Foote Dam Economic Impact Study

PSC

PUBLIC SECTOR CONSULTANTS

Prepared by

Public Sector Consultants
www.publicsectorconsultants.com

Prepared for

Consumers Energy
www.consumersenergy.com

Table of Contents

EXECUTIVE SUMMARY 4
Regional Economic and Employment Contributions 4
Property Value Analysis 6
BACKGROUND 7
Approach 7
Methodology 8
FOOTE DAM 11
Background 11
Environmental Context 11
ECONOMIC IMPACT ANALYSIS 12
Recreational Analysis 12
Property Value Analysis 16
CONCLUSION 17
REFERENCES 18
APPENDIX A: METHODOLOGY 21

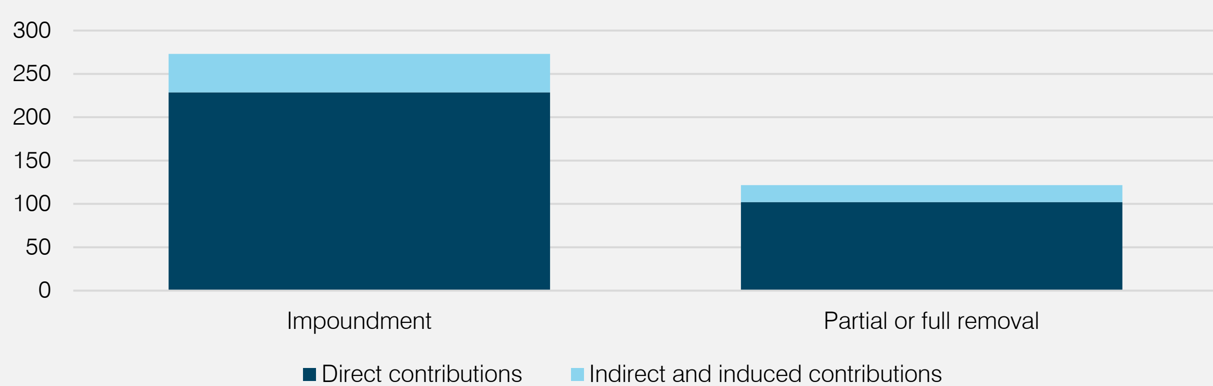
Executive Summary

Consumers Energy engaged Public Sector Consultants (PSC) to analyze the impacts of partial or full removal of dams on the economies surrounding its 13 river hydroelectric facilities. This work complements PSC's ongoing efforts to assist Consumers in collecting feedback from individuals, organizations, and businesses that would be affected by dam decommissioning. The previous dam studies examined how the dams currently affect the economies of the areas in which they are situated. These economic impact studies project the potential shifts in property values and the local economy within a year of partial or full dam removal under the assumptions outlined in the report's methodology section.

Regional Economic and Employment Contributions

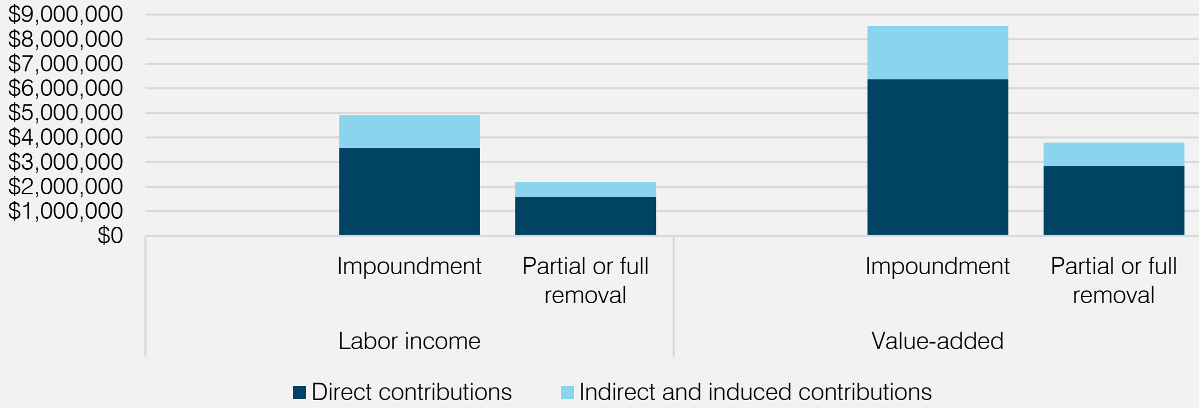
IMPLAN, a widely used, reputable economic modeling software, enables PSC to estimate the effects of shifts in expenditures made by recreational users in the area after a hypothetical dam removal. The net change in these expenditures is referred to as direct economic effects, which the IMPLAN model uses to estimate indirect and induced effects, which are secondary expenditures resulting from supply chain purchases, worker spending, and other subsequent expenditures. These measures of new economic activity are reported along with other economic impact measures, including jobs, labor income, and total regional income. Using IMPLAN and data collected from local and state sources, this analysis estimates the short-term economic impact of the full removal of the Foote Dam. The short-term estimated effects documented in this report are intended to reflect the economic impacts during the first year following dam removal. The extent to which they persist over time will depend on how quickly the local economy changes to accommodate the new economic environment. PSC estimates that in the first year after dam removal, recreational activity in the area surrounding the impoundment would result in 151 fewer jobs in the region and a $4.7 million reduction in value-added to the local economy (Exhibits 1 and 2).

EXHIBIT 1. Employment Results—Impoundment and Partial or Full Removal



Source: PSC analysis

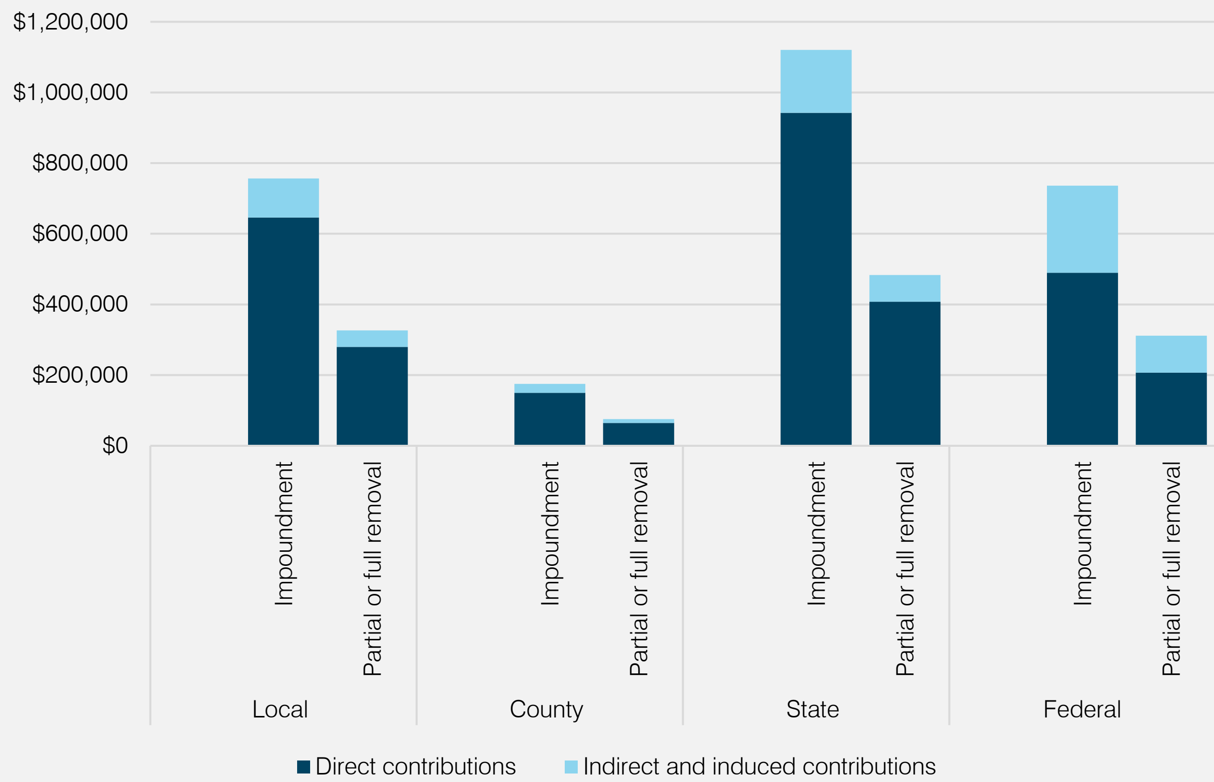
EXHIBIT 2. Labor Income and Value-added Impacts—Impoundment and Partial or Full Removal



Source: PSC analysis

These estimated shifts in recreational activity will also result in $1.6 million fewer contributions in total annual tax revenue, with $1.2 million of that reduction at the local, county, and state levels (Exhibit 3).

EXHIBIT 3. Tax Impacts— Impoundment and Partial or Full Removal



Source: PSC analysis

Property Value Analysis

PSC compiled assessed and taxable values from the Iosco County Equalization Department for the tax (calendar) year 2022. In other studies of Consumers dams, PSC conducted a property analysis to estimate the impact of partial and/or full dam removal on properties adjacent to the pond. Currently, there are fewer than 20 properties around the impoundment not owned by Consumers or the federal government, so PSC did not conduct this type of analysis for this study.

Background

Consumers Energy is developing a long-term strategy for its 13 river hydroelectric facilities. This work is in anticipation of an upcoming relicensing decision, compounded with significant infrastructure upgrades needed to remain in compliance with the Federal Energy Regulatory Commission licensing requirements for each dam. While Consumers is handling much of the work internally, the firm engaged PSC in 2022 to assist with gathering input from the communities where the dams are located as well as more broadly across the state.

In summer and fall 2022, PSC conducted more than 20 meetings with local officials, the public, and key stakeholders. At the meetings, PSC provided the communities with preliminary information on the process for dam removal and collected feedback to assist Consumers in developing its strategy. As part of the feedback collection process, PSC also surveyed more than 3,000 landowners with property abutting Consumers-owned land and created a website to solicit feedback and provide more context on long-term strategy development.

Consumers also engaged PSC to determine how much local economic activity can be attributed to dam-related industries. Previous dam economic contribution studies examined how the dams currently affect the economies of the areas in which they are situated. This economic impact study projects the potential shifts in property values and the local economy within a year of partial or full dam removal under the assumptions outlined in the report's methodology section. To complete this analysis, PSC conducted interviews and collected economic data to complete the assessments. Utilizing IMPLAN, PSC estimated the direct economic effects of spending associated with recreational activity and modeled supply chain purchases, worker spending, and other indirect effects. All the effects were modeled in three categories:

- **Employment:** The number of full- and part-time jobs associated with an industry.
- **Labor income:** The dollar total of employee compensation and proprietor income; the latter is associated with self-employed individuals.
- **Value-added:** The gross regional product, which includes labor income, other property income (e.g., rents and profits), and indirect business taxes (e.g., excise and sales taxes).

For more detailed information on IMPLAN methodology and terminology, see Appendix A.

Approach

This economic *impact* analysis differs from the previously completed economic *contribution* analysis. While both approaches use the same tools to simulate the economic effects of a resource, they differ in some basic assumptions. An economic contribution analysis is a current-state snapshot of the overall market and makes no assumptions about future changes in the underlying economy. An economic impact analysis measures changes in economic activity associated with an event. For this report, partial or full dam removal (considered singly as a full removal) is the event under assessment. A partial removal refers to a scenario in which the river hydroelectric facility is decommissioned yet a structure persists in the river to serve a purpose such as artificially retaining higher water levels or preventing upstream movement of invasive species, such as the sea lamprey.

An economic impact analysis must address several key issues, including the uncertainty of the exact shifts in the environment and recreational activity patterns at each river hydro site, the nonmarket character of many of those changes, and the time horizon for those shifts to occur and then stabilize (Smith 2006). To address uncertainty about how removal would change systems, PSC assumed that the water body will return generally to the river channel as depicted on maps prior to river hydro construction. PSC also focused only on how these changes impact economic behavior and could not place economic value on purely environmental and biological changes that did not directly impact human economic behavior. Finally, to address time-horizon issues, PSC estimated the impact in the first year after dam removal without assumptions regarding future investment, strategic planning, or changes in property ownership. Despite the likelihood of such planning and investment activity in the years between an announcement and completion of partial or full dam removal, it is difficult to accurately estimate its intensity and direction. As a result, PSC did not make any assumptions about its ability to influence economic impacts.

Methodology

PSC conducted a literature review, interviews, data collection and analysis, and utilized IMPLAN to complete the economic impact studies.

Data Collection

Literature Review

PSC conducted a review of applicable research literature and interviewed public and private recreational asset managers to develop assumptions about how the shift from an impoundment to the natural river state would affect recreational activity in the area within the first year of removal. While the research literature indicates that free-flowing rivers can provide greater recreational benefits than impounded rivers over the medium to long term, there is limited research on the immediate impacts, especially without making assumptions about the levels and types of investment and planning during the transition (Loomis 2002; McKean et al. 2005, 2010; Kotchen et al. 2006; Robbins and Lewis 2008).

Stakeholder Interviews

To supplement assumptions derived from the research literature, PSC also conducted dozens of interviews with public officials, recreational asset managers, and other key stakeholders across all 13 sites to discuss the impoundments' economic contributions and re-interviewed a dozen recreational asset managers to explore the potential impacts of partial or full dam removal on various types of facilities (e.g., boat launches, seasonal and nightly campgrounds, roadside parks, etc.). All participants in the dam removal–focused interviews agreed that dam removal would result in a significant short-term reduction of recreational usage, particularly at sites that will lose waterfront access after dam removal. Interviewees also strongly agreed that not all sites and activities would experience the same impacts, which aligned with PSC's research findings. For example, it is likely that camping and day use associated with recreational boating and swimming would be significantly impacted, while hiking and mountain biking are also likely to be impacted, but to a lesser degree. PSC found that facilities directly on the impoundment, which were the focus of the economic contribution and impact analyses, were also the most likely to be impacted than sites further away from the impoundment that serve other recreational opportunities in the area.

Analysis Types

Recreational Analysis

To estimate the impact of partial or full dam removal, PSC combined research findings and local stakeholder feedback to develop a weighted average approach that adjusted the site visitation assumptions in the economic contribution analyses. If a site-specific activity (e.g., fishing, boating, etc.) would be impacted by dam removal, PSC included it in the development of a site-specific weighted average reduction in recreational activity. PSC applied adjustments based on the types of activities currently being offered at each the site that would be impacted by dam removal–related water-level changes.

It is important to note that with proactive planning and enough preparation time, site owners will likely have an opportunity to pivot their offerings to align with the new water level, but in this analysis, PSC has not made assumptions that anticipate sites experiencing increases in other types of recreational activity. For example, a campground that currently offers boat slips for recreational boating could shift to supporting more tubers and paddlers (e.g., canoeists, kayakers, stand-up paddleboarders). That change would mitigate the loss of recreational boaters and provide an opportunity for growth in other areas, but it is challenging at this time to make those assumptions. These visitation adjustments were then applied to the same expenditure profiles used in the economic contribution analysis.

Angler Trips

River systems are complex and predicting how nature and how humans will interface with the changed environment is difficult. In the economic contribution study, PSC estimated the number of anglers at each site and applied an inflation-adjusted, angler-specific expenditure profile to derive estimates of the transactions that could be attributed to current angler activity and associated economic contributions. This was viewed as the best approach from which to derive comprehensive estimates of the economic value of recreational fishing along the Consumers Energy river hydro facilities. An economic impact assessment must go one step further to conjecture how angler-related transactions will change following a major event (e.g. partial or full dam removal). This effort is much more challenging to derive, as it requires inferring how partial or full dam removal will affect angler activity. Many factors will influence angler responses, including how the fish populations will change and the fishing preferences of those who currently fish the area as well as who are the potential anglers that would be drawn to the area.

Unfortunately, recent academic research shows that generalizing how fish populations will adapt to dam removals is difficult and results in questionable conjectures at best, as the large number of variables makes both short- and long-term projections inexact (Hansen et al. 2023). Even the most data-limited approaches require significant amounts of data related to growth, feeding and prey preference, reproduction, and biomass data for each individual species in combination with a variety of system-wide parameters (Bellmore et al. 2017). They also require significant use of assumptions that may bias findings depending on the validity of the assumptions applied.

In addition to these challenges, it is especially difficult to predict the short-term impacts of shifts in fish populations, how those impacts will affect the fishery, and how that will affect the number of anglers and types of angling at a former-impoundment water body. Due to the narrow prediction window of this analysis, capital investment and shifts in recreational access are not assumed to take place, further complicating the estimation of changes in angler activity following partial or full dam removal.

PSC's approach to estimating the economic impacts is predicated on applying similar methods across all 13 hydro facilities, which further constrains the ability to collect data and develop models with sufficient predictive power to inform on the expected changes in angler opportunities. That is, the objective to be consistent across the 13 study sites further complicates the ability to apply a universal approach across these sites in a methodologically consistent and rigorous manner.

Furthermore, most studies note that these shifts are impacted by the time frame for species recovery and environmental shifts and rely on analyzing systems outside Michigan, which is another complicating factor in attempting to analyze these shifts in this analysis. While the determination was made not to estimate the economic impacts of changes in angler activity in the short-term response to partial or full dam removal, PSC includes a discussion of potential long-term benefits in the report.

Foote Dam

To provide valuable context for the economic impact analysis results, this section includes a high-level overview of the dam, as well as some general and site-specific information about the short-term environmental context in the event of partial or full dam removal under the study's assumptions.

Background

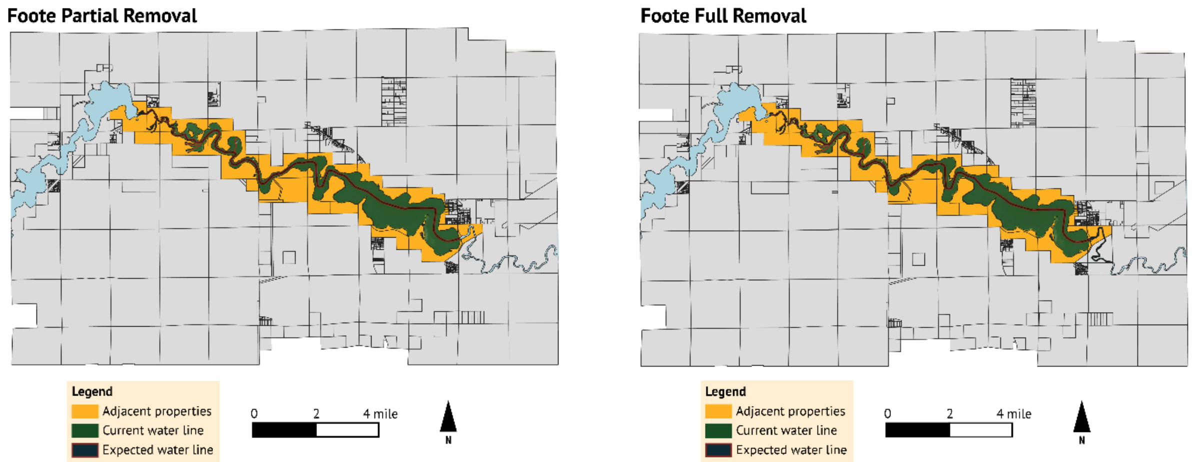
Foote Dam is the easternmost of Consumers Energy's 13 hydroelectric dams. It is located in Oscoda Township, Iosco County, about seven miles west of Lake Huron and the unincorporated community of Oscoda. Foote Dam was completed in 1918. It is about 47 feet in height and about 4,100 feet in length. Huron National Forest is to the south and west of the impoundment, Foote Pond, which also offers recreational opportunities.

Environmental Context

While no decision has been made on the Foote Dam's future, it is important to understand the short-term environmental context. With dam impoundment projects involving significant dewatering, there is a length of time where the exposed bottomlands (previously impounded sediments) need to dry out. This process usually completes itself during the construction phase of a project as the impoundment is lowered. Currently, there is no indication that the sediments within the 13 river hydros have an abnormal propensity to hold moisture. For the purposes of high-level environmental assessments, it is assumed that the impounded sediments have dried to the extent possible within the construction time frame, typically within the first six to nine months of the project. For all 13 impoundments, the first year after construction will largely consist of the progression of raw, recently disturbed soils to increased vegetation growth.

Where hydrologic conditions persist over time, wetlands will form. This will likely occur near and along tributaries, following the tributary's path to the point where it joins the mainstem of the restored channel, near groundwater seeps occurring along valley walls or high groundwater tables, and in the floodplain areas of the restored main channel. Generally, former dam impoundments will form a mix of wetland and upland ecosystems. The exact locations of these are largely determined by the site-specific hydrologic conditions of the soils and final topographic surface after partial or full dam removal. Exhibit 4 shows the projected shifts in water line and current impoundment-adjacent parcels.

EXHIBIT 4. Partial and Full Removal Parcel Analysis



The historic Foote Dam survey map indicated significant swamps and marshes within the existing impounded area, indicating the bottomlands have a propensity to form wetlands. However, the amount of sediment accumulation may impact wetland formation and thus the higher-elevation bottomlands would be expected to form as uplands once dewatered. Additionally, there are minimal wetlands adjacent to the impoundment, and it is less likely that wetlands would form on impounded sediments. If wetlands were to form, the most likely location is in the upper impoundment area where the impoundment narrows and there are wetlands closer to the impoundment. There is a high bluff on the north side of the impoundment, so wetlands are unlikely to form there. Wetlands may form along the adjacent wetland complexes or tributaries.

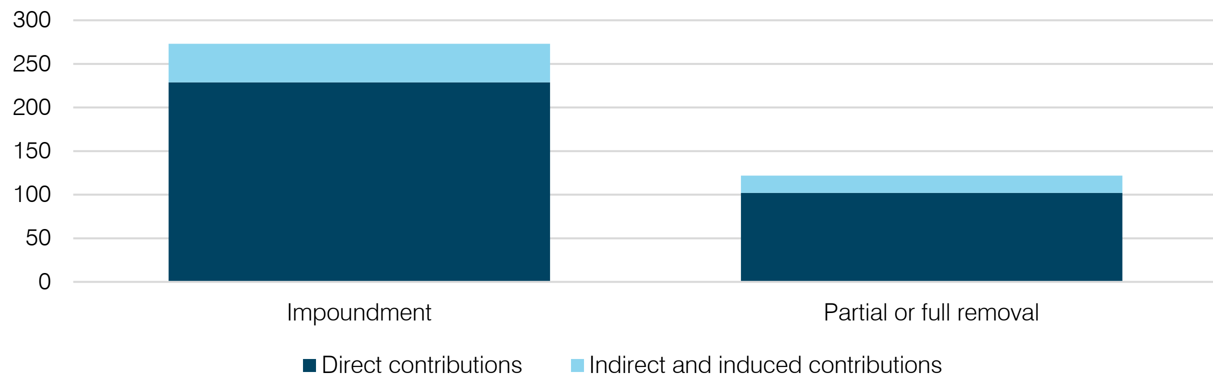
Economic Impact Analysis

To assess existing recreation-related activity for the economic contribution study, PSC spoke with local government officials, recreational asset managers, and other community stakeholders to identify existing reports and collect data on the number and types of visitors of the recreational facilities surrounding the pond. Where data were not available from local sources, PSC used a cell phone data mapping service to estimate annual users. PSC then applied nationally recognized, inflation-adjusted recreation expenditure profiles to these trip counts to create the inputs for the IMPLAN analysis.

Recreational Analysis

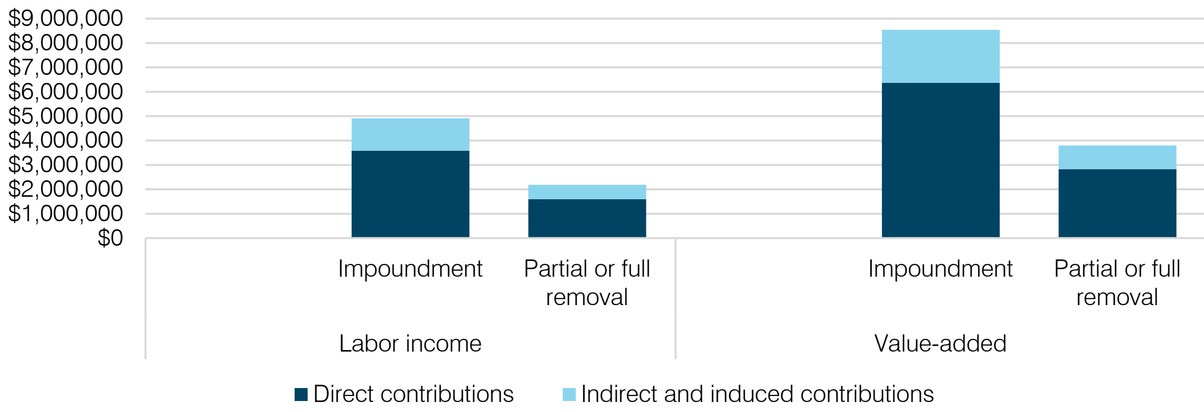
After applying the approach outlined in the methodology section of this report, adjusted site visitation estimates were applied to the same expenditure profiles used for the economic contribution analysis. The IMPLAN results under these assumptions were then compared to the previous economic contribution results to determine the economic impact of dam removal. After reviewing maps of the area, PSC conducted a single analysis of the full removal scenario because there was not a meaningful difference between the full and partial removal scenarios. Using IMPLAN and data collected from local and state sources, this analysis estimates the short-term economic impact of the full removal of the Foote Dam. The short-term estimated effects documented in this report are intended to reflect the economic impacts during the first year following dam removal. The extent to which they persist over time will depend on how quickly the local economy changes to accommodate the new economic environment. PSC estimates that in the first year after dam removal, recreational activity in the area surrounding the impoundment would result in 151 fewer jobs in the region and a $4.7 million reduction in value-added to the local economy (Exhibits 5 and 6).

EXHIBIT 5. Employment Results—Impoundment and Partial or Full Removal



Source: PSC analysis

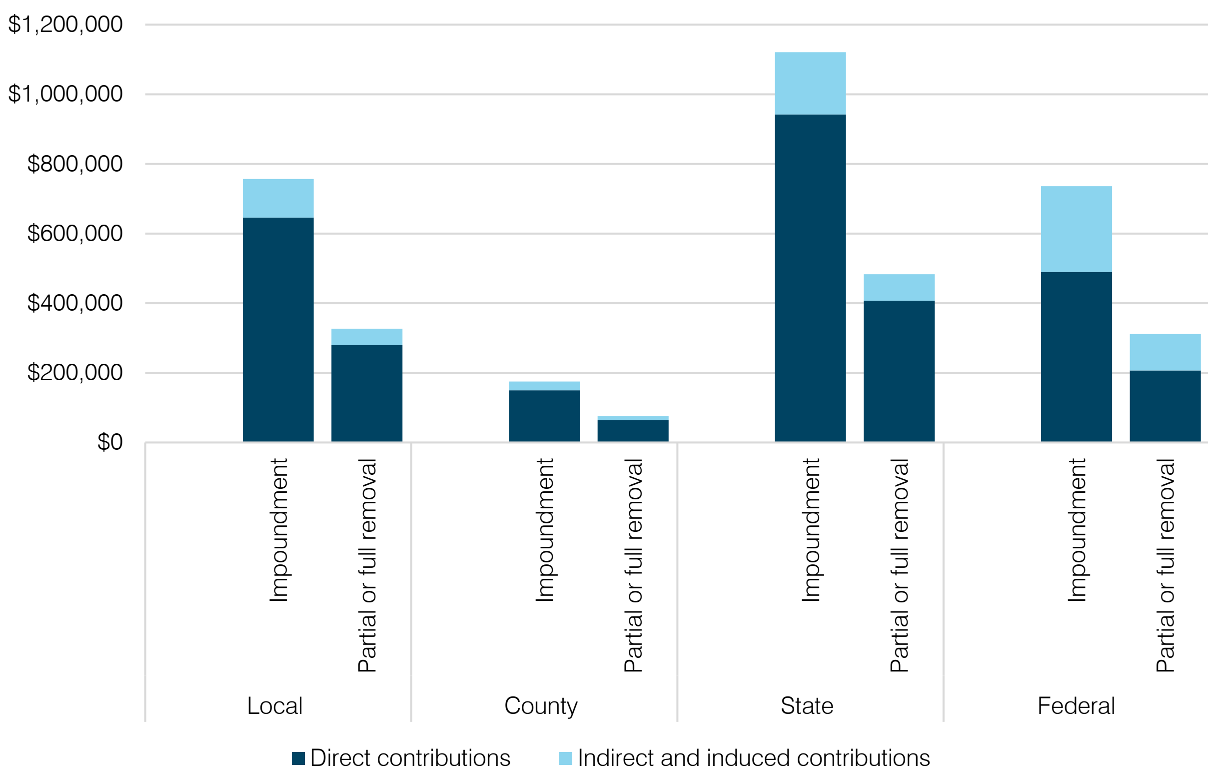
EXHIBIT 6. Labor Income and Value-added Impacts—Impoundment and Partial or Full Removal



Source: PSC analysis

These estimated shifts in recreational activity will result in $1.6 million fewer contributions in total annual tax revenue, with $1.2 million of that reduction at the local, county, and state levels (Exhibit 7).

EXHIBIT 7. Tax Impacts—Impoundment and Partial or Full Removal



Source: PSC analysis

Discussion

Short- versus Long-term Shifts in Economic Activity Following Partial or Full Dam Removal

Though this analysis focuses on short-term reductions in economic activity, studies show recreational activity and spending can recover and even outpace impoundment spending in the long term (Loomis 2002). Capital investments and other supports to help recreational assets shift to serving river-based activities could mitigate losses and maximize opportunity. Also, some studies indicate that a return to river creates opportunities for more access points, which can increase the economic contributions of river-based recreational activity (Bi, Borisova, and Hodges 2019).

At a regional or state level, the jobs and spending measured in this analysis are unlikely to be lost, given that those partial to the activities most impacted by dam removal (e.g., pontoon boaters, lakeside camping, water skiers, etc.) are likely to find another place in the state to do these activities (Bi, Borisova, and Hodges 2019). However, at the local level, unless these activities are conducted elsewhere in the immediate area—which is not assumed in this analysis—the reduction in visitor trips and spending will have economic impacts.

Partial and Full Removal Considerations

For all economic impact reports, PSC considered both full and partial removal scenarios, but in some cases, including at Foote Pond, it appears that the shifts in recreational activity associated with the water levels under a partial removal would not produce significantly different outcomes. While it is possible, if unlikely, that the economic impacts of a partial removal would be different from those following a full removal, those differences would not be measurable when making the assumptions and developing the approach necessary to model these shifts. For this reason, PSC did not conduct a separate analysis of what the impacts would be under a partial removal scenario.

Other Potential Impacts Not Measured

Angler Activity

As noted in the methodology section of the report, PSC did not estimate the changes partial or full dam removal will have on angler activity and the associated economic effects of those activities. However, there is sufficient research to suggest that dam removals generate significantly positive benefits to anglers and restore fisheries to their normal habitat. A recent long-term effect study following the removal of the Edwards Dam along the Kennebec River, showed greater overall angler satisfaction with fishing endeavors along the Kennebec (Robbins and Lewis 2008). Both willingness to pay to fish and actual fishing-related expenditures increased after dam removal. While McKean et al. (2010) support the finding that anglers' willingness to pay increases and their actual expenditures for fishing increase after dam removal, they found that the expenditure effects may be partially mitigated by lower visitor counts. Regardless, the net effect observed was a net increase in regional economic growth around angler activities. These long-term studies observe effects well after a new normal life cycle exists in the river system and that transition can take years.

Other mitigating circumstances should also be considered. For example, not all anglers prefer river fishing, as many seek deeper water fishing activities via boat rather than bank and/or fly fishing in cold spring waters. That is, the net effect on fishing activity may have as much to do with the preferences of recreational anglers as it does on the river ecosystem. Supply and demand dynamics are also important to consider, as changes that increase the costs of fishing activities may result in a decrease in visitor fishing trips (Hwang et al. 2020). If lowermost dams are removed, a seasonal barrier may be needed to prevent movement of the invasive sea lamprey upstream. Such barriers could also hamper natural fisheries restoration, which may or may not have long-term implications on angler activities along the river.

Ecosystem Services

Nature provides vital contributions to economic and social well-being that are often not traded in markets or fully considered in land use, business, and other economic decisions. Ecosystem services are direct and indirect benefits to people from nature and are often not priced because they are not traded, and often are difficult to observe. In the case of a river, these contributions include water cycling and purification; mitigating or propagating flood events; the support of habitat for diverse populations of birds, fish, and mammals; carbon sequestration; and cultural and aesthetic benefits, to name a few. Consider one known ecosystem disturbance by dams. Many of Michigan's fish populations prefer coldwater environments that are generally supported by spring water. Michigan's low water table produces multitudes of springs–groundwater that flows naturally to the water surface due to features of the water table and surface topography. Within a water system, impoundments result in warming river water, even downstream from the dam. Cold spring water that does intermingle with lake water gets diluted into the warmer water system to the detriment of natural habitat for cold water fish like salmon, trout and sculpins.

While research and literature on ecosystem services abound, PSC has not estimated the impacts of the presence or absence of the river hydros on ecosystem services because the scope of measurement is beyond the existing scope of work. Research articles highlight the challenge of quantifying the values of ecosystems of nonmarket goods and services, including recreational activity (de Groot et al. 2012; Steinman et al. 2017). Also, while decisions that affect these services are often made at the local level, "issues such as fisheries and water levels require sustainable management at the basin scale, where coordination, valuation, and assessment may face greater logistical challenges" (de Groot et al. 2012).

Property Value Analysis

PSC compiled assessed and taxable values from the Iosco County Equalization Department for the tax (calendar) year 2022. In other Consumers dam studies, PSC conducted a property analysis to estimate the impact of partial and full dam removal on properties adjacent to the pond. Currently, there are fewer than 20 properties around the impoundment not owned by Consumers or the federal government, so PSC did not conduct this type of analysis for this study.

Conclusion

Building on previous community engagement and economic contribution work conducted by PSC, this report is intended to provide insights on the potential economic and property impacts of partial or full removal of the Foote Dam. Given the levels of uncertainty present with any potential removal project, PSC made several key assumptions, which are discussed in more detail within the report's methodology section. These include analyzing the potential impacts in the first year after partial or full dam removal and not make any assumptions about new recreational activities or facilities that could increase visitation following regional planning and investment efforts.

Under this set of assumptions, local recreational assets are likely to be significantly impacted in a partial or full dam removal scenario. Shifts in visitation activity will affect employment opportunities, tax revenue, and economic contributions to the broader economy. PSC research suggests that over the long term, recreational activity is likely to return.

This report includes a full breakdown of the potential economic impacts of the partial or full removal of the Foote Dam, which includes:

- A reduction of $4.7 million in gross regional product and 151 jobs
- A reduction of $1.6 million in local, county, state, and federal taxes through direct, indirect, and induced tax effects from recreational spending

References

Bellas, Allen, and Lea Kosnik. 2019. "A Retrospective Benefit-Cost Analysis on the Elwha River Restoration Project. *Journal of Benefit-Cost Analysis* 11 (1): 76–100. https://ideas.repec.org/a/cup/jbcoan/v11y2019i1p76-100_9.html

Bellmore, J. Ryan, et al. 2017. "Status and Trends of Dam Removal Research in the United States." *Wiley Interdisciplinary Reviews: Water* 4 (2): e1164. https://doi.org/10.1002/wat2.1237

Bi, Xiang, Tatiana Borisova, and Alan W. Hodges. 2019. "Economic Value of Visitation to Free-flowing and Impounded Portions of the Ocklawaha River in Florida: Implications for Management of River Flow." *The Review of Regional Studies, Food and Resource Economics Department, University of Florida*. *49:* 244–267. http://dx.doi.org/10.52324/001c.9754

Boodt, William. 1978. "Effects of Reservoir Recreation Development upon Rural Residential Property Values." PhD diss., Oregon State University. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=94723ee2a9fbf845bcd84875b5141a315d0ef73a

Brown, Gardner, and Henry Pollakowski. 1977. "Economic Valuation of Shoreline." *The Review of Economics and Statistics* 59 (3): 272–278. https://ideas.repec.org/a/tpr/restat/v59y1977i3p272-78.html

Bureau of Labor Statistics (BLS). 2021. "Table 1300. Age of Reference Person: Annual Expenditure Means, Shares, Standard Errors, and Coefficients of Variation, Consumer Expenditure Surveys, 2021." *bls.gov*. https://www.bls.gov/cex/tables/calendar-year/mean-item-share-average-standard-error/reference-person-age-ranges-2021.pdf

Conner, J., et al. 1973. "The Effects of Water Frontage on Recreational Property Values." *Journal of Leisure Research* 5 (2): 26–38. https://doi.org/10.1080/00222216.1973.11970125

Coughlin, Cletus, and Thomas Mandelbaum. January 1991. "A Consumer's Guide to Regional Economic Multipliers." *Federal Reserve Bank of St. Louis Review* 73: 19–32. https://files.stlouisfed.org/files/htdocs/publications/review/91/01/Consumer_Jan_Feb1991.pdf

De Groot, Rudolf, Luke Brander, Sander van der Ploeg, et al. 2012. "Global Estimates of the Value of Ecosystems and Their Services in Monetary Units." *Ecosystem Services*. 1 (1): 50–61. https://doi.org/10.1016/j.ecoser.2012.07.005

Doss, Cheryl, and Steven Taff. 1996. "The Influence of Wetland Type and Wetland Proximity on Residential Property Values." *Journal of Agricultural and Resource Economics* 21 (1): 120–129. https://www.jstor.org/stable/40986902

Espey, Molly, et al. February 2007. "Living on the Edge: Residential Property Values in the Urban-Rural Interface." *Journal of Agricultural and Applied Economics* 39 (3): 689–699. http://dx.doi.org/10.1017/S107407080002335X

Hansen, Henry, Ken H. Anderson, and Eva Bergman. October 2023. "Projecting Fish Community Responses to Dam Removal—Data-limited Modeling." *Ecological Indicators* 154: 110805. https://doi.org/10.1016/j.ecolind.2023.110805

Hwang, Joonghyun, Xiang Bi, Nia Morales, Edward V. Camp. January 2021. "The Economic Value of Freshwater Fisheries in Florida: An Application of the Travel Cost Method for Black Crappie Fishing Trips." *Fisheries Research* 223: 105754. https://doi.org/10.1016/j.fishres.2020.105754

Iosco County Equalization Department. May 25, 2023. "IoscoParAdjusted." Unpublished data.

Johnston, Ronald and Randall Rosenberger. 2010. "Methods, Trends, and Controversies in Contemporary Benefit Transfer." *Journal of Economic Surveys* 24 (3): 479–510. https://doi.org/10.1111/j.1467-6419.2009.00592.x

Kotchen, Matthew, Michael Moore, Frank Lupi, and Edward S. Rutherford. 2006. "Environmental Constraints on Hydropower: An Ex Post Benefit-Cost Analysis of Dam Relicensing in Michigan." *Land Economics* 82 (3): 384–403. https://www.jstor.org/stable/27647719

Kruse, Sarah, and Josh Ahmann. February 2009. "The Value of Lake Adjacency: A Hedonic Pricing Analysis on the Klamath River, California." Portland: Ecotrust. http://archive.ecotrust.org/workingpapers/WPS5_Value_of_Lake_Adjacency.pdf

Loomis, John. June 2002. "Quantifying Recreation Use Values from Removing Dams and Restoring Free-flowing Rivers: A Contingent Behavior Travel Cost Demand Model for the Lower Snake River." *Water Resources Research* 38 (6): 1–8. https://doi.org/10.1029/2000WR000136

Mahan, Brent, Stephen Polasky, and Richard M. Adams. February 2000. "Valuing Urban Wetlands: A Property Price Approach." *Land Economics* 76 (1): 100–113. https://www.jstor.org/stable/3147260

McKean, John, Donn Johnson, and R. Garth Taylor. 2010. "Willingness-to-pay for Nonangler Recreation at the Lower Snake River Reservoirs." *Water Resources Research* 37 (2): 178–194. https://doi.org/10.1080/00222216.2005.11950049

McKean, John, Donn Johnson, and R. Garth Taylor. 2010. "Willingness-to-pay for Steelhead Trout Fishing: Implications of Two-step Consumer Decisions with Short-run Endowments." *Water Resources Research* 46: W09523. https://doi.org/10.1029/2009WR008664

Michigan Department of Treasury. n.d.a "State Equalization e-filing System." *Michigan Department of Treasury*. Accessed February 24, 2023. https://eequal.bsasoftware.com/Login.aspx

———. n.d.b 2021 *Total Property Tax Rates in Michigan*. Lansing: Michigan Department of Treasury. Accessed February 25, 2023. https://www.michigan.gov/treasury/-/media/Project/Websites/taxes/2022RM/PROPERTY2/2021_TOTAL_RATES_Report.pdf?rev=528122bd8be94aefabdcfb57c6bdf1dd&hash=69503DB118198847ED855098D6EC68D1

Michigan State University Extension. n.d. "Michigan Natural Features Inventory." *Michigan Natural Features Inventory*. https://mnfi.anr.msu.edu/

Muller, Nicholas. January 2009. “Using Hedonic Property Models to Value Public Water Bodies: An Analysis of Specification Issues.” *Water Resources Research* 45 (1). doi:10.1029/2008WR007281

Nicholls, Sarah, and John L. Crompton. March 2018. “The Contribution of Scenic Views of, and Proximity to, Lakes and Reservoirs to Property Values.” *Lakes & Reservoirs* 23 (1): 63–78. https://doi.org/10.1111/lre.12207

Robbins, Jesse L. and Lynne Y. Lewis. 2008. “Demolish It and They Will Come: Estimating the Economic Impacts of Restoring Recreational Fishery.” *Journal of American Water Resources Association 44* (6): 1488–1499. https://doi.org/10.1111/j.1752-1688.2008.00253.x

Sander, Heather, Stephen Polasky, and Robert Haight. June 2010. “The Value of Urban Tree Cover: A Hedonic Property Price Model in Ramsey and Dakota Counties, Minnesota, USA.” *Ecological Economics* 69 (8): 1646–1656. https://doi.org/10.1016/j.ecolecon.2010.03.011

Sander, Heather, and Stephen Polasky. July 2009. “The Value of Views and Open Space: Estimates from a Hedonic Pricing Model for Ramsey County, Minnesota, USA.” *Land Use Policy* 26 (3): 837–845. https://doi.org/10.1016/j.landusepol.2008.10.009

Stetler, Kyle, Tyron Venn, and David Calkin. September 2010. “The Effects of Wildfire and Environmental Amenities on Property Values in Northwest Montana, USA.” *Ecological Economics* 69 (11): 2233–2243. https://doi.org/10.1016/j.ecolecon.2010.06.009

Steinman, Alan D., Bradley Cardinale, Wayne R. Munns Jr., et al. 2017. “Ecosystem Services in the Great Lakes”. *Journal of Great Lakes Research*. 43 (3):161–168. https://doi.org/10.1016/j.jglr.2017.02.004

Tapsuwan, Sorada, et al. February 2015. “Valuing the Barmah–Millewa Forest and In Stream River Flows: A Spatial Heteroskedasticity and Autocorrelation Consistent (SHAC) Approach.” *Ecological Economics* 110: 98–105. https://doi.org/10.1016/j.ecolecon.2014.12.008

White, Eric. 2017. *Spending Patterns of Outdoor Recreation Visitors to National Forests*. Corvallis: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Accessed March 6, 2023. https://www.fs.usda.gov/pnw/publications/spending-patterns-outdoor-recreation-visitors-national-forests

Appendix A: Methodology

IMPLAN Modeling

To analyze the amount of money visitors and residents spend on recreation related to the dam impoundments, Public Sector Consultants used IMpact for PLANning (IMPLAN), an input-output model to estimate economic impacts and contributions. It is a staple for regional economic analysts.

Economic Impact and Contribution Analyses

There are two major frameworks for input-output simulations. The first is an economic impact analysis, which examines the effect of something that affects the economy—like changes in wages or jobs—in a specific area. In this case, it is the dam impoundment and the recreational activities and expenditures associated with it. Because an economic impact analysis provides a model of what the economy is like with the economic feature being examined—in this case, the dam impoundment—a full accounting of what the economy would be like without the feature is required in modeling the outcomes.

The second framework is called an economic contribution analysis. This framework does not consider the possible absence of an economic feature. It only models the value of economic activity that can trace its source back to the existence of the economic feature being modeled.

IMPLAN Terminology and Methodology

Input-output models trace transactions among and between different economic sectors (like households, businesses, and governments) over the course of a year. Tracing these transactions offers a clearer picture of how a change in economic activity in one part of the economy creates changes in other parts of the economy. When a business sells from inventory, it takes a portion of those earnings to pay for other goods and services (for example, to restock its inventory). Some of the wages companies pay to employees will go to local retailers and service providers, continuing the ripple effect throughout the economy. Because of all of these additional transactions, the overall economic effect is greater than the value of all the different direct revenue streams (employer to employee, consumer to business, business to business, etc.), which is called the multiplier effect. The existence of multiplier effects in regional and national economies is well documented in economics literature (Coughlin and Mandelbaum 1991).

Direct Effects

The standard approach to modeling economic impacts with input-output models is to begin by establishing the value of transactions that represent direct expenditures related to the dam and impoundment. For the purposes of this study, these are expenditures by individuals utilizing impoundment, feeder river system, and other adjacent recreational facilities. The direct effects of this spending are organized into various commodity categories. Each commodity type, such as grocery retailing, gasoline, and restaurant meals, have unique economic profiles in the local economy. For example, purchases made at a local grocery store create a different set of secondary transactions than purchases made in other industries.

While recreational expenditures make up the direct effects, they are largely derived from the number of recreational users at facilities around the impoundment. As discussed above, the analysis assumes that these users will spend money in a particular pattern while visiting recreational assets in and around the dam impoundment. The expenditure profile used for this analysis is an inflation-adjusted version of the one adopted by the United States Department of Agriculture and United States Forest Service (USDA/USFS) (White 2017). Expenditures by recreational users are measured on a per-party basis. To account for the different spending patterns of impound visitor types, party counts were broken out into distinct categories.

Indirect and Induced Effects

These direct effects are then used to estimate the secondary transactions that happen because of the direct effects. The first set of secondary transactions is the indirect effects, which are transactions between business sectors. Indirect effects are the intermediate purchases of goods from one business by another (such as restocking). A business's operational costs—like electricity, rent, and business services—are also indirect effects. Indirect effects ripple throughout the economy as businesses purchase goods and services from other businesses. These transactions cascade throughout the region, reduced only by the extent that inputs are purchased from suppliers outside the region. The second set of secondary transactions are called induced effects. Induced effects measure the value of new transactions by households, governments, and other institutions in response to higher labor income, taxes, and profits. These household and institutional expenditures from earnings generate new rounds of business-to-business transactions and associated payments to institutions. These expenditures continue throughout the regional economy, hampered only by the extent to which purchases are made for goods, services, and payments to institutions outside the local economy. The direct, indirect, and induced effects are summed together to calculate the total economic effects.

Contribution estimates start with the estimated total value of purchases by category. Standard input-output models examine the economy through the flow of transactions. However, figures for employment, labor income, and total regional income, which are also known as contributions to gross state product, are determined with fixed ratios to the value of sales transactions. For instance, if Industry X employs one employee for every $1 million in sales, then an increase in sales by $10 million translates into an increase in employment by ten workers. Similar fixed ratios for labor income and gross state product apply. The IMPLAN model provides 544 expenditure categories, and 11 household types by income group.

Property Value Analysis

Estimating the expected impact of removing or reducing the impoundment on residential property values relied on a long literature of academic studies on this topic. Most studies underlying this literature apply some form of Hedonic regression analysis to estimate the value of proximity to the water feature. For this analysis, water features entail lake/impoundments and rivers, where the contrasts in value contributions across the two provide a basis for understanding how the values of properties that are currently impoundment-adjacent will change once becoming river/stream adjacent.

Hedonic analysis assumes that the water feature, whether an impoundment/lake or stream/river, has some amenity value to adjacent homeowners that will be reflected in the property values. If proximity to the water feature is deemed desirable, those properties adjacent to the water will tend to command a higher market value than identical properties (comparable properties) that are not proximal to the feature. Accordingly, Hedonic analysis generates valuations of comparable properties statistically. These statistically derived baseline valuations can be compared to properties adjacent to water features for estimating the average or expected impact of the water feature to comparable properties.

This economic impact assessment of the effect of removing the impoundment on property values will use a benefit transfer method (Johnston and Rosenberger 2010). Relative to a site-specific specific study, which would use location-specific property data for developing a model that estimates the water feature's (whether impoundment or lake) contribution to property values, a benefit transfer approach applies a model of the relationship from another study site and applies that model to the site in question, usually called the policy site.

The benefits of this type of approach are that the underlying model representing the value contributions are often much more robust than can be attained from a site-specific study. Many reasons exist. First, inclusive studies of property value impacts of natural amenities are expensive to undertake and require significant time investment to collect the relevant property data. This project's budget and timeline over thirteen impoundments preclude such inclusive, site-specific studies. Second, the study area data is not uniformly sufficient for undertaking comprehensive hedonic analyses. Candidate study sites are those with significant counts and varieties of both effected and baseline housing units by which property values can be compared. The sites should also have comprehensive measures across each housing unit, like year built, square footage, age of last updates/mechanicals, number of rooms and baths, lot size, and other measures common in describing residential properties. That is, the valuations from published study sites are derived from ideal conditions that often do not exist in sites of interest and can therefore provide generalizable estimates of the relationship between residential property values and proximity to water features. However, benefit transfer applications have a shortcoming in that its application may bias the predicted contribution if the study site characteristics are sufficiently unmatched by the policy site.

In estimating effects, it is important to be able to apply unit-free measures, like percent change in values from baselines rather than absolute dollar values. Such unit-free measures allow for transference of values when value scales differ between the study and the policy sites. For example, a study that establishes that proximity to a river feature elevates property values by $8,000 on average is more significant if the baseline property values are $100,000 than if they are $200,000. Alternatively, a finding that shows proximity to a river elevates property valuations by 8 percent is fully scalable and applicable if the baseline property values are $100,000 or $200,000.

Accordingly, an inclusive review of existing hedonic studies of the effects of water features on residential property values was referenced to identify relevant studies for consideration in the benefit transfer estimates. Sarah Nicholls and John Crompton's 2018 article in the academic journal *Lakes & Reservoirs* is a comprehensive review of existing studies on the effects of lakes, lake water drawdowns and rivers on property values. The review shows a great deal of consistency in generalized findings, that adjacency to lakes or impoundments tends to be associated with increased market values of residential properties, even when controlling for other property amenities, like square footage, number of rooms, lot size, etc. Multiple studies suggest that adjacency to any water feature tends to be associated with higher residential property values, but that the effect is larger for lake adjacency than for that of rivers. Studies comparing residential property values before and after a permanent impoundment drawdown reinforce the valuation effect differences between lakes/impoundments and rivers/streams. However, the effect decreases with distance between properties and the water feature. The model should consider these three stylized findings.

Key papers that influenced the adopted model of residential property effects include studies that show a clear positive effect of water adjacency and views to water features, as well as a study that found no effect of water adjacency on property values. Additionally, studies used were geographically diverse. Boodt

(1978) compared property values surrounding five Oregon lakes against baselines finding both significant and insignificant effects, but an overall average positive effect of a 15 percent boost in residential property values for those lots adjacent to lakes or reservoirs. A study of Northern California properties (Kruse and Ahmann 2009) generated significantly more prolific estimates of the effects of adjacency to water bodies, showing that adjacency boosted property values by over 100 percent relative to comparable baseline properties. This study also shows the effect of unobstructed scenic views of water bodies alone contributes about 28 percent boost in property values. Varying geography, one study (Muller 2009) controlled for the presence or absence of reservoir management with proximity and views of reservoirs in Indiana and Connecticut, determining that proximity to or views of water bodies is not sufficient to assure a positive effect of lake proximity to residential lot values. Once the valuation of water views has been incorporated into property value estimates, the effect of adjacency on property values moderates (Espey et al. 2007; Sander and Polasky 2009), suggesting that the visual vista is a key component of the value homebuyers place on lake adjacency. For this assessment, the expected premium associated with reservoir adjacency is set to 37 percent, which is on the lower spectrum of estimates. The lower, more conservative estimate is applied because the loss of lake adjacency will be replaced by adjacency to the restored river.

A few studies in the review (Conner 1973; Sander and Polasky 2009, Tapsuwan 2015) compared the valuation boost to residential properties between adjacency to lakes and rivers, noting that the estimated effect of river adjacency is slightly less than one-half that of a reservoir. The general rule under the modeling scenarios is that with a full dam removal, all lake adjacent properties will lose the lake premium. After dam removal, those properties that remain adjacent to the river will benefit from the lesser river premium that will partially offset the lost lake adjacency premium.

Finally, several studies (Brown and Pollakowski 1977; Doss and Taff 1996; Mahan, Polasky et al. 2000; Sander, Polasky et al. 2010; Stetler, Venn et al. 2010) observed that distance from the water line tends to be associated with lower water adjacency premiums. Though the estimates varied by study, the findings tended toward centering on a.045 percent decrease in the overall adjacent property value per ten yards of distance from the water's edge.

Accordingly, the following model is applied to both assessed and taxable values to gauge the expected net effect of partial and full removal of the respective dam.

$$((\,PropValue_{n,s}\,) \,/\, (1 + .3696 * front_s)) \;*\; (1 + .1512 * river_s) \;*\; (1 - .00038 * \;yards_s)$$

The variable PropValue takes the value of n = {Assessed Value or Taxable Value} for scenario s = {Full Removal or Partial Removal}, where the scenario dictates whether water frontage is lost ($front = 1$), whether the property will retain adjacency to the river ($river = 1$) and the distance in yards the property's edge from the water front ($yards$). Because the same model is applied to taxable and assessed value, the model implicitly assumes that taxable, assessed, and market values move in proportion to the others.

PUBLIC SECTOR CONSULTANTS

230 N. Washington Square
Suite 300
Lansing, MI 48933