

United States Department of the Interior

NATIONAL PARK SERVICE
Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, CO 80525



VIA ELECTRONIC MAIL, NO HARD COPY TO FOLLOW

August 5, 2022

Memorandum

To: K Lynn Berry, Superintendent, John Muir National Historic Site (JOMU)

Through: Forrest "Ed" Harvey, Chief, Water Resources Division (WRD) *F. Edwin Harvey*

From: Derek Schook, Hydrologist, WRD
Michael Martin, Hydrology Program Lead, WRD

Subject: Reconnaissance-level evaluation of Strentzel Creek area development plans with follow-up flood risk modeling, JOMU

Executive Summary

This report evaluates flood risk within the Strentzel Creek alluvial fan area in John Muir National Historical Site. We used a standard hydraulic model to delineate the regulatory floodplain, estimate floodwater extent, characterize flow conditions, and assess proposed development in relation to NPS floodplain policy. Although Strentzel Creek flooding could threaten people and NPS infrastructure, the regulatory flood is predicted to be of low enough magnitude, velocity, depth, and extent that light development could occur with conscientious planning to mitigate flood threats. If NPS capital investments are limited to locations outside of the regulatory floodplain or the infrastructure is of low enough cost to be deemed sacrificial, and visitors are warned of potential flood hazards, then a formal Floodplain Statement of Findings should not be necessary.

Introduction

In response to STAR #2784, staff from the NPS Water Resources Division (WRD) visited the Strentzel Creek alluvial fan in John Muir National Historic Site (JOMU) for a reconnaissance-level site evaluation. JOMU regained active management of the Strentzel Creek alluvial fan area following the expiration of the 25-year Strain Ranch private reservation in 2016, and park staff have developed a proposed action that includes light development of the property for visitor use. Desired infrastructure includes parking for recreators accessing trails, a covered picnic pavilion, an open-air gathering site, and a building to host educational programs. Currently the property includes pre-existing structures associated with the farmstead, but the built environment is being redesigned and none of the existing structures will

remain. Proposed development alternatives are all relatively non-impacting and would enhance ecosystem conditions compared to the current conditions.

On April 21, 2022, JOMU and regional staff led a field tour and discussion of proposed plans for the site, and the concepts were evaluated by the group in the context of flood hazards and NPS floodplain policy. With some minor accommodating adjustments, it appears that proposed plans will be feasible, safe, and aligned with NPS policy.

NPS policy calls for a Floodplain Statement of Findings when a proposed action will have an adverse floodplain impact from flood hazards that threaten human life, capital investment, or natural and beneficial floodplain values. Following NPS Directors Order #77-2, all the actions associated with the proposed development are Class I actions and subject to compliance if they are within the base floodplain, or the 1% annual exceedance probability (AEP, or “100-year”) floodplain. Executive Order 13690 prescribes an additional Federal Flood Risk Management Standard (FFRMS) for any actions that include federal capital investment. One of the recommended FFRMS is the 0.2% AEP (i.e., “500-year”) flood, which will serve as the regulatory standard for this proposed action. We also estimate the maximum-flood experience to characterize potential flood risk to human life.

Valley Setting

Strentzel Creek emerges from the East Bay Hills south of Mount Wanda where it enters an alluvial fan system. Landscape evolution over millennial-scales has created a relatively wide and gently sloping valley bottom, an inviting setting for human occupation. However, the site remains subject to the same hydrogeomorphic processes that led to its formation, namely episodic flooding and sediment transport associated with ephemeral flows in Strentzel Creek. The creek is usually dry, but storm events create occasional flow over the alluvial fan, pitting humans and built infrastructure with flood hazards.

The Strentzel Creek watershed west of Alhambra Valley Road has a 0.39 mi² area with a mean annual precipitation of about 21 inches. Its upper reach is relatively steep and confined in its wooded valley before transitioning to the alluvial fan, where the valley is less confined and the slope flattens to 3.2%. These factors create a depositional and geomorphically active environment. In alluvial fan environments such as this, a creek has a natural propensity to laterally shift across its flood-prone valley bottom during flow events, which essentially renders most of the valley bottom subject to some degree of flooding.

In an attempt to manage floods, previous landowners pushed Strentzel Creek on the northern edge of its valley using a small ditch and levee system that likely required repeated maintenance. This configuration has caused hillslope erosion and altered fluvial processes. Furthermore, flows repeatedly left the artificial channel and traveled down the valley low point. This caused erosion and deposition, including onto Alhambra Valley Road and neighboring properties. To alleviate flooding of private properties downstream, the county directed Strentzel Creek in the lower fan area to discharge directly to Alhambra Creek through a levee-drain-culvert system. However, the current levee configuration does not provide complete protection from all flow events, and downstream properties still flood occasionally.

The proposed actions by NPS staff aim to provide some modest visitor services in this area, but also to alleviate some of the current problems such as hillside erosion, impaired fluvial processes, and flooding of neighboring properties.

Flow Modeling and Flood Hazard

We used the 0.2% AEP flood to evaluate flood risk to the proposed infrastructure. Per Director's Order #77-2, and to err on the side of caution, we also characterize threats to human life using the extreme-high flood estimate that is the USGS's regional maximum-flood experience approach (Qme; Crippen and Bue, 1977) for this small and steep watershed capable of flash-flooding. Although the proposed action does not include overnight occupancy in the valley bottom, day use will occur and a conservative evaluation of extreme flood conditions to characterize potential risk to human life is prudent.

We estimated depths and velocities of the two floods (0.2% AEP and Qme) using a standard one-dimension hydraulic model in HEC-RAS. The model assumes a static landscape as seen in 2019 lidar, but this assumption will not strictly hold given infrastructure changes and the dynamic nature of this alluvial fan system. Additionally, discharges used are best estimates. Therefore, modeling can be used for evaluation but should be considered uncertain in relation to realized future conditions.

Predicted peak flows were identified using two USGS programs that use regionalized equations for flow in ungaged basins. For the 0.2% AEP flood, Strentzel Creek is predicted to flow at 162 cubic feet per second (cfs) (USGS StreamStats, Gotvald et al. 2012), and the maximum depth at each cross-section would average 1.0 feet deep with flow velocity around 5 ft/s (Table 1; Figures 1 & 2). These conditions could be destructive to infrastructure and are potential hazards to humans, but in general they are low enough to be considered manageable and safe for park use with proper planning and mitigation.

We used USGS's National Streamflow Statistics Program to estimate the Qme (maximum flood experience; Ries 2006). This method incorporates flow data from across the West coast, a large region where hydroclimatic and runoff conditions vary widely, and it characterizes extreme risk. The Qme discharge was 2460 cfs and modeled to have a maximum cross-sectional depth averaging 3.0 feet with flow velocity of 8 – 13 feet per second. This flood would endanger human life, suggesting that precautionary mitigation measures should be taken.

Table 1. Modeled attributes of Strentzel Creek floods for the existing topography. The 0.2% AEP flood is the regulatory flood for infrastructure, and Qme the maximum flood experience. Flow depth is the channel cross-section maximum across all cross-sections, and velocity is for cross-sectional averages.

Statistic	0.2% AEP	Qme
Discharge (cfs)	162	2460
Flow depth (ft)	0.7 – 1.3	2.1 – 4.3
Flow velocity (ft/s)	4 – 7	8 – 13

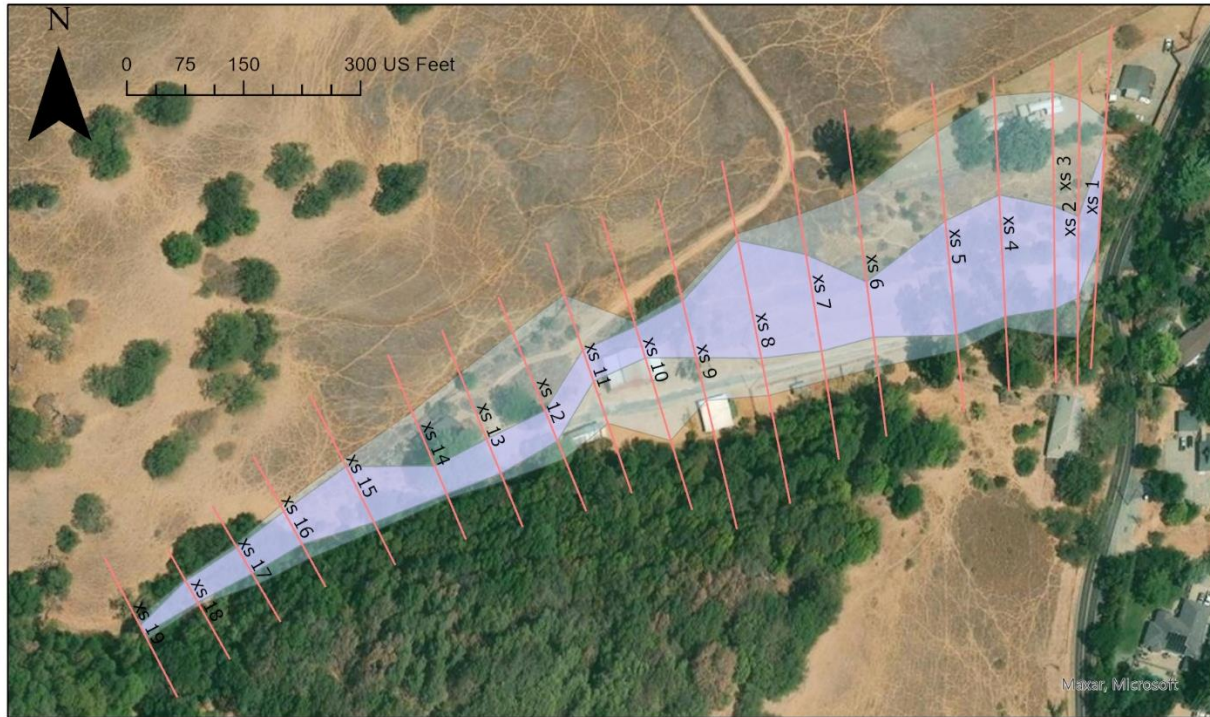


Figure 1. Strentzel Creek’s modeled floodplain boundaries during the regulatory (0.2% annual exceedance probability; purple shading) and maximum flood experience (larger, light shading) floods. The 19 cross-sections derived from 2019 lidar and used in modeling are shown. Because topography will be modified during site development and future floods, the flood zone depicted should be used as a general guide of the approximate width and location of floodwaters.

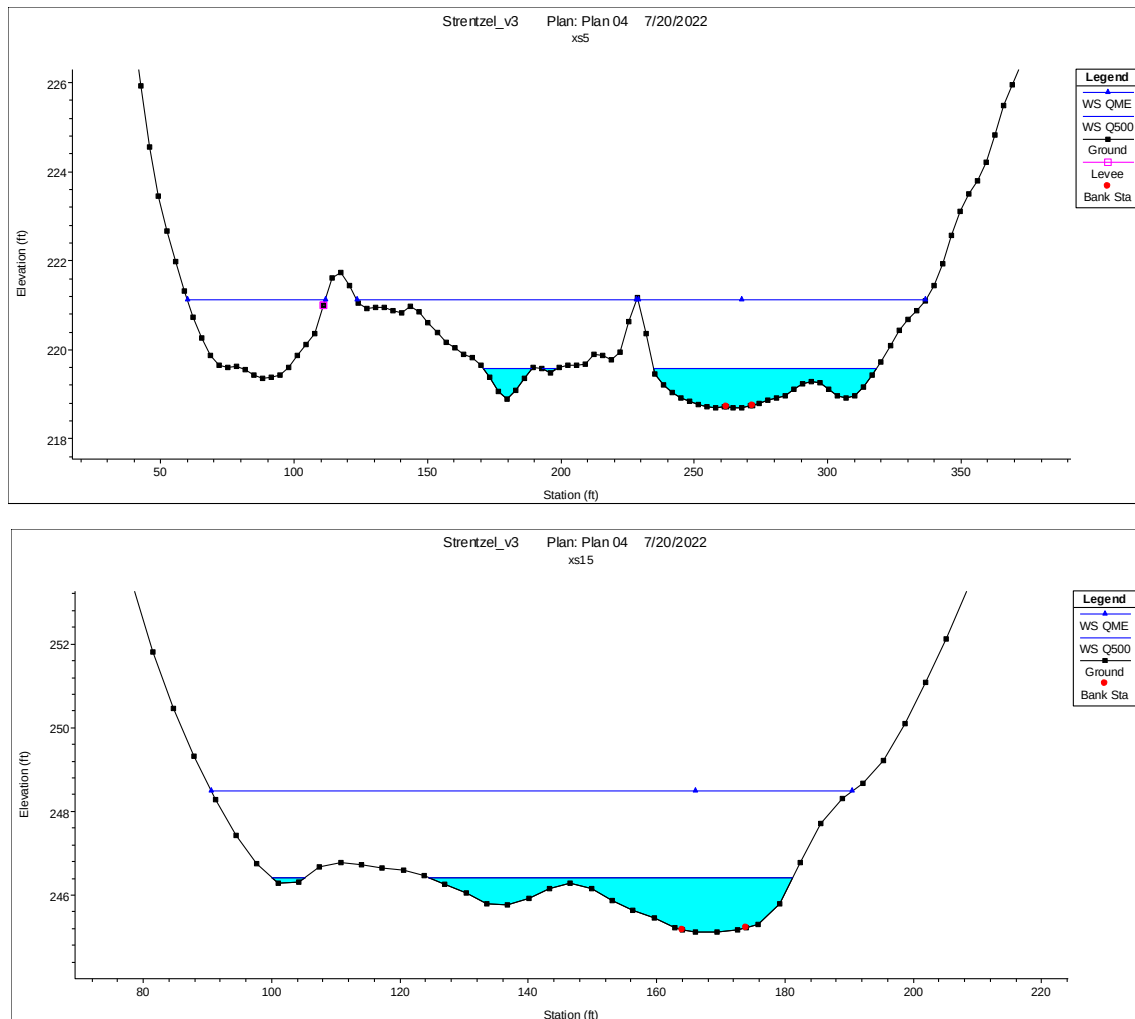


Figure 2. Modeled flow depths in two representative cross-sections, showing the 0.2% annual exceedance probability regulatory flood (blue shaded area) and maximum flood experience (top blue line). The example cross-sections are XS 5 (top) and XS 15 (bottom), whose locations are in Figure 1. Note that axis scales differ between panels.

Recommendations for Strentzel Creek Alluvial Fan Planning Efforts

NPS policy states that actions within a floodplain should be avoided unless there is no practicable alternative. Additionally, it is federal policy that any substantial NPS capital investment is subject to a FFRMS. Roads and small parking lots generally do not require floodplain compliance if they do not adversely impact floodplain values. Likewise, buried utilities are generally exempt from floodplain compliance. However, some of the proposed development may be subject to floodplain compliance.

It appears that the southern portion of the fan is less prone to flooding and may provide some non-floodplain locations for development. The proposed hillside location for the Environmental Education Center is well above the modeled Regulatory Floodplain (Figure 1).

When possible, all infrastructure should be located outside of the modeled Regulatory Floodplain (darker polygon in Figure 1). When this is not practicable, site selection should consider flood depths and velocities and design appropriate mitigation up to the level of the Regulatory Flood. Mitigation may include (but is not limited to) robust construction, flow-through or flow-over design, adding fill, etc. In the case of relatively low capital investment, determining the infrastructure as sacrificial is an acceptable mitigation.

Overall flood hazard varies with position on the fan. The upstream edge of the fan is most susceptible to destructive flows, sediment deposition, and channel avulsion, and this is the area where the greatest risk to human health and infrastructure exists. Placing the proposed gathering circle farther eastward and tucked against the shaded southern valley edge and the highest ground available would mitigate flood risk and its obstruction of flow.

For protection of human life, the regulatory flood in flash-flood prone zones like the Strentzel Creek alluvial fan is an extreme event such as the maximum-flood experience (Q_{me}). Provided that overnight occupancy is not a part of valley bottom development plans, day use still can put human life at risk. Generally, in this type of scenario the NPS mitigates the flood risk through signage, warning, evacuation, and/or area closure, depending on the nature of the site and potential flood conditions. Note that overnighting on the hillside near the Stewardship Ed Center would be well outside the modeled floodplains because it is >20 ft above the valley bottom.

Part of managing flood risk in the fan area will include reconfiguring the levees associated with the drain-culvert system emplaced by the county. Currently, the levee configuration does not redirect all flood flows on the lower portion of the fan into the drain system, but rather allows flow on the southern portion of the fan to pass into the downstream neighborhood. Because floodwaters will spread across the valley bottom and not remain in a pre-determined channel, a more extensive transverse levee may be necessary at the downstream end of the valley for flood mitigation of the road and neighboring properties. WRD will be available to provide advice and consultation regarding possible levee design.

In summary, Strentzel Creek and its alluvial fan are subject to flash flooding that is predicted to be of moderate depth and velocity during the regulatory flood. If infrastructure is either placed outside of the regulatory floodplain or deemed sacrificial, and visitors are warned of flood danger, then a Floodplain Statement of Findings should not be necessary.

The Water Resources Division is available to further advise on this process. If you have any questions, please contact Derek Schook (derek_schook@nps.gov) or Michael Martin (mike_martin@nps.gov).

References

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

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

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

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles, 2012, Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012-5113, 38 p., 1 pl., <http://pubs.usgs.gov/sir/2012/5113/>.

Ries, K.G., III, 2006, The National Streamflow Statistics Program: A computer program for estimating streamflow statistics for ungaged sites: U.S. Geological Survey Techniques and Methods Report TM Book 4, Chapter A6, 45 p., <https://doi.org/10.3113/tm4A6>

cc:

JOMU/Rice

PWR/ Phillips, Louie, Wooster, Denn

WRD/Wagner, Harvey