Exeter River Great Dam Removal Feasibility and Impact Study

Exeter, New Hampshire

Prepared for **Town of Exeter, NH**

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Executive Summary

ES-1 Background

The Great Dam is located in the Exeter River at the center of Exeter's business district, just upstream of where the river flows into the tidal Squamscott River. The dam impounds the river about 4.5 miles upstream, including a portion of the Little River.

The dam is a reinforced concrete run-of-river[1] dam consisting of a spillway, a fish ladder including a small lower dam or "weir" structure, a low level outlet and a penstock. The dam is approximately 136 feet long by approximately 16 feet high measured from its highest point to the streambed at its downstream face. The fish ladder was installed by the NH Fish and Game Department in the late 1960's to help restore upstream passage for certain fish that live in the ocean, but swim upstream to freshwater in order to spawn.

The New Hampshire Department of Environmental Services (NHDES) Dam Bureau has identified safety problems with the Great Dam. Most notably, the dam does not meet dam safety regulations which require low-hazard[2] dams to safely withstand a 50-year storm event without overtopping the abutments. The town was notified of these problems in a Letter of Deficiency (LOD) issued by NHDES on July 25, 2000.[3] The NHDES has given the Town deadlines to either modify or remove the dam to meet this legal requirement. The most recent deadline passed on December 31, 2011, but NHDES is aware that the town is in the process of making a decision on how best to address the dam safety issue.

Various alternatives have been considered to solve this safety problem, including the permanent modification of the dam and removing the dam entirely. Previous studies indicate that the Great Dam would require significant modifications to increase its discharge capacity to meet NHDES requirements. The current report is intended to determine the feasibility of removing the Great Dam from the Exeter River and to compare the impacts, benefits and costs of dam removal to other options such as modifying the dam to increase its discharge capacity.

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1 "Run of the river" dams allow all of the natural river flow to pass over the dam in a relatively consistent and steady flow as opposed to other dams which may divert, store, or release water flow for various reasons.

2 "Low hazard is used in the regulatory sense. See NH Administrative Rule Env-Wr 101.07 for the regulatory definition of a "low hazard" structure.

3 The original LOD was amended on June 1, 2004 and March 2, 2009 to allow the Town more time to study potential solutions.

This study will supplement previous studies and is not meant to be the sole piece of information on which to base a final decision. This report is not intended to make a specific recommendation regarding whether the dam should be modified or removed. Rather, the intent of this study is to provide specific information to allow the Town to choose an alternative at a future date.

ES-2 Alternatives Considered

A total of eight alternatives were considered during this study. Three of these alternatives were discarded due to issues related to regulatory, cost or constructability considerations. Five alternatives were brought forward for further analysis including:

- **Alternative A – No Action (Existing Conditions)**. Under this scenario, the existing dam and fish ladder would remain as is, with no modifications. However, this alternative was eliminated based on safety and regulatory concerns. Nevertheless, its inclusion in the study provides a baseline against which other alternatives can be evaluated.

- **Alternative B – Dam Removal**. This alternative involves the removal of the entire existing dam structure, including the fish ladder and lower dam, and reshaping of the river channel within the footprint of the existing dam and immediately upstream and downstream. This alternative substantially changes river elevations upstream from the existing dam site and river hydraulics, both upriver and at the former dam site.

- **Alternative F – Partial Removal.** Under this alternative, the dam spillway would be permanently lowered by 4 feet. Because this would permanently lower the water level upstream of the dam, the existing fish ladder would no longer work properly. Therefore, this alternative also involves construction of a new fish ladder on the eastern side of the reconfigured dam (opposite of the position of the existing ladder).[4]

- **Alternative G – Stabilize in Place.** During this study, it was determined that one potential solution would be to better anchor the existing dam to its underlying bedrock. Engineering calculations indicate that the dam could be made stable even if it is overtopped by a flood. This is a very different approach than trying to increase the hydraulic capacity of the dam. Thus, Alternative G would keep the dam more or less in its current configuration, with no changes to the spillway elevation, abutments or fish ladder. Based on the conceptual design developed as part of this study, ten "post-tension rock anchors" would be installed through

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[4] Gray shading throughout this Final Report indicates changes made since the Draft Report was issued in June 2013 in response to public comments.

the dam to anchor it.[5] While this information has yet to be fully reviewed by the NH Department of Environmental Services Dam Bureau, preliminary indications are that this alternative meets dam safety rules.

- **Alternative H – Dam Modification – Inflatable Flashboard/Gate System.** This alternative would lower the spillway by 4.5 feet then replace this portion of the spillway with a 4.5 ft tall adjustable flashboard system. The existing low-level gate would be replaced with a 14 ft long by 7 ft tall adjustable gate. The recommended adjustable flashboard and gate would be an "Obermeyer" system, which has been installed on numerous dams around the world and relies on an inflatable bladder to support the flashboard/gate structure. Because the removal of so much concrete from the dam would impact its stability, this alternative also would require installation of 13 rock anchors.[6] The Obermeyer flashboard and gate will have the same crest elevation as the existing dam (i.e., Elev. 22.5 ft) under normal flow conditions, so would therefore maintain the functionality of the fish ladder. However, the flashboard and gate could be lowered in the event of a flood. This alternative would also require the construction of a compressor building adjacent to the dam (presumably in Founders Park) to control the flashboard and gate.

The main difference among the alternatives relates to their potential effects on the size and depth of the dam impoundment. Alternatives B and F would lead to a significant reduction of the impoundment, although water levels upstream would be maintained to an extent due to naturally occurring bedrock outcrop at the site of the present dam. Alternative G would maintain the impoundment at its current level. Alternative H would allow the impoundment to be raised and lowered depending on flow conditions. Note that.

ES-3 Impacts and Benefits

The safety problems associated with the Great Dam are a significant challenge, and the Town faces an important decision. This study attempts to provide enough information to allow the community to make an informed decision on how to move forward. Below, we summarize the key findings that have developed over the course of the study.

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5 All of the conceptual designs presented in this report are preliminary and have yet to be fully reviewed by technical staff at the NHDES. They are therefore subject to change during final design.

6 All of the conceptual designs presented in this report are preliminary and therefore subject to change during final design.

ES-3.1 Changes in Flooding and Hydraulics

Dam Removal and Partial Removal would substantially lower water levels upstream of the dam under normal flow conditions.

The removal of Great Dam would lower water levels and river widths substantially near the Great Dam. The changes would be less significant further upstream until they diminish to zero at the limits of the existing impoundment near the Amtrak (Boston & Maine) Railroad Bridge. For example, if the dam were removed or partially removed, the following changes are predicted to occur under the median annual flows:

- **Between the Dam and the Little River Confluence:** Current average depths would decrease from about 5.2 ft to about 2.5 to 2.6 ft and maximum depths of roughly 10 feet would drop to about 5.4 ft. Average river width is predicted to decrease 59 feet from 134 ft to 75 ft for the Dam Removal Alternative to about 100 ft for the Partial Removal Alternative.

- **From the Little River Confluence to NH 108 Bridge:** During the median annual flow, the average depth in this reach is predicted to drop 2.1 ft from about 6.2 ft to about 3.8 ft if Great Dam were removed either fully or partially. River width is predicted to decrease 15 feet from 75 ft to 60 ft wide under typical flows.

- **NH 108 Bridge to Railroad** Bridge**:** In the upper reach of the Great Dam impoundment on the Exeter River, from NH 108 to the impoundment limit, the hydraulic control of the Great Dam steadily diminishes. At the Linden Street Bridge, for example, the river depth would drop about 1.9 ft from 4.2 ft to 2.3 ft. The width of the river would also decrease, from about 40 ft wide to about 28 ft.

- **Little River, Confluence to Impoundment Limit:** The impact of dam removal or dam modification on river hydraulics is not limited to the Exeter River; the Little River reach from its mouth to Linden Street is also predicted to decrease in depth and width.

There would be no changes in river depths, widths or velocities downstream of the dam under any of the alternatives.

The Great Dam is a "run of the river" dam. The existing dam allows all of the natural river flow to pass over the dam in a relatively consistent and steady flow; it does not divert, store, or release water flow. Therefore, the water levels and velocities downstream of the dam would remain unchanged, except in the immediate vicinity of the dam. Tidal forces within the Squamscott River will continue to exert a much greater influence on the downstream portion of the river than the dam.

For flood flows, the Dam Removal, Partial Removal and Dam Modification Alternatives would all have similar effects, reducing the depth of flooding substantially. The area subject to flooding would decrease, but not by a substantial amount.

While Dam Removal or Partial Removal would generally lower flood depths more than the Dam Modification Alternative, the differences between the two are not very significant. They would both be effective at reducing flood depths, generally by similar amounts. However, because the adjacent floodplain is relatively flat, most of the area that currently floods along the river would continue to flood, although with shallower water.

The Dam Modification Alternative could maintain the river in more or less its current state under normal flow conditions, but allow for management of river levels during floods.

The main feature of the Dam Modification Alternative would be a tall adjustable flashboard/gate system in place of the current static spillway. The system would be upright under normal conditions so that the normal river level is maintained. Under higher flows, the gate could be lowered to allow for higher flows to pass without as much upstream flooding. The current conceptual design could pass approximately 2,300 cfs through the lowered flashboard and side gate without the water surface elevation increasing over its normal level (22.5 ft NGVD), which is about the 5 to 10 year flood range. It may be possible to design a system that would maintain more or less constant water levels up to these flood flows.

The Stabilize in Place Alternative would meet dam safety rules, but would not mitigate future flooding damage, nor would it directly increase dissolved oxygen levels in the river or provide enhanced fish passage.

Because Alternative G – Stabilize in Place would not change the dam elevations, future flooding conditions would not change. Additionally, water quality in the river would not improve (i.e., improved dissolved oxygen levels, decreased thermal stratification, etc.), as is expected for partial or full dam removal. This alternative also would not provide enhanced fish passage and the associated benefit to habitat in the river.

The modification or removal of the dam is not expected to create hazards due to ice jams.

Ice dynamics can be important for rivers in New Hampshire. However, based on the lack of documented ice jams on the Exeter River and the lack of field evidence of ice jamming in the impoundment, the modification or removal of the Great Dam should have no effect of river ice dynamics.

ES-3.2 Sediment Transport and Potential Erosion

Removal of the Exeter Dam is unlikely to initiate a significant upstream migrating headcut, but could create some erosion of streambanks, as is normal for a free-flowing river.

Assessment of the Exeter River by a river scientist found that removal of the dam would not create a severe erosion feature known as a "headcut," because of the presence of ledge across the channel at the dam. A headcut is a type of erosional feature seen in flowing waters where a deep incision of the streambed forms, lowering the streambed and usually causing the riverbanks to erode and collapse. However, increased flow velocities are likely to increase channel migration along the meandering channel in the unconfined portion of the impoundment where a wide floodplain is present between the area where the Little River flows into the Exeter and the NH 108 Bridge. With little infrastructure in this marshy area, the increase in channel dynamics that might accompany dam removal or modification would have a positive impact on restoring normal river processes and improving aquatic habitat.

Dam Removal, Partial Removal and Dam Modification would restore sediment transport to the river to normal or near normal conditions, leading to a substantial but temporary increase in the amount of sediment transported into the Squamscott River.

River velocities would increase significantly near the dam, but that portion of the river bed is formed by bedrock which should be stable. Velocities and shear stress near Gilman Park and in other portions of the river will increase moderately. An engineering model of the river was constructed that suggests that sediment carried from the Exeter/Little River would increase from about 2,000 – 3,000 cubic yards over a five year period to about 10,000 cubic yards over the same period. This could affect ecological or recreational resources downstream, although these impacts would be temporary and are not expected to be very significant.

Testing of the sediment in the Exeter and Little River indicates the presence of some environmental contamination, but not at levels that would cause serious ecological or health risks.

Samples were taken from a total of six stations up- and downstream of the dam and tested for a wide variety of chemicals. While some chemicals were detected, the levels found do not raise serious issues that would eliminate any of the alternatives from consideration.

ES-3.3 Infrastructure

Bridges, walls and foundations upstream of the Great Bridge and downstream of the dam should not be affected by any of the Alternatives.

Changes in water surface elevations, water depths and water velocities can change scour potential and hydraulic loading conditions and therefore affect the foundations of buildings or other structures. These potential effects on existing infrastructure are reduced upstream of the Great Bridge and considered relatively minor. Additionally, there would be no risk to structures downstream of the dam.

Regardless of the alternative chosen, additional investigation is needed to ensure that structures in the immediate vicinity of the dam are properly founded and not damaged.

Some of the structures just above the dam may be adequately anchored to resist the increased loading and scour, while others may not. Further investigation is recommended for the Great Bridge abutments, northeast and southeast wing-walls, and the building foundations for the Loaf and Ladle and 11 Water Street Restaurant. This analysis is recommended for all alternatives. Additional monitoring of exposed foundations may also be necessary after implementation of either alternative.

Surface water intakes would be adversely affected by the Dam Removal, but these impacts could likely be mitigated. Costs associated with this mitigation, however, could be substantial.

As documented in the Water Supply Alternatives Study (Weston & Sampson, 2010a), after some modifications to the existing river intake, the Town should still be able to utilize the river as a water supply source. However, Phillips Exeter Academy utilizes the river for their steam heating system and irrigation, and their intake appears to be too high to capture river water under normal flow conditions if the dam were to be removed. Similarly, the intake associated with the Exeter Mills Apartments would be impacted by the elimination of the impoundment, as would the fire hydrant at the Exeter Library. Because no good plans of the Exeter Mills or hydrants were found during this study, the precise impact cannot be determined. However, it is likely that all three of the impacted systems could be retrofit. Further engineering analysis would be required during final design of the selected alternative. However, the cost of retrofitting these intakes could be very substantial – possibly as costly as the Dam Removal or Partial Removal Alternatives themselves. Further information on costs is provided below. If Dam Removal is the selected alternative, then the timeline of the dam removal will need to be closely coordinated with retrofits of these intakes. The intakes should be addressed prior to the permanent lowering of the impoundment.

Public and private wells are not likely to be impacted.

The Gilman Park Well and the Stadium Well are located on either side of the Exeter River, approximately 500 feet upstream (south) of the confluence of the Exeter River and the Little River. These two wells represent a potential yield of 1.2 million gallon per day. The impact of lowered groundwater levels on the safe yield of these production wells was estimated using the pumping test and river drawdown data. Combined, the two wells are still projected to produce approximately 1.08 million gallons-per-day of safe yield under post-dam removal conditions. However, as discussed in previous studies sponsored by the Town, there are substantial costs to reactivating these wells. Additionally, the only known private water supply wells in the vicinity of the Exeter River are drilled in bedrock. Since these withdrawals are from the deep bedrock aquifer and the river is hydraulically isolated from the bedrock, no impact to private wells is expected as a result of the project.

ES-3.4 Cultural Resources

The Great Dam is a contributing element of Exeter's historic character. Its removal or modification would represent an impact to a historic structure important to downtown Exeter.

The Great Dam has served an important role in the town's industrial history for almost 100 years. Its location just upstream of the Great Falls has been the site of a dam since the 1640s, which provided the source of water power for numerous mills that lined the banks. The dam lies within the Exeter Waterfront Commercial Historic District, which was originally listed in the National Register of Historic Places in 1980, with a boundary increase that added the former Exeter Manufacturing Company property in 1986. The dam has been determined eligible as a contributing resource to this district.

Dam Modification would also create an adverse effect on Exeter's historic nature.

Under Alternative H – Dam Modification, very significant modifications would need to be made to the dam in order to meet safety regulations, including removal of a large portion of the dam and the installation of a highly-engineered modern adjustable crest gate. The modified dam would not resemble the current dam. The impact of dam modification on the aesthetics of the dam would be significant, and would detract substantially from its historic nature.

The area around the Great Dam is considered sensitive for archaeological resources which could be impacted by either removal or modification of the dam.

Based on historical and environmental review and information gathered from the NHDHR archaeological site files, the area around the Great Dam should be considered archaeologically sensitive for Pre-Contact and Euro-American archaeological sites. Because of the level of construction expected during either alternative, steps should be taken to further investigate these resources and minimize impact if confirmed. Additionally, if the dam is removed, monitoring of archaeologically sensitive areas along upstream river banks is recommended.

ES-3.5 Recreation

The Stabilize in Place and Dam Modification Alternatives would not change the recreational experience on the river.

Because these two alternatives would maintain the current pool under typical flow conditions, there would be no change to the river and recreation opportunities and facilities that exist now would continue unaltered.

Dam Removal or Partial Removal would alter the recreational experience on the river, but opportunities would still be plentiful.

Both Dam Removal and Partial Removal would lower river elevations upstream from the existing dam site under low and normal flows which would alter recreational opportunities. The reduced river width would affect, but not eliminate, access at existing formal and informal launch sites. The river would continue to be navigable to non-motorized watercraft, but portage around shallows or bars may be necessary under low flow conditions. Cooler and faster flowing water may enhance opportunities for coldwater fishing for trout species and provide more insect forage for all game species. Generally speaking, the Partial Removal Alternative would have less impact on these resources relative to the Dam Removal Alternative.

ES-3.6 Natural Resources

Removing the dam would likely result in decreased thermal stratification and improved dissolved oxygen conditions in the river, which would create a substantial net benefit on water quality. This same benefit would not occur if the dam were to be stabilized-in-place or modified.

A decrease in residence time and surface area with a smaller impoundment would reduce the thermal gain that occurs in the reaches above the dam, which should improve dissolved oxygen conditions. Full dam removal, as proposed under Alternative B, would result in the greatest reduction in residence time and, would therefore have the greatest potential to improve dissolved oxygen levels relative to the other alternatives. In addition to the estimated reduction in residence time, the shallower water depths that would result from dam removal would allow for greater mixing and less temperature stratification at lower flows. Faster flow velocities could also lessen the accumulation of oxygen-consuming organic material and debris within the channel, and thus, reduce a source of oxygen demand. The Dam Modification Alternative would result in minimal change in the residence time for the typical flow conditions and would therefore not be expected to improve water quality.

The removal of the Great Dam would have a significant benefit to important fish populations.

The dam is a significant barrier to the upstream passage of fish, such as river herring, as well as other aquatic organisms. Removal of the dam would allow the fish to pass upstream to spawn, which would have a substantial benefit to the Exeter and Squamscott Rivers. Although the fish ladder currently allows some level of upstream passage, it is far less efficient than a free-flowing river.

Dam removal or modification is not expected to result in significant adverse impacts to wildlife populations.

The largest threat to wildlife habitat in the northeast is the excessive fragmentation of undisturbed blocks of land associated with increased urbanization, which is not a significant factor in the decision to remove or modify the dam. Indirect effects could occur based on changing flood regimes or hydrology of wetland adjacent to the impoundment which could create shifts in plant communities. Whatever indirect impacts may occur would likely be offset by beneficial changes associated the presence of increased numbers of forage fish, including adult and juvenile river herring.

The full or partial removal of the Great Dam could affect wetlands and floodplain forests which rely to some degree on flooding, including a rare swamp white oak forest community upstream.

Elimination of the impoundment could affect the existing wetlands within and adjacent to the impoundment by lowering surface and ground water elevations such that wetlands with a direct hydraulic connection to the river would be affected. Indirect effects to wetlands could also occur by falling local groundwater levels that are predicted to occur with removal or modification of the dam. Additionally, flood events would be shallower and would inundate less of the floodplain forests along the impoundment including a floodplain forest dominated by swamp white oak (*Quercus bicolor)*. It is impossible to quantify precisely the effects that these changes might have on wetlands and forest community dynamics. However, it seems unlikely that these changes would cause a sudden shift in community composition. Rather, gradual changes may occur which could allow plant species typically occurring in drier sites to colonize the forest. Ultimately, the areal extent of the swamp white oak forest community could decrease.

ES-3.7 Technical and Cost Considerations

Removal, Partial Removal, Stabilize in Place and Dam Modification are all feasible from a technical perspective.

The study confirmed that all of the alternatives carried forward would be feasible from an engineering perspective and found no technical reason to eliminate any of these alternatives except the “No Action.” Any of the five alternatives could be designed and constructed. Additional engineering would need to be completed prior to implementation of the selected alternative, and any alternative would require permitting through state and federal resource agencies.

Partially removing the dam would have the highest initial investment costs to the Town, while stabilizing in-place would have the lowest.

The initial investment required for each alternative would include the design, permitting and construction of the alternative plus the cost of mitigating various infrastructure and environmental effects. These costs, shown in Table ES-1, would total an estimated $1,244,758 for *Alternative B – Dam Removal*. *Alternative F - Partial Removal*, perhaps counter intuitively, would cost substantially more, about $2,251,238, due to the fact that it would require demolition of the existing fish ladder and installation of a new one. Of the two alternatives that could maintain current water levels upstream of the dam, the *Alternative G - Stabilize in Place* would be the less expensive option, at about $983,000, while *Alternative H - Dam Modification* would cost just over $1,811,200.

Table ES-1. Initial Construction and Mitigation Costs

Alternative	Design, Permitting and Construction	Infrastructure and Environmental Mitigation	Total
Alt A - No Action	-	$550,000	$550,000
Alt B – Dam Removal	$732,150	$512,608	$1,244,758
Alt F – Partial Removal	$1,338,630	$912,608	$2,251,238
Alt G – Stabilize in Place	$418,000	$565,000	$983,000
Alt H – Dam Modification	$1,016,000	$795,200	$1,811,200

Table ES-2. Total Costs including O&M and Replacement (30 Year Analysis)

Alternative	Initial Cost	O&M and Replacement Costs	Total
Alt A - No Action	$550,000	-	$550,000
Alt B – Dam Removal	$1,244,758	$0	$1,244,758
Alt F – Partial Removal	$2,251,238	$385,170	$2,636,408
Alt G – Stabilize in Place	$983,000	$181,894	$1,164,894
Alt H – Dam Modification	$1,811,200	$616,724	$2,427,924

These totals include the amount not only for construction, but also for mitigating potential impacts such as the cost to retrofit publicly-owned water intakes at the Exeter River Pumping Station and the fire hydrants at the Exeter Library and Founders Park, further archaeological and historic studies, future fish passage monitoring studies, and future water quality studies (due to the fact that the Exeter

River is an "impaired" surface water under state water quality standards). These totals do not include the funds needed to retrofit intakes owned by Exeter Mills and Phillips Exeter Academy, which are discussed below.

However, construction costs and direct mitigation costs are only one component of the total cost of an alternative. Therefore, the cost estimates also considered operation and maintenance as well as 30-year capital replacement costs for each alternative and are reported in Table ES-2.

While cost estimates based on conceptual engineering are considered a reliable way of assessing the relative economic impact of each option, the actual cost can be expected to change as additional engineering is completed on the selected alternative or as the cost of energy or other factors change in the future.

In addition to the direct costs to the Town of Exeter, two privately-owned water intakes would be impacted by the Dam Removal or Partial Removal Alternatives.

Phillips Exeter Academy and the Exeter Mills currently withdraw water from the river for various purposes. If the dam were either fully or partially removed, these intakes would require modification. A 2010 study by Weston and Sampson estimated the costs for these modifications as shown in Table ES-3.

Table ES-3. Cost of Retrofitting Private Water Intake Structures

	Low Estimate (2013 dollars)	High Estimate (2013 dollars)
Exeter Mills Penstock[2]	$271,000	$542,000
PEA River Intake[3]	$108,400	$271,000
	$379,400	$813,000

Note:
Weston and Sampson reported costs in 2009 dollars, which have been adjusted to 2013 dollars by applying an 8.4% inflation factor.

Grant funding may be available to offset the cost of implementing the selected alternative.[7]

Because of the importance of restoring coastal fisheries, a number of public and private grant funding opportunities exist for dam removal which could help to substantially offset the cost to the community if Alternative B – Dam Removal is selected. A sample of potential funding sources:

- National Oceanic and Atmospheric Administration - Community-based Restoration Program
- NH Fish and Game - Fish Habitat Program

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[7] Grant funding opportunities are described in greater detail in a technical memorandum dated September 30, 2013 from Peter Walker, VHB to Paul Vlasich, Town of Exeter.

- NHDES - Watershed Assistance Grants, Clean Water Act Section 319
- US Fish and Wildlife Service - Fisheries and Habitat Restoration Grants
- Natural Resource Conservation Service - Environmental Quality Incentives Program
- Trout Unlimited - Embrace a Stream Grant Program
- NH Charitable Foundation - Community Grants Program
- NH Corporate Wetlands Restoration Partnership – Restoration Grant
- NH State Conservation Committee - Conservation "Moose Plate" Grant

An informal review of recent projects in New Hampshire indicates that grant funding typically covers a significant portion of the cost of removing a dam – between 50 to 100% of design, permitting and construction costs.

Additionally, grant funding opportunities exist for other alternatives, particularly those which would preserve the historic character of the dam or mitigate flooding issues. For example:

- NH Land and Community Heritage Investment Program – Community Grant Program
- National Trust for Historic Preservation – National Preservation Loan Fund
- Society for Industrial Archeology – Industrial Heritage Preservation Grants Program

It is notable that these grant streams tend to have relatively small average awards, and there are no known examples of grant funds being awarded for dam repair or reconstruction in New Hampshire. Thus, while the grant programs listed above could possibly be applied to Alternatives F, G and H, it seems less likely funds would be available to offset a significant portion of the costs for these alternatives relative to the dam removal alternative.

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Legend

- Assessor's Tax Parcels
- Exeter Base Plan
- Building
- Parking Lot/Drive
- Concrete Wall/Dam
- Green Space
- Recreation
- Trail
- Sidewalk/Walkway

Note:
1. Base mapping data provided by the Town of Exeter.
2. 1' Bathymetric Mapping completed by Wright-Pierce.
3. 2010 imagery taken from the archives of NHGRANIT.

0 100 200 Feet

Vanasse Hangen Brustlin, Inc.

Figure 1.1-2
Great Dam Site Map

Exeter Great Dam Removal Feasibility & Impact Analysis

Exeter, NH

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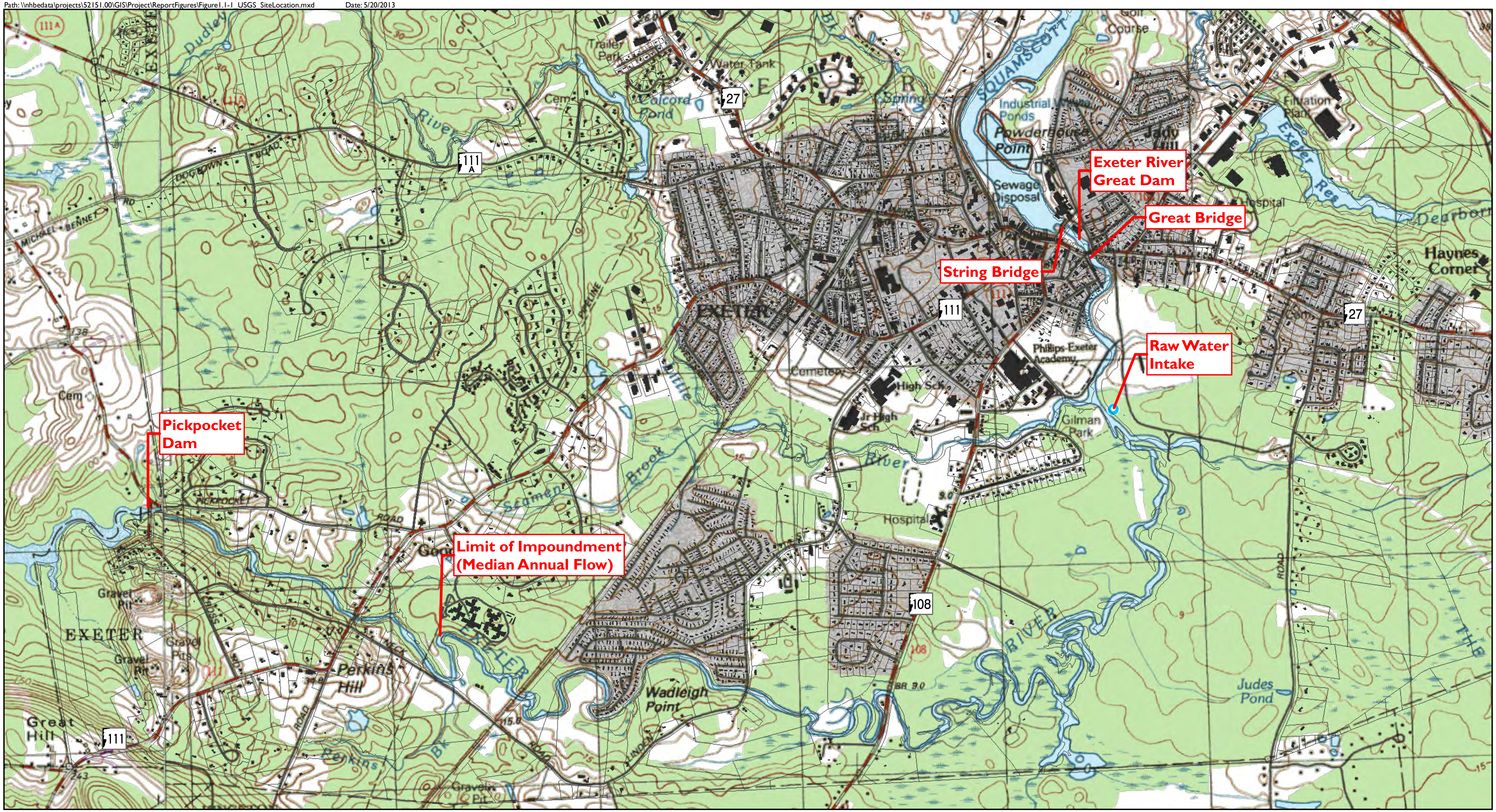

0 1,500 3,000 Feet

Source: USGS 7.5 Minute Quadrangles: Exeter, Kingston

Vanasse Hangen Brustlin, Inc.

Figure 1.1-1
Site Location Map
Exeter Great Dam Removal
Feasibility & Impact Analysis

Exeter, NH

SUMMARY OF ALTERNATIVES (FINAL)
Great Dam Removal Feasibility and Impact Analysis
Exeter River, Exeter, New Hampshire

Resource	Alternative A Existing Condition/No Action*		Alternative B Dam Removal		Alternative F Partial Removal		Alternative G Stabilize in Place		Alternative H Dam Modification	
Construction Costs	N/A		$732,150		$1,338,630		$418,000		$1,016,000	
Mitigation Costs	$550,000		$512,608		$912,608		$565,000		$795,200	
30-year Operations & Maintenance Costs	N/A		N/A		$385,170		$181,894		$616,724	
Total Direct and Indirect Cost	**$550,000**		**$1,244,758**		**$2,636,408**		**$1,164,894**		**$2,427,924**	
Achieve Dam Safety?	No		Yes		Yes		Yes		Yes	
Reduce Flooding?	No		Moderate Benefit		Moderate Benefit		No		Moderate Benefit	
Improve Fish Passage?	No		Major Benefit		No		No		No	
Improve Water Quality?	No		Major Benefit		Moderate Benefit		No		No	
Resource/Issue	**Negative Impacts**	**Positive Impacts**	**Negative Impacts**	**Positive Impacts**	**Negative Impacts**	**Positive Impacts**	**Negative Impacts**	**Positive Impacts**	**Negative Impacts**	**Positive Impacts**
Upstream Erosion	Interupts natual sediment transport processes	Impoundment slows water, limits erosion	Minor	Minor	Minor	Minor	Negligible	-	Minor	Minor
Downstream Sedimentation	Interupts natual sediment transport processes	-	Moderate	-	Moderate	-	Negligible	-	Minor	-
River Ice	-	-	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Bridges, Walls, Foundations	-	Impoundment slows water, limits erosion	Minor	-	Minor	-	Negligible	-	Negligible	-
Water Intakes	-	Maintains impoundment for withdrawals	Moderate	-	Minor	-	-	Major	-	Major
Public Wells	-	Impounded river provides 11% more available water	Minor	-	Minor	-	-	-	Negligible	-
Private Wells	No known private dug wells	No known private dug wells	-	-	-	-	-	-	-	-
Cultural Resources	-	Dam contributes to surrounding historic district	Major	-	Major	-	Negligible	-	Moderate	-
Recreation	Adversely affects coldwater angling opportunities	Creates flatwater boating environment	Minor	Minor	Minor	Minor	-	-	-	-
Fisheries	Dam prevents upstream migration of important fish species	Favors warm water species	Negligible	Major	Negligible	Minor	Major	-	Major	-
Wildlife	Dam limits availability of anadromous fish species as food source	Favors species preferring pond/lake environment	Minor	Moderate	Minor	Minor	Minor	Minor	Minor	Minor
Wetlands	-	Artificial water level creates wetlands along river	Moderate	-	Moderate	-	-	Moderate	Negligible	Moderate
Invasive Species	Creates conditions favoring aquatic invasives	-	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Rare Species/Exemplary Natural Communities	-	High water supports swamp white oak	Moderate	Negligible	Moderate	Negligible	Negligible	Moderate	Moderate	Negligible
Freshwater Mussels	Dam adversely impacts mussel habitat/ conectivity	-	Minor	Major	Minor	Moderate	Moderate	Negligible	Moderate	Negligible
Visual/Aesthetics	Eliminates views of riffle/pool complexes	Falling water at dam scene and impoundment considered picturesque	Moderate	Moderate	Moderate	Moderate	-	-	Moderate	Moderate

Note: The "No Action" alternative is not feasible due to public safety and regulatory considerations.

Description of Intensity Levels

Negligible: Impacts would not be detectable, measurable, or observable.

Minor: Impacts would be detectable, but not expected to have an overall effect on the resource.

Moderate: Impacts would be clearly detectable and could have short-term, appreciable effects on the resource.

Major: Long-term or permanent, highly noticeable effects on the resource.