

United States Department of the Interior



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VIA EMAIL, NO HARD COPY TO FOLLOW

March 10, 2026

Technical Assistance Report

To: Devon Bradley, Superintendent, Chickasaw National Recreation Area

Through: Susannah Erwin, Rivers Program Lead, Water Resources Division (WRD)

From: Derek Schook, Hydrologist, WRD

Subject: Evaluating channel condition and risks associated with Rock Creek after recent floods and a tornado, Chickasaw National Recreation Area

Summary

Chickasaw National Recreation Area (CHIC) staff requested support from the National Park Service Water Resources Division (WRD) to evaluate park waterways after recently experiencing several large floods and a tornado. The focus of this effort was on the park's largest stream, Rock Creek, and threats that it may pose to visitors, infrastructure, and natural resources. An assessment of Rock Creek conditions and their compatibility with existing and proposed infrastructure was undertaken as part of tornado disaster recovery efforts. Overall, we interpret Rock Creek to be adjusting in a resilient and relatively moderate way considering the recent extreme events. Its steep riverbanks have eroded and will continue to adjust, but they remain fairly stable because of high soil cohesion, bedrock control, and protection by riparian vegetation and downed wood. Widespread in-channel flow intervention and bank stabilization are not recommended, although redesign of some visitor use areas with an awareness of river dynamics will enhance visitor safety and infrastructure protection. A prime example would be replacement of the Job Corps Bridge, which would reduce flood hazard exposure to visitors and reduce maintenance needs associated with the bridge. Additional assessments in this report focus on Rock Creek at 1) Black Sulphur Springs, 2) Walnut Grove, and 3) a rock revetment wall, as well as a brief assessment of Travertine Creek.

Background

Several large floods and a tornado have occurred in CHIC since 2015, impacting visitor use and park infrastructure such as bridges, roadways, and structures. WRD staff visited the park on December 9 and 10, 2025 to conduct the reconnaissance-level investigation presented here in response to Technical Assistance Request #33753. The focus was on the park's largest river, Rock Creek, to evaluate channel and riparian conditions, threats to park infrastructure and visitor safety, and management actions that could be undertaken to reduce future flood hazard risks. Specific questions concerned if there is a need for streambank stabilization, what to do with the abnormally high wood loads present after the tornado, and how best to mitigate flood risks at the Job Corps Bridge.

As a general rule, a river adjusts to its watershed conditions to pass the surface runoff and sediment supplied to it. The width and depth of a river channel adjust accordingly, with channel dimensions being influenced by factors such as sediment load, riparian vegetation, downed wood, bedrock confinement, soils, and human infrastructure like roads, bridges, and bank protection. Independent of humans, bank erosion is a desirable attribute in rivers because it brings them toward equilibrium and contributes to diverse and important habitats (Florsheim et al. 2008). Additionally, river processes like bank erosion, sediment transport, and wood storage allow a river to dissipate hydraulic forces that would otherwise transfer downstream.

NPS management policies state “the Service will manage streams to protect stream processes that create habitat features such as floodplains, riparian systems, woody debris accumulations, terraces, gravel bars, riffles, and pools. Stream processes include flooding, stream migration, and associated erosion and deposition” (NPS 2006, p. 52). However, the NPS simultaneously prioritizes protection of cultural resources, capital investments, and visitor safety. Determining how to balance these multiple goals was the motivation for this evaluation.

Rock Creek: Physical setting and general conditions

Hydrologic and Physiographic setting

The Rock Creek watershed drains 44 mi² upstream from USGS gage #07329852 in the park's Historic District. Its river valley cuts through the Vanoss Formation conglomerate, with occasional bedrock outcrops controlling bank and bed locations. The channel is relatively incised, although it still has good access to its floodplain and its low width to depth ratio appears to be relatively common in this region.

Rock Creek is perennial with its flows being highly variable throughout the year. While recent floods have topped 10,000 cubic feet per second (cfs), its baseflows drop to low single-digits cfs before being joined by the spring-fed Travertine Creek, which adds a few more cfs. The continuous gaged flow record began in 1990 at the above gage. The first 25 years had relatively small flood peaks (usually 3,000 – 7,000 cfs), but four of the five years with the highest peak

annual flow have occurred since 2015, including each of the last two years (2024 and 2025, preliminary data; Figure 1). Park staff expressed concern that large floods are becoming more frequent.

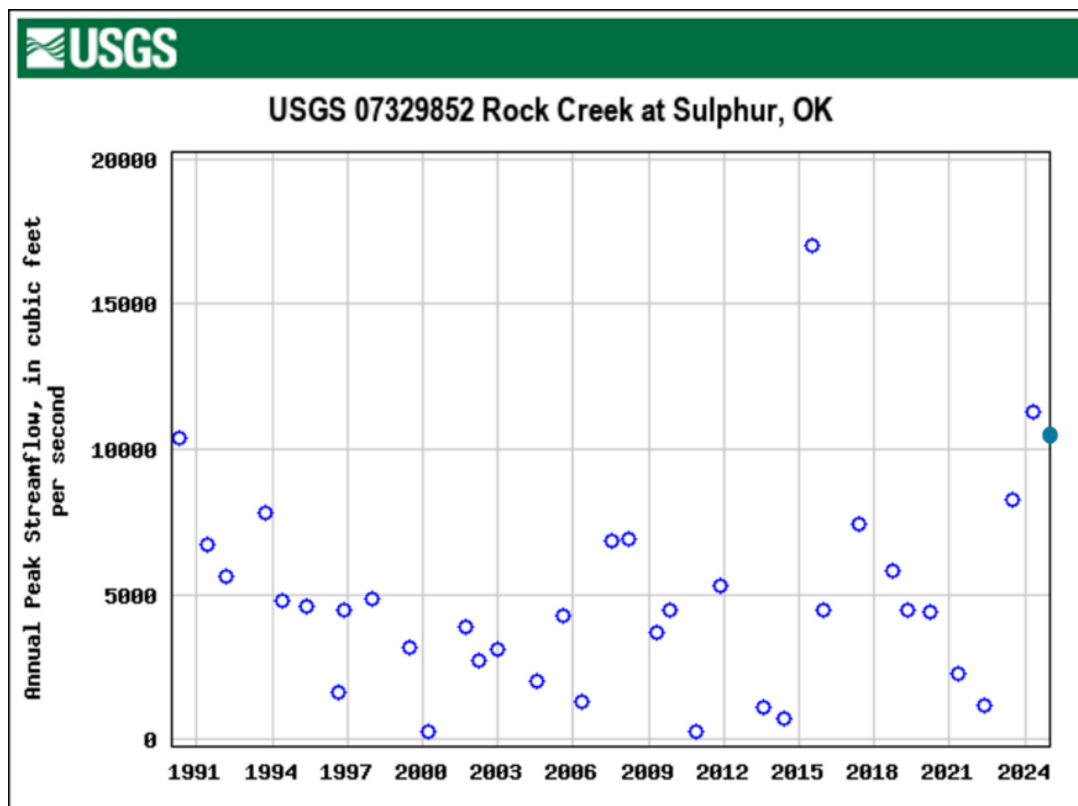


Figure 1. Rock Creek peak annual flows for 1990-2025. The highest flow was in 2015, a year in which there were approximately four events above 7,000 cfs. The 2025 flood peak is preliminarily estimated at 10,400 cfs (filled circle), making the past two annual peaks two of the top three in the 36-year record.

Central Oklahoma is prone to fast and large-magnitude flooding, with its flood hazard index being in the 88th percentile for sub-regions across the continental United States (Flood Potential Portal 2026). Rock Creek’s FEMA flood hazard map, updated in January 2024, shows that most infrastructure and visitor use areas along Perimeter Road in CHIC lie within the 1% annual chance flood hazard zone (i.e., 100-year floodplain; Figure 2; FEMA 2026). Therefore, flood concerns are especially poignant in CHIC because of visitor exposure and the speed and depth at which water rises.

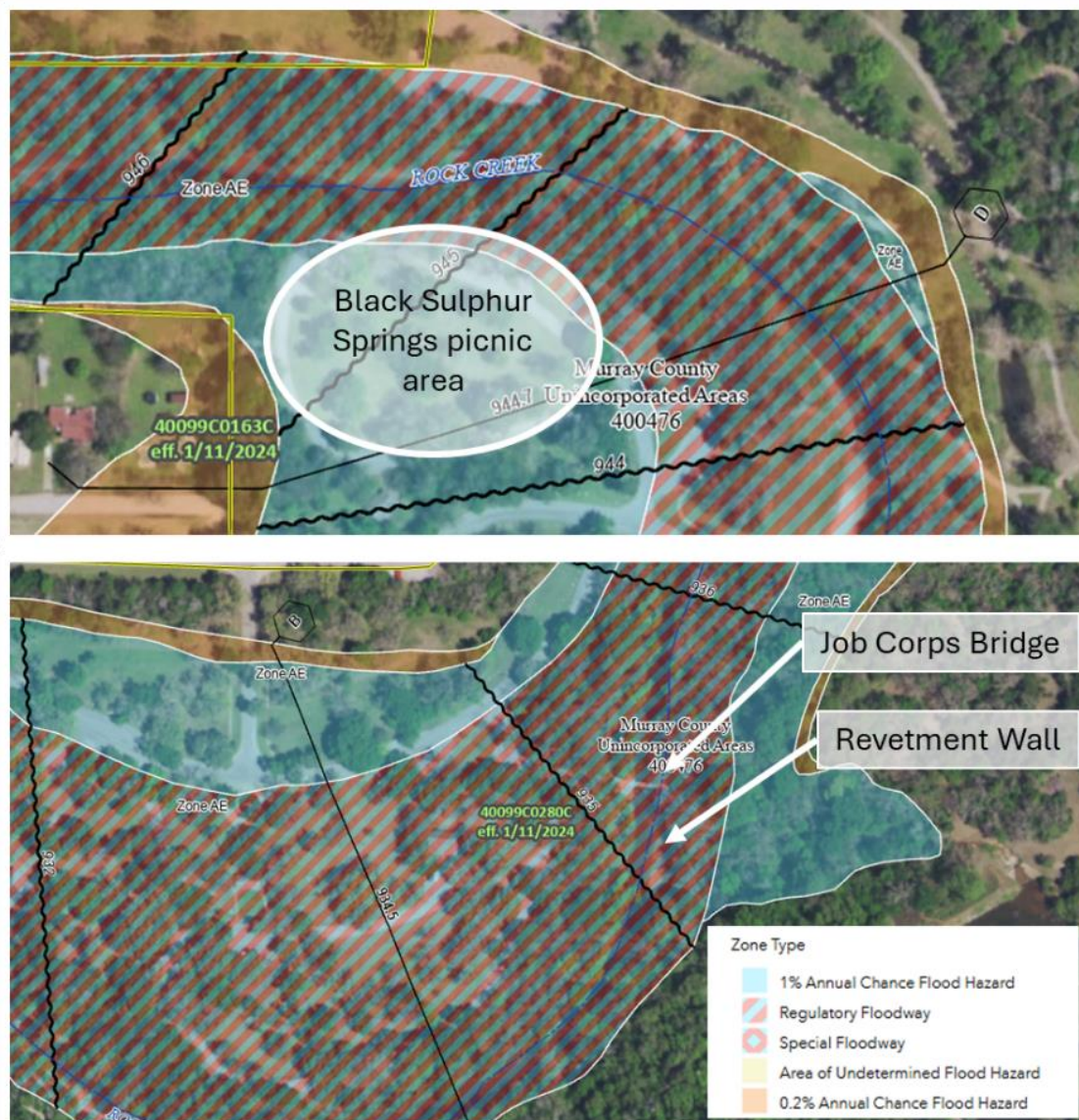


Figure 2. FEMA flood hazard zones along Rock Creek at Black Sulphur Springs (top panel) and Bromide Springs (bottom panel). Flow is from top to bottom in each. Note the abundance of park use areas within these flood hazard zones, including the labeled Black Sulphur Springs picnic area, Job Corps Bridge, and rock revetment wall.

Historically, from 1924-1943 there were five overbank floods per year (SCS 1959, as cited in Wikle et al. 1998). This frequency of floodplain-inundating events is unusually high and likely indicative of a watershed in transition, possibly because of new or intensive land uses in the preceding decades. With the desire to control flooding, the Soil Conservation Service initiated the Rock Creek Watershed project, in which nine flood control dams were built upstream from the park in 1961-1962 (OCC 2017). It is unknown whether the operation of these dams has been consistent or effective through time, but what is known is that watershed processes evolve with changing human land uses and climate.

Assessing Rock Creek Conditions

In 2014, one year prior to the flood of record in 2015, WRD staff conducted an assessment of Rock Creek. That assessment followed the proper functioning condition protocol, which considers physical and vegetative characteristics to evaluate a river's capacity to withstand and recover from floods (US DOI 1998, 2015). The report concluded that Rock Creek was in the best of three possible conditions, with "adequate vegetation and landforms to dissipate flood energy and pass high flows without significant erosion, loss of riparian vegetation or fundamental changes in channel/floodplain form" (Martin et al. 2015, p. 1). Given that several high flows have occurred since the 2014 assessment and there is renewed concern about Rock Creek, that conclusion is reevaluated here.

Recent flooding in Rock Creek has eroded banks, transported sediment and wood, and instigated other channel adjustments that commonly occur after floods. The Rock Creek channel is quite deep for its width, with its width-to-depth ratio measured at six in the Job Corps Bridge reach. Even though the channel is incised, the banks remain relatively stable because of cohesive soils, abundant riparian vegetation, and downed wood that deflects flow and protects against erosion. Steep banks and incised conditions are common in Rock Creek upstream from the park and in adjacent watersheds, as observed when WRD staff drove from Oklahoma City to the park.

The channel has an inset sinuosity, where relatively straight stretches of channel contain small-scale meandering that has deposited sediment in alternating bars (e.g., Black Sulphur Springs area; Figure 3). These bars provide a beneficial array of in- and near-channel habitats, with some being unvegetated and others dominated by horsetail, sedges, or saplings. Although there is a lot of downed wood in the riparian forest post-tornado, the in-channel wood load did not appear to be especially high. Overall, the channel does not appear to be on a trajectory toward instability or other conditions that would warrant large-scale intervention.



Figure 3. Upstream view of Rock Creek near Black Sulphur Springs picnic area. The channel bank at left has recently eroded, but the straight reach, the non-vertical bank, and quick revegetation suggest that further bank erosion will not extend significantly into the picnic area.

Locations of special concern

Job Corps Bridge and rock revetement wall

Site Conditions

The Job Corps Bridge (JCB) is a pedestrian walkway over Rock Creek that provides access to hiking trails across from its Bromide Springs parking area (Figure 4). Its stone walkway is about 5.1 feet above a hardened concrete channel bed. It has five adjacent archways with openings measured at 3.9 feet high and 9.2 feet wide. Low flows successfully pass through the bridge archways. The JCB was built in 1967 as part of the park's Mission 66 improvements and is considered a non-contributing feature to CHIC's historic landscape, which dates to the Civilian Conservation Corps period in 1933-1940. Ominously, the JCB was washed out three times during construction (Hohmann and Grala 2004), foreshadowing a troubled design and future.



Figure 4. Photos looking downstream (top) and upstream (bottom) at the Job Corps Bridge. High flows frequently overtop the bridge and pose a threat to visitors.

The JCB fails to serve what could be considered its primary purpose, to provide safe transport across Rock Creek. Flows frequently overtop the bridge, endangering bridge integrity and people in the vicinity. For example, hikers caught in the rain may be tempted to unsafely cross a flooded JCB to return to the safety of their vehicle. The bridge obstructs water, wood, and sediment transport downstream, with jams forming that exacerbate flood impacts. Some recent flows have undermined the bridge base, and repeated excavation of the sediment bar downstream of the bridge is a recurring maintenance demand on park staff. This bridge reduces channel conveyance of flow downstream and likely increases flood stages within the regulatory floodway.

After the 2015 floods, a 160-foot-long rock revetment wall was installed just downstream of the JCB to prevent erosion of the left bank toward the Bison Pasture Trail. This wall remains fully functional, with no immediate threats to its integrity. There is no appreciable flanking on its downstream end, and a vegetated gravel bar has formed at its base providing further stability (Figure 5).



Figure 5. The rock revetment wall on Rock Creek just downstream from Job Corps Bridge. Note 1) sedimentation with subsequent plant growth now stabilizes its base, 2) no flanking or excessive erosion on its downstream (right) end, and 3) living and downed vegetation are present to protect the bank and overbank areas during floods.

Upstream and downstream of the JCB, the channel bed and banks are recovering from recent floods. Live vegetation and downed wood guard many of the steep banks from future high flows, and bedrock outcrops control the bed level through the reach making further incision unlikely.

Recommendation

We recommend considering the JCB as the top management concern for Rock Creek in CHIC. The bridge invites visitors into the river corridor, but doing so comes with appreciable risk. In the short term, installing warning signage (e.g., “Caution: Do not use bridge during floods”) with a break-away rebuilt handrail could mitigate some of the danger, but bridge removal or replacement is the full solution.

Further downstream in the park, the Inkana Bridge provides an example of what an ideal replacement bridge could look like. It is a suspension bridge spanning 190 feet, even though active channel width here is closer to 90 feet. This bridge removes piers from areas affected by common floods, thereby largely removing prime locations where wood could become lodged. Its artistic foundational arches maintain the built aesthetic of CHIC's Historic District. Additionally, JCB replacement would also obviate its associated recurring gravel bar maintenance needs.

We do not recommend extending the rock revetment wall downstream of the JCB because it is functioning as designed and bank erosion downstream of it is not abnormally high compared to the rest of Rock Creek in CHIC. If extension were to occur, the most sensible length would be 250 feet to tie into the Vanoss conglomerate bedrock downstream. However, the Bison Pasture Trail is not currently threatened by channel widening or bank erosion, and there is abundant riparian vegetation and downed wood that will protect the bank during future floods. Any future bank erosion here is expected to occur slowly with or without the JCB in place, providing time to monitor future erosion and re-evaluate concerns. Additionally, the revetment wall will no longer be needed as a counter measure to erosive flows if the JCB is replaced. WRD recommends re-evaluating the role and necessity of the wall as part of a JCB replacement project.

Black Sulphur Springs

Site Conditions

We visited the Black Sulphur Springs picnic area to evaluate its relation to Rock Creek prior to planned redevelopment of this highly tornado-impacted site. The area currently contains a dirt loop road, but there are plans for potential picnic tables and a pavilion to serve visitors. The area lies within Rock Creek's floodplain (Figure 2). Rock Creek runs perpendicular to the site, occupying nearly the same location as it did in the 1936 historical aerial photo. The channel has inset bars that come and go through time (Figure 6). The right bank of the river channel has recently eroded a small portion of floodplain and proposed picnic area (Figure 3).



Figure 6. Aerial photo time series of Rock Creek near Black Sulphur Springs for 2012, 2015 (post-floods), 2018, and 2024 (post-tornado, with stockpiled debris visible) (Google Earth imagery). Instream bars come and go, but the eastward orientation has remained. Note that the channel has not moved substantially toward the road, a trend that goes back through the 1936 photo (not shown).

Recommendation

We recommend allowing the channel to naturally recover and adjust here instead of intervening to stabilize the bank or redirect flow. Any full bank stabilization would be hundreds of feet long, so accommodating channel adjustments is likely the easier option. This recommendation is consistent with NPS best management practices that advise avoiding bank stabilization when possible (Field et al. 2025). Furthermore, avoiding in-channel intervention also has the benefit of not transferring extra flow energy downstream. Instead, this is a timely opportunity to redevelop the site with an understanding of this relation to the river. Several-to-tens of feet of additional bank erosion and floodplain loss could occur as the bank lays back into a more stable angle, but bank erosion is not anticipated to proceed significantly into the picnic area, as evidenced by the 90-year air photo record. Flood inundation of the picnic area is likely to continue.

We recommend placing new infrastructure well away from the riverbank. This could include realigning the dirt road a few tens of feet further from the bank and ensuring that any new capital investments (e.g., pavilion) are placed away from the river and comply with Director’s Order #77-2: Floodplain Management (DO 77-2; NPS 2003). Near-channel locations can be preserved as open space or day-use picnicking, with low-value infrastructure (e.g., picnic tables) and safe

egress planned from the area. Redevelopment in this way will help avoid, rather than resist, future flood conflicts.

Walnut Grove

Site Conditions

Perimeter Drive follows an outside bend on Rock Creek downstream from the Walnut Grove picnic area. This is a vulnerable position along a river if it is actively migrating, so it is worth evaluating susceptibility of the road at this location.

Historical aerial photos, including those dating back to 1936, 1956, and 1969, indicate that river position remains mostly unchanged, and that the channel is not visibly progressing toward the road. Any bank erosion or channel widening that occurred after recent floods is likely localized or representing slight channel widening in response to the several large flows since 2015. Additionally, there are many areas throughout Rock Creek (e.g., between Walnut Grove and Job Corps Bridge) where the banks are very steep but also appear relatively stable; steep banks themselves are not necessarily concerning.

For the areas observed, an estimated ten feet or more of upland floodplain remains between the riverbank and roadway, with dense riparian vegetation and organic debris protecting the cohesive soils beneath (Figure 7). Downed wood and living vegetation are present to redirect and absorb flow energy to partly protect the bank from erosion.



Figure 7. Rock Creek and its riparian vegetation near Walnut Grove. The photo shows an upstream view as seen from the roadway edge, with vegetation and downed wood providing natural bank and road protection.

Recommendation

Although bank scour and localized erosion have recently occurred, the river does not appear to be threatening Perimeter Drive. Additionally, riparian vegetation and downed wood in the overbanks serve positive roles by reducing flow velocity and protecting the underlying soil from erosion. Therefore, leaving the wood and vegetation in place serves as natural bank and road protection. Restoration of native riparian vegetation could facilitate a healthier and more resilient riparian corridor, including the removal of invasive honeysuckle to facilitate the restoration of a more biodiverse understory. We do not see a need to introduce engineered bank protection.

Although we did not observe imminent threats to the road, continued evaluation and monitoring could be undertaken by initiating a simple protocol. For example, staff could measure the distance from road edge to top of riverbank every 20 feet throughout the area of concern, repeating the survey annually or after each flood.

Travertine Creek

Travertine Creek was visited as well, although there was no pressing concern here, so its assessment is brief. It is a spring-fed stream with a contributing watershed just a tenth of Rock Creek's (4 mi²), so it is much less likely to experience large flows. However, in association with the April 2024 tornado, it had an extreme flood lasting a few hours overnight that peaked at 7,570 cfs (USGS gage #073298507, gage since retired). In 2015, it also had high flows that likely topped 1,000 cfs three times (Smilie 2015), including from profuse groundwater discharging at its headwater Antelope and Buffalo Springs (J. Hoffman, *pers. comm.*).

Most of Travertine Creek appears appropriately healthy and stable. Exceptions to this are where direct channel manipulation has occurred (e.g., inline dams that create swimming holes) and where heavy visitor use affects streambanks, riparian vegetation, and water quality. The Nature Center is also a noteworthy constraint and vulnerability on Travertine Creek (Smilie 2015). It fully straddles Travertine Creek like a narrow and short bridge would, leaving it vulnerable to extreme floods. If not already in place, it would be prudent to have a mitigation plan for keeping the Nature Center's occupants and resources safe in future floods.

Summary

- Overall, Rock Creek and its riparian corridor appear to be in relatively healthy condition and are recovering from recent floods and the tornado in expected ways.
- Abundant riparian vegetation and downed wood stabilize Rock Creek's banks and protect near-channel infrastructure. Removal of either component comes with risks and lacks anticipated benefits, from the river and riparian perspectives.
- Intervention to stabilize streambanks is not recommended. Instead, recovery through natural channel adjustments should promote river health and more sustainable channel conditions.

- Continued monitoring of potentially at-risk resources is prudent.
- The Job Corps Bridge (JCB) is hazardous to park visitors, exacerbates floodwater elevations, and its replacement is recommended.
- The rock revetement wall downstream from the JCB is stable and fully functional, so no maintenance or expansion is recommended. If the JCB is replaced, removal of the revetement wall should be considered.
- Development of the picnic areas at Black Sulphur Springs can be done in a way that creates a safe and sustainable relationship to Rock Creek, although flood inundation is still expected and compliance with DO 77-2 is required.

Please do not hesitate to contact the Water Resources Division with follow-up questions or concerns that build off this reconnaissance-level investigation.

References

Federal Emergency Management Agency (FEMA). February 10, 2026. National Flood Hazard Layer. Retrieved February 10, 2026, from <https://msc.fema.gov/portal>.

Field, J. J., C. M. Leonard, D. M. Schook, J. M. MacCartney, and S. O. Erwin. 2025. Best practices for managing bank erosion within the National Park Service and National Wild and Scenic River System. Science Report NPS/SR—2025/234. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/2306106>

Flood Potential Portal. Accessed January 2026. Colorado State University and United States Forest Service. <https://floodpotential.era.ms.com/>

Florsheim, J.L., J.F. Mount, and A. Chin. 2008. Bank Erosion as a Desirable Attribute of Rivers. *BioScience*, 58(6), 519–529. <https://doi.org/10.1641/B580608>

Hohmann, Heidi and Katarzyna Grala. 2004. Cultural Landscape Report for the Platt Historic District – Chickasaw National Recreation Area. Iowa State University.

Martin, M., J. Wagner, and T. Folts-Zettner. February 2, 2015. “Condition assessment of the Rock Creek and Guy Sandy Creek riparian areas within Chickasaw National Recreation Area”. Technical Assistance Report, NPS Water Resources Division. Fort Collins, CO.

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

National Park Service (NPS). 2006. Management Policies 2006. U.S. Department of the Interior, National Park Service. Washington, DC.

Oklahoma Conservation Commission (OCC). 2017. “Rock Creek Watershed Dams No. 15 & 16 Rehabilitation Project.” Fact Sheet. <https://conservation.ok.gov/publications/watershed-fact-sheets/>.

Smilie, Gary. 2015. No Title. NPS Water Resources Division, Draft Memo.

Soil Conservation Service (SCS). 1959. Work plan, Rock Creek Watershed. Washington, D.C. *(not directly accessed but cited in Wikle et al. 1998)*.

U.S. Department of the Interior (US DOI). 1998. A user guide to assessing the proper functioning condition and the supporting science for lotic areas. Report TR 1737-15. Bureau of Land Management, National Applied Resource Sciences Center. Denver, CO.

U.S. Department of the Interior (US DOI). 2015. Riparian area management: Proper functioning condition assessment for lotic areas. Technical Reference 1737-15. Bureau of Land Management, National Operations Center, Denver, CO.

Wikle, T., M. Nicholl, T. Brown, J. Nord, R. Parker, and D. Weeks. 1998. Water Resources Management Plan – Chickasaw National Recreation Area. National Park Service, Water Resources Division, Fort Collins, CO.

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