



Economic Impacts of the  
Cotley River Restoration  
Project, Barstow's Pond Dam  
Removal

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## INTRODUCTION

The Massachusetts Department of Fish and Game's Division of Ecological Restoration (DER) requested IEC's support with evaluating short-term economic impacts associated with the Barstow's Pond Dam removal project (*a.k.a.*, the Cotley River Restoration Project). This report summarizes the methods and results of IEC's analysis, which focused on using project spending and labor data provided by DER to estimate the regional economic impacts of the restoration project.

Massachusetts has over 3,000 dams, most of which were originally built in the 1700s and 1800s to power mills. Since 2005, DER has supported efforts to remove over 40 of these dams. These dam removal projects provide environmental benefits by restoring river flows, sediment transport, and other ecological processes in riverine habitats. In addition, these barrier removal projects can eliminate public safety hazards and long-term costs associated with maintaining aging and failing dam structures (MA DER 2018).

The Barstow's Pond Dam was located along the Cotley River in Taunton, MA. The dam was first constructed in the 1780's to provide water power for a sawmill. The dam consisted of a 57-foot long earthen embankment, a 30-foot long timber crib spillway (river left side), and a 50-foot long sluiceway (river right side). River flows split variably between the dam spillway and the sluiceway, and converged approximately 75 feet upstream of Middleboro Avenue Bridge.

The project to remove the dam, known as the Cotley River Restoration Project, was led by the nonprofit Taunton Development Corporation, with additional funding and support provided by DER, the City of Taunton, the Mashpee Wampanoag Tribe, NOAA Fisheries, the U.S. Fish and Wildlife Service, Save the Bay, and other project partners. Removal of the dam aimed to restore riverine functions including migratory fish and wildlife passage along eight miles of the Cotley River, which serves as a tributary to the federally-designated Wild and Scenic Taunton River (MA DER 2017).

Efforts to remove the Barstow's Pond Dam began in 2010, when DER accepted it as a Priority Project and partners contracted with engineering firm Inter-Fluve, Inc. to initiate work on design and permitting. Between 2011 through 2017, project partners continued to work collaboratively to secure additional funding, finalize the project design, and obtain the necessary regulatory permits to proceed. Dam removal occurred in early 2018. As of December 2018, the project is in the final stages of project completion, documentation, and permit closeout.



BARSTOW'S POND DAM SPILLWAY



BARSTOW'S POND DAM REMOVAL, FEB. 2018

## METHODS

IEc used project spending and labor data provided by DER along with the IMPLAN model to estimate the direct, indirect, and induced regional economic impacts of the Barstow's Pond Dam removal project.

### IMPLAN ONLINE MODEL

The IMPLAN model is a standard input-output model that is used to analyze the multiplier effects (*i.e.*, ripple effects) associated with a change in demand within one or more sectors of the economy. IMPLAN uses data from several federal agencies, including the U.S. Bureau of Economic Analysis and the U.S. Bureau of Labor Statistics, to model the linkages and spending patterns between different industries in the U.S. economy. These relationships are geographic-specific and sector-specific, with the sectors organized based on the North American Industry Classification System (NAICS). IMPLAN uses these data to estimate economic impacts by sector and in the aggregate for a specified geographic region.

IMPLAN's economic impact outputs are measured in terms of four metrics: employment, labor income, value added, and output.

- **Employment:** This reflects a mix of full-time and part-time job-years that result from the employment demand created by a project.
- **Labor Income:** This captures all employment income received as part of the project-related employment demand, including wages, benefits, and proprietor income.
- **Value Added:** This reflects the total value of all output or production, minus the costs of intermediate outputs (*i.e.*, Gross Domestic Product).
- **Output:** This reflects the total value of all output or production, including the costs of intermediate and final outputs.

For each of these metrics, IMPLAN breaks the impacts out into direct, indirect, and induced effects:

- **Direct Effects:** These are the production changes or expenditures that directly result from an activity or policy. In this analysis, the direct effects are equal to the costs and labor hours that go into the restoration project, which we assign to appropriate economic sectors.
- **Indirect Effects:** The “ripple” impacts that result from changes in the output of industries that supply goods and services to those industries that are directly affected.
- **Induced Effects:** Changes in household consumption arising from changes in employment and associated income that result from direct and indirect effects.

For analyzing the Cotley River Restoration Project, IEc used the “IMPLAN Online” version of the IMPLAN model. IEc specified a study area region consisting of the entire State of Massachusetts, and used the 2016 IMPLAN dataset, the most current available for Massachusetts, to conduct the input-output modeling.

### PROJECT SPENDING AND LABOR DATA PROVIDED BY DER

DER provided project spending and labor data covering the entire dam removal project period from 2010 through 2018. Actual costs for consultant and construction contractor work were provided for each year as the project advanced to dam removal and river restoration. Labor hours for DER staff, federal partners,

and NGO partners were estimated by DER. Each line item for the expenditure and labor data was organized by amount and units of measure (*i.e.*, dollars or hours), activity description (*e.g.*, design/permitting), and vendor (*e.g.*, Inter-Fluve, Inc.).<sup>1</sup>

We initiated our analysis by converting the year-by-year project expenditure estimates into 2018 dollars using the Gross Domestic Product Implicit Price Deflator index (FRED 2018).<sup>2</sup> Then, we matched the project expenditure and labor activities to IMPLAN sectors. This sectoring exercise is summarized in Exhibit 1.

#### EXHIBIT 1: PROJECT ACTIVITIES AND CORRESPONDING IMPLAN SECTORS

PROJECT ACTIVITY TYPE	PROJECT ACTIVITY DESCRIPTION	IMPLAN SECTOR CODE	IMPLAN SECTOR DESCRIPTION
Expenditure	Design, permitting, and construction oversight	449	Architectural, engineering, and related services
Expenditure	Dam removal / construction	62	Maintenance and repair construction of nonresidential structures
Expenditure	Tree removal services	469	Landscape and horticultural services
Expenditure	Historical services for design and permitting	456	Scientific research and development services
Expenditure	Tribal oversight of regulatory compliance	533	Employment and payroll of local govt, non-education
Labor	DER Labor	531	Employment and payroll of state govt, non-education
Labor	NGO Labor	514	Grantmaking, giving, and social advocacy organizations
Labor	Federal Labor	535	Employment and payroll of federal govt, non-military

Exhibit 2 shows the total Cotley River Restoration Project expenditure and labor estimates by IMPLAN sector. We then used IMPLAN to estimate the regional economic impacts on regional output, value added, and employment demand.<sup>3</sup>

<sup>1</sup> In addition, some but not all of the line items for project expenditure data identified the funding source.

<sup>2</sup> As of the date of this analysis, data for the Gross Domestic Product Implicit Price Deflator (GDPDEF) index was only available for the first three quarters of 2018. Therefore, our conversion to 2018 dollars reflects an “annual” GDPDEF index value for only the first three quarters of 2018.

<sup>3</sup> IEc entered the project expenditure and labor inputs into IMPLAN Online as “Activities” as shown in Exhibit 2. For these inputs, IEc selected an IMPLAN event year of 2016. This decision was made so that the 2016 event year matches the 2016 vintage of the IMPLAN data set, which allows IEc to control the index used for all dollar year conversions. Similarly, IEc downloaded the IMPLAN results in terms of the IMPLAN “monetary year” of 2016. Since the project expenditure inputs are in 2018 dollars as converted by IEc, the IMPLAN outputs will be in 2018 dollars.

## EXHIBIT 2: PROJECT EXPENDITURE AND LABOR INPUTS BY IMPLAN SECTOR

IMPLAN SECTOR CODE	IMPLAN SECTOR DESCRIPTION	EVENT VALUE	EVENT UNITS
449	Architectural, engineering, and related services	\$458,207	2018 Dollars
62	Maintenance and repair construction of nonresidential structures	\$129,000	2018 Dollars
469	Landscape and horticultural services	\$5,610	2018 Dollars
456	Scientific research and development services	\$43,635	2018 Dollars
533	Employment and payroll of local govt, non-education	\$10,370	2018 Dollars
531	Employment and payroll of state govt, non-education	1,728	Hours
514	Grantmaking, giving, and social advocacy organizations	1,560	Hours
535	Employment and payroll of federal govt, non-military	396	Hours
Total	Project Costs	\$646,822	2018 Dollars
Total	Project Labor	3,684	Hours
*Totals may not sum exactly due to rounding.			

## ASSUMPTIONS AND LIMITATIONS

Assumptions and limitations related to interpretation of results of this study include the following:

- For this analysis, IEc assumed that all project-related expenditures and labor occurred in Massachusetts. This assumption reflects that all project vendors (*e.g.*, Inter-Fluve, Inc. and the Taunton Development Corporation) have employees and offices located within the Commonwealth. To the extent that payments or labor hours expended for the project took place outside the Commonwealth, the output results reported may be somewhat overstated.<sup>4</sup>
- Using an IMPLAN data set for Massachusetts, IEc could not estimate output or economic activity generated by this project that may have occurred outside the Commonwealth (*i.e.*, if certain indirect or induced economic activity “leaked” beyond the Commonwealth of Massachusetts into neighboring states and counties). To the extent that any economic activity produced by the Barstow’s Pond Dam removal project resulted in increases in regional economic expenditures outside of Massachusetts, the output results reported here may be understated.
- Finally, we note that this analysis is not equivalent to a benefit-cost analysis of the Cotley River Restoration Project. This study focuses only on the short-term economic impacts that result from the expenditures and labor hours associated with the project’s design and construction phases. Over the long-term, this restoration project is likely to produce additional ecosystem service benefits (*e.g.*, flood risk mitigation and improved ecosystem function) and cost savings (*i.e.*, avoided maintenance and repair costs for the aging dam) that are not included in the current analysis.

<sup>4</sup> The IMPLAN data for linkages and spending patterns between industries are sector- and geographic-specific. Thus, industry relationships for other states may be different than those for Massachusetts.

**RESULTS**

Exhibit 3 summarizes the results of IEc's analysis. As described in the assumptions and limitations discussion, these results reflect the analytic assumption that all project expenditures and labor hours occurred within Massachusetts. Further, these results only capture the regional economic impacts that were generated within the Commonwealth; they do not include "leakage" effects that may have spread into neighboring states.

**EXHIBIT 3: REGIONAL ECONOMIC IMPACTS OF THE COTLEY RIVER RESTORATION PROJECT <sup>5</sup>**

IMPACT TYPE	EMPLOYMENT (JOB-YEARS)	LABOR INCOME (\$)	VALUE ADDED (\$)	OUTPUT (\$)
Direct Effect	5.7	\$531,479	\$650,241	\$967,209
Indirect Effect	2.0	\$148,270	\$201,766	\$315,968
Induced Effect	3.6	\$209,965	\$346,910	\$555,643
<b>Total Effect</b>	<b>11.4</b>	<b>\$889,713</b>	<b>\$1,198,917</b>	<b>\$1,838,820</b>

Exhibit 4 provides additional detail by breaking out the total effects for the top ten industry sectors, as ranked by value added (*i.e.*, the total value of all outputs, minus the costs of intermediate outputs).

**EXHIBIT 4: REGIONAL ECONOMIC IMPACTS OF THE COTLEY RIVER RESTORATION PROJECT FOR TOP TEN SECTORS RANKED BY VALUE ADDED**

#	IMPLAN SECTOR	JOB-YEARS	LABOR INCOME	VALUE ADDED	OUTPUT
1	Architectural, engineering, and related services	2.7	\$284,278	\$282,257	\$488,607
2	Grantmaking, giving, and social advocacy organizations	0.9	\$52,016	\$124,464	\$167,552
3	Employment and payroll of state govt, non-education	1.0	\$97,499	\$108,966	\$108,966
4	Maintenance and repair construction of nonresidential structures	0.9	\$60,869	\$69,627	\$134,015
5	Real estate	0.3	\$5,551	\$51,572	\$66,254
6	Employment and payroll of federal govt, non-military	0.2	\$25,058	\$46,905	\$46,905
7	Owner-occupied dwellings	0.0	\$0	\$44,419	\$68,446
8	Scientific research and development services	0.2	\$21,135	\$27,669	\$46,130
9	Wholesale trade	0.1	\$15,447	\$26,573	\$38,386
10	Management consulting services	0.2	\$23,629	\$22,611	\$32,350
--	All Other Sectors	5.0	\$304,231	\$393,855	\$641,208
--	<b>Total Effect</b>	<b>11.4</b>	<b>\$889,713</b>	<b>\$1,198,917</b>	<b>\$1,838,820</b>

<sup>5</sup> IMPLAN's economic impact outputs are measured in terms of four metrics: employment, labor income, value added, and output.

1. **Employment:** Reflects a mix of full-time and part-time job-years that result from the employment demand created by a project.
2. **Labor Income:** Captures all employment income (*e.g.*, wages, benefits) resulting from the project-related employment demand.
3. **Value Added:** Reflects the total value of all output or production, minus the costs of intermediate outputs (*i.e.*, Gross Domestic Product).
4. **Output:** Reflects the total value of all output or production, including the costs of intermediate and final outputs.



## DISCUSSION

This analysis used the IMPLAN model to estimate the economic impacts associated with project expenditures and labor hours that occurred over a nine-year period associated with the Barstow's Pond Dam removal project in Massachusetts. The results suggest that approximately \$647,000 in expenditures (in 2018 dollars) and 3,684 labor hours on the Cotley River Restoration Project generated regional economic impacts of approximately 11.4 job-years, \$890,000 in labor income, \$1,199,000 in value added, and \$1,839,000 in total output.

These results for the Cotley River Restoration Project can be compared to previous studies that examined the economic impacts associated with ecological restoration projects. IEc completed one such study in 2012. For that analysis, IEc used IMPLAN to estimate the economic impacts associated with four restoration projects in Massachusetts that involved a mix of excavation operations, culvert replacement or removal, and dam removal. The bullet points below summarize the in-state project expenditure inputs and economic impact results that IEc estimated for each of these projects.<sup>6</sup> For this discussion, we have converted the original study results to 2018 dollars.

- **Broad Meadows Restoration in Quincy, MA:** This restoration project involved the excavation of 60 acres of dredge spoils along with the re-creation of a salt marsh and tidal creek system. IEc estimated that the project had approximately \$6,280,000 worth of in-state expenditures. Using IMPLAN, IEc found that these expenditures produced total economic impacts of approximately 81 job-years, \$5,435,000 in labor income, \$7,011,000 in value added, and \$11,496,000 in output.
- **Eel River Headwaters Restoration in Plymouth, MA:** This restoration project involved six dam removals, two culvert replacements, and 40 acres of wetland restoration. IEc estimated that the project had approximately \$2,373,000 worth of in-state expenditures. Using IMPLAN, IEc found that these expenditures produced total economic impacts of approximately 28 job-years, \$1,599,000 in labor income, \$2,225,000 in value added, and \$3,801,000 in output.
- **Stony Brook Restoration in Brewster, MA:** This restoration project involved removing a culvert from a former tidal wetland to restore fish passage and the natural tidal regime. IEc estimated that the project had approximately \$1,412,000 worth of in-state expenditures. Using IMPLAN, IEc found that these expenditures produced total economic impacts of approximately 16 job-years, \$980,000 in labor income, \$1,298,000 in value added, and \$2,202,000 in output.
- **North Hoosic River Restoration in Clarksburg, MA:** This restoration project focused exclusively on removing the Briggsville Dam in Clarksburg, Massachusetts. After adjustments for payments made to out-of-state vendors, IEc estimated that the project had approximately \$727,000 worth of in-state expenditures. Using IMPLAN, IEc found that these expenditures produced total economic impacts of approximately 8.8 job-years, \$535,000 in labor income, \$736,000 in value added, and \$1,263,000 in output.

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<sup>6</sup> For these restoration projects, IEc made adjustments for payments made to out-of-state vendors so that the analyses focused just on the impacts of expenditures made within Massachusetts. In addition, for these projects, IEc did not have additional input data for the labor hours. Therefore, these IMPLAN analyses focused exclusively on the impacts of in-state project expenditures.



Exhibit 5 converts the regional economic impacts for these ecological restoration projects and for the Cotley River Restoration Project into standardized estimates of impacts per million dollars of in-state expenditures. Because IMPLAN's output is linear, results can be scaled up or down to a theoretical million-dollar investment, effectively shifting the output function on the y-axis. This can be a useful tool to standardize results to a common input (\$1 million) so as to offer a clearer comparison of results across multiple projects.

**EXHIBIT 5: REGIONAL ECONOMIC IMPACTS PER MILLION DOLLARS OF IN-STATE EXPENDITURES**

#	RESTORATION PROJECT	JOB-YEARS	LABOR INCOME	VALUE ADDED	OUTPUT
1	Cotley River Restoration Project*	11.7	\$920,000	\$1,240,000	\$1,901,000
2	Broad Meadows Restoration Project	12.9	\$865,000	\$1,116,000	\$1,831,000
3	Eel River Headwaters Restoration Project	11.8	\$674,000	\$938,000	\$1,602,000
4	Stony Brook Restoration Project	11.6	\$694,000	\$919,000	\$1,559,000
5	North Hoosic River Restoration Project	12.1	\$736,000	\$1,012,000	\$1,737,000
*To calculate standardized impacts per million dollars of project expenditures for the Cotley River Restoration Project, we used IMPLAN's conversions of the labor hour inputs into estimated expenditure inputs by industry.					

The exhibit shows that despite the many differences between the Cotley River Restoration Project and the earlier restoration projects, the projects all produced similar impacts per million dollars of in-state expenditures. For example, all of the projects produced between 11.6 to 12.9 job-years, and \$1.56 to \$1.90 million in economic output, per million dollars of in-state expenditures. These findings also support the idea that while economic stimulus may not be a primary driver behind ecological restoration efforts, it is an auxiliary benefit.

The results described in this study focus on the short-term economic impacts produced by the Barstow's Pond Dam removal project. These include effects on employment, labor income, value added, and output. Over the long-term, this restoration project is likely to produce additional, positive effects in the form of ecosystem service benefits (*e.g.*, improved ecosystem function) and cost savings (*i.e.*, avoided repair costs for the aging dam). While these long-term ecological benefits are beyond the scope of this study, they would add to the benefits calculated in this report.

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