

South Campground Rehabilitation

Zion National Park

Statement of Findings for NPS Director's Order 77-2,
"Floodplain Management", PMIS 317454, 240254, 319664,
325305

National Park Service
U.S. Department of the Interior



Recommended: _____
Jeff Bradybaugh, Superintendent, Zion National Park Date

Certification of Technical Adequacy and Servicewide Consistency:

Ed Harvey, Chief, Water Resources Division Date

Approved: _____
Kate Hammond, Director, Regions 6, 7, and 8 Date

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SOUTH CAMPGROUND REHABILITATION ZION NATIONAL PARK

FLOODPLAIN STATEMENT OF FINDINGS

INTRODUCTION

Executive Order (EO) 11988, “Floodplain Management” and EO 13690, “Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input,” require the National Park Service (NPS) and other federal agencies to evaluate the likely impacts of actions in floodplains. The objectives of EO 11988 is to avoid, to the extent possible, the long-term and short-term adverse impacts associated with occupancy, modification, or destruction of floodplains and to avoid indirect support of development and new construction in such areas wherever there is a practicable alternative. EO 13690 was issued to establish a Flood Risk Management Standard for federally funded projects to improve the nation’s resilience to floods and to ensure new federal infrastructure will last as long as intended. The NPS administers floodplain policy through Director’s Order 77-2: *Floodplain Management* (DO 77-2) and Procedural Manual 77-2 *Floodplain Management* (PM 77-2).

It is NPS policy to preserve floodplain functions and values and minimize potentially hazardous conditions associated with flooding, including threats to human health/life, risk to capital (NPS) investment, and impacts on natural and beneficial floodplain values. If a proposed action is found to be in an applicable regulatory floodplain with associated impacts and relocating the action to a non-floodplain site is considered not to be a practicable alternative, then a formal floodplain “Statement of Findings” must be prepared. The “Statement of Findings” must (a) quantify flood conditions and associated hazards as a basis for management decision making, (b) describe the rationale for selection of a floodplain site, (c) disclose the resources and amount of risk associated with the chosen site, and (d) explain flood mitigation plans. The “Statement of Findings” will be available for public review and comment through the National Environmental Policy Act Environmental Assessment.

The NPS is proposing to reconstruct the South Campground at Zion National Park (ZION). Visitor use in and surrounding ZION has grown steadily for many years. Recently, the demand for public access in the ZION region has increased exponentially, stressing existing infrastructure on public lands, trail systems, and the environmental resources therein. The South Campground was constructed in the 1930s and expanded in the 1960s with little to no improvements since, and the facilities are beyond their intended design life and in poor condition. As a result, many of the facilities do not meet current accessibility standards and are in need of renovation to meet modern expectations and the increasing visitor demand, resulting in declining public services. The NPS proposes to reconstruct the campground to improve visitor experience, accommodate more demand placed on campground infrastructure, improve drainage from the west side of the campground to the North Fork of the Virgin River, and increase efficiency of operations while protecting natural and cultural resources. Additionally, the project would address compliance with the Architectural

Barriers Act (ABA) and Americans with Disabilities Act (ADA). The project components are described in more detail in the *Proposed Action* section.

This Floodplain Statement of Findings (FSOF):

- Quantifies the flood hazard associated with the proposed action.
- Presents the rationale for the development of proposed facilities within the regulatory floodplain of the North Fork of the Virgin River in ZION.
- Documents the anticipated negative impacts of these improvements on human health/life, capital investment, and floodplain functions and values.
- Presents mitigations to these impacts.

LOCATION

The South Campground is along Zion Mount Carmel Highway (Highway 9) on the valley floor at the South Entrance to ZION (project area; Figure 1). The project area is about 3,930 to 3,980 feet above sea level. The natural sources for surface water hydrology are the North Fork of the Virgin River, just south of the campground, and several unnamed ephemeral drainages that flow through the campground generally from north to south and outfall into the Virgin River.

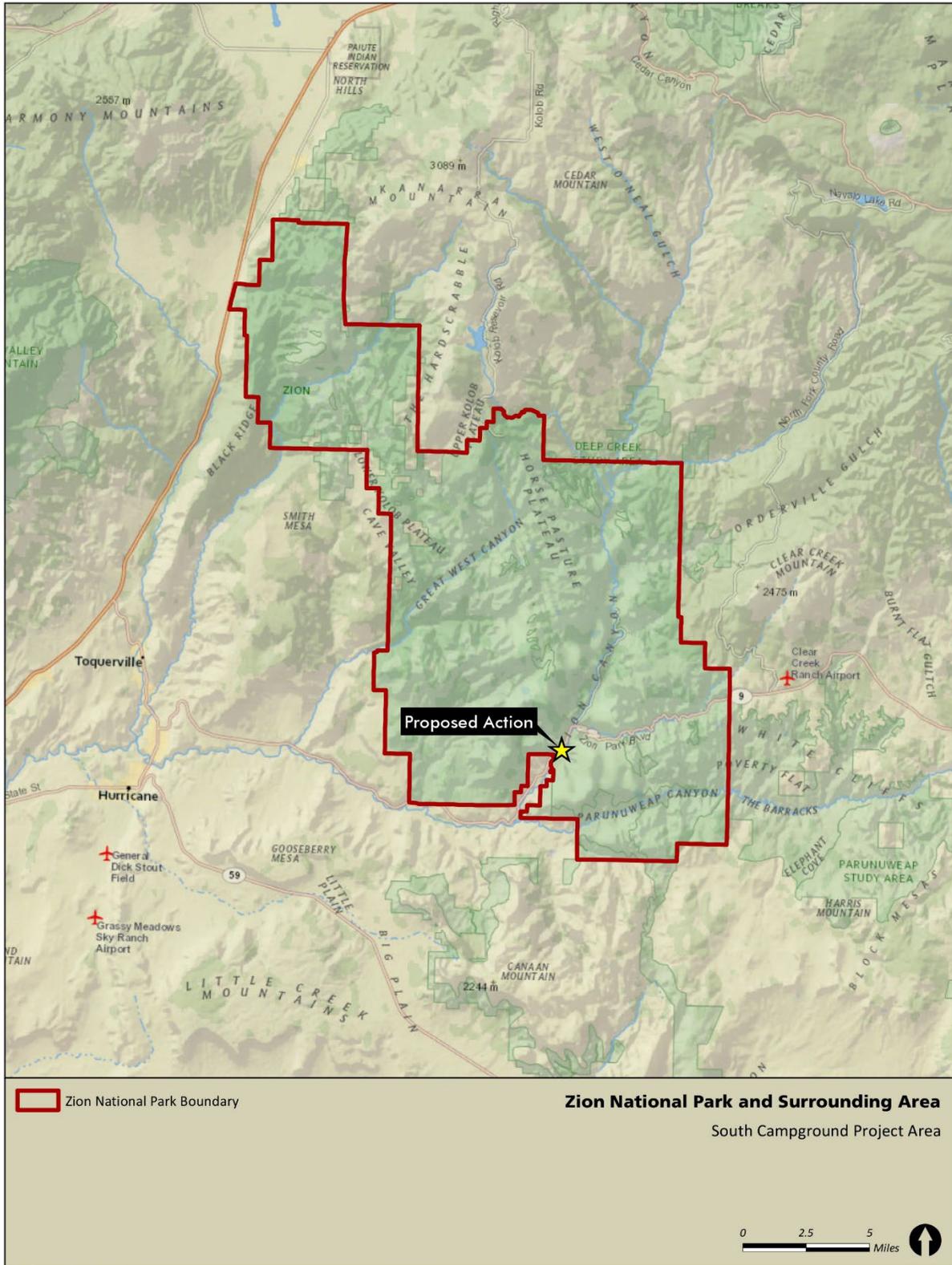


Figure 1. South Campground Project Area Location.

PROPOSED ACTION

The campground would be reconstructed to accommodate the new alignment of the road to the Visitor Center, clarify pedestrian and vehicle circulation, and improve visitor services and accessibility.

Campground improvements would include the following proposed elements (Figure 2 and Figure 3):

- Construct new circulation patterns with a roundabout separating two distinct loops to simplify wayfinding
- Construct a new campground fee and wilderness permitting office with associated short-term parking
- Improve campsite infrastructure and accessibility
- Construct three new comfort stations in place of existing Mission 66 facilities
- Renovate the 1930 historic comfort station
- Establish a multifunction drainage system by regrading existing ephemeral drainages
- Expand and improve the existing dump station
- Construct a new day use picnic area and associated short-term parking
- Plant a representative orchard in the day use area to acknowledge the past agricultural use of the area
- Remove hazard trees while retaining as much bird, bat, and insect habitat as possible, and revegetate impacted areas with native species
- Preserve natural rock outcroppings and sections of historic irrigation ditch systems
- Use the new campsite delineation and formal paths to reduce encroachment of visitors onto planted areas
- Incorporate irrigation swales in coordination with historic ditch alignments that would help provide appropriate water to all remaining and new trees
- Potentially expand the campground by adding an additional loop
- A 5,000 square-foot stormwater detention basin would be constructed just south of the existing parking lot

Access would be from Zion Mount Carmel Highway onto the existing campground entrance. Minimal anticipated disruption to traffic would occur. Large trucks may need a flagger to turn left to exit ZION. Construction may occur on one side of the road at the entrance and then the other side. The project could also use an alternative access from the Visitor Center access road to the west. Access areas would be revegetated with native species after work is complete. Staging would occur on the existing amphitheater parking lot (Figure 2). Staging could also occur where a new road for Visitor Center access would be constructed if additional staging space is needed (Figure 2).

Demolition would occur on the campground roads, spurs, and three Mission 66 restrooms. Tree removal would take place for specified trees throughout the South Campground and would include a total of about 147 trees. Up to 46 additional trees would be evaluated during construction and potentially removed if necessary.

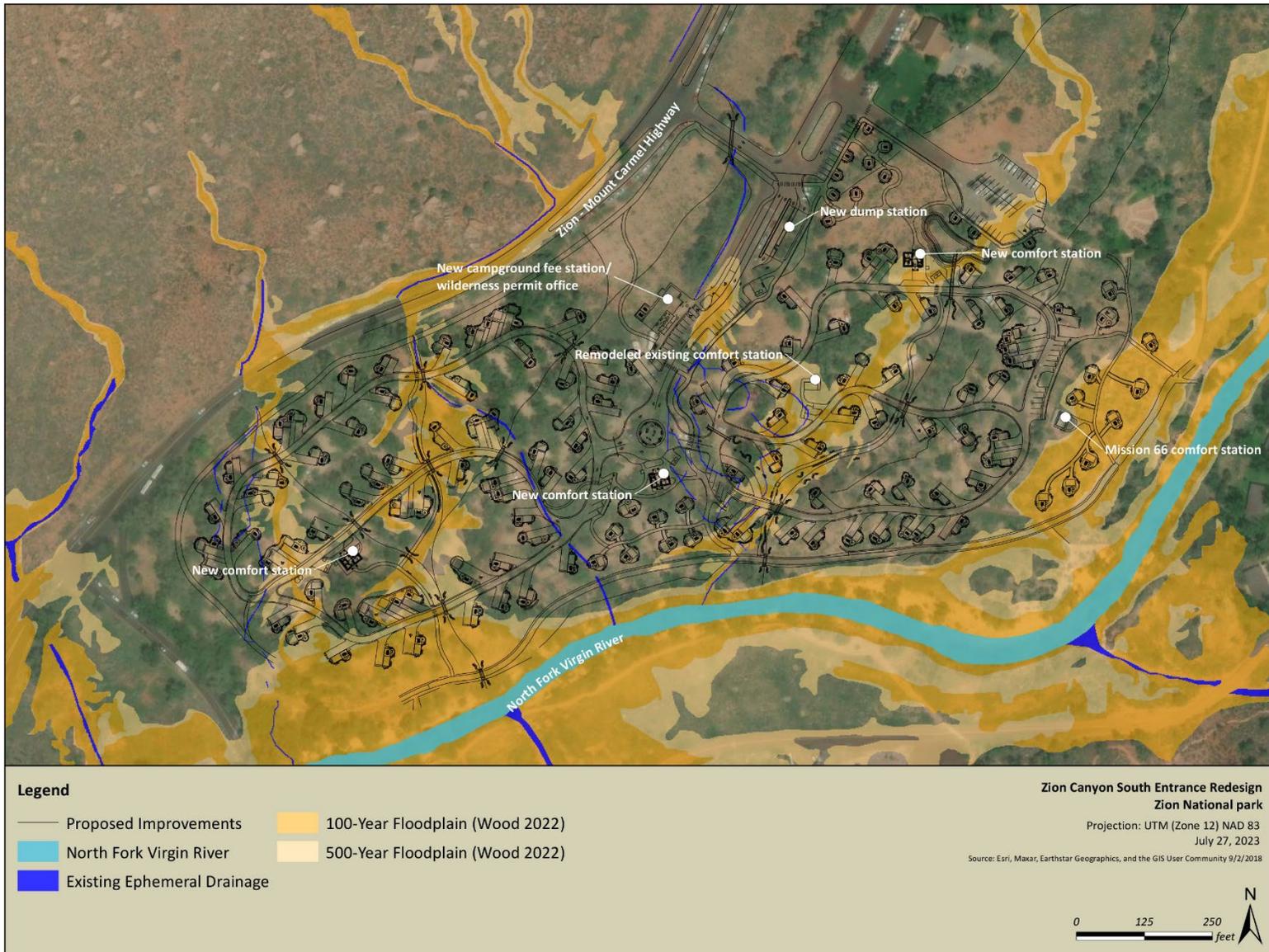


Figure 2. South Campground Overall Site Plan with Existing 100-year and 500-year Floodplains

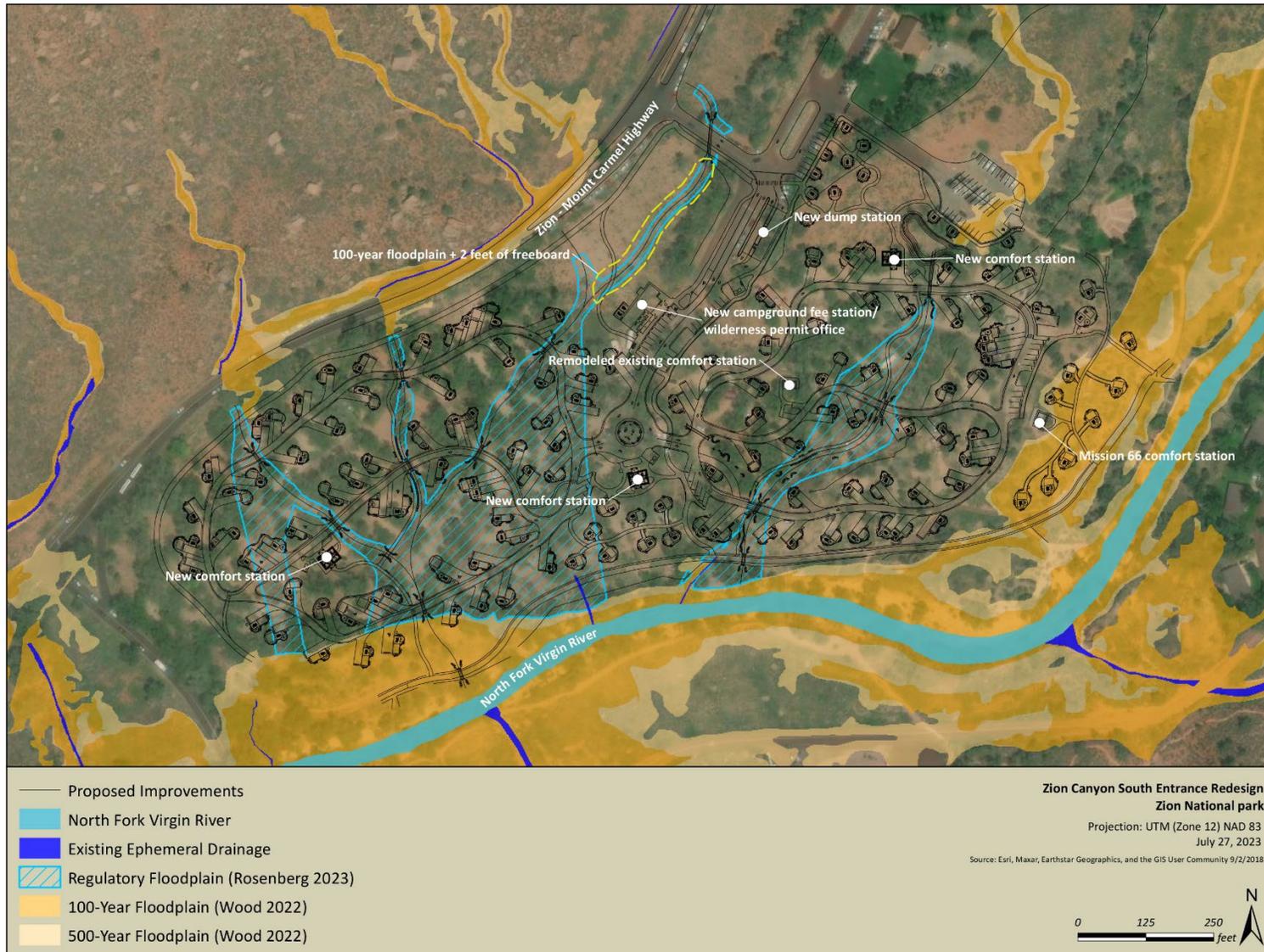


Figure 3. South Campground Overall Site Plan with post-Project regulatory floodplain. The regulatory floodplain is the blue cross-hatched polygon (100-year plus two feet freeboard in the drainages) and the light yellow polygon (500-year floodplain) along the river.

The ephemeral drainages in the campground would be widened and reshaped to allow them to convey the 100-year flood flow. The assumptions used for hydraulic modeling for the ephemeral drainages are described in Attachment A. The drainage channels currently range from about 2 to 4 feet wide, with steeply incised sides. The drainages would be reshaped to be about 18 feet across at the top of the streambanks, about 3 feet wide at the bottom, and about 2.5 feet deep, with banks sloping down at 2 to 1. The section of the ephemeral drainage northwest of the proposed fee station/wilderness office and dump station would be widened to accommodate the 100-year floodplain plus 2 feet of freeboard as a mitigation measure to reduce flood risk to the fee station/wilderness office (Attachment A). About 3,000 linear feet ephemeral streambed would be affected. The post-project 100-year floodplain within the campground would be contained within the reconstructed ephemeral drainages (Figure 3). The post-project 100-year and 500-year floodplain along the North Fork of the Virgin River would be unchanged.

Two new outfall structures would be constructed where the drainages outfall to the North Fork Virgin River. The reconstructed outfalls from the ephemeral drainages in the South Campground would be above the Ordinary High Water Mark of the North Fork of the Virgin River and would be constructed at the location of two existing outfalls to the river. The outfalls from the ephemeral drainages to the river would be protected by buried riprap that would be seeded with a riparian seed mix. The buried riprap would be tied in to existing grouted riprap on the riverbank at the northern outfall.

Grading would occur for the road and campsite spurs/sites, drainage areas, and pods. Clearing and grubbing would take place in areas identified for grading. Equipment and numbers used in the demolition phase (e.g., buildings, trees, and rocks) would include trackhoe (2), chainsaw (4), and dump truck (2). Equipment used in the grading phase (earthwork and utility installation) would include grader (2), skidsteer (4), trencher (1) for utilities, medium and large loaders (2), water truck (1 used for entire project), backhoe (2), trackhoe (2), belly dump (2), and small compacter (6). Equipment used for the improvements phase (concrete, buildings, and paving) would include concrete truck (2), tree spade (4), paver (1), trackhoe (2), grader (2) for roads, and small compacter (4). Finishing phase (campsites, trails, and buildings) equipment would include concrete truck (1), small loader (1), backhoe (2), and skidsteer (4).

The estimated ground disturbance at the South Campground would be about 11.92 acres. Revegetation would include preparing soil for revegetation, placing topsoil, seeding with native seed, planting up to about 298 new trees, and transplanting approximately 15 juniper trees and 10 pinyon trees in the project area. Trees planted would come from the ZION nursery and from local nurseries. Revegetation efforts would restore about 13.42 acres in the South Campground. There would be a net increase of about 1.5 acres of vegetation following construction due to gravel areas in the campground being planted and seeded. Changes in ground cover type in the project area are summarized in Table 1.

Table 1. Existing and Proposed Ground Cover in South Campground.

Ground Cover Type	Existing (square feet)	Proposed (square feet)
Buildings	1,990	5,805
Asphalt paving	141,155	219,166
Concrete paving	17,740	46,070
Gravel/crusher fines campsites	240,690	169,710
Soft surface trails		5,050
Gravel road shoulder		12,780
Open surface detention pond		5,000
Open surface drainage		46,510
Retaining walls		770
Exposed aggregate concrete edge		8,325
Total	401,575	519,186

Overall construction is anticipated to start in December 2023. Tree removal would occur in October and November and may occur in multiple years. Grading, work on restrooms, and other construction activities would occur from December 2023 through December 2025.

FLOODPLAINS

Following PM 77-2, the actions associated with the proposed alternative are Class I, or non-critical actions. The regulatory floodplain for Class I actions is the 1 percent annual exceedance probability flood, also referred to as the 100-year flood or the base flood (DO #77-2). Additionally, following EO 13690, any proposed action that involves federal capital investment must include a Federal Flood Risk Management Standard (FERMS). Per FEMA’s implementing guidelines for EO 11988 and 13690, agencies may use a Freeboard Value Approach (FVA) in establishing FFRMS flood elevations in areas where the 100-year base flood elevation (BFE) levels are known. This method adds 2 feet to the BFE for non-critical actions. Therefore, the regulatory floodplain for the proposed action is the 100-year flood elevation plus 2 feet.

The existing floodplain in the project area was mapped in 2022 by Wood Environment and Infrastructure Solutions, Inc. (Wood 2022). The project area is partially within the 100-year floodplain. Portions of the project area are also within the 500-year floodplain. As described above, the 100-year floodplain plus 2 feet is the regulatory floodplain for the proposed action. Figure 2 shows the existing 100-year and 500-year floodplain elevations in the project area. Post-construction flood conditions, including the regulatory floodplain, are described below under *Description of Flood Hazards and Effect on Floodplain Values*, and are shown in Figure 3.

Three types of floods typically occur in ZION: riverine floods, flash floods/debris flows, and sheet floods (Lund et al. 2010, 16-27). The project area contains areas subject to all three types of floods (Lund et al. 2010, 20). Riverine floods result from rapid melting of the winter snowpack or from prolonged heavy rainfall associated with major frontal storms, or from both conditions simultaneously. Flash floods occur when sudden, intense, localized events occur in response to cloudburst rainfall that often accompanies convective monsoonal thunderstorms. Because cloudburst storms result from strong convective cells produced by

differential atmospheric heating, flash floods are largely a summertime phenomenon in desert regions. Flash floods in ZION can affect both large perennial drainages and small ephemeral drainages. The North Fork of the Virgin River and its tributaries in the project area are subject to periodic flash floods (Lund et al. 2010, 17). Debris flows occur when flash floods contain large amounts of sediment, ranging in size from clay to boulders. Like flash floods, debris flows are fast moving. Because of their high density and high speed, debris flows are particularly dangerous to life and destructive to property. Sheetfloods occur when a broad expanse of unconfined moving storm water spreads as a thin, continuous, and relatively uniform sheet over a large area and is not concentrated into well-defined channels (Lund et al. 2010, 18). Additional types of floods could occur from unintentional water release from water retention structures or from breaching of rockfall or landslide dams. These two types of floods would not necessarily be associated with precipitation events.

Destructive floods have occurred periodically in ZION, including in the project area. The history of flooding and flood risk in ZION is described in Lund et al. (2010, 16-27) and summarized below. The project area is, and has been, susceptible to flooding during 100-year flood events. Major floods in the project area included a flood in December 1966 that produced a maximum flow of 9,150 cubic feet per second (cfs) on the North Fork of the Virgin River just outside ZION near Springdale and a flood in January 2005 that produced a maximum flow of 5,450 cfs on the North Fork of the Virgin River near Springdale. In 1998, a flash flood and debris flow inundated the current location of the Zion Canyon Visitor Center and the shuttle bus maintenance facility. Lund et al. (2010, 21) estimated the 100-year flood discharge on the North Fork of the Virgin River at the Springdale gage at 9,020 cfs and the 500-year flood at 13,500 cfs. In recent years, floods in Zion Canyon included a flash flood in June 2021 when ZION received more than an inch of rain in one hour. This flood required temporary closure of the South Entrance and evacuation of visitors.

REGULATORY FLOODPLAIN

Consistent with direction from EO 11988 and 13690, the regulatory floodplain is described as the 100-year plus two feet freeboard in the drainages that bisect the campground and the 500-year floodplain from the North Fork of the Virgin (Figure 3). The campground is partially in flood hazard areas because the rugged topography in the area leaves few alternatives. Facilities in the regulatory floodplain in the project area post-construction include portions of the reconstructed drainage swales, sections of road in the campground, several campsites, and pedestrian trails (Figure 3). Several of the walk-in campsites are within the regulatory floodplain. Roads providing access to the South Campground are also within the regulatory floodplain. Portions of Highway 9, which provides access into and out of the South Entrance are located in the regulatory floodplain. Visitors to the project area frequently travel in and through flood hazard areas. The South Campground is situated on levelled land adjacent to the North Fork of the Virgin River. While only portions of the South Campground would be flooded in a 100-year event, all roads leading into and out of the campground would be flooded.

No existing or newly constructed buildings would be within the regulatory floodplain in the South Campground after the project is complete (Figure 3). If the culvert crossing near just

downstream of this section of ephemeral drainage were to become blocked during a flood event, it is assumed that flood flows would travel south towards the Virgin River main channel as dictated by the proposed topography. As flood flows would travel south in the blocked culvert condition listed above, no impacts to the dump station or fee station due to flooding would be anticipated (Attachment A).

JUSTIFICATION FOR USE OF THE FLOODPLAIN

No practicable alternatives exist for locating the project outside of the regulatory floodplain because:

- The project area and associated floodplain have already been heavily disturbed by the existing infrastructure in the floodplain including the existing campground, roads, parking areas, and trails. Alternative sites nearby are less disturbed and moving these facilities out of the floodplain would result in impacts on nearby natural and cultural resources.
- Potential alternative sites outside the floodplain are constrained by steep terrain that is not suitable for construction without substantial grading and recontouring that would damage ZION resources.

INVESTIGATION OF ALTERNATIVE SITES

No alternative sites were identified that would entirely avoid locating project facilities in the floodplain. As described above under *Justification for Use of the Floodplain*, the existing campground is partially within the floodplain, and no practicable alternative sites exist for locating the project outside of the floodplain.

DESCRIPTION OF FLOOD HAZARDS AND EFFECT ON FLOODPLAIN VALUES

Flood risks associated with the proposed action include risk to human health and life due to overnight occupation and risk to capital investment resulting from damage to existing and expanded infrastructure. The post-project regulatory floodplain within the campground is shown in Figure 3. The post-project floodplain along the North Fork of the Virgin River would be unchanged, including several walk-in campsites that would remain within the floodplain. Based on flood modelling by Rosenberg Associates, flow depths in the reconstructed ephemeral drainages during a 100-year flood would range from about 0.3 to 2.3 feet (Rosenberg Associates 2023). Stream velocities in the reconstructed drainages during a 100-year flood would range from about 2.44 to 8.08 feet per second (Rosenberg Associates 2023).

Potential Risk to Human Health and Safety

As previously described, several roads and facilities in the project area are within the regulatory floodplain, including the roads providing access to the South Campground (Figure 3). Inundation of the roads leading into and out of the campground would affect vehicular ingress and egress during a flood event. These risks occur under existing conditions and would not change if the proposed action is implemented. The proposed action would not include constructing any new occupied buildings within the regulatory floodplain and would generally reduce flooding in the campground by improving and defining the existing ephemeral drainage swales. The South Campground has 127 sites and is full on most nights during the reservation season from March through October. About 43 campsites, including most of the walk-in campsites in the southeastern portion of the campground, are modeled to be within the post-construction regulatory floodplain. An additional 35 campsites not in the floodplain would potentially be inaccessible during a flood event because campground roads accessing them would be within the regulatory floodplain. Eight walk-in campsites are currently in the floodplain and would remain in the floodplain under the proposed action. Campsites in or affected by the floodplain post-construction are summarized in Table 2.

Table 2. Campsites in or Partially in the Regulatory Floodplain Post-Construction.

Campsite Type	Number in Floodplain	Potentially Isolated by Floodwaters
Drive-up	32	33
ABA	3	2
Walk-in	8	0
Total	43	35

A flood warning and evacuation plan exists for visitors and ZION staff. The plan includes maps and descriptions of areas vulnerable to flooding and nearby areas of safe refuge, a description of the flood risk, and an evacuation plan for quickly moving visitors and staff to safe refuge areas. A copy of the flood warning and evacuation plan is attached as Attachment B. Overall, the project reduces risks to human health and safety by improving traffic circulation and maintaining a flood warning and evacuation plan.

Potential Risk to Property

The proposed project would increase the infrastructure within the regulatory floodplain, increasing the impervious surface as described below by increasing the surface area of roads and parking areas. Most of the constructed facilities would be constructed at or near existing grade and would not substantially increase the flood elevation. Facilities in the floodplain could potentially be at risk from extreme flood events, including comfort stations and the new campground fee and wilderness permitting office building; however, as shown in Figure 3, no new buildings would be within the post-construction regulatory floodplain in the campground. Mitigation measures would be taken to reduce potential risks to property as described below and in the Potential Impact Mitigation Measures section. The new comfort stations would be constructed using flood-resilient construction methods to reduce the risk of damage from flood events, as described below under Floodplain Impact Mitigation Measures. To reduce the flood risk to the proposed fee station/wilderness office, which is downslope from one of the ephemeral drainages, the drainage would be widened to accommodate the 100-year floodplain plus 2 feet. As previously described, if the culvert crossing just downstream of this section of ephemeral drainage were to become blocked

during a flood event, it is assumed that flood flows would travel south towards the Virgin River main channel as dictated by the proposed topography. As flood flows would travel south in the blocked culvert condition listed above, no impacts to the fee station due to flooding would be anticipated (Figure 3; Attachment A). There is no specific NPS guidance on septic systems within floodplains at this time; however, widening the section of channel near the fee station would also reduce the flood risk to the dump station. ABA and host campsites in the campground would have infrastructure that could potentially be affected by flood events, such as electrical outlets for wheelchair charging. These sites would have electrical conduit installed so that an outlet for wheelchair charging could be installed in the future. Utilities at these sites would be designed to be elevated at least 30 inches above the ground to meet accessibility requirements, which would also elevate the utilities above the regulatory floodplain level. ABA campsites would be designated in the future, after a new vehicular bridge is designed/constructed. Until that time, these campsites would function as standard sites.

Potential Risk to Floodplain Values

The floodplain natural values in the project area have been altered by human activities such as construction of the campground. Modifications of the floodplain have resulted from construction of drainage swales and irrigation ditches, and construction of campground infrastructure, such as roads. Past construction of the campground resulted in increased impervious surface in the project area.

The floodplain would be negatively impacted during construction due to the presence of staging areas, construction equipment, and materials in the floodplain and possible erosion from bare soils prior to revegetation. However, construction activities would be monitored, and erosion and sediment control Best Management Practices would be implemented to minimize erosion and sediment movement. Disturbed areas would be revegetated following construction with native species.

Impervious surface in the project area would increase as shown in Table 1. Paved surfaces would increase from 160,885 square feet (sf) to 355,196 sf, a net increase in hardscape area of 194,311 sf. As previously described, gravel surfaces would decrease in area due to some existing gravel areas in the campground being reseeded. When the decrease in gravel surfaces is considered, the net increase in impervious surface would be 66,051 sf (about 1.5 acres).

Increasing the impervious surface by about 1.5 acres would be an increase of about 16 percent compared to existing conditions in the project area. Land cover changes would result from increased impervious surface, soil compaction, and changes in existing drainage patterns. Changes in land cover could alter the hydrology of the project area and increase the volume of runoff. Impervious areas also collect pollutants, which are then mobilized after rainfall and potentially transported to streams or other waters. Increases in impervious surface would adversely affect floodplain functions and values by decreasing flood storage capacity and reducing the ability of the floodplain to recharge and infiltrate stormwater. The project would include a 5,000-sf stormwater detention pond to reduce sedimentation and pollutants reaching waterways. To reduce the risk of pollutants entering waterways, fuel storage and hazardous waste storage would be at least 3 feet above the regulatory floodplain

elevation. Because the floodplain in the project area already contains 401,575 sf (about 9.2 acres) of impervious surface, any changes in floodplain value from changes in impervious surface are expected to be minor.

FLOODPLAIN IMPACT MITIGATION MEASURES

The following floodplain impact mitigation measures would be implemented:

- A flood warning and evacuation plan would be developed for visitors and ZION staff. The plan would include maps and descriptions of areas vulnerable to flooding and nearby areas of safe refuge, a description of the flood risk, and an evacuation plan for quickly moving visitors and staff to safe refuge areas. The flood warning and evacuation plan is attached as Attachment B.
- To reduce the flood risk to the proposed fee station/wilderness office, which is downslope from one of the ephemeral drainages, a section of the drainage would be widened to accommodate the 100-year floodplain plus 2 feet, as described in Attachment A.
- There is no specific NPS guidance on septic systems in floodplains at this time; however, widening the section of channel near the fee station would also reduce the flood risk to the dump station.
- The new comfort stations would be designed to be flood resilient using heavy block construction with stone veneer around the base, with concrete foundations. Heating and plumbing equipment would be in the ceilings of the buildings, windows would be high on the walls, and doors would be metal.
- ABA campsites would have electrical conduit installed so that an outlet for wheelchair charging could be installed in the future. Utilities at these sites would be designed to be elevated about 30 to 36 inches above the ground to meet accessibility requirements, which would also elevate the utilities above the regulatory floodplain level. These sites would be designated to be ABA campsites in the future, after a new vehicular bridge is designed/constructed. Until that time, these campsites would function as standard sites.
- Gravel areas in the campground would be reduced, and about 1.5 acres of current gravel areas would be revegetated, which would partially offset the increase in impervious surface.

SUMMARY

The NPS has determined that implementing the proposed action would not result in any additional disruption of floodplains. Risk to life, property, and natural resources from flooding can be mitigated. The proposed action would improve visitor experience, accommodate more demand placed on campground infrastructure, improve drainage from

the west side of the campground to the North Fork of the Virgin River, and increase efficiency of operations while protecting natural and cultural resources. Additionally, the project would address compliance with the ABA and ADA. New structures would be designed at grade or would be designed for resilience against future storm events. Avoidance of floodplains is not possible due to the location of the campground in the floodplain. Necessary adverse floodplain impacts have been reduced to the greatest practicable extent while meeting the design requirements and operation needs of the site. With the proposed mitigations applied, the NPS finds that the proposed action would not have any additional adverse impacts on floodplains and their associated values.

REFERENCES

Executive Order 11988, "Floodplain Management." 1980. Executive Order of the President of the United States. May 28.

Executive Order 13690, "Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input." 2015. Executive Order of the President of the United States. January 30.

Lund, W.R., T.R. Knudsen, and D.L. Sharrow. 2010. Geologic hazards of the Zion National Park geologic hazard study area, Washington and Kane Counties, Utah: Utah Geological Survey Special Study 133, p. 16-27.

National Park Service (NPS). 2003. Director's Order 77-2: *Floodplain Management*. Washington Office, Washington, D.C.

Rosenberg Associates. 2023. Floodplain Data for Zion South Campground Ephemeral Drainages. May 24.

Wood Environment and Infrastructure Solutions, Inc. (Wood). 2022. Floodplain Mapping for Zion National Park South Entrance Area.

ATTACHMENT A
Zion South Campground
Ephemeral Drainages - Hydraulic Modeling Assumptions

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May 8, 2023

Walker Christensen, PLA
DHM Design
1309 East 3rd Ave, Room 205
Durango, CO 81301

Subject: Zion South Campground
Ephemeral Drainages - Hydraulic Modeling Assumptions

The purpose of the document is to describe the design methods and assumptions used to model and map the 100-year flood event within the proposed ephemeral drainages to be constructed with the Zion South Campground project.

100-year flow data was developed by Rosenberg Associates using the HEC-HMS program (version 4.10) based on NOAA Atlas14 rainfall depths, SCS Curve Numbers, TR-55 time of concentration, and a modified Farmer-Fletcher rainfall distribution. See Table 1 and Exhibit 1 in the Appendix for detailed information.

Hydraulic modeling of the ephemeral drainages was performed using the HEC-RAS program (version 6.3.1). A Manning's "n" value of 0.035 was used to model roughness within the proposed drainages. It was assumed that all flows generated northeast of SR-9 were conveyed by the existing stormdrains and would be present in the proposed drainage channels.

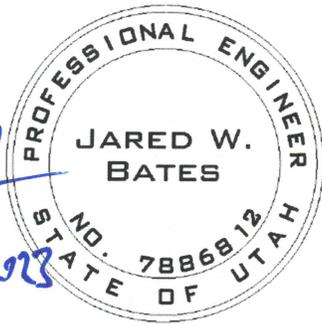
Based on the assumptions and data listed above, the proposed ephemeral drainages as designed convey the 100-year storm event. In an effort to mitigate the impacts of flooding to the proposed fee building, the "northeast drainage channel" from stations 1+50 to 5+00 was expanded to contain the 100 year-year storm event plus 2 feet of freeboard. The "channel connect" drainage was also expanded from stations 0+00 to 1+54 as an additional measure of mitigation.

In the case that the culvert crossing near station 6+00 of the "northeast drainage channel" becomes blocked, it is assumed that flood flows would travel south towards the Virgin River main channel as dictated by the proposed topography. As flood flows would travel south in the blocked culvert condition listed above, no impacts to the fee station due to flooding would be anticipated in this condition.

Please contact me if you have any questions or need additional information.

Sincerely,

JWB
5/8/2023



A circular professional engineer seal for Jared W. Bates, State of Utah, License No. 7886812. The seal contains the text "PROFESSIONAL ENGINEER" at the top, "JARED W. BATES" in the center, and "STATE OF UTAH" and "NO. 7886812" at the bottom. Handwritten in blue ink to the left of the seal are the initials "JWB" and the date "5/8/2023".

Jared Bates, P.E., C.F.M
Rosenberg Associates

Table 1

Reach	100-year Flow
North Channel Alignment 0-500	12.0 cfs
North Channel Alignment 500-1025	56.7 cfs
North Channel Alignment 1025--1100	59.1 cfs
North Channel Alignment 1100-1300	79.3 cfs
Channel Connect	46.7 cfs
Middle Channel	3.0 cfs
West Channel	21.6 cfs
East Channel	35.4 cfs

ATTACHMENT B
Flood Warning and Evacuation Plan

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Flood Warning and Evacuation Plan

South Campground

Zion National Park

August 11, 2023

JEFFREY
BRADYBAUGH

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8/11/23

Approved by: _____ Date: _____
Jeff Bradybaugh, Superintendent

Background:

The South Campground in Zion National Park was originally constructed by the Civilian Conservation Corps and was modified during the Mission 66 Construction period. South Campground was subsequently redesigned in 2022 to improve the flood capacity of four drainages that cross the campground and simplify vehicle circulation while leaving the location substantially unchanged. The Campground sits in the floodplain of the North Fork of the Virgin River as well as within the floodplain of four ephemeral drainages that bisect the campground. The North Fork of the Virgin River and drainages that bisect that campground are susceptible to floods and debris flows with flows regularly increasing several orders of magnitude in a few minutes to hours.

Known Flood Risk:

The North Fork of the Virgin River runs on the south edge of the campground and is susceptible to flooding both in spring snowmelt and runoff and precipitation-caused flooding events. Precipitation-caused events are more likely to result in debris-laden flash floods to debris flows whereas spring snowmelt

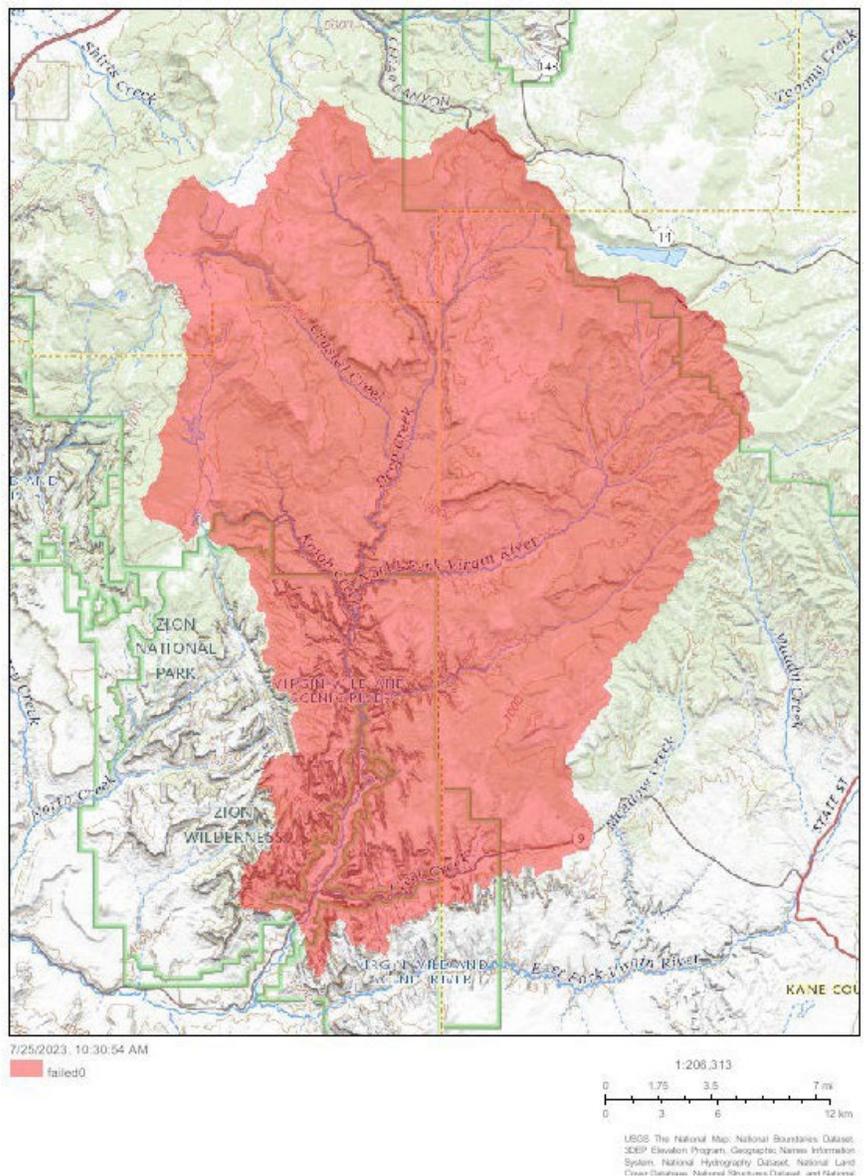


Figure 1: Map of the 354 square miles watershed (red) upstream of South Campground. Precipitation anywhere within this watershed has the potential to cause flooding in the North Fork of the Virgin River.

runoff floods are more predictable and tend to mobilize less debris. Precipitation-caused flash flood events can occur year-round and are a particular concern during rain-on-snow events in the winter and spring as well as during the summer monsoon. The watershed area which could contribute to flows at South Campground is 354 square miles and has a perimeter of 183 miles (Figure 1). Precipitation anywhere within this watershed has the potential to cause flooding within the North Fork of the Virgin River affecting South Campground.

Four ephemeral drainages that drain precipitation-caused flows from the hillslope to the northwest of the campground bisect the campground. During short-lived, high-intensity precipitation events within this small watershed these drainages convey debris-laden flood flows. The regulatory floodplain (100-year event plus two feet of freeboard) for these drainages is shown in Figure 2 by the blue cross hatched polygon. The regulatory floodplain for the North Fork of the Virgin River is the 500-year floodplain identified by the light-yellow polygon.

Several roads and facilities in the project area are within the regulatory floodplain, including the roads providing access to the South Campground (Figure 2). Inundation of the roads leading into and out of the campground would affect vehicular ingress and egress during a flood event. These risks occur under existing conditions and would not change if the proposed action is implemented. The proposed action would not include constructing any new occupied buildings within the regulatory floodplain and would generally reduce flooding in the campground by improving and defining the existing ephemeral drainage swales. The South Campground has 127 sites and is full on most nights during the reservation season from March through October. About 43 campsites, including most of the walk-in campsites in the southeastern portion of the campground, are modeled to be within the post-construction regulatory floodplains. An additional 35 campsites not in the floodplain would potentially be inaccessible during a flood event because campground roads accessing them would be within the regulatory floodplain. Eight walk-in campsites are currently in the floodplain and would remain in the floodplain under the proposed action. Campsites in or affected by the floodplain post-construction are summarized in Table 1.

Table 1. Campsites in or Partially in the Regulatory Floodplain Post-Construction

Campsite Type	Number in Floodplain	Potentially Isolated by Floodwaters
Drive-up	32	33
ABA	3	2
Walk-in	8	0
Total	43	35

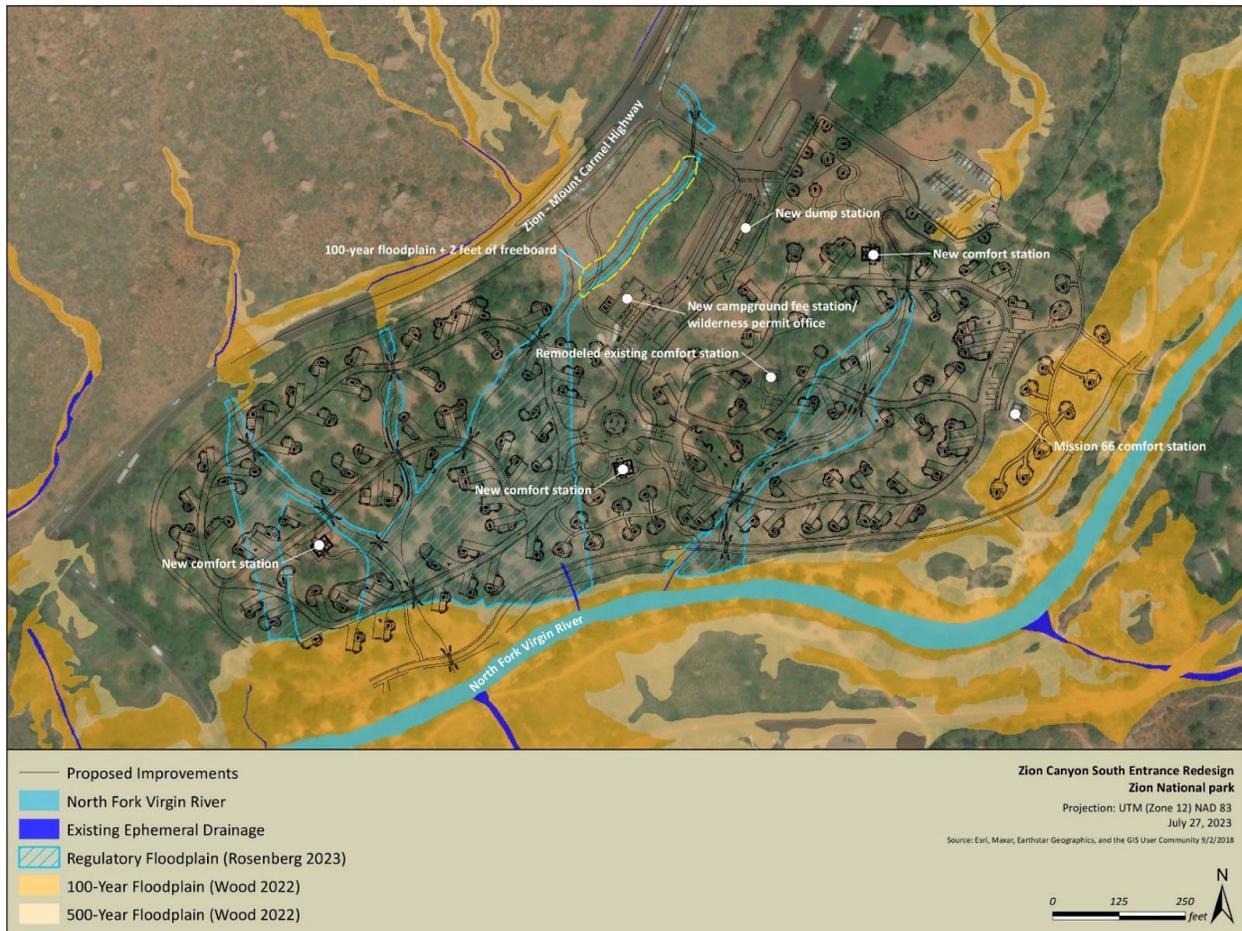


Figure 2: South Campground Overall Site Plan with post-Project regulatory floodplain. The regulatory floodplain is the blue cross-hatched polygon (100-year plus two feet freeboard in the drainages) and the light yellow polygon (500-year floodplain) along the river.

Warning:

Flash floods occur in South Campground both in the North Fork of the Virgin River and within the ephemeral drainages with little to no warning. Therefore, Zion National Park will provide a preemptive warning to all campers that they are within a floodplain. All campers in the South Campground make reservations up to two weeks in advance on Recreation.gov. The park will provide information on flood risk and flood mitigation behavior in the “Need to Know” section. In order to complete the reservation, the user must acknowledge receipt of this information. Users will be informed that the campground is in a floodplain and given a link (i.e. [Floods \(weather.gov\)](https://www.weather.gov)) with further information. In addition, the campsite maps distributed at check-in will include information on flood risk and exit paths.

The language in the “Need to Know” section of Recreation.gov will read:

South Campground in Zion National Park is located within a known floodplain. Additionally, seasonal grasses and shrubs dry quickly throughout the year and may pose a wildfire risk. As a user of this recreational facility, it is your responsibility to:

- familiarize yourself with exit routes and have a plan for exiting the campground if needed,

- pay close attention to weather warnings and fire restrictions when in effect, and
- follow directions provided by emergency responders in the event of an emergency.

Evacuation:

Guided by Homeland Security Presidential Directive (HSPD) 20 and National Security Presidential Directive (NSPD) 51, Zion National Park has established a Continuity of Operations Plan (COOP) which identifies steps to be taken in an emergency situation to minimize disruption to essential functions and return Zion National Park to normal operations as soon as possible. The COOP would be activated in case of flooding in Zion Canyon. Continuity of operations planning aims to identify risks, institute preventative mechanisms, and develop measures to deal with consequences when prevention fails.

The COOP is a flexible, structured common sense approach to outline the prudent actions relevant to any adverse situation that could arise, but specific to each individual park's needs and the severity of the crisis. The COOP covers evacuation planning for the campground and other continuous area of the park that may be affected by the same event.

Because flood events in Zion Canyon could affect a wide range of visitor and administrative facilities (lodge, visitor center, multiple campgrounds, roads and bridges), and involve rapid changes and developments in what areas are impacted, an Incident Command structure will be utilized in order to be responsive to evolving conditions. As directed by the Incident Commander, Zion National Park rangers on scene will notify campers of impending conditions if information and time allows and will direct evacuation timing and path as dictated by best paths open at the time of the event. In some cases, campers may be directed to shelter in place at the campground or nearby buildings until conditions permit evacuation.

The campground is located in the front country of the park with good access to communications and timely weather and reporting data.

The COOP also includes information on communication and agreements with Springdale, and other local government entities to ensure that evacuation and flood response is coordinated, and that shelter or evacuation instructions to campers and other park visitors are consistent with conditions including road closures in the surrounding area.

In addition, campground exit paths will be clearly marked to facilitate evacuation.

Attachment:

Zion Group Continuity of Operations Plan, 2022