



Mancos Water Conservancy District

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JACKSON GULCH RESERVOIR

The Mancos Project has stored and delivered water for domestic, agriculture, and recreation uses for over 50 years. It is a vital cornerstone underpinning the economy and well being of an entire community and region hosting national historic resources. The 55 year old Mancos Project has retained most of its structural integrity and functionality. However, restoration and rehabilitation work is needed to preserve and protect the project's canal system, the operations and maintenance buildings (operations facilities) to extend its working life for another 40 or 50 years.

Aging and gradual deterioration of the canal system, increasing maintenance costs, and a history of delivery interruptions caused by landslides and rockfall incidents, have seriously jeopardized the life expectancy and reliability of the entire canal system. Since Jackson Gulch Reservoir supplies municipal water to Mesa Verde National Park (419,662 visitors in 2003--the eleven year average annual visitation is 591,660 visitors), the Town of Mancos, and the Mancos Rural Water Company, the continued viability of the canal system is critically important to the region.

Recognizing the burden of their responsibility, the Mancos Water Conservancy District entered into a contract with Buckhorn Geotech, Inc. on September 18, 2003, to conduct a thorough assessment and evaluation of the condition of the canal system and identify restoration and rehabilitation work necessary to extend the life of the canal system, improve access and operational efficiency, protect against catastrophic losses, and assure dependable water delivery.

The assessment and evaluation of the Jackson Gulch canal system and operations facilities has identified significant catastrophic problems in the form of concrete aging and deterioration, structural distress, hydraulic constrictions, access limitations, and risks from geologic hazards.

The intention of this project is to preserve and protect 4.9 miles of the canal system and associated operations facilities (workshop/dam tenders residence/public office). Only the areas with problems of the highest priority have been addressed in this proposal.

This is a federal project – title is held by the federal government. The Mancos Water Conservancy District is taking a proactive stand to protect the federal interest and extend the productive life of the Mancos Project facilities. Unfortunately, a project of this magnitude is beyond the financial capability of the population of the District.

The Jackson Gulch Reservoir system consists of an off-line storage reservoir located in Jackson Gulch, which is a deep gulch with very little tributary drainage. The reservoir functions by diverting water from the West Mancos River and transporting it to the reservoir via an Inlet Canal. The stored water is used as a domestic water supply for Mesa Verde National Park, the Town of Mancos, and the Mancos Rural Water Company, hydroelectric generation, and irrigation. The domestic water supply is processed through a treatment plant located just below the reservoir. Water mains feeding the distribution systems are buried beneath the access road that parallels the Outlet Canal. Released water that is not diverted for consumption is returned to the West Mancos River at the end of the Outlet Canal.

Water diversion from river to canal begins as soon as snow pack begins to melt. During this time, six weeks of maximum capacity flow to fill the reservoir, the canal is the most vulnerable and frequent inspections are made around the clock. The three greatest threats to the canal at this time are:

- 1) Maximum flow – the canal is running the maximum amount water it can carry.
- 2) Landslide action above or below the canal due to spring thaw, rain and saturated soil, combined with maximum flow.
- 3) Rock damage due to spring thaw and rain combined with maximum flow.

The dam tender can decrease the first threat – the others are not controllable.

Deterioration and erosion of retaining walls built in 1943-1948 has resulted in the loss of 2,000 feet of access road to the middle section of the canal. A failure of the canal especially at this point would have catastrophic consequences, especially during the spring run-off.

The Buckhorn Geotech, Inc. report of February, 2004 has “identified significant problems in the form of concrete aging and deterioration, structural distress, hydraulic constrictions, access limitations, and risks from geologic hazards” for the entire 4.9 miles of canal.

The federal operations facilities were constructed in 1941 by the Civilian Conservation Corp as the temporary construction offices. After completion of the project (1952), the offices were modified into the present operations facilities (workshop/dam tenders residence/public office). Due to the nature of their construction, purpose, and age (63 years); rehabilitation and/or modernization of these buildings is cost prohibitive.

These structures suffer from increasing wood rot and concrete deterioration. They lack reinforcement in the concrete floor and foundation. They are non-compliant with any United Building Codes.

Title to the Project is held by the federal government. It is time to look toward the future and protect the existing federal interest; but in order to move forward with the restoration/rehabilitation of these operations facilities, appropriation is essential.

Evaluations show that aging and deterioration are jeopardizing the future reliability of the project. Buckhorn Geotech, Inc. has determined that rehabilitation is one-third less costly than replacement. Continuing emergency management places a greater financial burden on the local economy and threatens the Project. As a result, the Board of Directors of the Mancos Water Conservancy District is taking a proactive stance to restore and rehabilitate the operations facilities securing it for the future generations. Loss of any of the Project’s operations facilities is NOT an option.

The principal findings are as follows:

- 53% of the joints in the northern concrete bench flume section have experienced serious deterioration as have 46% of the joints in the southern concrete bench flume section. This deterioration is causing reduced structural integrity and seepage losses.



- 106 instances of concrete blowouts have been recorded in the concrete bench flume sections. These blowouts are gaps in and around the joints indicative of stress induced failure and deterioration of the concrete.
- Excessive lateral pressures from uphill slope failures, rockfall, soil creep, and debris flows have pushed sections of the concrete bench flume laterally, caused walls to be displaced, and created numerous stress cracks in the walls. Pressures in 320 linear feet of the concrete bench flume are approaching the ultimate load capacity of the walls and some wall sections are in danger of collapsing inward.



- Hundreds of cubic yards of rockfall and colluvial debris have accumulated atop the concrete bench flume. This debris may be in excess of the safe load capacity of the lids. Additional loading or rockfall impacts could cause the lids to collapse.



- 7000 square feet of the flume floor have experienced scour and damage from freezing of ponded water during winter periods.
- Seepage from leaking flume joints has contributed to slope instability problems resulting in loss of support in some areas along the base of the flume.



- Landslides have removed a large section of the access road alongside the flume so that approximately 2000 linear feet of canal cannot be accessed for maintenance purposes. Any failure of the flume within this section would result in a prolonged shutdown of the canal with severe consequences to Mesa Verde National Park, the Town of Mancos, Mancos Rural Water Company and the many farms and families that depend on this water source.



- Seepage losses in the vicinity of a previously damaged section of the canal have contributed to activation of a landslide below the canal. This landslide is actively moving and its headwall is migrating uphill towards the canal. If this seepage is not arrested quickly, a portion of the canal could slide into the lower canyon.



- The canal system has been found to have two flow constrictions that are limiting its hydraulic capacity to only 58% of the District's diversion entitlement. These constrictions restrict operational flexibility and the ability to optimize storage during times of uncertain supply.



- Weak geologic formations and weathering of the steep canyon walls above the canal have created rockfall hazards. Fourteen hundred and five (1,405) linear feet of the canal system are exposed to high to moderate rockfall hazard. Rockfalls have destroyed sections of the canal in the past. Thirteen patches in the concrete walls were noted in the upper flume section alone indicating that, on average, this section of flume is damaged about every four years by impact from rockfall. If this hazard is not mitigated, pending rockfall events can be expected to take the canal out of service at any time.



- Twenty slope failure features have been identified along the canal route. If these features are not de-watered, buttressed or otherwise stabilized, the canal will be subjected to continuous risk of damage, loss of service, and extensive maintenance problems.



- A section of the earthen canal is subject to seepage losses that are adversely affecting the stability of a large landslide area downslope of the canal as well as the soil materials supporting the foundation of the Mancos Rural Water Company's treatment plant. Any significant movement of the hillside below the canal could result in rupture of the domestic water lines buried beneath the access road. Such rupture would terminate water flow to the Mesa Verde National Park, the Town of Mancos, and the Mancos Rural Water Company.
- Unconventional (temporary) building (operations facilities) construction method does not conform to any uniform building code.



- Deterioration of concrete by displacement and stress-cracks to the foundations and floors has weakened the structural integrity of the buildings also allowing uncontrollable seasonal flooding



- The buildings do not comply to any building code and can not be made to comply.
- Existing heating system does not comply with current code and will require extensive remodel to replace.
- American Disability Act standards are not compatible with existing structural deficiencies.

- The buildings are not energy efficient nor do they meet snow load capabilities for Colorado.

A detailed description of recommendations for restoration and rehabilitation of the canal system is given in the final report submitted by Buckhorn Geotech, Inc. These recommendations will restore the integrity of the canal system, protect against catastrophic loss, restore the hydraulic capacity, and extend the life of the Jackson Gulch canal system and operations facilities by another 40 or 50 years.

The significant components include the following:

- Rehabilitate concrete blowouts, scoured floors, and damaged joints within the concrete bench flumes, apply a waterproof synthetic liner over sides and floor of the flume, and apply a protective coating of gunnite concrete.
- Restore a uniform grade within the earthen canal, dress side slopes, and apply a buffered synthetic liner to eliminate seepage loss, prevent slope instability, and reduce maintenance costs.
- Eliminate hydraulic flow constrictions by removing a bridge and installing a 600-foot length of elliptical concrete pipe to increase flow capacity, eliminate seepage losses, improve drainage, and buttress an unstable slope.
- Salvage an existing corrugated metal pipe and reuse it, along with additional piping, to provide a 300-foot long double pipe to replace a section of the earthen canal. This pipe section will stop seepage losses, improve drainage, and stabilize an area of active landslide.
- Install drilled tie-back anchors into the hillside where additional protection from earth pressures and landslides is needed to preserve stability and prevent collapse of the flume walls.
- Remove excessive overburden to prevent lid collapse while placing a wedge of soil over unprotected lid sections to provide mitigation against potential rockfall impacts.
- Restore access along a 2000-foot length of canal by anchoring a retaining wall into the narrow canyon wall for restoration of a lost roadway section.
- Install a 24-inch diameter HDPE pipeline to run alongside the canal for use during low-flow periods so that the construction season can be greatly expanded, winter water can be utilized to augment seasonal runoff, and to provide an opportunity for hydroelectric power generation.
- Rehabilitate the drop chute, prevent seepage losses, and eliminate a severe safety hazard by laying a 42-inch diameter welded steel pipe inside the existing concrete chute.
- There is no method of remodel of the buildings that would be any less expensive or any more efficient than total replacement.

Restoration of both concrete flumes, including concrete patching, flume lining, slope stabilization, rockfall mitigation, and access retaining walls is approximately \$180 per linear foot. Whereas, the cost to build new flumes would be approximately \$525 per linear foot, which does not include removal of the old flume, slope stabilization, rockfall mitigation, or access retaining walls.

The estimated cost to rehabilitate 5,040 feet of earthen canal is approximately \$150 per linear foot. This includes canal lining, piping 900 feet, slope stability improvements, and bridge replacement.

By using this method of rehabilitation for the canal system, we will be able to preserve the historical integrity of the original project.

In preparation of the rehabilitation as described, the Board of Directors requested an increase to the District's mill levy of 5 mills. The measure passed by a comfortable margin. The increase raised the original mill levy of 1.5 mills to 6.5 mills. This enables the District to provide the 20% cost share without interfering with the operations and maintenance budget.

In March of 2006, the District received a request to increase the Project's M&I water allocation due to increased development within our boundaries.