DRAFT TECHNICAL REPORT
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Pickpocket Dam Feasibility Study

Exeter, New Hampshire

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Acronyms

AUID	Assessment Unit Identification
bgs	Below Ground Surface
cfs	Cubic Feet per Second
CN	Curve Numbers
CRREL	Cord Regions Research and Engineering Laboratory
DEM	Digital Elevation Model
Dkey	Determination Key
DO	Dissolved Oxygen
EFH	Essential Fish Habitat
EMC	Exeter Manufacturing Company
EMD	Environmental Monitoring Database
EOC	Emergency Operations Center
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
fps	Feet per Second
GIS	Geographic Information System
GMZ	Groundwater Management Zone
gpm	Gallons per Minute
GPS	Global Positioning System
HEC-HMS	Hydrologic Engineering Center, Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center, River Analysis System
HQ	Hazard Quotient
HQ-PEC	HQ calculated with a PEC
HQ-TEC	HQ calculated with a TEC
IPaC	Information for Planning and Consultation
LCHIP	Land and Community Heritage Investment Program
LOD	Letter of Deficiency
LOMR	Letter of Map Revision
MBTA	Migratory Bird Treaty Act (1918)
mg/kg	Milligrams per Kilogram
NFIP	National Flood Insurance Program
NHB	New Hampshire Natural Heritage Bureau
NHDES	New Hampshire Department of Environmental Services
NHDHR	New Hampshire Division of Historical Resources
NHDOT	New Hampshire Department of Transportation

NHFGD	New Hampshire Fish and Game Department
NHFGD WAP	NHFGD Wildlife Action Plan
NHGS	New Hampshire Geological Survey
NHPA	National Historic Preservation Act (1966)
NIST	National Institute of Standards and Technology
NLEB	Northern Long-Eared Bat
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
OMP	Operation and Maintenance Plan
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyls
PEC	Probable Effect Concentrations
PP-13	Priority Pollutant 13
RCMP	Risk Characterization and Management Policy
RMPP	Rivers Management and Protection Program
RTE	Rare, Threatened, and Endangered
RTK	Real-Time Kinematic Positioning
SAP	Sampling and Analysis Plan
Sas	Sensitive Areas
SIA	Society for Industrial Archeology
SRS	Soil Remediation Standards
sVOCs	Semi-Volatile Organic Compounds
SWP	Small Whorled Pogonia
Tc	Times of Concentration
TEC	Threshold Effect Concentrations
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds
WSE	Water Surface Elevations

Executive Summary

The Pickpocket Dam (Dam #029.07) is located on the Exeter River on the boundary between the towns of Exeter and Brentwood in New Hampshire. The dam is solely owned by the Town of Exeter. The first recorded structure at Pickpocket Falls dates back to 1652. The current dam was built in 1920 and generated power for mills. This dam is a 'run-of-river' dam, meaning that it allows all of the natural river flow to pass over the dam spillway at roughly the same rate as the natural flow of the river.

The dam was recently reclassified as a "High-Hazard" structure. The dam does not meet the current NHDES safety standards which require "High-Hazard" dams to pass 2.5 x the 100-year storm event with one foot of freeboard between the water surface and the top of the dam abutments without manual operations.

This Feasibility Study evaluates various alternatives to modify or remove the dam to bring the dam into compliance with the NHDES safety standards.

The evaluation included collecting additional data on the dam including ground and bathymetric survey to update an existing hydraulic model. Additionally, an inspection of the dam was performed and found that the dam and fish ladder are in fair condition, however the low-level gate is inoperable due to rot and leakage is present on the downstream face of the dam.

The hydrologic analysis was updated to reflect current NOAA Atlas 14 rainfall values. However, given the changes in weather patterns in recent years, it is recommended for future rainfall events to be taken into consideration to safeguard the public and reduce the need for a potential costly secondary modification in the future. The projected extreme precipitation estimate recommended is a 15% increase from the best available rainfall data.

Additionally, regulations periodically go through rulemaking process to ensure they reflect current information. During the preparation of this document NHDES started the process of rulemaking for proposed changes to Env-Wr 100-700. With the proposed rule change the "high-hazard" dams shall pass the 1000-year design event with one foot of freeboard and without manual operations.

Descriptions of Alternatives

During the early phases of the Feasibility Study, five alternatives were developed that investigated the hydraulic impacts from adjusting the dam's abutment and removal of an island that has formed just upstream from the spillway on river right, looking downstream, to assess bringing the dam into compliance. Alternative 1 evaluated increasing the abutment height and Alternative 2 evaluated adding a secondary abutment. Both alternatives also included evaluating the removal of the island upstream from the spillway (Alternative 1A and 2A). Alternative 3 - Dam Removal was also considered. As the Feasibility Study progressed Alternative 1 was refined and carried forward to further conceptual design as Alternative 1 – Raise Top of Dam, discussed below. Similarly, Alternative 2 was also further progressed, and to simplify the design was transitioned so that the second-tier abutment was only on one side of the dam. This option was progressed further in the evaluation as Alternative 3 - Auxiliary Spillway. Alternative 3 – Dam

Removal of the preliminary investigation was also further progressed and discussed further as Alternative 4 – Dam Removal.

The project team developed a set of six alternatives to address the deficiencies of the Pickpocket Dam.

- Alternative 1 – Raise Top of Dam
- Alternative 2 – Spillway Replacement (Labyrinth)
- Alternative 3 – Auxiliary Spillway
- Alternative 4 – Dam Removal
- Alternative 5 – No Action / Hazard Reduction
- Alternative 6 – Lower Normal Pool Elevation

Based on an initial analysis that considered cost, constructability, and compliance with regulatory requirements, three alternatives were eliminated from further evaluation. Alternative 2 – Spillway Replacement (Labyrinth) was eliminated from further consideration primarily due to the intensive costs associated with this alternative. Alternative 5, which proposed no action or hazard reduction, was dismissed as it doesn't resolve safety issues with the dam. Further, it could lead to financial and legal ramifications, including enforcement action from the New Hampshire Department of Environmental Services and the Department of Justice. Alternative 6, which proposed lowering the normal pool elevations, detrimental environmental impacts, such as increased water temperatures and decreased oxygen levels, without offering the ecological benefits of a full dam removal. Additionally, this strategy could adversely affect recreational use due to degraded water quality and reduced surface area, thereby making it a less preferred and potentially non-permittable approach.

The three alternatives were determined to have merit and were therefore advanced for detailed study and are outlined below.

Alternative 1 – Raise Top of Dam

Alternative 1 would include maintaining the existing spillway discharge structure and raising the top of the dam elevation such that the design storm is contained with 1 foot of freeboard remaining. Both the left and right training walls at the spillway would be extended to meet the required top of walls. To prevent overtopping of the abutments beyond the limits of the existing dam, earthen embankments would be constructed to impound high water during design storm events. The dam's low-level gate would need to be repaired as part of this alternative, but there would be no other impacts to the dam's appurtenances.

Alternative 3 – Auxiliary Spillway

Alternative 3 includes meeting regulatory spillway design flood requirements by constructing an auxiliary spillway through the left abutment. The elevation of the auxiliary spillway would be set at the top of the existing dam elevation. To prevent overtopping of the right abutment, an earthen embankment would be constructed to impound high water during design storm events. The dam's low-level gate would need to be repaired as part of this alternative, but there would be no other impacts to the dam's appurtenances.

Alternative 4 – Dam Removal

Alternative 4 would include the complete removal of the dam and its appurtenances including the low-level gate, fish ladder and fish weir. The islands downstream of the dam would be retained and repurposed to help recreate the geomorphology of the natural river. The river channel would be reconstructed through the former dam location, design to simulate the geomorphology of a natural river. Planting of the former underwater areas will be necessary to stabilize the new stream banks and reintroduce appropriate native vegetation to reduce erosion and improve habitat diversity. This would include bank plantings/seeding from the current dam site to approximately 2.5 miles upstream.

Summary of Alternative Costs

Table ES-1 Summary of Alternative Costs

	Alt 1: Raise Dam		**Alt 3: Auxiliary Spillway**		**Alt 4: Dam Removal**
	Current	**Future**	**Current**	**Future**	
Initial Capital Cost	$1,964,100	$2,322,800	$2,289,100	$2,434,800	$1,468,000
Capital Replacement Costs	$809,200	$957,000	$943,100	$1,003,100	$0
Operations and Maintenance	$266,800	$294,300	$376,800	$411,200	$45,000
Total Present Cost	**$3,041,100**	**$3,575,100**	**$3,609,000**	**$3,849,100**	**$1,513,000**

Impacts and Benefits

The alternatives carried through the study were evaluated, both quantitatively and qualitatively, to determine the impact to hydraulics and sediment transport, infrastructure, water supplies, cultural resources, recreation, water quality, and natural resources. For each Alternative, the magnitude of change compared to existing conditions decreases with increasing distance upstream from the dam.

Alternatives 1 – Raise Dam and Alternative 3 – Auxiliary Spillway yield similar outcomes with little to no change in the impoundment up to the 100-year storm event flow condition. For storms greater than the 100-year event, there would be a slight increase in the water surface elevation upstream from the dam. Because of the similarity to existing conditions, the dam modification alternatives will not have a noticeable impact on the existing state of the Exeter River or impoundment. Under Alternative 4 – Dam Removal, some accumulated sediment behind the dam could become mobile due to the small increases in velocity and transported downstream. It was found that sediment depths range from 0-2 feet deep near the channel thalweg and with greater depths closer to the banks of the impoundment. With dam removal, the sediment in the main channel area would be predominately removed as part channel regrading activities. Following removal the newly exposed banks that would have previously been underwater with the deeper soft sediment depths would be vegetated to stabilize in place reduce the potential for erosion. Sediment transported from the former impoundment area was found to likely deposit at region upstream of the Route 108/Court Street Bridge, but with proper stabilization of the new river banks following dam removal a large volume of sediment deposition and no negative impact is expected.

Infrastructure

Alternative 4 – Dam Removal, provides a reduction of the water surface elevation at all evaluated storm events and therefore decreases the flood risk to adjacent public infrastructure. However, the magnitude of change in the river, as compared to existing conditions, decreases with increasing storm event recurrence interval.

Whereas the dam modification alternatives do not improve the flood risk for storm events smaller than the 100-year storm event and increases water surface elevations upstream for storms greater than the 100-year storm event.

The change in water elevations and flow characteristics following dam removal will impact slopes adjacent to the river valley in two ways. Firstly, reducing the impoundment elevation will reduce groundwater within the adjacent slopes, improving soil resistance and therefore slope stability, since unsaturated soil strengths are greater than saturated soil strength. Though this process would occur gradually to maintain short-term stability. Secondly, the altered flow could increase the potential for scour at the base of embankment slopes, potentially decreasing slope stability. Countermeasures such as vegetation can be used to ensure long-term stability and prevent potential impact on homes along the Exeter River.

Water Supply

The known water supply wells in this area rely on water from the deep bedrock aquifer, where a lowering of the overburden groundwater table would not impact the availability water in the bedrock aquifer, which is recharged from the larger watershed through a network of fractures. The removal of the dam will not affect groundwater levels in the bedrock aquifer that supplies wells within the study area. Additionally, metering water out of the impoundment for water supply was found to provide a minimal amount of additional water to provide a viable backup source of drinking water.

Cultural Resources

Upon review, the NHDHR DOE committee recommended the Dam eligible for the National Register due to its historical and architectural significance. Additionally, a Phase IA archaeological sensitivity assessment for Pickpocket Dam identified two archaeologically sensitive areas for Pre-Contact Native American cultural deposits and several Post-Contact Euro-American resources.

The Pickpocket Dam might be adversely affected by Alternatives 1 – Raise Dam and Alternative 3 – Auxiliary Spillway both of which involves modifying the dam, potentially compromising its architectural and historical integrity. Alternative 4 – Dam Removal, would lead to an adverse effect on the eligible resource and possible impacts on archaeological resources due to exposure of submerged sites. As part of the permitting process, for all the Alternatives, the Town will work with NHDHR to reduce the potential for an adverse effect under Section 106.

Recreation

The Pickpocket Dam impoundment predominately serves recreational purposes like fishing, boating, and bird watching. The impoundment is mostly accessible by boat and there are three public access points available by foot. The land surrounding the impoundment is primarily private land that has been placed under conservation easement. Under the dam modification alternatives, there would be no changes to the current recreational activities. Under Alternative 4

– Dam Removal, there would be a loss of open water boating however, a potential increase in angling due to the improvement of fish passage within the river.

Fisheries & Fish Passage

The Exeter River, home to several ecologically important native diadromous fish species, serves as a habitat for spawning and nursery life cycle functions. The fish ladder at Pickpocket Dam allows for some upstream passage of diadromous fish to reach spawning and nursery habitat, however fish ladders have limited success and need to be maintained. Under Alternative 1 – Raise Dam and Alternative 3 – Auxiliary Spillway, the current condition of fish passage would remain the same. Under Alternative 4 – Dam Removal, fish passage would be enhanced with the restoration of the dam site to a natural river state.

Natural Resources

Alternatives 1 – Raise Dam and Alternative 3 – Auxiliary Spillway would have negligible impact on existing wetlands. On the other hand, Alternative 4 – Dam Removal would lead to changes in habitat, wetlands, rare species, and natural communities. However, it was found that any one change would not create a detrimental effect to natural resources surrounding the Pickpocket Dam impoundment since the benefit of dam removal would likely offset the impact from any one change. Additionally, the Pickpocket Dam reduces the natural fluctuation of river flows, also reduces the river valley ecological diversity. Allowing for more natural variation in water flows would diversify the adjacent areas and provide opportunities for more plant and animal species to utilize the riparian and floodplain habitat within the study area.

Conclusion

In conclusion, this feasibility study demonstrates that the modification or removal of the dam is both technically and financially feasible. The resultant choice of alternative hinges on the importance assigned to preserving the current recreational opportunities, existing habitats and species, versus bringing the Exeter River back to its natural state and improving fish passage and long-term water quality in the process.