

Fish Passage: Temple of Sinawava Dam Removal
Floodplain Statement of Findings
PEPC 123321



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FISH PASSAGE: TEMPLE OF SINAWAVA DAM REMOVAL 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 objective 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 NPS Planning, Environment and Public Comment website from May 30 to June 28, 2024.

This Floodplain Statement of Findings:

- Describes 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 proposed project area is located at the Temple of Sinawava Waterline Dam located on the North Fork of the Virgin River at the Temple of Sinawava (Figure 1).



Figure 1. Project location map.

PROPOSED ACTION

The Temple Sinawava waterline delivers water to the restrooms and comfort station located at the north end of Zion Canyon Scenic Drive at the start of the Riverside Walk which leads to the Narrows Trail. Spring water is collected on the west side of the river, and travels through a two-inch galvanized steel pipe under the river and to the park facilities. Based on historical design drawings (1955), as it passes under the river the pipe is enclosed in a six-inch steel pipe which was embedded in a five by five foot concrete collar. When originally installed, the top of the concrete collar likely matched the existing river grade. However, over time a scour hole developed downstream of the concrete; this was then reinforced with rock and additional concrete creating a drop in the river (Figure 2). The vertical drop across the dam varies from 3 to 3.5 feet. Although the height of the dam crest is consistent, the steepness of the drop varies across the width of the dam based on the amount of rock and concrete located on the downstream side. The park proposes to remove the dam and replace the waterline through this project.

Purpose and Need

The purpose of the project is to (1) provide upstream fish passage across the Temple of Sinawava waterline crossing while (2) maintaining or, where possible, improving park water infrastructure.

Modeling and current monitoring support the hypothesis that the Temple of Sinawava Waterline Dam is a complete barrier to native fish passage at target flow conditions, 40-170 cubic feet per second (cfs). Preventing natural fish movement through the system degrades fish and aquatic ecosystem health. Barriers prevent native fish from occupying different types of habitats during various life stages and flow conditions, cuts off access to food resources, and degrades genetic diversity by isolating populations over time.

The Temple of Sinawava waterline section under the river is 67 years old (1957), is nearing the end of its lifespan, and needs replacement in the near term. The dam is showing signs of undercutting and will continue to undercut, leading to its failure without intervention. This dam structure poses a health and safety risk of visitors recreating in the river at this site who may slip and fall off the dam structure.

Objectives:

- Protect and enhance native fish habitat in the North Fork of the Virgin River
- Address maintenance backlog
- Reinvest in park infrastructure



Figure 2. The Temple of Sinawava waterline dam encases a 67-year-old waterline which conveys water from a spring source on the west side of Zion Canyon to a comfort station on the east side of Zion Canyon.

Duration of the proposed activities

Anticipated implementation of project work is estimated to be continuous and occur from October through December 2024. Work would occur during a two-month construction period on weekdays (daytime only). All work would be contracted and dependent upon favorable weather and river flow conditions. The order of demolition and construction components may change based on in-water work restrictions for spawning fish (no in water work from April 1 to July 31, 2024), riverine flooding, and other mitigation measures.

Equipment & Staging

Staging would take place in disturbed areas in both the Temple of Sinawava parking lot and the beach on the east embankment near the site of the dam. Some visitor parking in the Temple of Sinawava parking lot would be used for parking for project workers for the duration of construction. The construction site would be clearly marked and fenced (6-foot-tall construction fencing) to prevent visitor access. River access would be closed at the site of the dam and project area. A temporary access road from the Temple of Sinawava parking lot would be cleared and grubbed to provide vehicle access to the project site (6,700 square feet (SF)).

Proposed Project Components*Demolition:*

Demolish the existing concrete dam and waterline removing 800 cubic yards of concrete material from the river.

River Restoration and Waterline Replacement:

The river would be regraded 50 feet downstream and 200 feet upstream of the existing dam. 400 cubic yards of fill would be brought in to regrade the river. Four buried grade control weirs would be installed along the length of the regraded river to protect new buried waterline from scour. 425 cubic yards of locally sourced boulder fill would be installed in the river to maintain grade. 60 feet of boulder rip rap embankment protection would be installed to protect historic features and water infrastructure (pre-2009 Wild and Scenic River designation) from the existing cutbank from continuing to migrate west. 250 linear feet of new waterline pipe and an adjacent second conduit for future utilities made of PVC at 2 inches in diameter would be installed encased by a 6-inch diameter steel pipe. 100 linear feet of the new pipe would be installed three to four feet below the river bottom. Waterline and conduit would be stubbed to a buried watertight access box on both sides of the river.

Vegetation

Vegetation removal for the temporary access road would total 6,700 SF. Complete restoration and revegetation would occur causing no long-term net impacts to vegetation. Revegetation with native seed mix would be implemented after construction is complete by NPS vegetation crews.

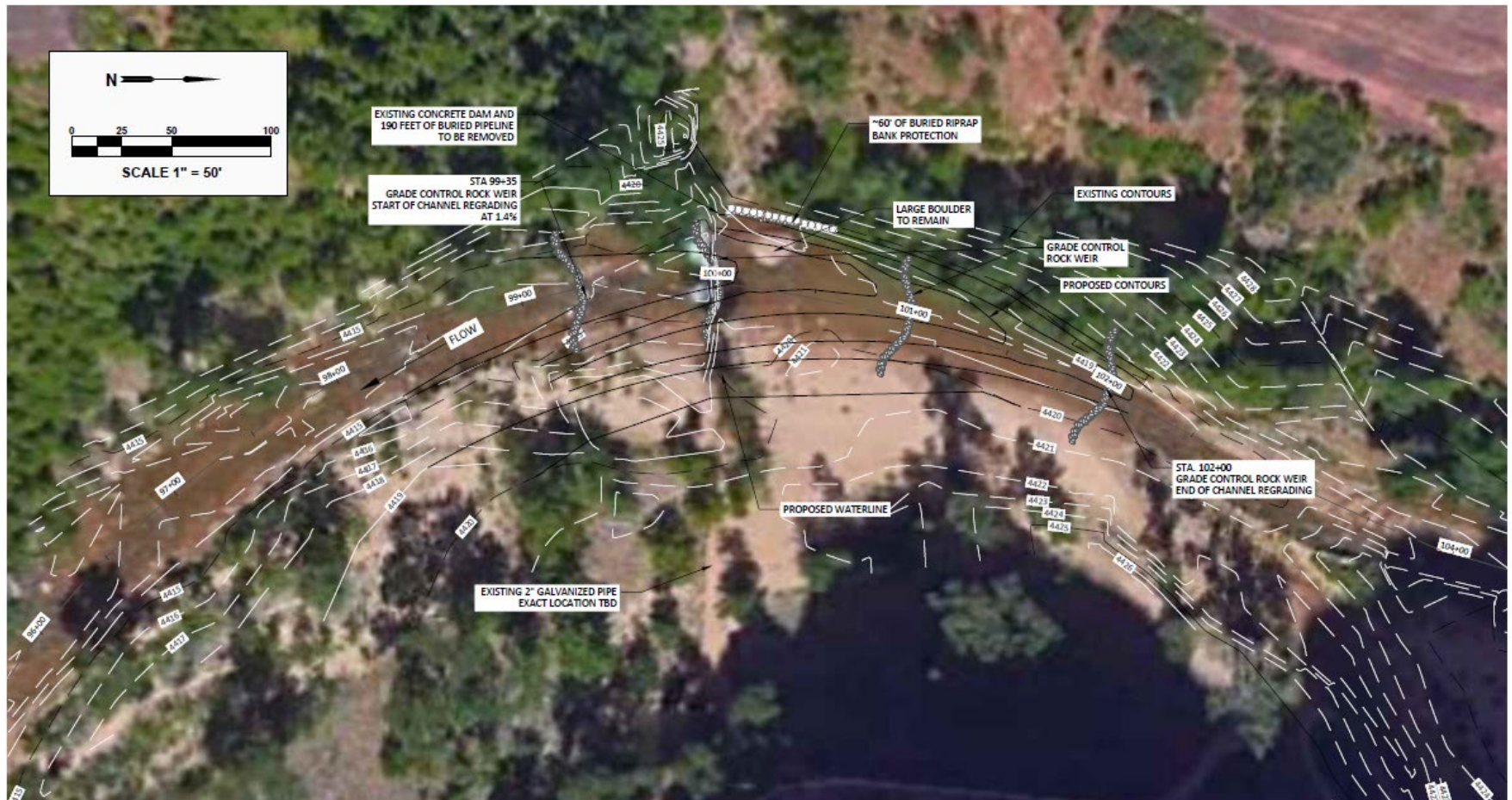


Figure 3. Temple of Sinawava dam removal and river restoration plan.

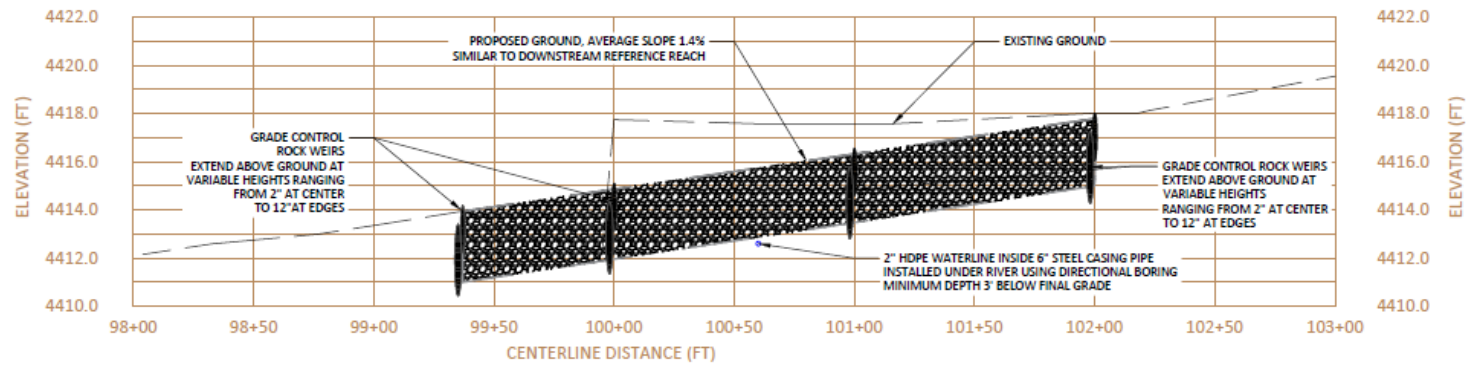


Figure 4. River profile of restored section.

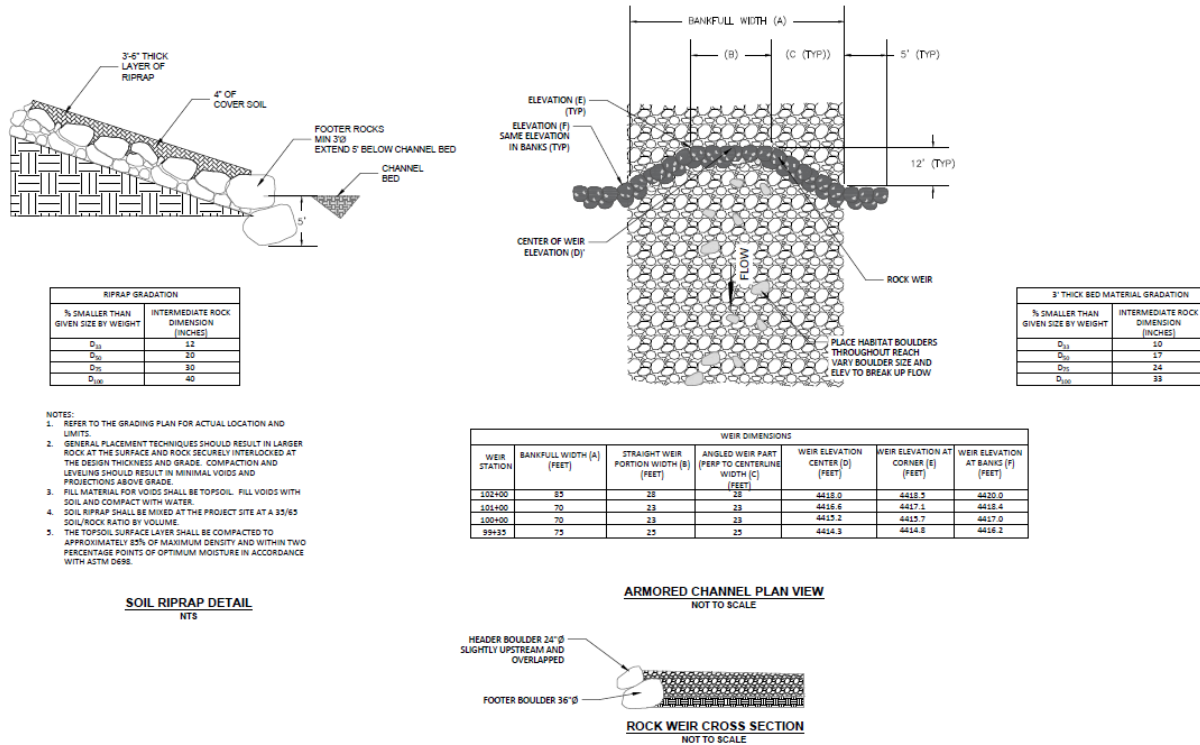


Figure 5. Design details of the rock weirs and embankment stabilization.



Figure 6. Erosion control and temporary river diversion plan.

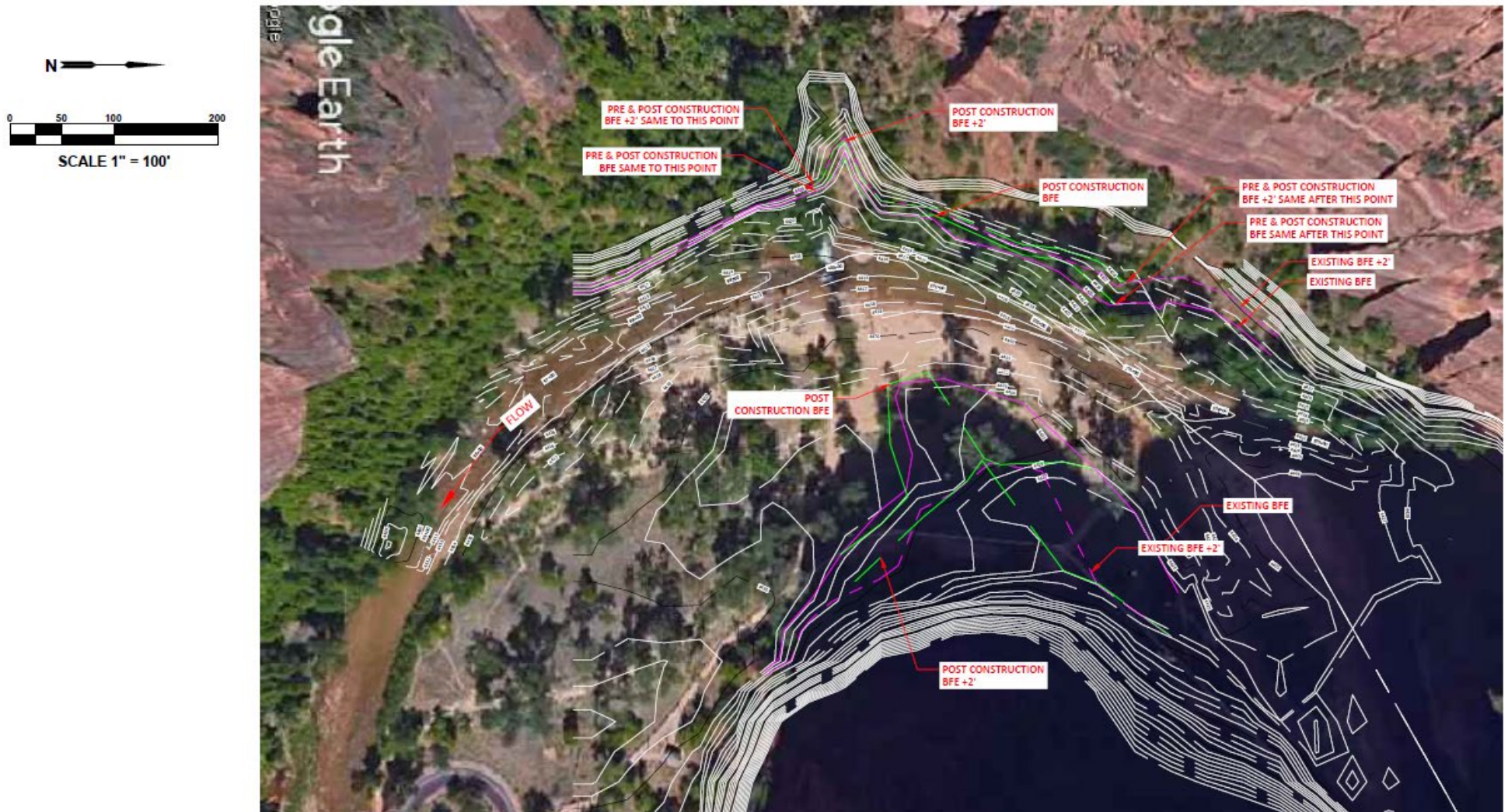


Figure 7. Floodplain elevation map modeled under **current conditions** and **post-restoration conditions**. The **solid purple** line represents the current Base Flood Elevation (BFE) or the 100-year floodplain and the **dashed purple** line represents the current regulatory floodplain (2-feet added to the Base Flood Elevation). The **solid green** line represents the post-restoration BFE or the 100-year floodplain and the **dashed green** line represents the post-restoration regulatory floodplain (2-feet added to the Base Flood Elevation).

FLOODPLAINS

Following PM 77-2, three action classes were considered when establishing the regulatory floodplain:

1. Class I Actions, also referred to as Non-Critical Actions, include location or construction of administrative, residential, warehouse, and maintenance buildings; non-excepted parking lots; or other man-made features which by their nature entice or require individuals to occupy the site, are prone to flood damage, or result in impacts to natural floodplain values.
2. Class II Actions, also referred to as Critical Actions, include any activity for which even a slight chance of flooding is too great such as construction of schools, medical facilities, emergency services, hazardous material storage, and records/collections storage.
3. Class III Actions include any action that involves human occupation or substantial human exposure in high hazard areas such as drainages subject to flash flooding.

This project, proposing to remove a dam, restore 250 linear feet of the river and install 250 feet of buried waterline as well as an open conduit for future utilities, constitutes a Class I, Non-Critical, Action. While the North Fork of the Virgin River is a high hazard area subject to flash flooding, this project does not propose human occupation or substantial human exposure, therefore, this project constitutes a Class I Action. 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 (FFRMS). Per the Federal Emergency Management Agency's implementing guidelines for EOs 11988 and 13690, agencies may use a Freeboard Value Approach in establishing FFRMS flood elevations in areas where the 100-year or base flood elevation (BFE) levels are known. This method adds two feet to the BFE for Non-Critical Actions. Therefore, the regulatory floodplain for the proposed action is the 100-year flood elevation plus two feet added to the BFE.

Through this section, the meandering North Fork of the Virgin River riverbed and banks are comprised of boulder to sand size alluvial material. This project area occurs around a meander with a cutbank on the west embankment and point bar on the east. The east point bar is a popular beach for recreators to access the river. Excessive trampling in this location has completely denuded the point bar of vegetation.

One-dimensional floodplain modeling utilizing HEC-RAS demonstrates the current location of the regulatory floodplain and the proposed impacts to the floodplain after river restoration occurs (Figure 7). Topography was derived from 2020 land/bathymetric survey and 2015/2016 ariel Light Detection and Ranging survey. Flood flow data from the North Fork of the Virgin River near Springdale USGS gage (0940550) located about seven miles downstream of the project site were analyzed using PeakFQ, a utility used to estimate flood frequency values. The 100-year return period corresponds to a flow of 8,800 cfs. A 100-year flood of 8,800 cfs was used in the model to create the BFE. The model was then modified to incorporate the proposed construction conditions and rerun with the same 8,800 cfs flow to create the post-construction BFE. Two feet was then added to the BFE under both the modeled scenarios to derive the regulatory floodplain.

Figure 7 depicts modeled impacts to the BFE and the regulatory floodplain as a result of this project due to removal of the dam and regrading of 250 feet of the river channel. More significant impacts occur on the east side of the river, the river's natural floodplain, as compared to the west side where the west embankment climbs steeply toward the canyon cliff base. Downstream of the dam, post-

construction flood elevations are expected to increase slightly as local fill will be installed to fill in unnatural scouring resulting from the dam. Upstream of the dam, flood elevations will decrease slightly as removal of the dam and sediment deposited as a result of the dam removal and regrading. The entirety of the project area is located within the regulatory floodplain.

JUSTIFICATION FOR USE OF THE FLOODPLAIN

This project involves work related to culinary water infrastructure that crosses the North Fork of the Virgin River unavoidably within the river's floodplain.

INVESTIGATION OF ALTERNATIVE SITES

This project proposes to remove a dam and restore the area affected by the dam placement. The new waterline will be replaced within the previously disturbed section to reduce impacts to the river. No alternative sites were considered.

DESCRIPTION OF SITE-SPECIFIC FLOOD RISK

The watershed of the North Fork of the Virgin River at this location extends for over 300 square miles. The primary type of flooding that occurs in the North Fork of the Virgin River through this section include riverine and flash floods.

Riverine flooding is typically regional in nature and can occur over a period of hours to weeks. A substantial snowpack accumulates throughout the winter and early spring within the watershed of the North Fork of the Virgin River. Temperatures rising in the spring result in a rapid snowmelt runoff, which typically occurs from March through May, and causes a sustained riverine flood within the North Fork of the Virgin River. Prolonged heavy rainfall associated with regional storm events may cause riverine flooding as well. During the winter months, rain-on-snow events can also cause significant riverine flooding. The largest recorded flood within the project area occurred during a rain-on-snow event in December 1966 causing a large riverine flood to occur in the North Fork of the Virgin River (Lund et al. 2010). A USGS gage (North Fork Virgin River Near Springdale, UT – 09405500) located roughly seven miles downstream from this project site recorded discharge as 9,150 cfs which constitutes a flood with a return period of about 200 years. The 1966 riverine flood resulted in \$14,000,000 (figure not adjusted for inflation) worth of infrastructure damage in Zion National Park. While riverine flooding can cause significant damage to infrastructure located within the floodplain, riverine flooding is often predictable based on temperature and precipitation forecasts. Therefore, riverine flooding poses a lower risk to human health and safety.

The North Fork of the Virgin River is also subject to flash floods which are sudden, often localized, flood events which typically occur during short-lived, high-intensity cloudburst storms during the monsoon (July through September). Due to the unpredictability of the exact location of cloudburst storms and the sizable watershed upgradient of the project site, flash floods are difficult to predict (Lund et al. 2010). Like riverine floods, flash floods may cause significant damage to infrastructure located within the floodplain. Most concerning, flash floods pose a significant risk to human health and safety where floods can form quickly with little warning. Flash floods have caused over 20 fatalities in Zion National Park since 1919. In locations with little to no access to higher terrain, such as narrow slot canyons, flash floods pose a significant risk to human health and safety.

Potential Risk to Human Health and Safety

Riverine and flash flooding across the Temple of Sinawava Waterline Dam poses a significant risk to human health and safety due to powerful and dangerous hydraulic forces, including helical and reciprocal flows downstream of the dam crest. These hydraulic forces are directly caused by the dam. This project proposes to remove the dam, therefore removing the hydraulic forces downstream of the dam that pose a significant elevated risk to visitors. Grade control devices will be buried at grade with the stream bed and designed to reduce scour so the hydraulic impact of the grade control weirs will be negligible during flood events. Despite the improvement on human health and safety in the project area, the river in this area still poses an inherent risk during flood events and risk cannot be eliminated.

Potential Risk to Property

This project proposes to remove the current dam and replace the aging waterline with a new line buried below the river bottom. Access to the waterline and adjacent fiberoptic conduit will be stubbed in a buried watertight access box. The waterline and access box will be buried and grade control weirs protect exposure of these systems during flood events. Despite design elements to protect infrastructure during a flood event, risk to property cannot be eliminated.

Potential Risk to Floodplain Values

The North Fork of the Virgin River floodplain is adjacent to the river and serves important functions such as reducing flood risks downstream by absorbing and storing excess water during flood events, improving water quality by filtering contaminants during flood events, providing habitat for plants and animals, and recharging groundwater aquifers. The floodplain natural values in the project area have been significantly altered by human activities by constructing the current waterline dam and human trampling on vegetation on the east embankment point bar.

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.

This project proposes to restore natural channel and floodplain geomorphology; therefore, this project is expected to enhance floodplain values.

FLOODPLAIN IMPACT MITIGATION MEASURES

The following floodplain impact mitigation measures would be implemented:

- Best Management Practices for erosion control will be implemented during construction.
- Dam presenting significant risk to human health life and safety during flood events will be removed.
- All utilities will be buried below the river bottom and floodplain surface and grade control weirs installed within the river channel to prevent scour and surface exposure of buried utilities during flood events.
- Disturbed areas will be revegetated with native plants.
- Storage of fuels and hazardous materials will occur outside of the regulatory floodplain.

- Utilities, new waterline, open conduit and access box, are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60)

SUMMARY

The NPS has determined that implementing the proposed action to remove the Temple of Sinawava Waterline Dam and replace the existing waterline will result in inherent risks to human health and safety as well as property. However, through removing the dam, risk to human health and safety is reduced as compared to existing conditions. Further, risks to water infrastructure can be mitigated through buried grade control weirs reducing scour and erosion of these utilities and all utilities will be buried and access boxes watertight. Dam removal and restoration of the river channel and floodplain enhances floodplain values. Therefore, the NPS finds the proposed action to be consistent with EO 11988, 13690, and NPS DO-77-2 for the protection of floodplains and has determined that it would not have additional significant 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.