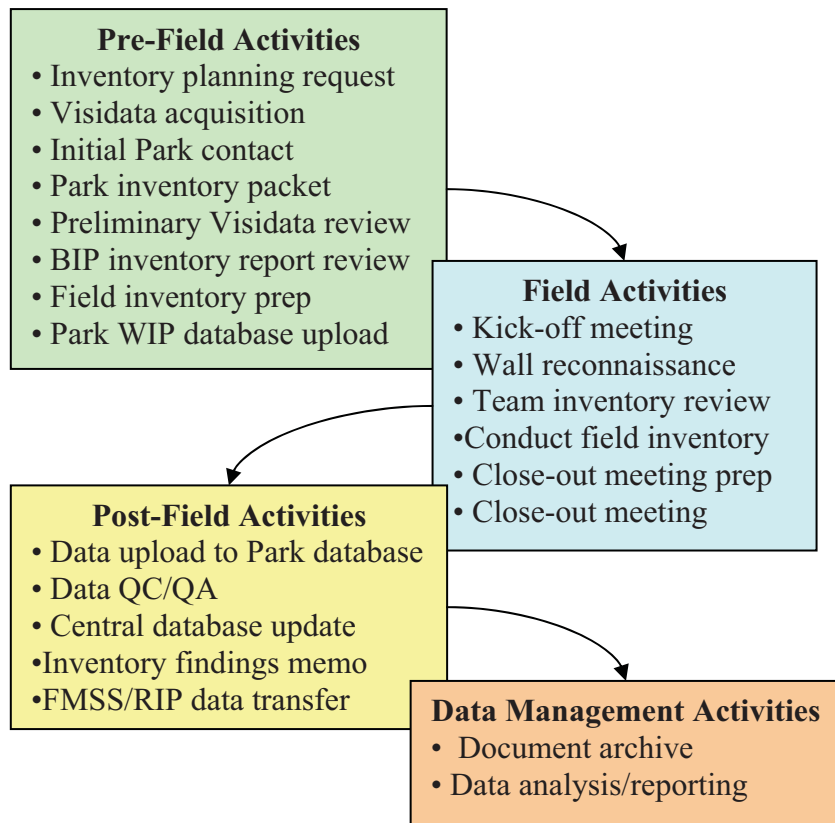


Figure 4. Graphic. Key activities within the four basic activities categories comprising the FLH Wall Inventory Program.

Pre-field activities generally include coordinating park inventory planning and information gathering, acquisition and review of Road Inventory Program (RIP) and Visidata information, assembling/checking required field equipment and inventory forms, and uploading the Park WIP Database from the Database Administrator. Field activities include holding a kick-off meeting with park facility, maintenance and/or FMSS staff; performing as-needed wall reconnaissance with knowledgeable park maintenance staff; conducting initial “calibration” wall inventories with team members to ensure consistency amongst the teams; conducting the remainder of the wall inventory (and interim database uploads); conducting a team review meeting to prepare for the park close-out meeting; and, finally, holding a close-out meeting with park facilities management. Post-field activities include uploading field data to the Park WIP Database (if not already completed in the field), updating the Central WIP Database, and submitting general findings to the park. Finally, data management activities include transferring FMSS data to and requesting data from the park FMSS coordinator, transferring final wall feature data to the RIP system, managing data archives, and responding to requests for database queries and reports.

Responsibilities for managing, completing and communicating each of these tasks falls to the FLH WIP Program Manager, Database Administrator, and/or Team Lead, as described in the following subsections. Providing consistent, high-quality field inventories, and ensuring the long-term security and accessibility of park wall data requires all contributors be fully trained on inventory procedures and program delivery expectations.

2.2 PRE-FIELD ACTIVITIES AND PROCEDURES

Several planning and coordination tasks need to be completed prior to arriving at the park. The success and expediency of field efforts hinges on the timely completion of each task, follow-up with inventory team and park personnel, and overall attention to detail. Pre-field activities goals include:

- Determining the early scope and schedule of the on-site wall inventory effort;
- Establishing roles and responsibilities of both inventory team and park personnel, generally pertaining to pre-site wall information collection, on-site reconnaissance support, and field inspection safety requirements; and
- Developing early site data to be included in the inventory, including route names and locations, estimated number of walls and their approximate locations and ages, general wall types and conditions, and cultural resource information.

The following subsections describe pre-field activities, identify responsible parties for task management and completion, and provide approximate task start times and durations prior to arriving at the park. Associated documents and forms referenced within the following subsections are available in Appendices A and B. Definitions of wall attributes, elements and location descriptors associated with the field forms referenced in this section are provided in subsequent chapters.

2.2.1 Inventory Planning Request

All park inventory work is requested by the NPS WIP Program Manager, with field inventory scheduling and staffing coordinated through the FLH WIP Program Manager. The FLH WIP

Program Manager is responsible for efficiently managing the WIP field program and scheduling inventories and resources to take best advantage of seasonal park access, personnel availability, and potential inventory economies, such as combining trips to nearby parks.

One to two months prior to site work, the FLH WIP Program Manager assigns a Team Lead and support staff to the inventory, and directs the Team Lead to initiate inventory planning with the park Superintendent and Facilities Manager. At the same time, the Program Manager notifies the Database Administrator of the tentatively scheduled inventory. From this point forward, the Team Lead is the primary party responsible for organizing and directing field teams, conducting the wall inventory/assessment, providing compiled field data to the Database Administrator, and delivering findings to park management

2.2.2 Visidata Acquisition

At the request of the Team Lead, and at least one month prior to site work, the Database Administrator requests the FLH Road Inventory Program Administrator to provide for each field team an external hard-drive loaded with the complete Visidata files for the park to be inventoried, as well as .pdf versions of the full RIP Route Inventory Report and associated Route Identification and Intersections listings (RIP Route listing example is provided in Appendix A). The Database Administrator quality checks the hard-drive files to ensure all reports are uploaded and all routes are available and viewing-operational in Visidata. The Team Lead further checks that each team has laptop resources loaded with the Visidata software, the hard-drives and park Visidata files are fully functional on each laptop, and team members are skilled in the use of Visidata and the identification/interpretation of WIP-required data.

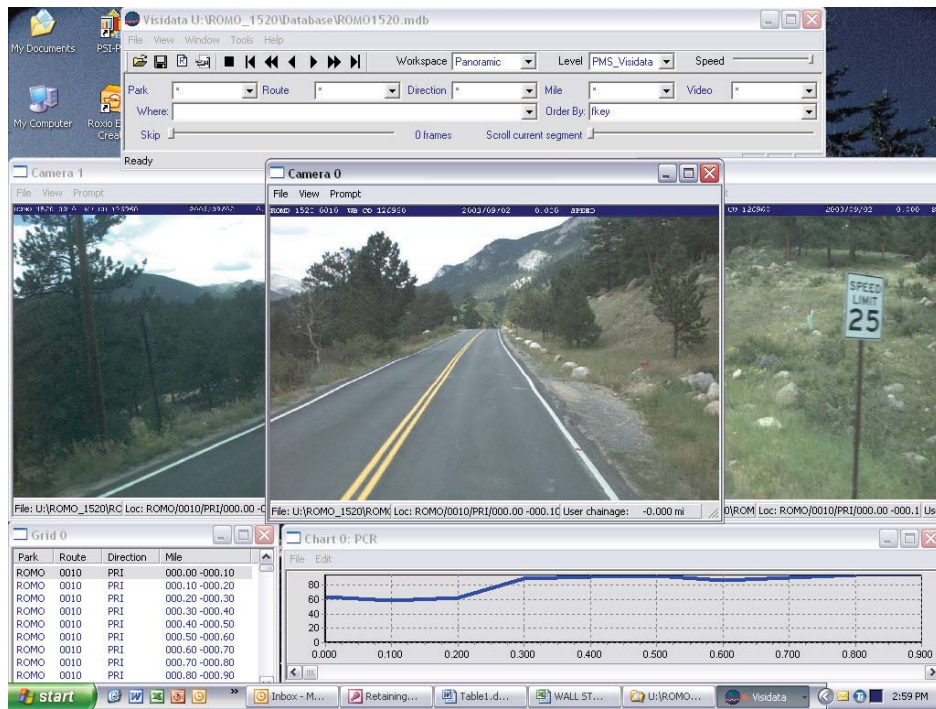


Figure 5. Graphic. Typical Visidata screen showing roadway video, milepoints, features, etc.

It should be noted that virtually all of the initial 32 parks inventoried in Phase 3 employed Visidata Cycle 3 road survey data. Future inventories will employ Cycle 4 roadway surveys. Cycle 4 will have milepoint reference changes to many, if not all, routes to eliminate rolling starts captured in Cycle 3. This survey change will result in variances to previously recorded wall start milepoints. The RIP version being used should be noted in all inventory documentation and the Park WIP Database, and wall milepoint locations should be updated during all future inspections (crosswalk of WIP data to Cycle 4 is underway now).

2.2.3 Initial Park Contact

One month prior to site work, the Team Lead contacts the park Superintendent and Facilities Manager to discuss the following:

- Authority, scope, processes, deliverables and general roles and responsibilities;
- Specific criteria defining park retaining wall structures to be inventoried;
- Tentative park inventory scheduling – respective of park commitments – including date, time and location of the park kick-off meeting (, anticipated duration of the field inventory, approximate date of the close-out meeting;
- Request for park personnel assistance, including pre-site questionnaire response, kick-off meeting attendance, wall reconnaissance support, traffic control support, and close-out meeting attendance;
- Listing of FLH and park personnel to conduct/support the wall inventory, including inventory team members, park FMSS and maintenance personnel knowledgeable in the park road construction history, etc.;
- Safety issues pertaining to safety planning and coordination, traffic control requirements, time-of-year traffic issues, wall access requirements, and potential wall/slope hazards;
- General listing of RIP and non-RIP routes and parking areas with retaining walls;
- Estimated number of walls in the park, and approximate locations;
- General types, sizes and ages of walls present, if known;
- General condition of walls, particularly noting recent or pending wall failures, substantive/recurring maintenance/repair, etc.;
- Acquisition of existing FMSS wall data, including wall locations, wall geometrics, equipment numbers and maintenance-repair-replace recommendations/costs;
- Cultural and environmental resource aspects of retaining walls and associated roadway corridors, including availability of supporting documentation and recommended park personnel contacts; and
- Availability of wall documentation, including as-builts, repair histories, cost data, and park-developed wall inventories.

Fully documenting each of these items is critical to a well-planned and successful field inventory. To assist the Team Lead in collecting this vital information during the interview, a “Pre-Inventory Phone Interview Checklist” is provided in Appendix A. Before closing the interview, the Team Lead should notify park management that an information request packet will be sent to them, including a cover letter recapping the scope and scheduling of the wall inventory, a draft kick-off meeting agenda, and a brief questionnaire regarding wall resources within the park (all of which is described under the next subsection).

Before wall assessments can be conducted, the inventory team needs to first locate qualifying earth retaining structures (as defined in Chapter 3 – Wall Inventory Criteria and Guidelines). The initial phone interview, and subsequent discussions with park personnel prior to arriving on site, is the first stage of a four-stage process to locate wall assets within the park. Phone interviews are followed by more detailed requests for wall counts and locations in the park wall inventory packet. Concurrent with the park request for information, an office review is conducted, including RIP route reports, Visidata video files, FLH Bridge Inventory Program (BIP) data, and available FLH as-builts. Finally, a pre-inventory park reconnaissance is undertaken following the kick-off meeting. Each stage helps to further identify and refine wall locations and draws on the several resources available to the program, including (1) park management, maintenance, and cultural staff experience; (2) existing park cultural resource and construction reports; (3) “home-grown” wall resource inventories; (4) previously compiled FMSS information; and (5) historic as-builts. Communicating this wall location process to park management during the initial phone interview is critical to engaging appropriate park personnel in the inventory planning process and, ultimately, developing a comprehensive wall inventory.

Although wall location information is requested prior to the site visit, it is not uncommon for park staff to provide this information for the first time at the kick-off meeting.

2.2.4 Park Wall Inventory Packet

Immediately following the initial phone interview with park management, the Team Lead submits the following information packet and data request to the park Superintendent and Facilities Manager:

Cover Letter: As a formal follow-up to the phone interview, the authorization, purpose, scope, and proposed schedule for park inventory work are covered in a brief notification letter. In addition, park support is also solicited in compiling available wall information, completing the enclosed wall resources questionnaire, participating in on-site kick-off and close-out meetings, providing knowledgeable staff for wall reconnaissance, and assisting with traffic control and related wall access safety requirements. An example cover letter is provided in Appendix A.

Kick-Off Meeting Agenda: A draft kick-off meeting agenda is enclosed in the packet to ensure appropriate park staff are invited to the meeting and engaged at the onset of the field inventory. An example of the meeting agenda is provided in Appendix A, and is fully discussed in Subsection 2.3.1.

WIP Retaining Wall Questionnaire Form: Also enclosed in the packet is a brief retaining wall resource questionnaire to be circulated amongst knowledgeable park staff. The intent of the questionnaire, discussed during the initial phone interview, is to provide general wall information based on available knowledge; it is *not* a request for park personnel to formally recon, locate and/or describe walls prior to inventory team arrival. The information should be transmitted to the Team Lead prior to inventory team arrival at the park. At a minimum, the park should be prepared to discuss the requested information at the time of the kick-off meeting. An example of an appropriately completed questionnaire is provided in Appendix A. The questionnaire requests the following general information:

- (1) What is the estimated number of walls in the park, and their approximate age?
- (2) What specific routes/parking areas have retaining walls, and approximately where are they located along the route?
- (3) Have any repairs been done to retaining walls, and is cost/repair data available?
- (4) Do any cultural resource issues exist pertaining to walls, and is related information available?
- (5) Does the park maintain any type of wall inventory or structures database?
- (6) Are there any walls with serious problems, and where are they approximately located?



Figure 6. Photo. Multi-tiered soil nail wall under construction with decorative modular block facing. Without input from knowledgeable park staff, the wall inventory might overlook the soil nail reinforcing elements when evaluating the completed structure.

2.2.5 Preliminary RIP and Visidata Review

Following delivery of the full RIP Route Inventory Report and Visidata roadway video files, and prior to the site visit, the Team Lead (and other key team members, as appropriate) should review the available route/parking area information to further identify known and suspected wall locations. Numbered/named routes included in RIP and Visidata should be cross-checked with those noted during the phone interview and/or provided in the subsequent questionnaire sent to the park to identify routes and parking areas not covered by the RIP survey. Walls listed in the RIP Route Inventory Report roadway/parking area features tables and those located during a review of the Visidata video files should be logged on the Visidata Retaining Wall Location Form for quick reference once on site. An example of the Visidata form is provided in Appendix A. Wall information to be collected on this form includes:

- RIP route/parking area name and/or number, or park-designated route/parking area name if not in RIP;
- Side of road in which the wall is located when traveling in the direction of increasing RIP milepoints (or approximate location within the parking area);
- Approximate Visidata wall start and end milepoints (if available);

- Apparent wall function (e.g., fill wall, cut wall, etc.);
- Apparent wall type (e.g., MSE, crib, bin, soldier pile, etc.); and
- Comments regarding wall accessibility, general wall condition, etc.

Definitions for wall attributes, elements, and location descriptors are provided in subsequent chapters of this Procedures Manual. A copy of the Visidata Quick Start Guide, included in the required field documents list, but useful when conducting in-office Visidata reviews, is provided in Appendix B.

2.2.6 Field Inventory Prep

To ensure the inventory team is fully prepared, the Team Lead should hold a planning meeting 1-2 weeks prior to site work to review the wall information collected to date, plan for efficient route inventory scheduling, and discuss personal safety issues unique to the park environment (terrain, weather, insects, poisonous plants/animals, tourist traffic, etc.). The team should also review the following WIP information/equipment checklist (provided in Appendix A) to ensure *each team* is fully equipped for field inventory work:

Electronic Files

- WIP team and park contacts
- Park-provided wall inventory information and reports
- Visidata software uploaded to laptops (and tested)
- Park Visidata video files loaded to external hard drives (and tested)
- Visidata Retaining Wall Location Form (preliminary wall location information)
- Visidata Quick Start Guide
- Park WIP Database (Microsoft Access and supplemental programs loaded onto laptops and tested)
- WIP Field Inspection Forms
- WIP Field Guide
- WIP Cost Guide
- WIP Procedures Manual
- RIP Route Inventory Report (complete report – electronic file is backup to hard copy)
- RIP Route Identification Report (summary route listing)
- RIP Intersection Report

Hard Documents

- WIP Procedures Manual
- WIP Pre-Inventory Interview Checklist (phone interview notes)
- Park-provided wall inventory information and reports
- Park notification letter
- WIP Kick-Off Meeting Agenda (several copies for the meeting)
- WIP Retaining Wall Questionnaire (several copies, blank or what the park provided)
- Visidata Retaining Wall Location Form (preliminary wall location information)
- WIP Retaining Wall Reconnaissance Forms (several blank for field recon)
- WIP FMSS Data – Manual Input Procedure and Test Guide (copies for the park)
- FMSS Specification Data Template spreadsheet (several copies for meeting)
- Visidata Quick Start Guide

- RIP Route Inventory Report (complete report)
- RIP Route Identification Report (summary route listing)
- RIP Intersection Report
- BIP bridge inventory listing (with bridge numbers/names)
- WIP Field Inspection Forms (2x the anticipated number of walls, “Rite-in-the-Rain” paper)
- WIP Field Guide
- WIP Cost Guide (current year version)
- Park maps (from park website)

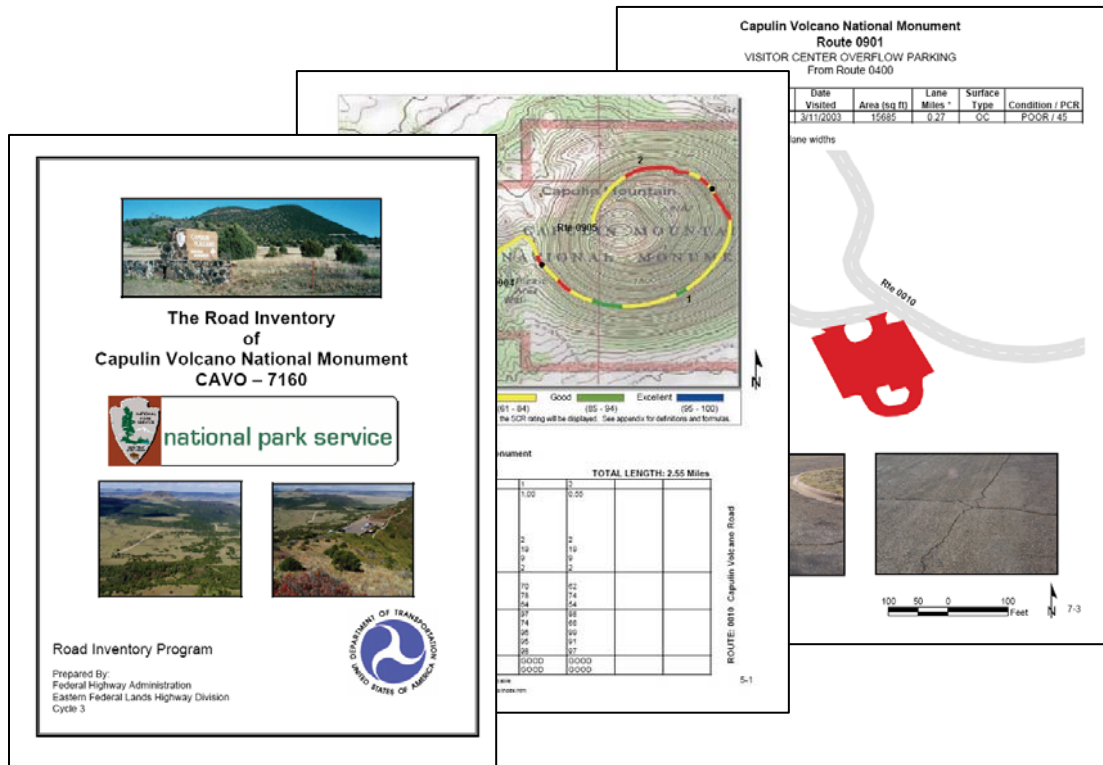


Figure 7. Graphic. Example of a RIP Route Inventory Report. This document is essential for all field inventory work as it contains complete route and parking area listings and locations, detailed route and parking area maps, and features tables providing useful Visidata milepoints for such things as visible retaining walls, guardwalls/guardrails, signs, etc.

Field Equipment

- Personal safety equipment (vest, hard hat, gloves, waterproof boots, first-aid, sunscreen, insect repellent, etc.)
- Climbing gear (safety harness, ropes, anchors, belay/ascension hardware)
- Laptop with writeable CD and ports for thumb drives, mouse, and external drives (two per team desirable)
- Thumb drive with backup electronic files
- External hard drives with Visidata and RIP Route Inventory Report files (tested)

- DC-to-AC power converter with two AC outlets for laptop and external hard drive
- Wall measuring tools (tapes – 25’, 100’, 300’, clinometers, distance meter, etc.)
- Enclosed metal clipboard (with Field Form, Field Guide and Cost Guide storage capacity)
- Calculator (two per team)
- Camera (two per team, with spare storage card)
- Misc. supplies (batteries, survey flagging, flashlight, toilet paper, etc.)

The Team Lead is also responsible for scheduling and coordinating transportation, lodging, and meeting times and locations for the inventory team. This is particularly important when multiple teams are working together in large, expansive parks.

2.2.7 Park WIP Database Upload

Although teams generally complete field form data uploads to the WIP database upon return to the office, it is recommended to upload data in the field whenever possible to improve day-to-day accuracy and consistency in recording wall condition and performance, and to provide data redundancy in the event field forms are misplaced or lost (field data management procedures are described in detail in subsection 2.3.3). The Database Administrator will provide the park-specific database to team members via an FLH FTP site, along with supplemental database programming, documentation and training. Team members must ensure that current versions of Microsoft Access are loaded on field laptops, and that the provided version of the Park WIP Database is functioning properly before traveling to the field. Additional information on database access and use is provided in Appendix D.

2.3 FIELD ACTIVITIES AND PROCEDURES

Upon arrival at the park, the inventory team is responsible for four basic tasks:

- (1) Holding a kick-off meeting with park facilities, resource, maintenance and FMSS staff;
- (2) Conducting a reconnaissance of wall resources with park maintenance staff;
- (3) Conducting the wall field inventory and assessment for all park routes and parking areas; and
- (4) Holding a close-out meeting with park facilities, resource and maintenance management.

All team members, to the extent practical, should participate in each of the four tasks to ensure walls are fully located and inventoried, and that inventory needs and findings are fully communicated to interested park personnel. Field inventory and assessment activities goals include:

- Engaging park facilities, resource and maintenance staff in generally scoping wall locations and conditions prior to wall inventory and assessment (final step in pre-locating walls prior to the inventory);
- Collecting required inventory data to accurately locate walls, describe wall types and geometrics, characterize wall elements and their condition, and determine if and what maintenance-repair-replace measures are needed; and

- Communicating wall condition and performance findings to park staff following the field inventory and assessment – particularly poorly performing walls that may represent a safety hazard to the traveling public.

The following subsections describe field inventory/assessment activities, and identify responsible parties for task management and completion. Supporting forms and documents are provided in Appendix B.

2.3.1 Kick-Off Meeting

A kick-off meeting is held with key park personnel before commencing wall inventory field work. Although park management may attend, kick-off meeting participation is generally limited to facilities, maintenance, resource, and/or FMSS staff directly responsible for managing the structural and cultural aspects of park retaining wall resources. Key meeting subjects include preliminary wall locations within the park, WIP wall assessment procedures, roadway traffic control, wall access safety requirements, reconnaissance planning, and reporting. More specifically, the meeting should include the following (an example meeting agenda is provided in Appendix A):

Overview of the NPS Retaining Wall Inventory Program

- Intent of the Wall Inventory Program:
 - To provide parks with information regarding roadway and parking area retaining walls for FMSS asset management.
 - To also provide FHWA with baseline retaining wall condition information to assist with future project analyses and development.
- General Site Inventory Procedures: Overview wall location, description, measurement, condition assessment, cultural resource, consequence of failure, required action, and work order considerations contained within the Inventory Field Form.
- Integrating Cultural Resource Needs: Review cultural/historic wall resource and roadway corridor issues, as well as wall maintenance-repair-replace considerations.
- Data Access and Management (FMSS): Overview FMSS Specification Data Template, park transmittal of equipment numbers to FLH, and data transmittal process and responsibilities.

Inventory Safety Practices

- Wall Data Collection Practices: Review wall measurement and assessment procedures, noting roadway and wall access requirements.
- Roadside Safety Practices: Review number of participating personnel, parking restrictions/practices, wall access issues, personal safety gear, designated traffic spotters, etc.
- Traffic Control: Discuss final traffic control plan, including signage, traffic cones, FLH/NPS flaggers/spotters, and identification of congested, high-traffic areas.
- General Fall Protection/Hazard Management: Discuss FLH wall access procedures (limited to top and toe of walls), recognition of rock fall hazards during wall access, and park-specific safety requirements.
- Communication Planning: Review emergency contacts/procedures and acquire park-provided radios.
- Park Entrance Passes: Arrange for park entrance passes (as needed), vehicle identification placards, and alerts to park security of inventory team activities.



Figure 8. Photo. Although signage is a key element of a minimum roadway safety plan, best practices require pulling vehicles well off the road at high-visibility locations, maintaining ample sight distance, using cones to delineate vehicles, and using flashers or roof-mounted safety lights.

Inventory Activities and Schedule Review

- Pre-Site Questionnaire Review: Kick-off meeting review of pre-site questionnaire results regarding general location of park retaining walls, location/condition of problem walls, and prep for wall reconnaissance with park staff.
- Wall Location Reconnaissance: Conduct maintenance staff interview (or other facilities knowledgeable park personnel) and perform park-wide wall reconnaissance.
- Wall Inventory/Assessment: Discuss general strategy for systematically conducting the inventory (including safety/traffic considerations), and refine wall inventory completion schedule.
- Close-Out Meeting: Arrange tentative close-out meeting schedule and required attendance.

During the kick-off meeting, the Team Lead should provide park staff with copies of the WIP Field Inspection Form, FMSS Specification Data Template spreadsheet, and the WIP FMSS Data – Manual Input Procedure and Test Guide (provided in Appendices B and C).

*****IMPORTANT*****

It cannot be overstated that *conducting retaining wall assessments is hazardous work*. The kick-off meeting and subsequent wall reconnaissance with park staff are the best opportunities to identify potential safety hazards (e.g., steep slopes, rockfall onto lower roadways during wall inspections), establish park-specific safety practices and emergency procedures, and communicate and reinforce required safety measures with team members.

2.3.2 Wall Reconnaissance

Following the kick-off meeting, inventory teams should conduct a wall reconnaissance along assigned park routes and parking areas. Knowledgeable park maintenance or resource staff should accompany the teams to identify wall locations not readily visible from the roadway or parking area. Often, retaining walls, and particularly qualifying culvert headwalls, are obscured by vegetation, located well out of sight below road grade, exist in areas where earth retention requirements may not appear to be required (generally includes historic structures preserved by subsequent roadway construction), or blend in with the surrounding environment so well as to be potentially missed by the inventory team. Park staff can significantly increase the chances for capturing these hidden structures in the wall inventory. Park staff also greatly assist by interpreting available documents describing historic wall location/construction, translating past structure inventories (which are often not clearly associated with roadway features or mile markers), and relating wall performance observations over time.

When conducting the reconnaissance, teams should have at their disposal **(1)** the Visidata Retaining Wall Location Form listing previously identified wall features, **(2)** the RIP Route Inventory Report, **(3)** several Retaining Wall Reconnaissance Forms for logging identified walls (provided in Appendix B), and **(4)** supplemental maps of the park (though the route maps within the RIP Inventory Report may suffice). The reconnaissance is conducted as a drive-by “windshield survey” – rarely stopping to examine walls in order to expedite the review of what is typically many routes and parking areas. In some instances, it may be advantageous to flag wall starts with surveyors tape to assist in locating the walls during the inventory. Labeling the flagging with wall information also helps to distinguish it from other flagging used by the park. This is particularly useful when walls are located in areas of dense vegetation.

Information collected on the Reconnaissance Form includes:

- RIP route/parking area name and/or number, or park-designated route/parking area name if not in RIP;
- Side of road in which the wall is located when traveling in the direction of increasing RIP milepoints (or approximate location within the parking area);
- Approximate Visidata wall start milepoint (if available), or route milepost;
- Approximate wall length;
- Apparent wall function (e.g., fill wall, cut wall, etc.);
- Apparent wall type (e.g., MSE, crib, bin, soldier pile, etc.);
- Approximate year the wall was built; and
- Comments regarding wall accessibility, general wall condition, etc.

Wall reconnaissance can be very time consuming, so teams should plan accordingly when scheduling site inventory work. Team Leads should clearly communicate the intentions of the reconnaissance effort(s) to park staff well ahead of time to ensure staff resources are available, particularly in large parks where multiple, concurrent reconnaissance efforts may be required. When park resources are limited, the size of the park calls for multiple inventory teams, or remote wall locations require excessive drive times, the Team Lead may opt to conduct the reconnaissance concurrent with wall assessments to expedite the inventory schedule.

Once the reconnaissance is completed, the Team Lead should hold a team meeting to (1) cross-check and update wall locations with previously compiled RIP/Visidata locations, and (2) develop strategies for efficiently conducting the park wall inventory, focusing on wall types and conditions to be encountered and the development of appropriate work orders.

When conducting future wall inventories in parks with prior wall assessments, be careful to note the RIP cycle used to locate walls during the previous inspection. For Cycle 1 WIP, RIP Cycle 3 milepoint data was used. RIP Cycle 4 surveys were underway nationwide at the conclusion of the initial WIP inventory, requiring migration of Cycle 3 milepoints into the new Cycle 4 measurement system.

2.3.3 Wall Inventory and Assessment

Following the wall reconnaissance, inventory teams undertake a systematic process of inventorying and assessing wall conditions along RIP and non-RIP routes and parking areas per the qualification criteria and condition assessment guidelines presented later in this Procedures Manual. The inventory is further guided by the findings from the staff interviews, RIP/Visidata review, and park reconnaissance; however, additional walls will undoubtedly be located as teams systematically work their way along park roads. Teams should anticipate inflation of preliminary wall counts, particularly if numerous qualifying culvert inlet and outlet headwalls may be encountered (culvert headwall qualifications are described in Chapter 3).

Teams are generally comprised of two individuals, typically led by a Geotechnical, Geological or Structural Engineer and supported by engineering or technical staff from the survey, design and/or construction disciplines. Team members should be knowledgeable in wall components and construction, and skilled in recognizing a wide range of element distresses and failure modes. Team members should also be fully trained in WIP processes and procedures, and proficient in the use of the RIP Route Inventory Report, Visidata, and supporting field documentation.

Efficiently conducting wall assessments requires one person to assume the lead on locating walls with respect to Visidata features and milepoints/mileposts, measuring wall dimensions, and acquiring representative wall photos, while the other team member assumes the responsibility for recording static wall data, condition assessments, and recommended actions on the Field Inspection Forms. More specifically, teams are responsible for the following:

- Accurately locate the wall (park, route number/name, milepoint, etc.);
- Describe wall dimensions and features;
- Acquire descriptive photos;
- Rate the condition of the wall and its key elements, as well as the reliability of the data supporting the wall rating;
- Assess if further investigations are required;
- Determine the design criteria used to construct the wall (if any);
- Determine the consequences of wall failure;
- Determine whether the wall is a cultural resource or not;

- Determine the appropriate repair/replace actions (no action/monitor, maintenance, repair element, replace element, replace wall, and/or investigate);
- Develop an appropriate work order, as needed, estimating investigation, maintenance, repair, replacement costs; and
- ***Conduct all aspects of the inspection in a manner promoting safety amongst the team and traveling public.***



Figure 9. Photo. Inventory team members must work together to measure wall attributes, accurately describe and rate wall elements, and watch for unsafe conditions.

Wall inventory and condition assessment information is captured within the approximate 65 wall attributes and elements documented on the Field Inspection Form, examples of which are provided in Appendix B. Developing this information in the field is further supplemented by two companion documents: the WIP Field Guide – a quick reference guide for wall codes and condition assessment definitions, and the WIP Cost Guide – a compilation of general wall repair and replacement costs. Both of these documents are provided in Appendix B and further described in Chapter 4.

Although responsible for different aspects of the wall assessment, ***team members do not work independent from one another.*** The team as a whole is responsible for producing a complete, accurate and quantitatively descriptive assessment of each wall inventoried. This requires that team members discuss and agree on wall conditions and recommended actions, and check each other's work products, ensuring all relevant elements of the Field Inspection Form are addressed. ***Inventory teams should not leave a wall site until the assessment is complete to the satisfaction of both team members*** and is ready for upload to the Park WIP Database – the first level of program quality control (QC). At no time should teams forego completion of Field Inspection

Forms or simply copy prior forms for similar wall types. This practice, although inviting when regularly encountering nearly identical structures (e.g., repetitive headwall features), leads to errors and inaccuracies, and diminishes the value and substance of the inventory.

To optimize inventory team efficiency and the quality of wall assessments, teams should implement the following quality control/quality assurance (QC/QA) practices at every park:

- (1) *Post-Recon Inventory Practice:* Immediately following wall reconnaissance, and prior to initiating full-scale wall inventories, teams should assess several different wall types/functions as a group to ensure wall assessment methods and expectations are well understood, that consistent, highly descriptive condition narratives are being produced, and that appropriate work orders are being developed. **This effort is especially critical when multiple teams are inventorying a wide array of wall types in diverse settings throughout a large park.**
- (2) *Daily Progress Reporting:* Teams should meet each evening to report daily progress, discuss wall findings and issues, and refine route inventory planning.
- (3) *Regular Database Upload:* Teams should regularly upload wall data to the park WIP database to improve day-to-day accuracy and consistency in recording wall condition and performance, to expedite yet-to-be-completed wall assessments, and to provide data redundancy in case field forms are misplaced or lost. Teams commonly inventory between 15 to 25 walls per day, depending on drive times, weather, wall access, wall sizes, vegetation, etc. Over the course of a day, and throughout the course of the park inventory, teams will naturally refine wall descriptions and condition evaluations. Teams should strive for consistency in conducting and reporting wall assessments, requiring regular review and “fine tuning” of their work product as the inventory progresses. Uploading at least a portion of the wall data to the database every couple of days will help to achieve these goals (it simply may not be practical to load all of the data in the field). In addition, completing data uploads in the field avoids the potential for data entry to languish weeks after the field work was completed.

*****IMPORTANT*****

Providing high-quality, consistent wall assessments requires team members adhere to the data collection and reporting processes and standards presented in this Procedures Manual. Bear in mind that not only will the collected inventory information support current NPS FMSS asset management initiatives, but it also serves as the foundation for future park wall inventories.

2.3.4 Close-Out Meeting

At the conclusion of the wall inventory, the Team Lead, and preferably the entire inventory team, meets with park facilities, maintenance and resource staff to review preliminary findings, reiterate FMSS specification data table and equipment number transmittal requirements, and briefly discuss the contents of the forthcoming findings memorandum to be submitted to the park Superintendent and Facilities Manager (discussed in subsection 2.4.3). In addition, and most importantly, *park staff is informed of any walls exhibiting severe distress, that are actively failing, or that represent significant short-term capital expenditures or risks to public safety.* If

park staff are not available to meet at the end of the field inventory, the Team Lead should teleconference with interested park staff as soon as possible following return to the office. To make the most of the close-out meeting, team members should meet before the meeting to compare notes and list specific issues to be transmitted to park staff. This is also a good time to double-check that all roads and parking areas were covered by the inventory.

Before leaving the park, the Team Lead should ensure that all traffic control signage and cones, park radios, vehicle placards, etc., are returned to the park in working order.

2.4 POST-FIELD ACTIVITIES AND PROCEDURES

Post-field activities include uploading field data to the Park WIP Database (if not already completed in the field), updating the Central WIP Database, submitting general findings to park management, transferring FMSS data to the park FMSS coordinator, transferring final wall feature data to the Road Inventory Program (RIP), and managing data archives and requests for database queries and reports. Post-field activities goals include:

- Capturing, maintaining and reporting wall data in an efficient, safe, quality-assured manner that allows flexible interfacing with FMSS and RIP databases; and
- Supporting FMSS and RIP program needs and inventory reporting.

Supporting forms and documents are provided in Appendix C. The WIP Database Users Manual is provided in Appendix D.

2.4.1 Field Data Upload to Park WIP Database

Although it is recommended to complete wall data uploads to the Park WIP Database in the field (or at least a large portion of the wall data), teams often opt to perform this task upon return to the office. In either event, a system of quality checks (QC) and quality assurance (QA) needs to be followed to ensure the final database presents a complete and consistent representation of wall features, conditions, and recommended actions. Although the WIP database automatically employs a system of basic quality checks, including missing, invalid or conflicting data fields/formats, the database cannot discern between correct/incorrect measurements or complete/incomplete condition narratives. It is the responsibility of the team member to ensure measurements are accurate, wall descriptors are correct, and narratives are concise and informative. Additional guidance on documenting wall data is provided in Chapter 4.

In general, the following QC/QA approach is recommended:

- Team members are responsible for uploading the Field Inspection Forms they recorded. This allows the team member a final opportunity to make corrections and refinements for accuracy and consistency (and avoids obvious problems with reading others handwriting).
- Wall data should be uploaded to the WIP database as soon as possible. Opportunities for quality improvements diminish with the passage of time, so every effort should be made to upload the wall data immediately upon return to the office (preferably already completed in the field).
- If the responsible team member is assisted by others in uploading the field forms, the responsible team member performs a final quality check, comparing each field form to the

uploaded database, before submitting to the Database Administrator (this method of data upload is the least desirable, and commonly results in errors and inconsistencies).

- Each Field Inspection Form is initialed and dated by the individual responsible for adding the data to the WIP database and archiving the hard copy. This ensures that all walls are included in the database, and allows quality discrepancies to be quickly resolved.
- The Database Administrator compiles the Park WIP Database and conducts a second quality check to ensure (1) that recorded wall measurements appear reasonable, and (2) that condition narratives are well-composed, descriptive, and reasonably consistent from one team member to the next.
- The Database Administrator then provides wall summary reports to the Team Lead for a final quality check. The Team Lead spot checks database condition narratives and thoroughly reviews all work orders for completeness and accuracy.
- The Team Lead formally assures database quality by preparing the Inventory Findings Memorandum.

The figure shows three overlapping screenshots of a web-based form for wall inspection. The top form is titled "Wall Repair / Replace Recommendations" and includes fields for "WALL ID", "FINAL WALL RATING", "DATA RELIABILITY", and "WALL STATUS". The middle form is titled "Wall Element Condition Assessment" and includes a table with columns for "ELEMENT", "CONDITION NARRATIVE", "COND RATING", "WEIGHT", "SCORE", and "RELIABILITY". The bottom form is titled "Wall Location and Description Data" and includes fields for "PARK ALPHA", "TEAM LEAD", "DATA ENTRY", "INSPECTION DATE", "WALL MILEPOINT START", "WALL MILEPOINT END", "RP ROUTE NO", "RP ROUTE NAME", "SIDE OF CENTERLINE", "WALL LENGTH, FT.", "MAX WALL HEIGHT, FT.", "AVG WALL HEIGHT, FT.", "WALL FACE AREA, Sq. FT.", "AVG VERTICAL OFFSET, FT.", "WALL ID", "VEGDATA EVENT LOCATOR", "WALL BEGN/LATITUDE", "WALL BEGN/LONGITUDE", "WALL START OFFSET, FT.", "WALL END OFFSET, FT.", "AVG UPSLOPE HEIGHT, FT.", "FACE ANGLE, Deg", "WALL FUNCTION", "PRIMARY WALL TYPE", "SECONDARY WALL TYPE", "GENERAL WALL DESCRIPTION", "ARCHITECTURAL FACINO", "SURFACE TREATMENT", and "APPROXIMATE YEAR BUILT".

Figure 10. Graphic. The WIP database 3-page architecture follows the general flow of wall attribute and element documentation on the Field Inspection Form.

As previously noted, the Database Administrator is responsible for providing the Park WIP Database to the team, as well as supporting its use and update. Specific information on database access and use is provided in Appendix D.

*****IMPORTANT*****

Field data has a “shelf-life”. The quality of field inventories is directly proportional to the effort made in the field to write concise and descriptive condition assessments, assure that assessments are consistent throughout the field inspection, and expeditiously upload the data to the Park WIP Database. Every effort should be made to complete as much of the work in the field as possible to avoid data refinement and database uploading from languishing once in the office.

2.4.2 Central WIP Database Update

Once the Park WIP Database is completed, the Database Administrator merges the information into the Central WIP Database, along with photo files updated to reflect park wall ID numbers and archive documents. Once uploaded to the Central WIP Database, changes or edits should be provided to the Database Administrator as written and initialed changes to the original Field Inspection Forms. Electronic edits/changes within the database should not be made in lieu of documenting changes/edits on the Field Forms.

The Central WIP Database is resident at the Central Federal Lands Highway Division (CFLHD) office in Lakewood, CO, and is supported by the CFLHD Information Technologies group. The Database Administrator is responsible for managing all system upgrades or changes to the database architecture or platform, and is currently the main point of contact for all ad hoc database queries and reporting. A web-based interface for conducting user-defined database queries may soon be available allowing team members easy access to the Central WIP Database without having to submit requests through the Database Administrator. Additional information on the structure of the database system and management protocols is provided in the WIP Database Users Manual, located in Appendix D.

2.4.3 Inventory Findings Memorandum

Once the Park WIP Database is uploaded and all QC/QA checks have been completed, and preferably within a month of completing the field inventory, the Team Lead is responsible for preparing a brief memorandum to the park Superintendent summarizing inventory findings. Copies, with attachments, are also sent to the park Facilities Manager, NPS WASO WIP Coordinator, and the FLH Program Manager, as well as the Central WIP Database document archive. The memorandum, an example of which is included in Appendix C, should include the following basic information:

- Dates and duration of the park inventory;
- NPS and FLH participants involved in planning and conducting the work;
- Tabulation of the general survey findings, including route name/number, number of walls surveyed per route, types and functions of walls surveyed per route, range of conditions encountered, breakdown of recommended actions, work order costs per specific wall location, etc.;
- Location and description of at-risk walls in the park requiring immediate attention;
- Overview of the pending FMSS data exchange process between the park and the FLH Database Administrator, and
- Contact information for the NPS WASO WIP Coordinator, FLH Program Manager and Database Administrator.

In addition, four attachments are included with the memorandum:

- (1) Retaining Wall Summary Data Tables – listing of pertinent information on each of the walls inventoried and/or requiring work orders (example provided in Appendix C);
- (2) FMSS Work Order File – final specification data template file for data transfer directly to FMSS (example provided in Appendix C);
- (3) FMSS Data Input Procedures and Test Guide – brief reference manual describing the FMSS upload process (example provided in Appendix C); and
- (4) Wall Photos – CD containing all wall photos listed by wall identification number.

These items are transmitted with the Findings Memorandum in order to remain under the strict control and responsibility of the Team Lead. The Database Administrator assumes the responsibility for assisting with park FMSS data uploads, uploading final FMSS wall equipment numbers to the Central WIP Database, and sending final wall feature location data to RIP.

2.4.4 FMSS and RIP Data Transmittals

Once the Findings Memorandum has been sent to the park, the Database Administrator archives a copy of the FMSS Work Order File in the Central WIP Database and contacts the park Facilities Manager and/or FMSS Coordinator to request that they submit FMSS-generated wall equipment numbers to FLH for WIP database completion. The Database Administrator is available to support the process, but the park is ultimately responsible for uploading and forwarding requested FMSS information.

Upon receipt of the FMSS wall equipment numbers from the park, the Database Administrator updates the Central WIP Database and forwards a RIP Wall Features Update File to the FLH RIP Coordinator. An example of the wall features file is provided in Appendix C.

2.5 DATA MANAGEMENT ACTIVITIES

Once the FMSS wall equipment numbers have been added to the Central WIP Database, and RIP wall features have been forward to the RIP program, the park inventory process is complete. From this point forward the Database Administrator is responsible for managing and updating the Central WIP Database, generating ad hoc reports, and supporting new and recurrent wall inventories.

The current WIP Database was developed as a Microsoft Access application to mirror similar inventory developments in the FLH Road Inventory Program and the Bridge Inventory Program, while ultimately allowing migration to an Oracle platform for database management, rapid queries, and future developments (e.g., incorporation within an FLH Geographical Information System). The park-specific version of the database is very user-friendly and is structured to enter data in the same systematic manner in which the Field Inspection Forms are recorded. Wall files can also be easily edited, following the same page-to-page format as data entry. Data quality is enhanced by automated checks for missing data, invalid characters or data formats, and conflicting data fields or formats. The database also provides the user with a number of quick-access “canned” reports summarizing wall functions, types, required actions, route numbers and repair costs, as well as the option to request ad hoc reports from the Database Administrator regarding any of the 60+ data fields logged per inventoried wall. Web-access developments are

also currently underway that will allow remote users to interface with the Central WIP Database and generate user-defined queries and reports, as needed.

Specific information on the structure and functionality of the WIP Database are included in the WIP Database Users Manual, located in Appendix D.