Executive Summary

Introduction and Overview

Clean water in the New York-New Jersey Harbor Estuary (referred to throughout the report as the Harbor Estuary) is key to recreational activities such as safe swimming and boating, environmental safety for shoreline parks and waterfront neighborhoods, and healthy aquatic environments for wildlife. Since the passage and implementation of the federal Clean Water Act (CWA) in 1972, significant investments have been made to improve water quality in the Harbor Estuary. However, there are still areas of the Harbor Estuary where further investments are needed to achieve the "swimmable and fishable" (including shell fishing) goals of the CWA.

This study estimates the economic value of meeting these goals through analysis of four illustrative scenarios of water quality improvement. These scenarios reflect the water quality improvements, relative to current water quality, that would occur if the Harbor Estuary met swimmable and fishable goals of the CWA as well as other standards linked to healthy ecosystems for aquatic life.[1] The four scenarios considered in this study are summarized in Table ES-1. Two of the scenarios (primary and secondary contact recreation) are based on water quality targets of planned improvements in the Harbor Estuary. The remaining two scenarios (aquatic life and combined) are illustrative scenarios intended to show the range of benefits for larger water quality improvements. For each of these scenarios, we estimated the economic benefits that would be realized directly by households that value water quality improvements in the Harbor Estuary.

Table ES-1. Summary of Water Quality Scenarios

Scenario Name	Threshold Values[a]
Scenarios Based on Water Quality Targets of Planned Improvements	
Primary Contact Recreation	130 CFU/100 mL for daily values of enterococcus (EC) and 35 CFU/100 mL for average values of EC
Secondary Contact Recreation	70 CFU/100 mL for average values of EC
Illustrative Scenarios	
Aquatic Life	3.0 mg/L for daily values of dissolved oxygen (DO) and 4.8 mg/L for mean values of DO
	0.4 mg/L for daily values of total nitrogen (TN)
	0.03 mg/L for daily values of total phosphorus (TP)
Combined	130 CFU/100 mL for daily values of EC and 35 CFU/100 mL for average values of EC
	3.0 mg/L for daily values of DO and 4.8 mg/L for mean values of DO
	0.4 mg/L for daily values of TN
	0.03 mg/L for daily values of TP

[a] Parameter-specific thresholds expected to be achieved under the different water quality scenarios.

Economic benefits (or values – the two are synonymous) for the water quality scenarios in Table ES-1 are calculated using benefit transfer methods that follow contemporary best practices, analogous

[1] We note that estimating the cost of treatment technologies and best management practices that would be needed to achieve the scenario goals is beyond the scope of this study.

to methods applied commonly by EPA for regulatory benefits analysis under the CWA. Benefits are quantified in terms of households' individual and total willingness-to-pay (WTP) for water quality improvements under each scenario. WTP is the most common measure (or theoretical construct) used to quantify economic values for environmental improvements that benefit individuals or households, as part of benefit-cost analysis. Within the present application to water quality benefits, a WTP estimate may be thought of as measuring, conceptually, what each household would be willing to pay in binding terms (for example within the context of a binding statewide bond referendum) to achieve a particular set of water quality improvements, rather than to forgo those improvements and maintain the status quo. WTP represents the total value of that improvement to the household, in monetary terms.

As discussed in the main report, these WTP values implicitly include values for numerous underlying ecosystem services that would be affected by different types of water quality improvements, and are valued by the public. These include values such as (1) improved value of water-based recreation and reduced human health risks from water contact, (2) improved fishing catch rates and recreational fishing experience, (3) improved aesthetics (*e.g.,* water clarity) for recreation occurring near the water, (4) existence value for aquatic species and healthy ecosystems, (5) enhanced aesthetic values and sense of place, (6) avoided household costs (*e.g.,* costs associated with water treatment), and (7) increased property values. Because these ecosystem service values are already be captured in large part by a comprehensive measure of household WTP, they are not measured separately (to avoid double-counting).

The estimates provided in this report thereby represent the large majority of economic benefits that are expected due to water quality changes in the Harbor Estuary. Other potential benefits, which are not expected to be captured by household WTP and are not measured by the analysis, are described in narrative terms, with reference to studies that quantify similar benefits elsewhere.

Methods

The study's main objective is to estimate the economic benefits of achieving the goals of the CWA. To achieve this goal, the ICF team developed and applied a benefit function transfer to estimate ecosystem service values linked to water quality in the Harbor Estuary. The function used to conduct this benefit transfer was derived via a meta-analysis (a "study of studies") that statistically combines information from 58 previously published studies on water quality benefits that were conducted in different regions across the United States. By synthesizing information from different studies, the model supports more accurate benefit predictions for the Harbor Estuary that can be linked to the specific characteristics of water quality changes and households in particular areas. The resulting benefit-transfer approach, which is grounded in methods previously developed by the project team to evaluate water quality values for EPA federal rulemakings under the CWA, entails the following steps:

1) **Define water quality baselines (*i.e.,* current conditions) and changes under the four water quality scenarios using a water quality index (WQI).** The WQI incorporates six parameters: DO, biological oxygen demand (BOD), EC, TN, TP, and total suspended solids (TSS). The WQI uses a 0-100 scale to reflect varying water quality, with 100 representing the highest possible quality and 0 the lowest (although index values <10 do not generally occur).

2) **Define the "extent of market" of affected households, or locations of households likely to hold values for water quality improvements in the Harbor Estuary.** ICF used two different market extents when calculating benefits, including (1) the 30 counties corresponding to the

scope of the Harbor Estuary Program and (2) the two states in which the Harbor Estuary resides (New York and New Jersey). The county-level market extent is the primary market extent for the analysis, while the state-level market extent serves as an alternative to assess the sensitivity of benefit estimates to the market extent selection.

3) **Monetize (i.e., calculate the economic benefit to households of) water quality improvements using a meta-analysis of surface water valuation studies that provide data on the public's WTP for water quality changes.** For each of the four water quality scenarios, the model produced average annual WTP values per household in the selected market extent. ICF then estimated the aggregated, or population-level, total present value[2] over a 20-year analysis period, assuming that water quality targets would be met at the beginning of 2043 and persist through 2062. Estimating the total present value of water quality improvements entailed multiplying the per household WTP values by the projected number of households expected to benefit from water quality improvements in a given analysis year, discounting values to 2023 using a 3 percent discount rate, and summing across analysis period years. We then used the total present value estimates to estimate annualized benefits.[3]

The approach accounted for specific characteristics of the Harbor Estuary and surrounding watershed and enabled estimation of water quality values linked to a wide range of policies and programs focused on conserving and restoring the Harbor Estuary and enhancing ecosystem services. As explained earlier in this Executive Summary, the resulting per household WTP and total present values estimates were designed to capture the total value of water quality improvement to households, and hence capture underlying values for numerous services provided by the Harbor Estuary, including recreational and aesthetic values.

Summary of Results

ICF estimated WQI changes under the four water quality scenarios, relative to current water quality conditions in the Harbor Estuary. Each scenario characterized water quality changes that could occur throughout the Harbor Estuary, based on different possible water quality targets related to achieving the fishable and swimmable goals of the 1972 CWA. These targets, as shown in Table ES-1, were primary contact recreation, secondary contact recreation, aquatic life, and a combined scenario which considered both primary contact recreation and aquatic life.

The associated mean WQI changes, on a 100-point scale, were 6.3 points for the primary contact recreation scenario, 2.5 points for the secondary contact recreation scenario, 17.8 points for the aquatic life scenario, and 28.0 points for the combined scenario. For each of the four water quality scenarios, Table ES-2 presents the average annual number of households within the market extent assumed to value the water quality improvements, average annual household WTP values estimated via the meta-regression model, total present value of benefits accrued over the 20-year analysis period using a 3 percent discount rate, and annualized benefits using a 3 percent discount rate. The estimated benefits are based on the county-level market extent (all households living in counties that border the Harbor Estuary) and an assumption that the Harbor Estuary remains unavailable for

[2] Total present value is the current value of future benefits over a given analysis period, with benefits in future years discounted to account for how benefits accrued today are valued more than benefits accrued in the future.

[3] Annualized benefits are benefits over a time period (*i.e.,* the 20-year analysis period) scaled down to a 12-month period, enabling comparison of values over any time period.

swimming following the water quality improvements under each scenario (sensitivity analyses provided in the report show how benefit estimates change under different market extent and swimming use assumptions). These benefit estimates reflect values realized directly by households from water quality improvements (*e.g.,* improved water-based recreation, reduced health risks from water contact, enhanced aesthetic values).

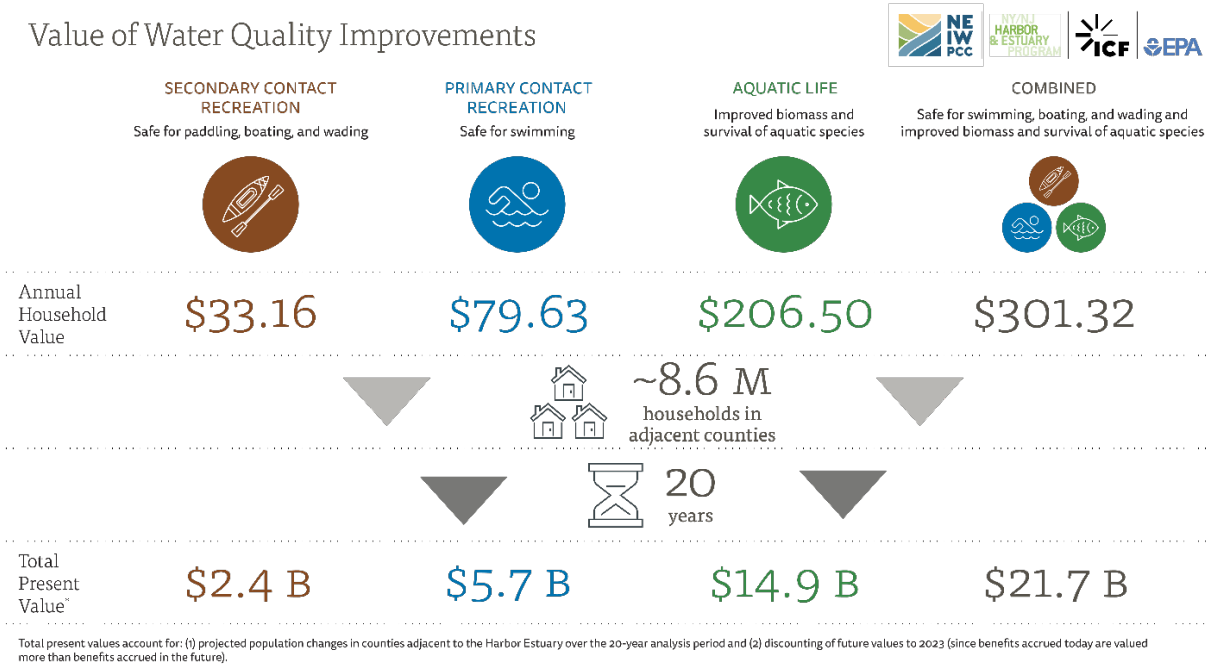
Table ES-2. Estimated Benefits for Water Quality Improvements Under All Water Quality Scenarios

Scenario	Average Annual Number of Households[a]	Average Annual Household WTP (2021$)	Total Present Value (3% Discount Rate; Millions 2021$)	Annualized Value (3% Discount Rate; Millions 2021$)
Scenarios Based on Water Quality Targets of Planned Improvements				
Primary Contact Recreation	8,639,847	$79.63	$5,744	$375
Secondary Contact Recreation	8,639,847	$33.16	$2,392	$156
Illustrative Scenarios				
Aquatic Life	8,639,847	$206.50	$14,896	$972
Combined Scenario	8,639,847	$301.32	$21,735	$1,418

[a] Average annual number of affected households during the 20-year analysis period (2043-2062). Number of households for each year in the analysis period accounts for projected population growth,

Figure ES-1 visually demonstrates the estimation of the total present value estimates by aggregating average annual household WTP value over space (*i.e.,* all households in counties that border the Harbor Estuary) and time (*e.g.,* 20 years).

Figure ES-1. Graphic Representation of Estimated Benefits for Water Quality Improvements Under All Water Quality Scenarios



Results of the analysis reveal that even relatively modest water quality improvements, such as those under the Secondary Contact Recreation scenario, generate large values for households in New York and New Jersey. For example, the estimated average annual household WTP under the Secondary Contact Recreation Scenario is $33.16, leading to a total present value (or total economic benefit) of $2.4 billion. The economic value of water quality improvements depends on how much water quality improves and where. Scenarios with larger water quality improvement targets, such as the aquatic life and combined scenarios, generate even higher values for surrounding households once these water quality targets are met. If water quality targets were to be met sooner than anticipated, economic benefits would increase even further.

Prior to this study, no economic valuation studies have been conducted for the Harbor Estuary. The lack of economic literature for the Harbor Estuary region to date makes this economic analysis valuable for raising awareness of the tremendous value that the Harbor Estuary provides. As noted above, however, there are some types of potential benefits that are not quantified by this report. For example, this report does not quantify benefits that could potentially be realized by commercial businesses (*e.g.,* businesses that rent boats or fishing equipment or operate charter fishing trips) due to the same water quality changes. Commercial benefits are typically many times smaller than household benefits for these types of water quality improvements. The report also does not quantify additional ecosystem services (*e.g.,* improved wildlife habitat, improved flood protection) of restored wetland habitats used to meet water quality targets or benefits to tourists who visit the Harbor Estuary. Future work would be needed to capture the economic values of these additional benefit categories.