

Dam Maintenance and Safety



Colorado Parks and Wildlife Dams

In addition to managing state parks and wildlife areas, outdoor recreation opportunities, and Colorado’s wildlife, CPW owns and operates many dams throughout the state. With an inventory of over 119 dams, CPW is the largest dam owner in Colorado. The water impounded by CPW’s dams is used for downstream irrigation, fish hatcheries’ operations, and a multitude of recreational activities including fishing, boating and swimming.

CPW’s reservoirs are some of the most popular places to visit in the state. However, public infrastructure and population centers are often located downstream, which increases the likelihood of devastating consequences in the event of a dam failure. As such, maintenance and rehabilitation of CPW’s dams is paramount for upholding its commitment to public safety.

Public Safety is CPW’s First Priority

Who oversees CPW’s dams?

CPW has three full-time Dam Safety Engineers who, with the help of other dedicated staff located around the state, manage all the work and monitoring on CPW’s dams. They perform regular dam safety inspections on all CPW-owned dams and maintain current Emergency Action Plans for First Responders.

CPW is making dam rehabilitation a priority by allocating capital construction funds to dam improvement projects ahead of less critical capital construction projects. Prioritizing the financial needs of CPW’s dams has allowed for significant improvements in the operating condition of CPW’s dam inventory over the last few years.

Hazard Classification of CPW’s Dams

CPW owns over 119 dams, of which 92 are jurisdictional. A dam is considered jurisdictional once its size is large enough to threaten human life and/or property downstream if it should fail. A jurisdictional dam is given one of four hazard classifications, based on the criteria below. As a dam’s assigned hazard level increases, so too do the regulations and degree of resiliency required of the dam’s operations and its appurtenant structures.

Classification <small>(Based on CO Dam Safety Standards)</small>	Number of CPW Dams
Total Jurisdictional <small>A dam exceeding 10 feet in height, 20 acres in surface area, or 100 acre-feet storage</small>	92
High Hazard <small>Loss of human life expected in the event of dam failure</small>	22*
Significant Hazard <small>Significant damage expected in the event of dam failure, no life loss expected</small>	15
Low Hazard & No Public Hazard <small>Minor damage expected in the event of dam failure that will be confined to non-critical infrastructure (low hazard) or CPW property only (No Public Hazard), no life loss expected</small>	55
Non-Jurisdictional <small>A dam having less than or equivalent to 10 feet in height, 20 acres in surface area, and 100 acre-feet storage</small>	27+
Total number of CPW dams	119+

* Since 2016, five dams have been reclassified from Low or Significant Hazard to High Hazard, following a change to public safety conditions downstream

The average age of CPW’s High and Significant Hazard dams is 75 years. Six of these dams were constructed over 100 years ago. Most of CPW’s dams were built between 1950 and the mid-1970s.

**Meadow Creek Dam,
Garfield County**



Funding CPW Projects

By State statute, Parks funding and Wildlife funding must remain separate; therefore, CPW cannot use Parks funds to fix dams in State Wildlife Areas, and vice versa. Funds are strictly monitored when completing these projects.

What is CPW doing about its dams?

As dams age and their structures deteriorate, more involved activities are needed to bring them back into compliance with safety regulations. Given the significant costs associated with those necessary repairs and maintenance, CPW performed a Screening Level Risk Analysis (SLRA) study in 2014 to provide an overview of its dams' risk profiles and assist in the prioritization of future projects. The SLRA study identified the most critical rehabilitation needs on CPW's High and Significant Hazard dams. The SLRA evaluated the potential risk of CPW's High and Significant hazard dams based on the following criteria in the event of a dam failure:

Primary consideration

- Loss of human life downstream

Secondary Consideration

- Environmental impacts
- Economic impacts
- Recreational impacts

Based on these measures, the 2014 SLRA identified 11 dams in CPW's portfolio that posed a higher risk than the others. Since the 2014 release of the SLRA's findings, 4 additional dams were added to that list when their routine safety inspections revealed conditions that surpassed an acceptable level of risk. Of these 15 dams, 3 are Parks-owned dams and 12 are Wildlife-owned dams. There is also a cost to maintaining and rehabilitating the dams posing a less critical risk. The current maintenance and repair estimate for all of CPW's dams based on the 2014 SLRA study was approximately \$120.7 million. Most of this cost will be incurred by the wildlife part of the agency, as the majority of the dams are Wildlife-owned.

Tarryall Dam, Park County



Funding for CPW dams

The majority of Parks dams are funded with Colorado Lottery and GOCO money, while the majority of Wildlife dams are funded with wildlife cash funds (money gained through license sales), federal match dollars, and more recently, GOCO funds. By funding a 50 percent reduction to the backlog of CPW's dam maintenance and repairs, the 2018 Future Generations Act will allow CPW to further reduce risks to life and property and sustain water-based recreation opportunities. Since July 2015, CPW has further allocated funding for routine dam maintenance. The availability of this maintenance funding allows for proactive attention and care for these assets in an effort to reduce the need for large-scale, costly rehabilitation that can result from prolonged deferred maintenance.

Over the last five years, CPW has experienced about one emergency dam repair annually. Projects of this nature require a quick response and reallocation of available funds, including dam maintenance funds, to stabilize rapidly developing, adverse conditions.

2022 CPW Successes



- Undertook two successful Construction Manager/General Contractor (CM/GC) project delivery method for design & construction work on high hazard dams
- The intake tower at Two Buttes Reservoir was rehabilitated and an early warning system implemented
- An early warning system was implemented at Upper Highline Lake

CPW Challenges

The total maintenance and repair estimate for all CPW dams was \$120.7 million based on the 2014 SLRA study. Since 2015, CPW has allocated over \$84.7 million for this work, leaving \$36.0 million in funding needs remaining. The majority of the remaining work is for Wildlife-owned dams.

Summary of CPW's Highest Risk Dams as of January 2023

Dam	Remaining Needs as of January 2023	Status as of January 2023
Alberta Park (W) High Hazard Area 17 – SW Mineral County Constructed: 1953	Dam Rehabilitation to address: - Inadequate spillway flow capacity and deteriorated condition - Deteriorating outlet conduit and outlet gate - Inadequate seepage control - Set monitoring instrumentation as required by the SEO for High Hazard dam	Unforeseen emergency repair work was needed in July 2017 during initial reconnaissance work for the outlet rehab design. Following the emergency repair, it was decided to pursue a full dam rehab and not just an outlet rehab first. Planning and preliminary design work completed in 2021 included a Hydrology Study, Geological Study, and Dam Rehabilitation Alternatives Analysis for a full rehabilitation. During 2022, development of the rehabilitation design for the dam, through a CM/GC design and preconstruction approach was completed. Construction of the rehabilitation is anticipated to begin during summer 2023.
Willow Creek (P) High Hazard Steamboat Lake SP Area 10 – NW Routt County Constructed: 1966	- Maintenance for the remote data acquisition system to increase reliability - Seepage mitigation system maintenance	Construction was completed in Fall 2018 that included rehab of the outlet works system and structure, installation of a seepage mitigation system, and installation of a remote data acquisition system. The construction completed in 2018 adequately addressed dam safety concerns. Operations and maintenance items remain, including seepage mitigation system maintenance. In 2022 installation of a new operator for the low flow gate was completed.
Rito Hondo (W) Significant Hazard Area 17 – SW Hinsdale County Constructed: 1956	- Address loss of seepage control on embankment and abutments - Evaluate and address spillway deficiencies - Set monitoring instrumentation as required by the SEO	Outlet works rehabilitation construction was completed in 2019 and the reservoir was refilled in spring 2020. Unforeseen emergency drawdown of the reservoir was required in summer 2020 due to a loss of seepage control following refilling. The reservoir is currently empty due to a 'zero storage restriction'. Planning and preliminary design work for a complete dam rehabilitation was started in 2021, which included Dam Rehabilitation Alternatives Analysis. The planning and design work through a CM/GC design and preconstruction approach was completed in 2022. Construction of the rehabilitation is anticipated to begin during summer 2023.
Trujillo Meadows (W) High Hazard Area 17 – SW Conejos County Constructed: 1956	- Spillway modification to prevent backwater of outlet and erosion encroachment on dam due to current alignment - Set monitoring implements as required by the SEO	Construction to address deteriorated outlet works was completed as of October 2018, which adequately addressed the pressing dam safety concerns. Operations and maintenance items remain. A Hydrology Study is planned for FY 23. The Study will inform potential spillway modifications to meet State Dam Safety criteria. A risk-informed prioritization will then be used to determine the scope and timing of a future spillway rehabilitation project.
Big Meadows (W) High Hazard Area 17 – SW Mineral County Constructed: 1968	- Piezometer and seepage monitoring on main dam and saddle dam	Video inspection of outlet works completed in 2021 identified that the outlet gate leaf is in adequate condition and is not cracked. CPW plans to begin instrumentation installation and seepage investigation efforts in summer 2023 or 2024.
Spring Creek (W) High Hazard Area 16 – SW Gunnison County Constructed: 1961	- Investigate and repair deteriorating concrete service spillway	- Construction to rehabilitate outlet pipe including installation of gate and operator was completed in 2022 construction season. - A water level monitoring devise (bubbler) was installed in 2022 to remotely monitor lake levels. - Future Project may address other deficiencies with spillway.
Garnet Mesa (P) High Hazard Sweitzer Lake SP Area 18 – SW Delta County Constructed: 1954	- Design and construction of spillway replacement	Preliminary Design of emergency spillway replacement is currently underway - Engineering design consultant was selected in spring of 2022. - Onsite soils investigation was completed in January 2023. Results are pending - Alternatives analysis for spillway design has started
Meadow Creek (W) High Hazard Area 7 – NW Garfield County Constructed: 1957	- Investigation, design and construction of spillway and outlet works rehabilitation. - Investigation, design & construction of seepage mitigation	The outlet works and spillway are in need of rehabilitation. The outlet works gate valve has not been operated since 2015 and the outlet pipe is partially submerged restricting discharge capacity The concrete spillway is deteriorating with concrete spalling & cracking along the entire length. A design consultant was selected in 2021 and an alternatives analysis for the proposed rehab was completed in 2022 Design is scheduled for completion in 2023 and construction scheduled for 2024/2025
Haviland Lake (W) High Hazard Area 15 – SW La Plata County Constructed: 1927	- Evaluate and plan for potential rehab needs due to suspected undersized spillway - Set monitoring implements as required by the SEO	Construction for outlet rehabilitation was finalized in Spring 2021. The reservoir was equipped with a remote data acquisition system in Fall 2021. A Hydrology Study is planned for FY 23, which will inform potential dam modifications that will be needed to achieve SEO compliance for spillway capacity. A risk-informed prioritization will then be used to determine the scope and timing of a future spillway rehabilitation project.
Chief Creek #4 (W) Significant Hazard Area 3 – NE Yuma County Constructed: 1956	- Perform hydrologic and hydraulic study to determine spillway capacity - Potential rehab for deteriorated and potentially undersized spillway	Construction was completed in early 2021 that resulted in a rehabbed outlet conduit, new gate, repaired upstream concrete slope protection, abandoned obsolete conduit, and improved dam monitoring implements. Additional future analysis will be performed to assess the need for spillway modifications.
Tarryall (W) High Hazard Area 1 – NE Park County Constructed: 1929	- Left abutment rock stabilization - Downstream material scour protection - Repair to joints and waterstops to limit leakage	The alternatives analysis was completed in 2021. This included completion of the risk analysis, structural analyses, hydrology study, preliminary hydraulic analysis, and development of the preferred alternative. The results of the analyses aided in the development of reasonable risk estimates and a targeted conceptual design. Phase 2, preconstruction and the final design for rehabilitation began in late 2022 and will be complete in early 2024. Construction of the rehabilitation is anticipated to begin during summer 2024.
Two Buttes (W) High Hazard Area 12 – SE Baca County Constructed: 1908	- No further repairs are needed at this time	Construction to replace the outlet gates was completed in spring 2021. Construction to rehabilitate the intake tower was completed in 2022. An Early Warning System Program was installed and implemented in 2022. The reservoir storage restriction was removed by the SEO in 2022
North Michigan Creek (P) Significant Hazard State Forest SP Area 10 – NW Jackson County Constructed: 1963	- No further repairs are needed at this time	Phase I was completed in Spring 2021 and covered final engineering design and preconstruction planning for a full rehabilitation. Phase II spillway construction was started in 2021 & completed through CM/GC project delivery method in 2022. Phase II construction included: - Remove and replace deteriorated spillway - Construct internal filter system at right abutment and under spillway to address significant seepage problem - Comprehensive outlet works rehabilitation - Set monitoring implements including remote data acquisition system as required by the SEO.
Skaguay (W) Significant Hazard Area 13/14 – SE Teller County Constructed: 1901	- Investigate, design, and rehab upstream steel face - Rehab spillway and outlet works, including structural analysis of retaining wall - Set monitoring requirements by the SEO	Gate stem replaced and outlet works inspection completed in Spring 2018. Hazard Classification Study completed in 2021 that confirmed Significant Hazard classification. Additional monitoring began in 2021 and will continue in 2023. Vegetation Maintenance on the dam and in the spillway was completed in 2021.
Beaver Park (W) High Hazard Area 17 – SW Rio Grande County Constructed: 1912	- Troubleshooting and mitigation of cavitation related issues within the outlet works.	Construction on this 110-year-old dam was completed in 2016, which addressed deficiencies with the spillway, outlet works, seepage, slope instability, and access limitations. Road improvements were completed in Summer 2022, addressing low-lying areas adjacent to the reservoir. Cavitation occurs in the outlet works piping when a certain flow rate is reached. Final design and construction for cavitation mitigation should occur in 2023
Upper Highline (P) High Hazard Upper Highline SP Area 7 – NW Mesa County Constructed: 1967	Rehab/replace spillway	The concrete spillway has deteriorated to state where rehab/replacement is needed. Solicitation for professional services to complete engineering studies, develop rehabilitation alternatives, and complete final design to address spillway deficiencies is scheduled for the later part of 2023.

(W): Wildlife-owned dam; (P) Parks-owned dam

SEO: Colorado Dam Safety Branch (Regulatory authority under the CO State Engineer's Office)