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Discount Rates in the Economic Evaluation of U.S. Army Corps of Engineers Projects

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Summary

Since 1936, Congress has relied on benefit and cost information to justify investments of federal involvement in water resource projects of the U.S. Army Corps of Engineers (Corps). Today, Congress faces more demand for Corps projects than the agency can deliver at recent funding levels. Congress also faces stakeholder concerns about how water resources issues are addressed; this brings attention to how the Corps develops and evaluates the alternatives considered for congressional construction authorization. Corps benefit-cost analyses (BCAs) and their underlying assumptions are central to decisions currently shaping the portfolio of federal water resources assets and their benefits, costs, and risks for decades to come. The quality and reliability of the BCAs shape federal decisionmaking and the efficacy of federal and nonfederal spending on federal water resource projects.

Disagreement persists about the use of BCAs in decisionmaking, how benefits and costs are captured and monetized, and how to value future benefits and costs. A main element of the debate is the *discount rate* used to convert future benefits and costs into present values. For some projects, the discount rate applied can influence which alternative is deemed the most economically efficient and whether a project's net benefits appear to justify federal investment. The higher the discount rate, the less present value is attributed to future benefits and costs. The Water Resources Development Act of 1974 (WRDA 1974; P.L. 93-251) requires the executive branch to use an annually adjusted water planning discount rate for project planning. The Corps continues to use the water planning discount rate for planning; however, in recent years, the executive branch has chosen to use a different discount rate when selecting Corps construction projects to include in its annual budget request. The executive branch's approach to budgeting has focused its funding requests on a limited set of projects. The executive branch uses as a principal performance metric for a project's inclusion in its budget request the project's benefit-cost ratio (BCR, ratio of the present value of benefits to the present value of costs), calculated with a 7% discount rate. Projects with BCRs less than 2.5 (calculated at a 7% discount rate) are largely excluded from the budget request. An issue for Congress and nonfederal project sponsors is the uncertain prospects for construction for the suite of congressionally authorized projects that do not meet the executive branch's BCR threshold.

Pursuant to WRDA 1974, the water planning discount rate is calculated annually based on a formula established in S.Doc. 97 from 1962; the rate was 3.125% in FY2016. The calculation uses the average yield on Treasury securities with 15 years or more remaining to maturity, rounded to the nearest one-eighth of 1% and capped at an annual change of 0.25%.

The executive branch has used a 7% discount rate for its evaluation of most federal programs since 1992, pursuant to Office of Management and Budget (OMB) Circular A-94. According to the circular, the 7% rate is intended to reflect the pretax rate of return on capital in the private sector. Since the late 1990s, the water planning discount rate has been below 7%.

Critics of the water planning discount rate have argued for a rate that better reflects the opportunity cost of capital. Others argue that Corps projects are public investments with long-term benefits that are appropriately evaluated with a low discount rate. For many Corps stakeholders, the current interest in the water planning discount rate is less a function of these long-standing debates and more part of the concern about the uncertain construction funding prospects for congressionally authorized projects that are below the BCR at the 7% discount rate threshold used by the executive branch. This report discusses the role and significance of discount rates in the economic evaluation of Corps projects. It also discusses the water planning discount rate's history, theoretical underpinning, and related issues and criticisms.

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Introduction

In the United States, the federal government uses benefit-cost analyses (BCAs) to inform decisionmaking on federal investments by comparing the monetized benefits and costs of alternative projects or programs.[1] BCAs for U.S. Army Corps of Engineers (Corps or Army Corps) water resource projects have had a long and central role in the executive branch's recommendations to Congress on construction authorization for Corps projects. Disagreement persists about the use of BCAs in decisionmaking, how benefits and costs are captured and monetized, and how to value future benefits and costs. The debate on how to value future benefits and costs is related to the *discount rate* used to value future benefits and costs in the present.[2] A discount rate converts a future stream of benefits into a "present value." (See the box titled "What is a Discount Rate?" and **Appendix A** for more information.) The higher the discount rate, the less present value is attributed to future benefits and costs. In the Water Resources Development Act of 1974 (WRDA 1974; P.L. 93-251), Congress required that federal agencies use in their evaluations of water resource projects a discount rate calculated annually using a formula established in S.Doc. 97 from 1962.[3] This discount rate is a largely a function of the average yield of long-term government securities. For FY2016, the water planning discount rate was 3.125%.

This report discusses the role and significance of discount rates in the economic evaluation of Corps projects. It also discusses the history of, theoretical underpinning for, and issues and criticisms of the water planning discount rate. This report is structured to first provide a primer on the Corps and the economic analysis of proposed projects. Second, the report explains how the discount rate used impacts the economic evaluation of projects and project alternatives. Two Corps projects are used to illustrate how projects with different streams of

What Is a Discount Rate?

In performing a benefit-cost analysis (BCA), it is necessary to account for the difference in value of a benefit or cost in the present and a benefit or cost in the future. To account for this temporal difference in value, economists apply a discount rate to future costs and benefits to express their value in present terms. Lower discount rates place a relatively higher value on future benefits and costs, whereas higher discount rates place a relatively lower value on future benefits and costs. Economists attempt to select discount rates appropriate to the type of decision being evaluated by the BCA; however, economists often disagree on the appropriate discount rates to use. Some of the disagreement derives from differences of opinion on the extent to which the discount rate should account for society's preference for consumption today versus the future, limitations on the availability of capital, concern about government spending "crowding out" private investment, and other risks and uncertainties.

Some discount rates are calculated to reflect the next-best use of capital, which is known as the opportunity cost of capital. Others are meant to represent the rate needed to induce people to defer an additional unit of current consumption, which is known as the marginal social rate of time preference (SRTP). The water planning discount rate is largely an SRTP rate. For more on methods for deriving discount rates, see **Appendix A**.

[1] Another prominent use of benefit-cost analyses in federal decisionmaking is its use in the federal rulemaking process. This report does not address BCAs for rulemaking. For more on BCAs in rulemaking, see CRS Report R41974, *Cost-Benefit and Other Analysis Requirements in the Rulemaking Process*, coordinated by Maeve P. Carey.

[2] The term "discount rate" with regard to the Federal Reserve has a different meaning, referring to the interest rate it charges banks for loans. See http://www.federalreserve.gov/monetarypolicy/discountrate.htm.

[3] Although this report focuses on the Corps, the water planning discount rate also is required for the evaluation of water resource projects evaluated by the Bureau of Reclamation (Department of the Interior), the Tennessee Valley Authority, and the Natural Resource Conservation Service (Department of Agriculture). Pursuant to WRDA 1974, the water planning discount rate is calculated annually based on a formula established in S.Doc. 97 from 1962; it was 3.125% in FY2016. The calculation uses the average yield on Treasury securities with 15 years or more remaining to maturity, rounded to the nearest one-eighth of 1% and capped at an annual change of 0.25%.

future costs and benefits are valued using different discount rates. The report then describes how each Corps project has two benefit-cost ratios because of the distinct discount rates applied during project development and during budget development (when the executive branch uses a 7% discount rate). The third section of the report focuses on the water planning discount rate.[4] It discusses the history of the water planning discount rate and technical issues with the rate. A brief conclusion section is provided.

Three appendices provide additional information. **Appendix A** includes a brief discussion of various approaches that economists use to derive a discount rate. **Appendix B** provides additional information on the economic evaluation of water resource projects; it includes information on the categories of benefits and costs included in evaluations, an overview of the evolution of federal planning guidance, and data on the water planning discount rate from 1957 through 2016. **Appendix C** provides a calculation of what the water planning discount rate would have been if it had been adjusted to remove the influence of inflation.

Issues for Congress

Economists often disagree on the appropriate discount rate to use, especially for projects with implications for future generations and those related to natural resource consumption.[5] The discount rate applied can influence which alternative for addressing a water resources problem is deemed most economically efficient and whether a BCA indicates that a project's net benefits justify federal investment. Consequently, Corps BCAs and their underlying assumptions, such as the discount rate, are central to current decisions that will influence the portfolio of federal water resource assets and the accompanying benefits, costs, and risks from these assets for decades to come. The quality and reliability of the BCAs shape the quality of decisionmaking and the efficacy of the federal and nonfederal spending on federal water resource projects.

Today, Congress is faced with more demand for Corps projects than the agency can deliver at recent funding levels. Whereas the Corps uses the water planning discount rate for project planning, in recent years, the executive branch has chosen to use a different discount rate when selecting Corps construction projects to include in its annual budget request. Since the mid-2000s, the executive branch's approach to budgeting, known as performance-based budgeting, has focused its funding requests on a limited set of projects. The executive branch uses as a principal performance metric for a project's inclusion in its budget request the project's benefit-cost ratio (BCR) calculated with a 7% discount rate (i.e., ratio of the present value of benefits to the present value of costs discounted at 7%). For most water resource projects, which have concentrated up-front costs and benefits accruing over decades, the 7% discount rate results in a lower BCR than the BCR that was calculated in the planning process using lower water planning discount rates. Projects with BCRs less than 2.5 (calculated at a 7% discount rate) are largely excluded. An issue for Congress and nonfederal project sponsors is the uncertain prospects for construction for the

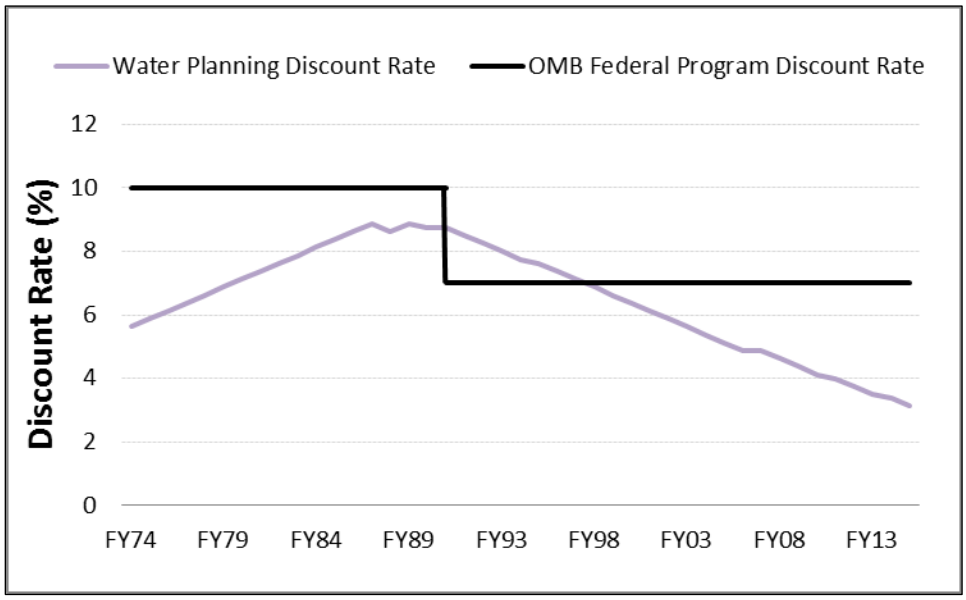
[4] This report is largely focused on Corps discount rate issues. Other factors may affect the quality of the economic information used in Corps BCAs. For example, the federal government does not systematically perform analyses of Corps projects after their construction and during their operations in order to derive lessons for improving future estimates of benefits and costs. That is, there are no ex-post analysis requirements for Corps projects. The Corps has adopted some sensitivity analysis for cost and schedule risk; it is unclear the robustness of implementation of these sensitivity analyses and to what extent sensitivity analyses have been adopted for estimating benefits. These issues, however, are beyond the scope of this report.

[5] Intergovernmental Panel on Climate Change, "Working Group II: Impacts, Adaptation and Vulnerability," 2001, at http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=65, referred hereinafter as IPCC Working Group II.

suite of congressionally authorized projects that do not meet the executive branch's BCR threshold.[6]

The use of a 7% discount rate for executive branch budgeting for the Corps is consistent with general guidance from the Office of Management and Budget (OMB) for discounting federal programs; this guidance is elaborated in Circular A-94.[7] Since 1992, OMB has recommended a 7% discount rate (referred to herein as the OMB federal program discount rate) for BCAs of most federal programs.[8] Prior to 1992, OMB had recommended a 10% discount rate. The OMB federal program discount rate is intended to reflect the pretax rate of return on capital in the private sector.[9] There has been no adjustment in the rate since 1992. **Figure 1** shows the two discount rates, the OMB federal program discount rate and the water planning discount rate (as calculated annually by formula) over more than four decades. Since the late 1990s, the water planning discount rate has been below the OMB federal program discount rate.

Figure 1. Water Planning Discount Rate and Office of Management and Budget (OMB) Federal Program Discount Rate, FY1974-FY2016



Source: Congressional Research Service (CRS) using data for the Water Planning Discount Rate from Bruce D. Carlson, Deputy Chief, Planning and Policy Division of the U.S. Army Corps of Engineers, "Economic Guidance Memorandum 16-01: Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2016,"

[6] The application of distinct discount rates to the same Corps project has increased concerns about a disconnect between the Corps project authorization and Corps budget development processes. For more information, see minute 59 of U.S. Congress, House Committee on Transportation and Infrastructure, Subcommittee on Water Resources and Environment, *A Review of Recently Completed United States Army Corps of Engineers Chief's Reports*, 114th Cong., 2nd sess., May 17, 2016, at http://transportation.house.gov/calendar/eventsingle.aspx?EventID=400199.

[7] Office of Management and Budget (OMB), "Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Program," Transmittal Memo No. 64, Oct. 29, 1992, at https://www.whitehouse.gov/omb/circulars_a094/. Hereinafter referred to as Circular A-94.

[8] Ibid.

[9] Circular A-94 states: "This rate approximates the marginal pretax rate of return on an average investment in the private sector in recent years. Significant changes in this rate will be reflected in future updates of this Circular." For more on the OMB federal program discount rate and the theoretical foundations of various approaches to discounting, see **Appendix A**.

October 14, 2015, at http://planning.usace.army.mil/toolbox/library/EGMs/EGM16-01.pdf (hereinafter referred to as Carlson, 2015) and OMB Federal Program Discount Rate from Circular A-94.

Although there are no current proposals to alter the water planning discount rate, there are long-standing criticisms of the rate. Critics of the water planning discount rate have argued that a discount rate based on private capital returns (such as the OMB federal program discount rate) would be more appropriate than a Treasury-based rate.[10] Economists have also criticized the Corps for its application of a nominal discount rate (i.e., the water planning discount rate includes inflation) to real values for benefits and costs, which do not include the influence of inflation. They suggest that the Corps should either measure benefits and costs in nominal terms and continue to discount using the nominal rate or continue measuring benefits and costs in real values but alter the water planning discount rate to make it a real rate (see **Appendix C**).[11] Supporters of a lower discount rate for Corps projects argue that lower discount rates are appropriate for planning public projects with longer lifetimes.[12] Other stakeholders are concerned about the water planning discount rate's role in the Corps project development process and how a number of aspects of Corps BCA may favor certain project alternatives over others.

For many Corps stakeholders, the current interest in the water planning discount rate is less a function of these long-standing debates and more part of the concern about the uncertain construction funding prospects for congressionally authorized projects that are below the BCR (at 7% discount rate) threshold used by the executive branch. Although these projects have brought attention to the water planning discount rate, actions to effectively address the funding challenges facing the universe of congressionally authorized Corps projects may reach well beyond adjustments to either the water planning discount rate or the budgeting discount rate.

Primer on the Corps and Economic Analyses of Proposed Corps Projects

The U.S. Army Corps of Engineers is an agency within the Department of Defense that has both civil and military programs. Under its civil works mission, the Corps evaluates, plans, and implements water projects in three major areas: navigation, flood risk reduction, and aquatic environmental restoration. For more on Corps programs, see CRS Report R41243, *Army Corps of Engineers: Water Resource Authorizations, Appropriations, and Activities*, by Nicole T. Carter and Charles V. Stern.

Corps Project Development and Implementation Process

The standard process for developing a Corps project consists of the following steps:

- Congressional study authorization is obtained for the Corps to study the water resource problem.
- The Corps performs a feasibility study if funds are appropriated.

[10] Richard O. Zerbe Jr., *What Should Be the Return On Public-Sector Investment*, Cato Institute, Washington, DC, 2013, http://object.cato.org/sites/cato.org/files/serials/files/regulation/2014/1/regulation-v36n4-3.pdf. Hereinafter referred to as Zerbe 2013. There are alternative methods to derive discount rates that fall between the water planning discount rate and the OMB federal program discount rate. These include the shadow price of capital or the weighted average method. See **Appendix A** for more information.

[11] Richard O. Zerbe et al., "A History of Discount Rates and Their Use by Government Agencies," October 2002, p. 7.

[12] IPCC Working Group II.

- Congressional construction authorization is recommended by the executive branch if the feasibility study is favorable.
- Congress authorizes construction of the project in legislation.
- The Corps constructs the project if funds are appropriated.

The process is not automatic. Appropriations are required to perform studies and to undertake construction; that is, congressional study and construction authorizations are necessary but alone are insufficient for the Corps to study and construct a project. For most types of projects, the Corps also is required by law to have a nonfederal sponsor share the study and construction costs. Nonfederal sponsors generally are state, tribal, county, or local agencies or governments.

The objective of a Corps feasibility study is to formulate and recommend solutions to the identified water resources problem. During the first few months of a feasibility study, the Corps formulates alternative plans, investigates engineering feasibility, conducts BCAs, and assesses environmental impacts under the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. §4321). An important outcome of the feasibility analysis is a determination of whether the project warrants further federal investment. For projects that are largely designed to produce economic benefits, such as flood damage reduction projects and navigation projects, the identification of a federal interest and the selection of the alternative to recommend for construction are often determined by the results of the BCA. Once a preferred alternative has been selected, the recommendation for congressional authorization is often based on whether the benefits exceed the costs.

Once the final feasibility report is available, the Chief of Engineers signs a recommendation on the project, known as the Chief's Report or Chief of Engineers report. The Corps submits the completed Chief of Engineers report and the accompanying feasibility report to the congressional authorizing committees (33 U.S.C. §2282a) and also transmits the Chief's Report to the Assistant Secretary of the Army (Civil Works) and to OMB to review the report and recommendation for consistency with the Administration's policies.

Corps Benefit-Cost Analyses

Congress established federal policy for evaluating Corps projects in the Flood Control Act of 1936 (49 Stat. 1570) by stating that a project should be undertaken "if the benefits to whomsoever they may accrue are in excess of the estimated costs" and if a project is needed to improve the lives and security of the people.[13] Since then, executive branch and Corps guidelines have narrowed this evaluation to focus on specific categories of benefits and costs.[14] The Corps calculates whether a project's National Economic Development (NED) benefits outweigh its NED costs benefit discounted using the water planning discount rate. Since 1983, the planning objective for Corps projects has been to increase net National Economic Development benefits (i.e., to develop and recommend the alternative that provides the greatest cumulative net benefit discounted using the water planning discount rate).

[13] Flood Control Act of June 22, 1936, ch. 688, 49 Stat. 1570 (33 U.S.C. §701).

[14] As of mid-2016, the Corps follows the executive branch's 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Principles and Guidelines, or P&G) for its water project evaluations. The Corps also has agency-specific guidelines for how to implement the P&G. Under the P&G, the objective of Corps projects is to increase National Economic Development benefits. For more on the evolution of water planning guidance and Corps BCAs, see **Appendix B**.

- NED benefits include increases in national output of goods and services, such as increased recreation or decreased flood damage.
- NED costs include the direct costs of constructing the project as well as indirect costs associated with the project, such as costs of displaced resources, reduced economic output, and negative externalities.[15]

The Corps typically calculates benefits and costs in *real* dollars (i.e., the Corps does not include in its estimates the potential impacts of inflation on benefits and costs) over a period of 50 years.[16] (For more on the difference between *nominal* and *real* values, see "Nominal and Real Values: Accounting for Inflation" box.)

After measuring NED benefits and NED costs, the Corps applies the water planning discount rate to express the value of future benefits and costs in terms of present dollars. That is, the discount rate is used to assign future benefits and costs a *present value.* At this stage, the Corps subtracts the present value of costs from the present value of benefits to calculate the net present value of each of the alternatives analyzed. If the present value of benefits is not in excess of the present value of costs, the executive branch does not recommend congressional authorization for proceeding with the project.[17]

BCAs are necessarily based on assumptions and decisions on the inclusion (or exclusion) of categories of impacts, the value of environmental benefits in monetary terms, the weighting of future benefits and costs, and projections of future economic conditions and environmental parameters (e.g., flood frequencies). Environmental benefits and environmental costs, such as the economic value of a restored or damaged wetland, respectively, are particularly challenging to monetize and typically have not been included in the Corps' economic evaluations of project alternatives.[18] **Appendix B** includes additional detail on BCA procedures.

Because of the discount rate's influence, higher discount rates are sometimes viewed as more appropriate when evaluating the benefits and costs for projects with shorter lifetimes. Lower discount rates may be appropriate for investments that are to be judged over longer periods of time, particularly those that affect future generations.[19] These lower discount rates, however, are

[15] The Corps guidance defines a negative externalities as "the costs or damages of a transaction or decision imposed on someone other than the parties to the transaction, without corresponding compensation being paid by those who generate the externality" (U.S. Army Corps of Engineers, Institute for Water Resources. *National Economic Development Procedures Manual-National Economic Development Costs*, Report 93-R-12, June 1993; hereinafter referred to as Corps NED Manual – Costs 1993). An example is that a flood damage reduction project upstream inadvertently may increase the flooding experienced downstream.

[16] According to executive branch guidance, the period of analysis is to be the time required for implementation plus the lesser of (1) the period of time over which any alternative plan would have significant beneficial or adverse effects or (2) a period not to exceed 100 years (Principles and Guidelines). A discussion of the selection of a period of analysis is beyond the scope of this report.

[17] Under the P&G, the executive branch generally recommends the project alternative that maximizes NED for congressional authorization; for more on this, see **Appendix B**. For projects that have primarily environmental benefits such as aquatic ecosystem restoration, the Corps pursuant to congressional direction (33 U.S.C. §2284) assumes that the benefits exceed the costs. The Corps applies other efficiency metrics for these projects and applies different metrics for identifying the alternative to recommend for congressional authorization. The Corps uses the concept of national ecosystem restoration (NER) benefits for evaluating these projects. NER outputs are increases in the net quantity and/or quality of desired ecosystem resources. Multipurpose project alternatives that include both economic and ecosystem restoration components are to use and make trade-offs across the NED and NER contributions. For more details, see U.S. Army Corps of Engineers, *Planning Guidance Notebook*, Engineer Regulation 1105-2-100, April 22, 2000.

[18] For more information on the Corps' project evaluation process, see **Appendix B**.

[19] The national governments of France and the United Kingdom prescribe discount rates that decline over time for long-lived public investments. For discussions of issues in determining discount rates, see Cropper, Maureen. "How Should

not considered to be based on observed economic behavior in private markets.[20] Private investors often give strong preference to near-term returns. Thus, the debate over the discount rate for federal water resource projects is at its core about the relative importance of near-term versus long-term benefits and the opportunity cost of funding these projects.

Nominal and Real Values: Accounting for Inflation

Because Corps projects are evaluated over an extended period of time, often 50 years, economists must decide how to account for inflation. *Inflation* is defined as a general increase in prices and a fall in the purchasing value of money. Due to inflation, the value of $1 today is under normal circumstance worth more than the value of $1 next year. Values for a future costs and benefits can be expressed in *nominal* or *real* dollars.

- Nominal value includes the influence of inflation.
- Real (or constant-dollar) values are absent the influence of inflation; a real value is simply the nominal price adjusted to remove the influence of inflation.

Nominal prices often measure the value of something in terms of the current year's prices, whereas real prices measure the value of something in terms of the value of a dollar in a chosen base year. For purposes of benefit-cost analyses, nominal and real values should generally not be combined in an analysis. That is, a nominal discount rate should be used with nominal values and a real discount rate should be used with real values.

The BCA procedures and discount rate used for federal water resource projects are relevant to federal investment decisions for new projects that the federal government builds, owns, and operates (e.g., navigation improvements) and for new projects that the federal government constructs, then turns over to others to operate and maintain (e.g., levees for flood risk reduction). They also are used to evaluate investments in the repair, rehabilitation, and replacement of aging federal water resources that the federal government owns and operates.[21] Congressional authorization of Corps projects can illustrate the relevance of BCA procedures and discount rates to current federal decisionmaking. Congress authorized in the Water Resources Reform and Development Act of 2014 (WRRDA 2014; P.L. 113-121, enacted June 2014) 22 construction projects at a total real cost of $18.53 billion ($11.33 billion federal, $7.20 billion nonfederal) based on Corps feasibility studies that incorporate the economic evaluations using the legally prescribed water planning discount rate.[22] As of early August 2016, the Chief of Engineers had completed Chief's Reports with favorable construction recommendations for an additional 22

Benefits and Costs Be Discounted in an Intergenerational Context? The Views of an Expert Panel," *Resources for the Future*, June 14, 2013, at http://www.rff.org/research/publications/how-should-benefits-and-costs-be-discounted-intergenerational-context-views; Bruce Flory, *Updating the Discount Rate Used for Benefit-Cost Analysis at Seattle Public Utilities*, Municipal Research and Services Center, at http://mrsc.org/getmedia/9d05a8d7-b36d-4af4-8e1c-94491c351bb0/s42discrate.pdf.aspx.

[20] L. H. Goulder and R. C. Williams, III, "The Choice of Discount Rate for Climate Change Policy Evaluation," Resources for the Future, Sept. 2012, at http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-12-43.pdf.

[21] The federal government owns roughly $300 billion in water resources infrastructure assets (measured using replacement value) based on 2012 data from the Federal Real Property Profile. Roughly 80% of these assets (by value) are owned by either the Corps or the Bureau of Reclamation. Other agencies own the remaining 20% of these assets. The federal water resources assets are distributed by use as follows: 25% for flood control and river navigation, 25% for coastal navigation and harbors, 25% for reclamation and irrigation, and 25% for hydropower.

[22] WRRDA 2014 authorized 34 construction projects at a total cost of $25.65 billion ($15.64 billion federal, $10.01 billion nonfederal). Twelve of these projects had significant environmental purposes and have been excluded from the figures cited in the paragraph. As discussed in footnote 17, environmental and ecosystem restoration projects are not subjected to the same economic evaluation procedures as other Corps projects. While some of the WRRDA 2014-authorized projects had high BCRs (e.g., Topeka, Kansas flood risk reduction project had a BCR of 13.2 at a 4.625% discount rate as shown in **Table 1**), others had BCRs below 2. For example, the Fargo-Moorhead, ND & MN flood risk reduction project had a 1.8 BCR at a 4.000% discount rate, and the Jacksonville Harbor navigation improvements had a 1.4 BCR at 4.000%, and the Sabine-Neches Waterway, TX navigation project had a1.3 BCR at 4.125% discount rate.

projects at a total cost of $8.8 billion ($5.44 billion federal, $3.39 billion nonfederal) for congressional authorization.[23]

Discount Rate Impact on Benefit-Cost Ratios

The discount rate used can impact how attractive a Corps project appears in a BCA and may affect which project alternative appears to be the most economically efficient solution to a water resources problem. Pursuant to executive branch planning guidance for Corps feasibility studies, the Corps evaluates a variety of alternatives. For example, for a coastal storm damage reduction project, the alternatives considered may include using structural solutions (e.g., seawalls and storm surge gates), buyouts of vulnerable properties, and regularly nourished dunes and beaches. These alternatives may have significantly different temporal distributions of benefits and costs. Structural solutions generally have (1) significant up-front costs, (2) benefits for the useful life of the project (up to the point when the structures are overwhelmed by a large enough storm), and (3) operations, maintenance, rehabilitation, and eventual replacement costs) benefits. Buyouts generally have (1) concentrated up-front cost to acquire the properties, (2) long-term flood damage reduction benefits, and (3) low operations and maintenance and rehabilitation costs; however, some of the current use of the acquired properties has been foregone. Regularly nourished dunes and beaches generally have (1) lower up-front costs, (2) more ongoing costs associated with the renourishment, and (3) long-term benefits (until the dunes and beaches are overwhelmed by a large enough storm).[24] Because of these variations in the timing of benefits and costs, the discount rate selected can significantly affect alternatives' economic evaluations, including the calculation of their net national economic development benefits and their BCRs.

In particular, the BCRs calculated may vary significantly for projects and project alternatives with benefits and costs that are unevenly distributed throughout the period of analysis. That is, water project alternatives with high construction costs in the present, low maintenance costs in the future, and benefits distributed across the lifetime of the project are highly affected by the discount rate used. BCRs for this type of project alternative are higher at lower discount rates and lower at higher discount rates. Water projects that may fall into this category include dams, levees, and floodwalls, as well as many navigation improvements. In contrast, BCRs for project alternatives with both costs and benefits fairly evenly dispersed throughout their lifetimes are less affected by the discount rate applied. These projects may include coastal storm damage reduction projects with significant sand renourishment episodes and navigation projects with maintenance dredging requirements. See "Impact of Discount Rate on Benefit-Cost Ratios" for an illustration of the impact of different discount rates on different kinds of projects.

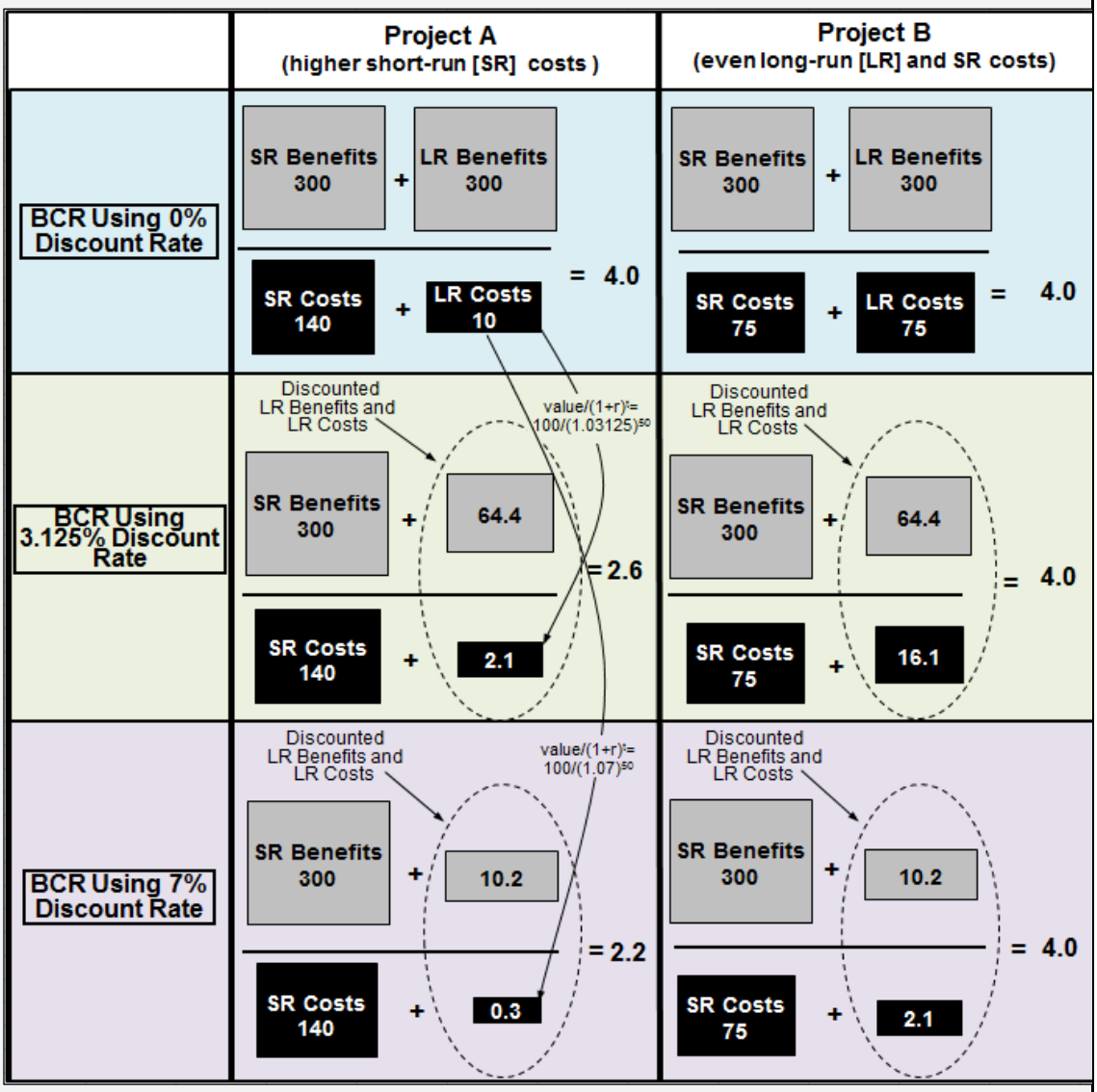
Impact of Discount Rate on Benefit-Cost Ratios

The illustration below shows how the discount rate affects two projects with the same distribution of benefits but different distributions of costs over the projects' useful lives. For simplicity, benefits and costs are assumed to occur in two time periods: year 1 (the short run, or SR) and year 50 (the long run, or LR). The 0% discount rate (no discounting) assigns the same weight to short-run values and long-run values, while the 3.125% and 7% discount rates assign less weight to the LR values. Project A has higher short-run costs and lower long-run costs, and its benefits are evenly distributed. For Project A, the discount rate used notably affects the project's BCR. Discount rate selection has less of an impact on projects with benefits and costs more evenly distributed throughout the period of analysis, as shown by Project B.

[23] An additional six projects with completed Chief's Reports that have significant environmental purposes are not excluded from these estimates.

[24] These alternatives also have different environmental impacts and associated residual flood risks from project failure and the project being overwhelmed by a storm.

Figure 2. Discount Rate Effect on Benefit-Cost Ratios (BCRs) of Projects with Different Distributions of Benefits and Costs



Source: CRS.

Illustration of Discount Rate Impact on Economic Evaluation of Corps Projects

Two projects that the Corps formulated that have contrasting cost streams illustrate the impacts of the discount rate. The first project on the Cedar River, Cedar Rapids, IA, is a traditional flood risk reduction project using levees and floodwalls to manage riverine flood risks. The project's costs are largely concentrated in the first five years, whereas the project's benefits are distributed across its 50-year design life. The second project illustrated is a coastal storm damage reduction project that uses engineered dunes and regularly renourishes the dunes and adjacent beaches with sand. This project is the Hereford Inlet to Cape May Inlet Coastal Storm Damage Reduction Project.

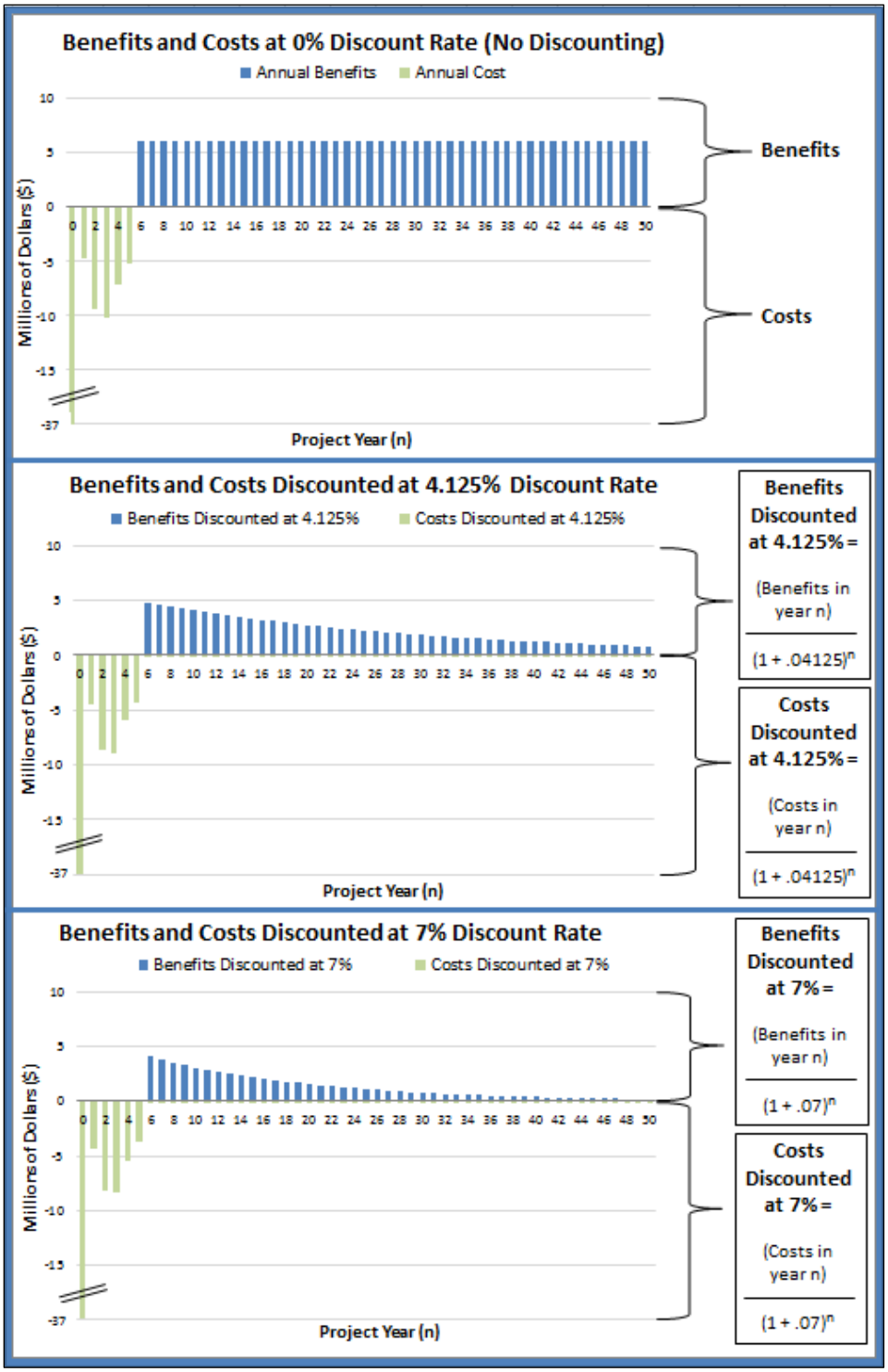
Both the project costs and the project benefits are distributed across the 50-year design life of the project. The discount rates used in the discussion below are the water planning discount rates that the Corps applied to evaluate the feasibility of each of these projects and the OMB federal program discount rate of 7%.

Figure 3 shows the Corps' benefit and cost estimates for the preferred alternative for the Cedar River, Cedar Rapids project, which consists of a 2.2-mile floodwall and a 0.8-mile earthen levee. The figure shows the Corps' estimated benefits and costs for the project with no discounting, discounted at 4.125%, and discounted at 7%. The Corps estimated that this project alternative would require a five-year construction period, with benefits accruing upon completion through the project's useful life. The estimates for benefits and costs that have not been discounted (discount rate = 0%) illustrate the high construction costs of the project during the first five years, followed by constant annual benefits thereafter. The Corps discounted the benefits and costs with a 4.125% discount rate, which was the water planning discount rate in 2011 when the project was evaluated. Discounting at 4.125% reduces the present value of future project benefits, as shown in **Figure 3**. **Figure 3** also shows that discounting using a 7% discount rate leads to lower estimates for the present value of future project benefits.

Because the project's costs largely would be concentrated in the 5-year construction period but its benefits would accrue over 50 years, the discount rate used strongly influences the discounted cumulative net benefit for the project and the BCR, as shown in **Figure 4** and **Figure 5**, respectively. **Figure 4** shows the evolution of the project's cumulative net benefits discounted at 4.125% and at 7%. At the end of the 50-year period of analysis, the cumulative net benefit was $32.24 million at a 4.125% discount rate. At a discount rate of 4.125%, the Cedar River, Cedar Rapids project would break even (where cumulative net benefits equal zero) in year 26. In contrast, at a 7% discount rate, the project was not found to have a cumulative net benefit. Instead, the discounted project costs were estimated to exceed the project's discounted benefits by $7.32 million. At a discount rate of 7%, the project would not break even during the 50-year period of analysis.[25]

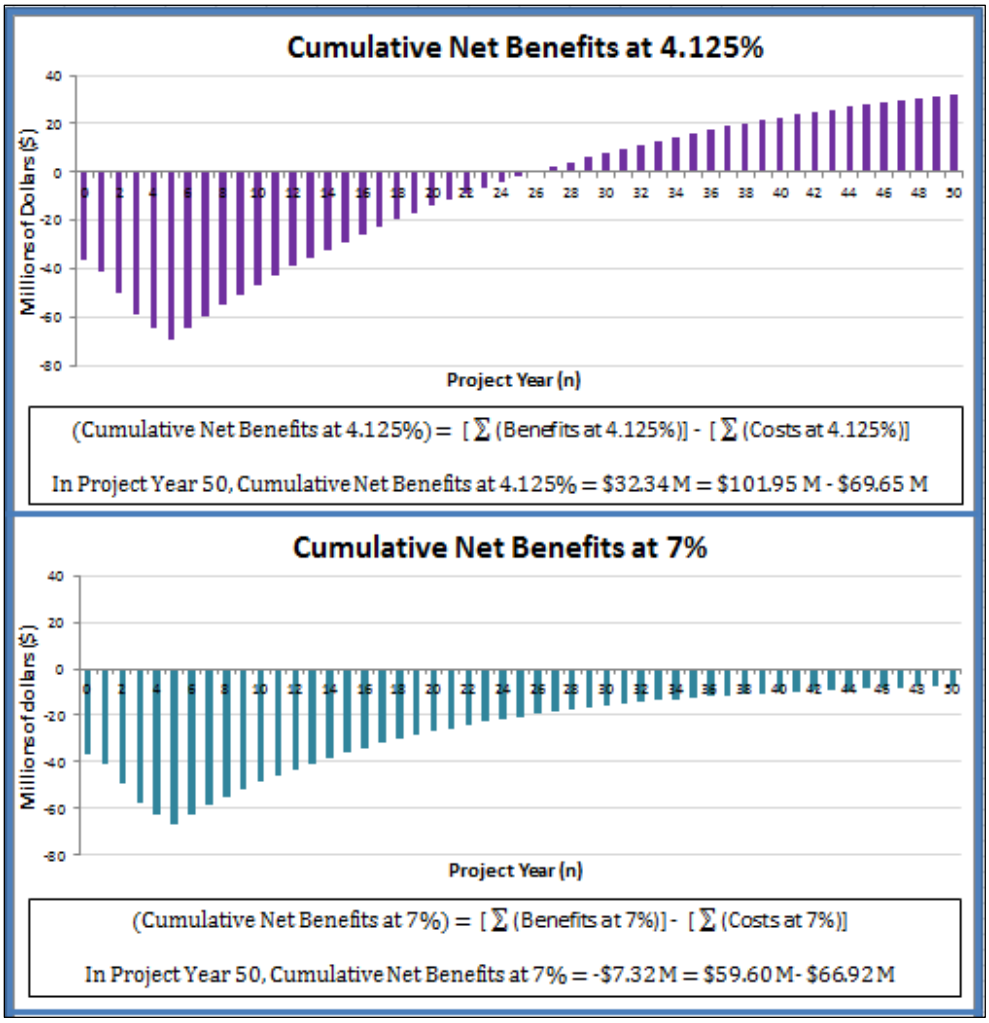
[25] At a 0% discount rate (no discounting), the cumulative net benefits in year 50 equal $201.77 million, and the project breaks even in year 17.

Figure 3. Effect of Discounting on Benefits and Costs of Cedar River, Cedar Rapids Flood Risk Reduction Project



Source: CRS using data from U.S. Army Corps of Engineers, "Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study Report with Integrated Environmental Assessment: Report Summary for Civil Works Review Board," November 18, 2010, at http://www.usace.army.mil/Portals/2/docs/civilworks/CWRB/cedar/cedar_proj_summary.pdf.

Figure 4. Effect of Discounting on Cumulative Net Benefits of Cedar River, Cedar Rapids Flood Risk Reduction Project

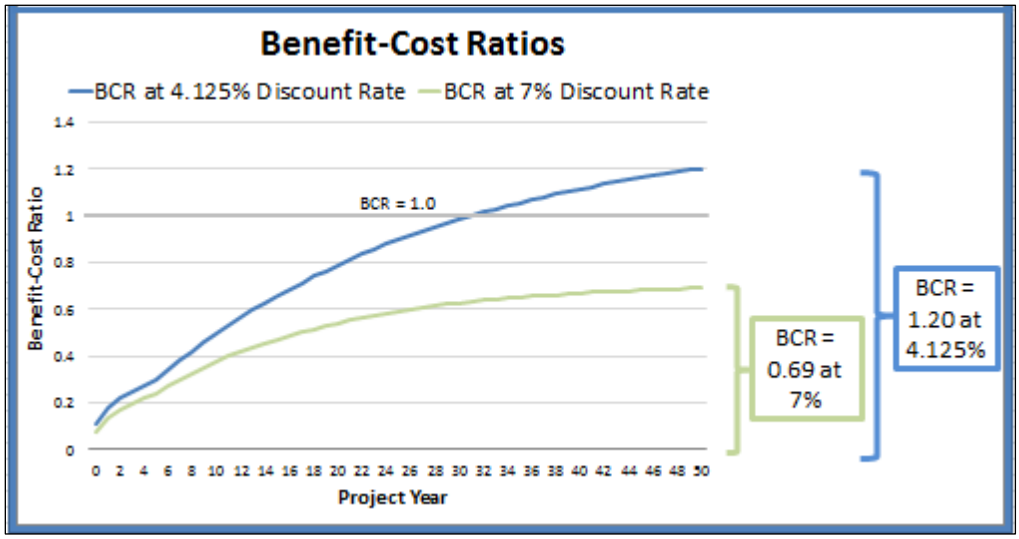


Source: CRS using data from U.S. Army Corps of Engineers, "Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study Report with Integrated Environmental Assessment: Report Summary for Civil Works Review Board," November 18, 2010, at http://www.usace.army.mil/Portals/2/docs/civilworks/CWRB/cedar/cedar_proj_summary.pdf.

Note: M = millions.

BCRs are calculated by dividing cumulative discounted benefits by cumulative discounted costs. Due to the distribution of benefits and costs for this project, increasing the discount rate from 4.125% to 7% would change the BCR from 1.2 to 0.69 in project year 50, as shown in **Figure 5**.

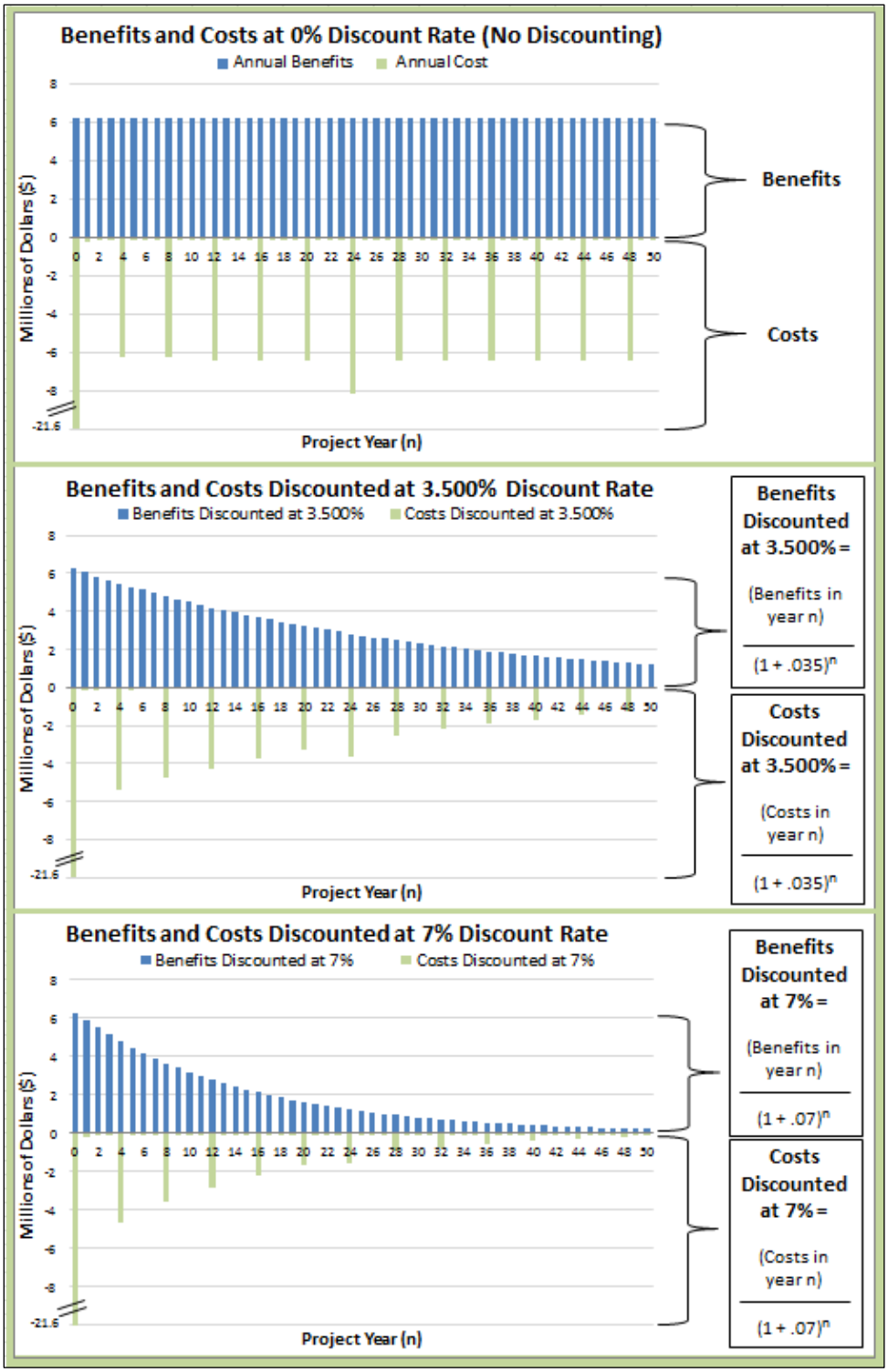
Figure 5. Effect of Discount Rates on Benefit-Cost Ratios (BCRs) of Cedar River, Cedar Rapids Flood Risk Reduction Project



Source: CRS using data from U.S. Army Corps of Engineers, "Cedar River Cedar Rapids, Iowa Flood Risk Management Feasibility Study Report with Integrated Environmental Assessment: Report Summary for Civil Works Review Board," November 18, 2010, at http://www.usace.army.mil/Portals/2/docs/civilworks/CWRB/cedar/cedar_proj_summary.pdf.

Figure 6 illustrates a less common distribution of costs for a water resource project in which both costs and benefits are fairly evenly dispersed throughout the lifetime of the project. The Hereford Inlet to Cape May Inlet Coastal Storm Damage Reduction Project consists of the construction of a dune and berm, which largely rely on regular beach nourishment activities to reduce coastal storm damages. As **Figure 6** shows, the discount rates reduce the present value on not only the benefits but also the project's costs; the impact of the discounting on the project's costs (which are in the early years of the period of analysis) is less than the impact of discounting on the benefits derived from the project in later years.

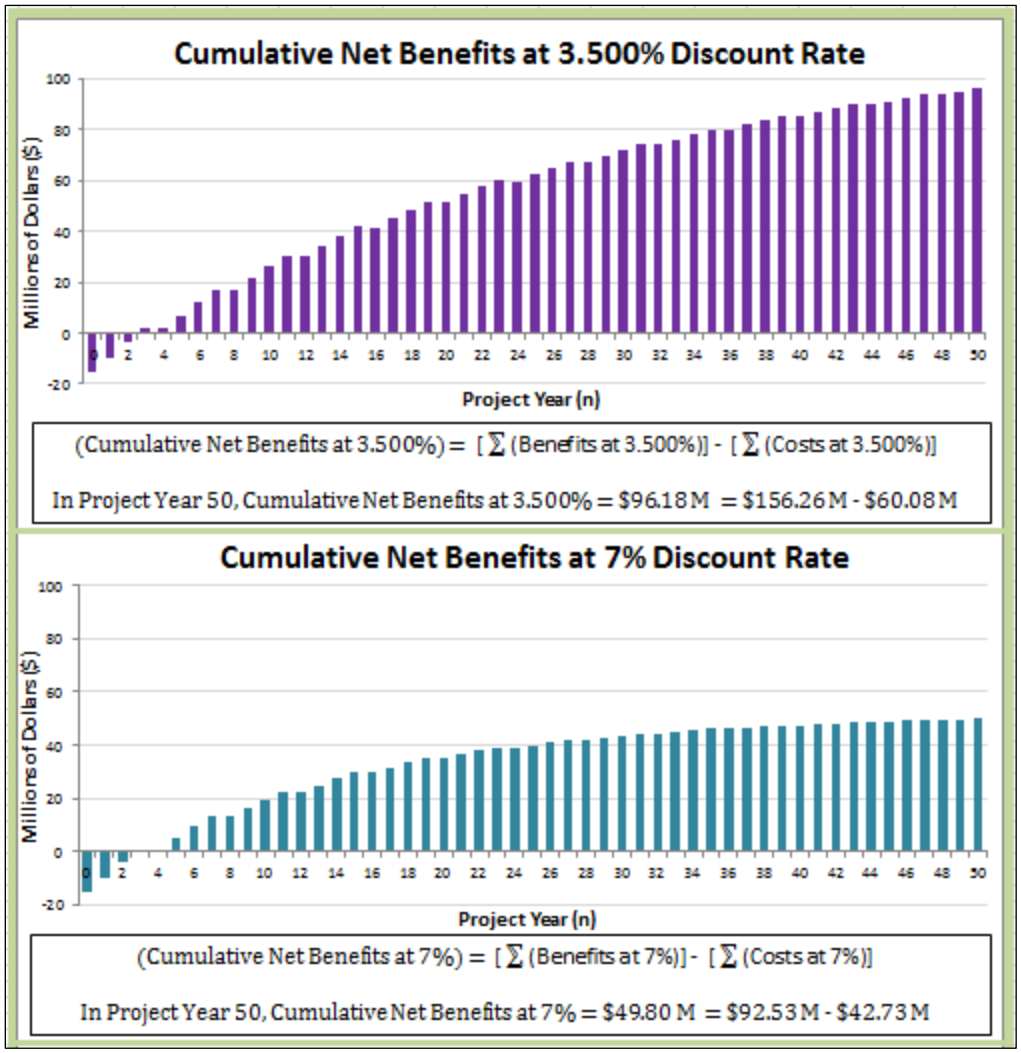
Figure 6. Effect of Discounting on Benefits and Costs of Hereford Inlet to Cape May Coastal Storm Damage Reduction Project



Source: CRS using data from U.S. Army Corps of Engineers, *Hereford Inlet to Cape May Inlet: Final Feasibility Report and Integrated Environmental Assessment*, April 28, 2014, at http://www.nap.usace.army.mil/Portals/39/docs/Civil/Hereford_to_CapeMay/Volume_I_Hereford_FINAL.pdf.

Because both costs and benefits are fairly evenly dispersed throughout the project's 50-year design life, the discount rate used has less of an impact on the year in which the project would break even than in the Cedar River, Cedar Rapids example. As shown in **Figure 7**, the Hereford Inlet to Cape May project would break even around year three at a discount rate of 3.500% and at a discount rate of 7.0%. The two discount rates did produce different estimates of the project's cumulative net benefit. The net benefit of the project was $96.18 million at 3.500%; it was $49.80 million at 7%.[26]

Figure 7. Effect of Discounting on Cumulative Net Benefits of Hereford Inlet to Cape May Coastal Storm Damage Reduction Project



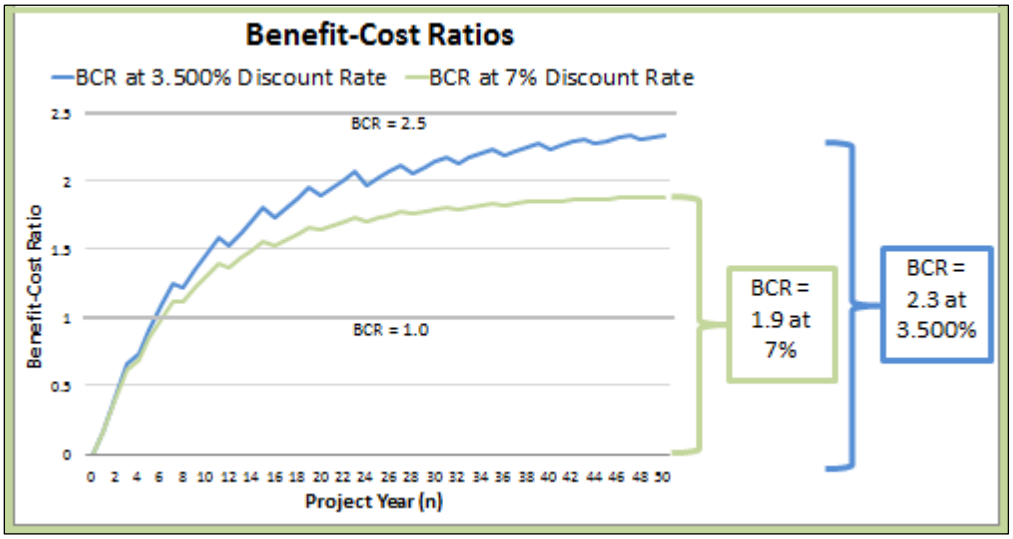
Source: CRS using data from U.S. Army Corps of Engineers, *Hereford Inlet to Cape May Inlet: Final Feasibility Report and Integrated Environmental Assessment*, April 28, 2014, at http://www.nap.usace.army.mil/Portals/39/docs/Civil/Hereford_to_CapeMay/Volume_I_Hereford_FINAL.pdf.

Note: M = millions.

[26] At a 0% discount rate, the cumulative net benefits equal $214.83 in year 50, and the project breaks even in year 4.

Changing the discount rate also has a lesser effect on the BCR for the Hereford Inlet to Cape May project than in the Cedar River, Cedar Rapids example due to the more even distribution of the coastal project's benefits and costs. Raising the discount rate from 3.5% to 7.0% changed the coastal project's BCR from 2.3 to 1.9, as shown in **Figure 8**.[27]

Figure 8. Effect of Discounting on Benefit-Cost Ratios (BCRs) of Hereford Inlet to Cape May Coastal Storm Damage Reduction Project



Source: CRS using data from U.S. Army Corps of Engineers, *Hereford Inlet to Cape May Inlet: Final Feasibility Report and Integrated Environmental Assessment*, April 28, 2014, at http://www.nap.usace.army.mil/Portals/39/docs/Civil/Hereford_to_CapeMay/Volume_I_Hereford_FINAL.pdf.

Two Benefit-Cost Ratios for Each Corps Project

For a selected set of Corps projects, **Table 1** shows the discount rates and BCRs from the Corps' feasibility studies that were used to inform Congress's decision to authorize the project; the table also shows a second BCR for the same projects based on the 7% discount rate. As illustrated by the table, a benefit of applying a single discount rate to all projects is that doing so can facilitate a comparison or ranking across a suite of authorized projects. The executive branch uses BCRs all calculated with the same discount rate to inform its identification of projects to fund from a pool of authorized projects. As shown in **Table 1**, the universe of authorized Corps projects is challenging to compare using the BCRs used for congressional authorization because the project BCAs were calculated in different years and do not share a common discount rate. For example, the Brays Bayou, TX, project was developed using a 7.625% discount rate, which was the rate in effect in 1988. In 2015, the Corps analyzed the Hereford Inlet to Cape May project at a 3.375% discount rate. The discount rates for these two projects were 4.250% apart.

Although the use of the 7% discount rate provides a common baseline for Corps project construction budgeting, the executive branch is applying a 7% discount rate to projects for which the preferred alternative was selected using the water planning discount rate. As previously noted, the discount rate used during the planning process can influence the relative attractiveness of different approaches to address a water resource problem, and the preferred alternative for a

[27] In recent years, the Obama Administration's standard for inclusion of a Corps construction project in the President's budget is usually a BCR at 7% equal to or greater than 2.5, exceptions are made especially for projects addressing life safety concerns. The BCR threshold is not used for applied to aquatic ecosystem restoration projects.

federal water project is identified using the water planning discount rate. In most cases, Congress then authorizes the agency to proceed with that preferred alternative. However during the executive branch's budget development, a 7% discount rate is then applied to projects that were evaluated and authorized using a different discount rate. Hypothetically, if a project had been evaluated with a 7% discount rate, the executive branch could have recommended and Congress could have authorized a different preferred alternative for the project. The result is that one set of assumptions are used to evaluate and select the preferred alternative for Corps projects; a different set of assumptions then are applied to the authorized projects.

Table 1. Benefit-Cost Ratios (BCRs) Using Water Planning Discount Rate and 7% Discount Rate

Project Name, State	Authorization		Budget Request BCR at 7% Discount Rate
	Water Planning Discount Rate	Planning BCR	
Topeka, KS	4.625%	13.2	9.1
Texas City Channel, TX	4.875%	8.5	5.9
Kansas City, MO & KS	5.125%	8.0	5.4
Savannah Harbor, GA	4.000%	5.5	3.3
Wood River Levee, IL	4.875%	3.3	3.1
Alviso Pond Complex, CA	3.375%	5.3	3.0
Brays Bayou, TX	7.625%	3.0	2.2
Hereford Inlet to Cape May, NJ	3.375%	2.3	1.9
Folsom Dam Raise, CA	6.875%	3.4	1.8
Muddy River, MA	5.875%	3.2	1.8
Yuba River Basin, CA	4.125%	2.3	1.7
Delaware River Main Channel, NJ, PA, & DE	7.375%	1.4	1.2
East St. Illinois, IL	4.000%	1.7	1.1

Sources: CRS using Army Corps of Engineers, *Fiscal Year 2017 Civil Works Budget of the U.S. Army Corps of Engineers*, February 2016 and *Fiscal Year 2015 Civil Works Budget of the U.S. Army Corps of Engineers*, March 2014.

Note: Projects in the table were selected largely based on inclusion of a project's BCR at a 7% discount rate in the executive branch's budget request documents.

Water Planning Discount Rate

History of the Water Planning Discount Rate

As previously noted, since 1974, the Corps and other federal water resource agencies have evaluated water projects using a discount rate that is calculated using a formula required in law. **Table 2** summarizes the effective dates of the discount rates used for federal water planning.

The table begins with the discount rate formula established for federal water project planning in a 1950 report entitled *Proposed Practices for Economic Analysis of River Basin Projects*.[28] The report became known as the Green Book. Notably, the Green Book and all subsequent planning guidelines used a discount rate formula for water resource projects based on the average interest rate on long-term U.S. Treasury bonds. The Green Book guidelines were initially voluntary; they became mandatory within the executive branch with the Bureau of the Budget's (predecessor to the Office of Management and Budget) publication of Circular A-47.[29]

In Circular A-47, the Bureau of the Budget stated that the discount rate should be "the average rate of interest payable by the Treasury on interest-bearing marketable securities of the United States outstanding at the end of the fiscal year preceding such computation." Furthermore, the choice of which market securities rate to use was based on the economically useful life of the project being evaluated. If the economically useful life of the project was longer than 15 years, then the marketable securities in question were to be those that had original terms to maturity of 15 years or more. When the economically useful life of the project was less than 15 years, the marketable securities in question were to be those that, at the time of original issue, had "terms to maturity not more than 12 months longer or shorter than the economically useful life of the project." Under this formula (as shown in **Table B-1** in **Appendix B**), the water planning discount rate varied from 2.5% in 1957 to 2.625% in 1961 for long-lived water projects.

Table 2. Effective Dates of Guidelines on the Federal Water Planning Discount Rates

Document	Effective Dates
Bureau of the Budget Circular, A-47	12/31/1952- 05/15/1962
Senate Document 97	05/15/1962- 12/24/1968
Water Resources Council	12/24/1968- 10/25/1973
Principles and Standards	10/25/1973- 03/07/1974
§80 of Water Resources Development Act of 1974	03/07/1974- present

Sources: John C. Furry, *A History of Water Resources Policies and Guidance*, U.S. Army Corps of Engineers, Washington, DC, March 3, 2011, using Bureau of the Budget, *Report and budget estimates relating to Federal programs and projects for conservation, development, or use of water and related land resources*, Circular A-47, December 31, 1952; U.S. Congress, Senate, Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources, Senate Document 97, 87th Congress, 2nd session, June 4, 1964; and Principles and Standards from Water Resources Council, "Establishment of Principles and Standards for Planning," 38 *Federal Register*, September 10, 1973.

In 1962, S.Doc. 97 replaced Circular A-47 as the document governing discount rates for federal water projects. This document simplified Circular A-47 by establishing a uniform discount rate. Specifically, S.Doc. 97 dropped the differentiation among projects with different useful lives. Instead, all projects were to use a discount rate calculated as "the average rate of interest payable by the Treasury on interest-bearing marketable securities of the United States outstanding at the end of the fiscal year preceding such computation, which, upon original issue, had terms to

[28] Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs. Proposed Practices for Economic Analysis of River Basin Projects (Washington, DC: May 1950).

[29] Bureau of the Budget, Report and budget estimates relating to Federal programs and projects for conservation, development, or use of water and related land resources, Circular A-47, December 31, 1952, at http://www.jfklibrary.org/Asset-Viewer/Archives/JFKWHSFLCW-013-002.aspx.

maturity of 15 years or more." Under this formula, the discount rate ranged from 2.625% in 1962 to 3.250% in 1968.

In 1968, the Water Resources Council (WRC)[30] changed the discount rate formula from the coupon rate (the interest rate stated on a Treasury bond) to the yield rate on long-term Treasury bonds (the face value divided by the market price).[31] It also revised the guidelines as printed in S.Doc. 97 to cap annual changes in the discount rate. The council's criteria stipulated that the rate could not change by more than 0.25% per year. Under these revisions, the discount rate increased at its maximum annual rate of 0.25% annually from 4.625% in 1969 to 5.625% in 1974.

In October 1973, the WRC issued new regulations known as Principles and Standards (P&S), which altered the discount rate formula to be used for evaluating federal water resource projects.[32] Specifically, the P&S differed from the existing criteria (the 1968 alteration of S.Doc. 97) by basing the rate on securities with an average term of 50 years remaining to maturity, rather than 15 years or more as stipulated by the 1968 revision. The P&S also increased the allowable change in the discount rate to 0.5% per year. However, the P&S only guided the formulation of the discount rate for a matter of months. During this period, the discount rate was 6.875%.

Six months later, section 80 of the Water Resource Development Act of 1974 (WRDA 1974; P.L. 93-251) reinstated the discount rate formula formerly established in S.Doc. 97, as amended by the WRC in 1968. By reverting to the discount rate formula under S.Doc. 97, the 1974 discount rate decreased from 6.875% to 5.625%. Furthermore, the maximum yearly rate change again became 0.25%.

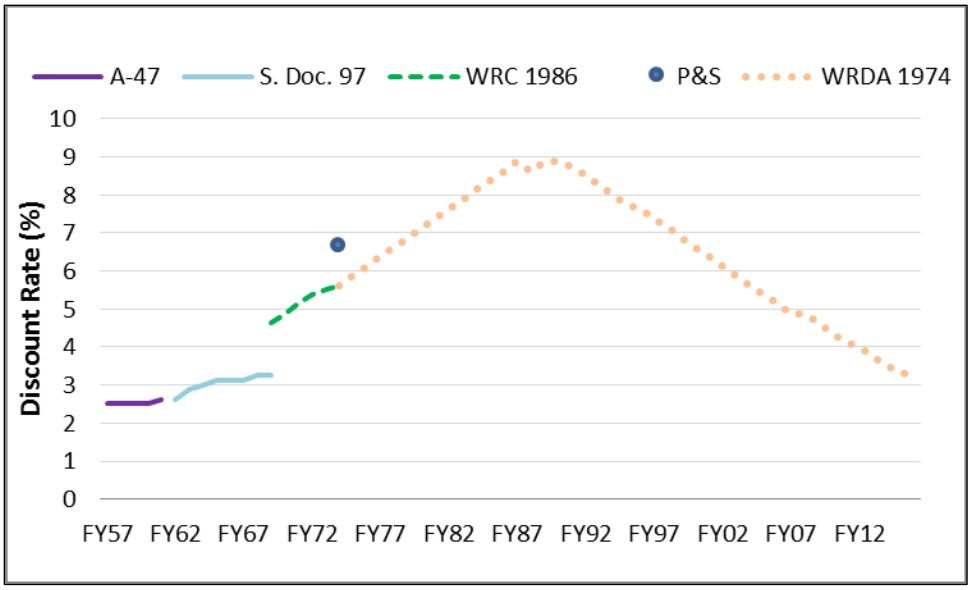
Since 1974, the formulation of the discount rate has remained unchanged. In practice, the rate is the average year yield on government securities with 15 years or more to maturity. **Appendix B** provides the water planning discount rates used from 1957 to 2016. The discount rate increased from 1975 (5.625%) to 1987 (8.875%), then decreased steadily after 1990. In 2016, the rate was 3.125%. **Figure 9** shows the value of the discount rates used from 1957 through 2016.

[30] U.S. water resource agencies largely acted autonomously in proposing project plans until an interagency Water Resources Council was established in 1965 to coordinate federal water programs and policy. The council was created by the Water Resources Planning Act of 1965 (P.L. 89-80, 78 Stat. 245, 42 U.S.C. §1952); it challenged more established institutional decision mechanisms of both executive and legislative branches and was subsequently disbanded in 1983. While the Water Resources Council has been largely inactive since 1983, it was convened as recently as 2014 and 2015 for issuing the Principles and Requirements (see **Appendix B**) and interagency guidance on a federal flood risk management standard.

[31] Depending on whether the bond is selling at a premium or a discount, the coupon rate will be higher or lower than the yield rate.

[32] In 1970, a WRC task force suggested an interest rate based on the social rate of time preference (SRTP). The proposed initial rate was 5.5%. In 1971, the WRC, not the WRC task force, proposed a discount rate of 7%.

Figure 9. Water Planning Discount Rate for Federal Water Project Investments



Source: CRS using data presented in **Appendix B**.

Technical Aspects of and Issues with the Water Planning Discount Rate

Federal water projects are evaluated in accordance with WRDA 1974, using a discount rate that most closely follows the social rate of time preference (SRTP) approach to discounting,[33] except that the water planning discount rate has not been adjusted for taxes. The SRTP approach attempts to reflect the compensation required by society to substitute future consumption for current consumption. Many economists are critical of discount rates based on an SRTP approach because these rates reflect only the resources diverted from consumption and fail to account for the resources diverted from investment. **Appendix A** provides more information on the SRTP and three other approaches for deriving a discount rate.

The specific methods behind the calculation and use of the water planning discount rate could be criticized on several grounds. Particular technical issues include (1) the use of a nominal discount rate to estimate real benefits and real costs, and (2) the effect of the fluctuation cap. These are discussed below. Other technical issues exist, but are beyond the scope of this report; for example, the Corps' valuation and discounting practices do not incorporate the uncertainty associated with future benefits and costs.

Real Dollars and a Nominal Discount Rate

Corps planning guidance calls for the estimation of benefits and costs in real dollars,[34] but WRDA 1974 requires the agency to use a nominal discount rate.[35] Generally, a real discount rate should

[33] As discussed in **Appendix B**, the SRTP approach would use a rate adjusted for taxes (i.e., an after-tax rate); the water planning discount rate is pretax.

[34] The Principles and Guidelines stipulate that the Corps use real dollars.

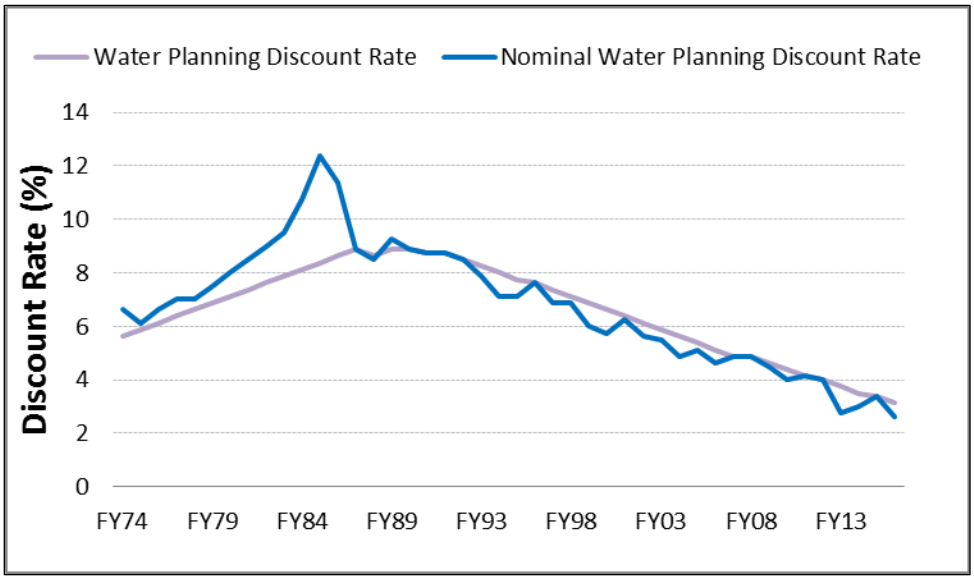
[35] Section 80(a) of WRDA 1974 sets the discount rate formula.

be used to discount real dollars, or a nominal discount rate used to discount nominal dollars.[36] Either alternative will result in approximately the same present value and BCR. However, mixing real estimates for benefits and costs and a nominal discount rate understates the discounted present value. Given the temporal distribution of benefits and costs for many Corps projects (i.e., near-term costs and long-term benefits), the use of real estimates and a nominal discount rate reduces the BCR for longer lived projects. **Appendix C** describes and presents a real (rather than a nominal) water planning discount rate.

Discount Rate Fluctuation Cap

By capping annual changes in the water planning discount rate at 0.25%, the volatility in the discount rate is reduced; however, the cap no longer precisely reflects current borrowing costs, a main rationale for tying the water planning discount rate to long-term Treasury bonds. As shown in **Figure 10**, the water planning discount rate generally changes by the maximum allowable percentage of 0.25%.[37] Without the cap, the discount rate (the nominal water planning discount rate in **Figure 10**) would have changed by at least 0.25% per year.[38] Due to the cap, the water planning discount rate remained lower than the nominal discount rate throughout the 1980s and has generally been higher since the 1990s.

Figure 10. Comparison of the Water Planning Discount Rate and the Nominal Water Planning Discount Rate, FY1974 to FY2016



Source: CRS, using data for the Water Planning Discount Rate (Federal Discount Rate for Fiscal Year 2016) and the Nominal Discount Rate (Hydropower Interest Rates for Fiscal Year 2016) from Carlson, 2015.

[36] Office of Management and Budget, *Circular No. A-94 Revised*, Transmittal Memo No. 64, Washington, DC, October 29, 1992, 8a, https://www.whitehouse.gov/omb/circulars_a094#8, hereinafter referred to as Circular A-94 8a.

[37] Since 1974 when the cap was reinstated, there have been six years—1989, 1990, 1996, 2008, 2012, and 2015—in which the water planning discount rate changed by less than the maximum of 0.25%.

[38] The water planning discount rate without the cap (the nominal rate) is reflected in "Hydropower Interest Rates for Fiscal Year 2016" from Bruce D. Carlson, Deputy Chief, Planning and Policy Division of the U.S. Army Corps of Engineers, "Economic Guidance Memorandum Number 16-01:Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2016," October 14, 2015, at http://planning.usace.army.mil/toolbox/library/EGMs/EGM16-01.pdf. Hereinafter referred to as Carlson, 2015.

Conclusions

Robust economic analyses are necessary elements for efficient federal and nonfederal investments in federal water resource projects. As illustrated in this report, the discount rate used can result in certain project alternatives being favored over others; the discount rate used also can alter the calculation of a project's net benefits and BCRs. Congress established in law in 1974 that the Corps is to use the water planning discount rate for planning projects. There are no current proposals to alter the water planning discount rate. However, since the mid-2000s, the executive branch has used a 7% discount rate to calculate construction project BCRs for use as metric for budgeting. For many Corps projects, the BCR at the 7% discount rate is used to set a minimum threshold for inclusion in the executive branch's annual budget request for Corps construction.

For many Corps stakeholders, the current interest in the water planning discount rate is less a function of long-standing debates about a long-critiqued discount rate and more part of the concern over the uncertain construction prospects for the suite of congressionally authorized projects that do not meet the executive branch's BCR threshold. Although these projects have brought attention to the water planning discount rate, actions to effectively address the funding challenges facing the universe of congressionally authorized Corps projects may reach well beyond adjustments to either the water planning discount rate or the budgeting discount rate. For other stakeholders, their concern about the water planning discount rate is its role in Corps' project development.

Supporters of a lower discount rate for Corps projects argue that lower discount rates are appropriate for planning public projects with longer lifetimes. Others raise technical issues with the rate and debate the basing of the water planning discount rate on Treasury rates. Economic theory provides other methods to derive discount rates. Economists, however, often disagree on the appropriate discount rate to use. Some of the disagreement derives from differences of opinion on the extent to which the discount rate should account for society's preference for consumption today versus in the future, the opportunity cost of capital, concern about government spending "crowding out" private investment, and risks and uncertainties.

Corps benefit-cost analyses and their underlying assumptions, especially the discount rate, are of significance to Congress and other policymakers because of their central role in decisions currently shaping the portfolio of federal water resources assets and their benefits, costs, and risks for decades to come. Estimates of the present value of future benefits and costs influence federal decisionmaking, and the quality of those estimates can shape the efficacy of funds spent on federal water resource projects.

Appendix A. Approaches for Deriving a Discount Rate

The discount rate is a component in benefit-cost analyses (BCAs) because it determines the present value of future benefits and costs. Different discount rates will result in different present values for those benefits and costs. Academic experts disagree on the appropriate discount rate for evaluating public investments, especially long-lived projects. The debate has economic, political, and ethical components. On one level, many economists support discounting because constructing and maintaining a federal project diverts resources from other investments or from consumption.[39] Therefore, each investment has a cost. This cost is either associated with the return that could be earned on the next-best use of capital (known as the opportunity cost of capital, or OCC) or with the rate of return (the productivity of capital) that must be paid to induce people to defer an additional unit of current consumption. Theoretically, this latter rate is equivalent to people's marginal social rate of time preference (SRTP).

The social returns can be difficult to monetize, and private capital may not provide an adequate substitute for social or natural capital (e.g., community cohesion or wild places). For many projects, there are often benefits and costs experienced by future generations, which do not have a "say" in current capital markets or the trade-off between market goods and services or future non-market ones.[40] For multigenerational investments, discount rates raise questions about the appropriate rate at which society would trade a unit of consumption in the present versus the consumption of future generations.[41] For example, at discount rates set at private rates of return, even catastrophic losses 200 years in the future would be valued at almost nothing in present values. Some economists propose that the discount rates for federal programs should vary depending on the conditions of the specific action being examined (such as whether the project has effects on future generations known as intergenerational effects, and whether it causes crowding out of private investment).[42]

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[39] Federal Aviation Administration (FAA), Department of Transportation. "Chapter 5: Multi-period Economic Decision Criteria" in Economic Analysis of Investment and Regulatory Decisions: Revised Guide, January 1998, a: http://www.faa.gov/regulations_policies/policy_guidance/benefit_cost/media/economic.pdf on Dec. 2, 2002. (Hereinafter referred to as FAA.) See also Marco Boscolo, Jeffrey Vincent, and Theodore Panayotou, *Discounting Costs and Benefits in Carbon Sequestration Projects*, Harvard Environment Discussion Paper No. 41, February 1998. (Hereinafter referred to as Boscolo et al.)

[40] Although most experts agree that it is appropriate to discount monetary sums payable to future generations, some ethicists, legal scholars and economists have argued that the non-market benefits and costs passed to future generations are just as valuable as those accrued today, and thus should not be discounted. Edward R. Morrison, "Judicial Review of Discount Rates Used in Regulatory Cost-Benefit Analysis," *The University of Chicago Law Review*, V. 65 (1998): 1333-1369.

[41] See, among other resources, the varying views of 20 economists in Paul Portney and John Weyant, ed., *Discounting and Intergenerational Equity*, RFF Press, 1999.

[42] For more information on the debate on the discount rate used by federal agencies, see Art Fraas and Randall Lutter, *The Challenge of Improving the Economic Analysis of Pending Regulation: The Experience of OMB Circular A-4*, Resources for the Future, Washington, DC, December 2010, pp. 7-8; Institute for Energy Research, *OMB's Whitewash on the Social Cost of Carbon*, Washington, DC, July 9, 2015, at http://instituteforenergyresearch.org/analysis/ombs-whitewash-on-the-social-cost-of-carbon/; *Natural Resources Defense Council v. Herrington*, 15 ELR 20781 F.2d 1355 (D.C. Cir. 1985); Zerbe 2013; John D. Graham, *Valuing the Future: OMB's Refined Position*, University of Chicago Law Review, 2007.

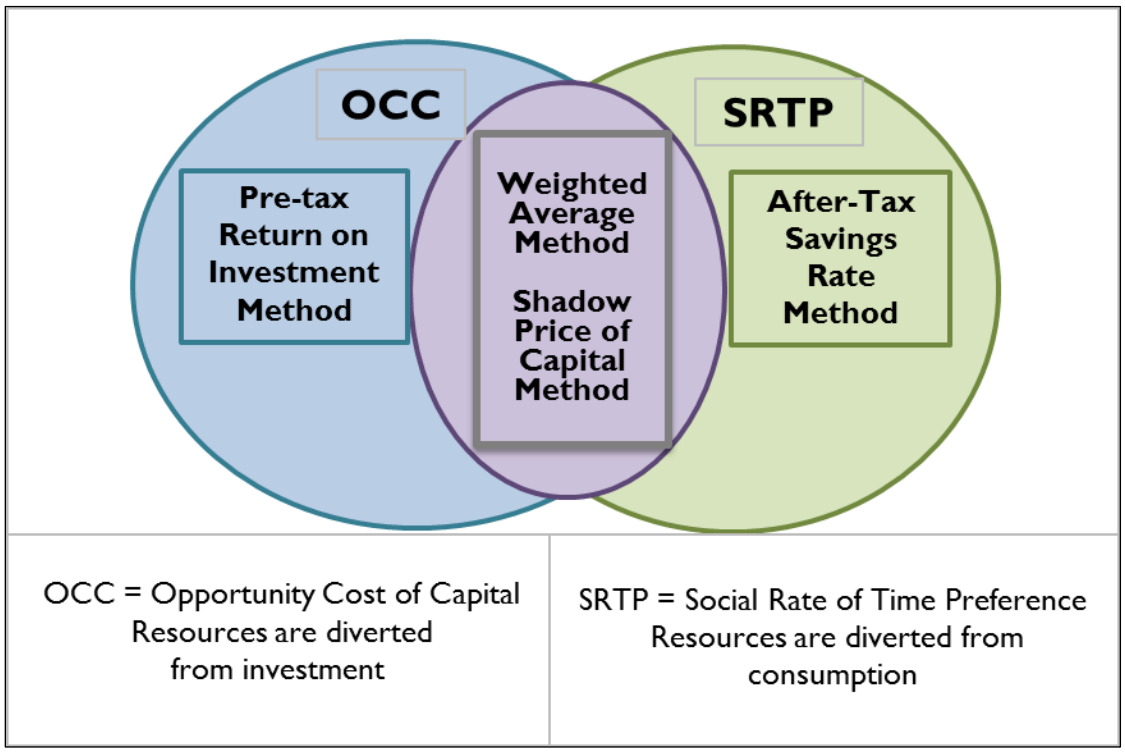
Four Ways to Calculate the Discount Rate

In a perfectly functioning market, a discount rate calculated to reflect the SRTP would be identical to a discount rate calculated to reflect the OCC. However, capital market imperfections, such as taxes, risk aversion, and uncertainty, cause these discount rates to differ and incite disagreement regarding the appropriate discount rate. Economists have generally proposed four major methods for calculating the social discount rate; they are the following:

- pretax return on investment method,
- after-tax savings method,
- weighted-average method, and
- shadow price of capital method.[43]

Figure A-1 depicts the relationship between the four methods and the approach to accounting for the cost of the investment in terms of capital. Following a brief discussion on the OMB recommendations for discount rates, each of the four approaches to calculating the discount rate is discussed below.

Figure A-1. Methods for Calculating the Discount Rate



Source: CRS.

[43] Boscolo et al.

OMB's Recommendation on Discount Rates

OMB would prefer that benefits and costs of federal programs be discounted using the shadow price of capital method.[44] However, because the shadow price method is difficult to implement, OMB recommends in Circular A-94 a discount rate that is based on the opportunity cost of capital approach in order to reflect how federal investment diverts resources from private investment. The OMB federal program uses an opportunity cost of capital approach; it is a pretax return on private investment. The circular provides some leeway to use other rates. For example, OMB recommends a discount rate based on the Treasury's borrowing rates in certain circumstances. OMB in Circular A-94 suggests the Treasury-based rates for cost-effectiveness analysis, lease-purchase analysis, internal government investments, and asset sales analysis.

In 1992, OMB revised Circular A-94 and lowered the recommended federal program discount rate from 10% to 7%. One reason the rate changed was that tax rates on capital were lowered between the 1960s and 1990s. It was changed to 7% to approximate the average rate of return to private capital in the United States using data from that period. OMB recommends this real discount rate to most federal agencies for assessing their projects. Water resource projects are explicitly exempted from Circular A-94. Since 1999, the OMB federal program discount rate of 7% has exceeded the water planning discount rate.

A discount rate based on the rate of return on private capital is the approach that is preferred by those economists who believe that government projects shift resources from the private sector to the federal government. This approach, however, has been criticized for improperly accounting for the welfare of future generation leading to a debate about its use.

Notably, for federal regulations, OMB recodes that the assessments of the impacts of regulations should apply both a 7% and a 3% discount rate, with the 3% used to reflect that regulatory impacts do not always fall exclusively or primarily on the allocation of capital. The 3% discount rate is used to reflect the SRTP and is relevant to the regulations that primarily and directly affect private consumption. According to OMB, the 3% was calculated based on the real rate of return on long-term government debt in real annual terms on a pretax basis for the thirty years prior to 2003.[45]

Pretax Return on Investment Method

One method for calculating a discount rate that attempts to approximate the next best use of private capital (i.e., the OCC) is the pretax return on investment. The pretax return on investment is the rate of return on private-sector investments, adjusted for inflation.[46]

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[44] Circular A-94 states that the shadow price method is the preferred method for calculating the discount rate. Due to the method's stringent information requirements, OMB approves the shadow price method on a case-by-case basis. There are four commonly discussed alternatives for calculating the discount rate: pretax return on investment, after- tax savings, the weighted average method, and the shadow price of capital. See **Appendix A** for a discussion of approaches to deriving a discount rate.

[45] Office of Management and Budget, *Regulatory Impact Analysis: A Primer*, Washington, DC, pp. 11-12, at https://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf.

[46] See FAA and Boscolo et al. This method is based on the idea that investing in private markets is the best alternative use of capital to using the capital to fund federal projects. Using this rate of return allows policymakers to compare the project's estimated rate of return to what return might have come from investing the same capital in private markets. It assumes that there is perfect substitutability between market and non-market goods and services

Although this formula is widely used, calculating a discount rate using the pretax rate of return on private investments is nonetheless contentious. In part, the difficulty is based on the vast array of possible private-sector interest rates. Additionally, there are a number of theoretical bases for arguing that the pretax rate of return on private-sector investment does not accurately measure the OCC. For example, some argue that this formula generates an average rather than a marginal rate of return.[47] Furthermore, the private-sector rate of return may reflect individual rather than societal premium for risk.[48] This argument is based on the perspective that people may be more willing to accept risks as a group than as individuals. Therefore, a rate based purely on the pretax return on investment may overestimate the discount rate, making it more difficult to obtain a benefit-cost ratio of greater than one, particularly for long-lived projects.

After-Tax Savings Method

The resources used for federal projects may also be diverted from consumption through taxes. Therefore, some economists argue for a discount rate that reflects the compensation required by society to substitute future consumption for current consumption (i.e., the SRTP).[49] This figure is sometimes measured as the rate of return on U.S. Treasury debt adjusted for taxes.[50] The water planning discount rate generally follows the SRTP except that it has not been adjusted for taxes; that is, the water planning discount rate is a pretax rate.

Critics have expressed concerns about using the after-tax savings rate as the discount rate. As with the pretax rate of return on private investments, this formula may generate an individual rather than a social rate of time preference, even if the rate is equal to the individual rate of time preference. According to economists at the Federal Aviation Administration, "observed interest rates reflect the preferences of individual members of society who have finite lives and are currently living."[51] Because society exists for an indefinite time period, society may place more value on future consumption than would an individual. Therefore, observed rates may overestimate the discount rate for actions that will affect future generations, but the overestimation may be less relevant for projects with short- and medium-term effects. Conversely, some economists argue that a riskless rate of interest, such as the Treasury rate, should not be used for evaluating long-term projects. Some also contend that tax finance should take into account the welfare loss from taxes, called the excess burden of taxation. The "excess burden of taxation" is the difference between welfare gains from trade with and without taxes.[52] Such a welfare loss could be reflected in a higher discount rate.

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[47] A. E. Bordman et al., *Cost-Benefit Analysis: Concepts and Practice* (Upper Saddle River, NJ: Prentice Hall, 1996). A marginal rate of return is more appropriate for evaluating proposed projects because it is the rate of return that could be earned if the capital were invested rather than an average of what has been earned on past investments. From a numerical standpoint, this difference is important because marginal rates of return are usually lower than average rates of return.

[48] Boscolo et al., p. 5.

[49] The social rate of time preference (SRTP) is composed of two factors: (1) a pure rate of time preference based on people's desire to gain short-term gratification and (2) an assumption that per capita consumption will grow over time, diminishing marginal returns to future consumption.

[50] Boscolo et al., pp. 5-4. The after-tax savings rate is calculated by subtracting the tax rate (expressed as a decimal) form from 1.0, then multiplying by the pretax real discount rate. See R. O. Zerbe, Jr. and D. D. Dively, *Benefit-Cost Analysis: In Theory and Practice*, (New York, NY: HarperCollins College, 1994), p. 287. Hereinafter referred to as Zerbe 1994.

[51] FAA, p. 5-5.

[52] Zerbe 1994, p. 128.

Weighted-Average Method

The weighted-average method recognizes that a project may divert resources from private consumption and from alternative investments. If the resources were not used for a federal project, for example, private individuals could spend the money, or the money could be invested in the private sector. Because the SRTP and the OCC may yield different discount rates, the weighted average method uses a discount rate that combines the pretax return on investment and the after-tax savings techniques. Specifically, this method defines the social discount rate as the weighted average of the SRTP (which is often computed as the after-tax savings rate of return) and the OCC (typically computed as the pretax return on private investment),[53] so it provides a middle ground, while facing the same critiques as both methods.

Shadow Price of Capital Method

In addition to the other three methods, OMB and some economists prefer a fourth approach to discounting known as the shadow price of capital method. Similar to the weighted-average method, this method also provides an approach that combines aspects of the OCC and STRP approaches to discounting. The shadow price of capital discount rate is intended to reflect the social value of private capital. It requires that displaced and increased private investments from benefits and costs of a public investment be converted to consumption equivalents by multiplying them by the shadow price of capital, which is the present value of the stream of consumption resulting from $1 of private investment. This method then discounts the consumption over time using the compensation required by society to substitute future consumption for current consumption, which represents an SRTP adjustment.[54] The shadow price of capital approach is rarely used to examine federal projects because it has stringent information requirements. It also generates different discount rates for each project depending on how the project affects future consumption and investment.[55]

[53] Boscolo et al., p. 7. The weights represent the resources diverted from consumption versus the percentage diverted from savings.

[54] For more information on the shadow price of capital method, see Environmental Protection Agency, *Guidelines for Preparing Economic Analyses: Discounting Future Benefits and Costs*, Washington, DC, December 2010, pp. 8-9, at https://yosemite.epa.gov/ee/epa/eerm.nsf/vwan/ee-0568-06.pdf/$file/ee-0568-06.pdf and Diana Guguitti and Shanton J. Wilcox, "Chapter 11: Discount Rate," in *Cost-Benefit analysis for Public Sector Decision Makers* (Quorum Books, 1999), p. 105, at https://books.google.com/books?id=WJsizO4ZligC&printsec=frontcover&dq=cost+benefit+analysis+for+public+sector+decision+makers&hl=en&sa=X&ved=0ahUKEwi88I3FzqjOAhWJ4iYKHe8DCY8Q6AEIKjAA#v=onepage&q=cost%20benefit%20analysis%20for%20public%20sector%20decision%20makers&f=false.

[55] For more information on how to compute the shadow price of capital, see FAA or Boscolo et al.

Appendix B. Planning and Economic Evaluation of Federal Water Resource Projects

Decisions about constructing water resource projects inherently involve trade-offs between various river and other water-related uses and between impacts of projects on current and future generations. Generally, decisions regarding each water project and its management result in winners and losers. For example, a free-flowing river supports recreation, fisheries, and scenic beauty, but dams may support hydropower, flood control, navigation, water supply, and motorized or other recreation purposes. Managing rivers to achieve any individual benefit or combination of benefits may diminish the benefits derived from other river uses. Agencies often evaluate these trade-offs as part of project-feasibility analyses. A significant component of the feasibility analysis is the economic evaluation of project alternatives.[56]

Another significant component is the documentation of environmental effects, as required by the National Environmental Policy Act.[57]

The Corps evaluates projects based on federal objectives as defined in federal water resource project planning guidelines. As of mid-2016, the Corps follows the 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Principles and Guidelines, or P&G) for its water project evaluations. Under the P&G, the objective of Corps projects is to increase National Economic Development (NED) benefits, which is the cumulative net benefit discounted using the water planning discount rate.[58] A project must generally have a positive NED benefit for congressional construction authorization; alternatively, this is expressed as a BCR of at least 1.0.[59]

While the P&G emphasize the NED objective, other planning guidance has used different, sometimes broader, planning objectives. See "Evolution of Federal Water Planning Guidance," below, for a discussion of water planning guidance documents and their objectives.

This appendix is organized into four major sections around the following four topics:

- national economic development benefit and cost categories,
- evaluating NED benefits and costs,
- evolution of federal water planning guidance, and
- evolution in water planning discount rate.

[56] Notably, many federal agencies with oversight over large construction projects, such as the Federal Aviation Administration or Department of Transportation, generally do not conduct benefit-cost analyses. Any such analysis for these transportation projects likely occurs at the state level, with the federal agency providing partial project funding.

[57] For more on the environmental requirements addressed during Corps project planning, see CRS Report R43209, *Environmental Requirements Addressed During Corps Civil Works Project Planning: Background and Issues for Congress*, by Linda Luther.

[58] For more information on NED see U.S. Army Corps of Engineers, Institute for Water Resources. *National Economic Development Procedures Manual-National Economic Development Costs*, Report 93-R-12, June 1993, at http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/93r12.pdf.

[59] To recommend a project with a benefit-cost ratio of less than one or to recommend a plan other than the plan with the greatest net economic benefit consistent with protecting the environment (the NED plan), the Assistant Secretary of the Army must grant an exception.

National Economic Development Benefit and Cost Categories

A significant challenge in developing a benefit-cost analysis (BCA) is deciding which categories of benefits and costs should be included. For federal water projects, the P&G and subsequent agency-specific guidance define which categories of costs and benefits the NED account may include increases and decreases in categories of goods and services expressed in monetary units. However, NED calculations do not include those benefits and costs that the Corps chooses not to value in monetary terms. The specific types of NED benefits and costs are described in the following paragraphs.

NED Benefits

The P&G establish procedures for identifying and measuring NED benefits. The P&G define NED benefits of a project alternative (which the P&G refers to as a "plan") as "increases in the national economic value of the national output of goods and services from a plan; the value of output resulting from external economies caused by a plan; and the value associated with the use of otherwise unemployed or under-employed labor resources."[60] This definition includes direct and indirect increases in production and employment attributable to a plan. Production benefits are measured "as the willingness of users to pay for each increment of output" a plan will create.[61] A project's output may include increases to the following categories of goods and services: municipal and industrial water supply; agricultural flood-water reduction; agricultural drainage; agricultural irrigation; erosion and sedimentation reduction; urban flood damage reduction; hydropower; transportation; recreation; and commercial or recreational fishing. NED benefits can also include other direct benefits that "result from incidental increases in outputs of goods and services or incidental reductions in production costs."[62] For example, another direct benefit of a project designed to produce hydropower and to reduce flood damage might be to store water for summer irrigation releases.

Although the NED account may include a wide variety of direct benefits, it does not address the distribution of project benefits. For example, the NED benefit calculation does not distinguish between benefits that are gained by a few people (e.g., coastal property owners) and those that are spread widely (e.g., reduced natural disaster payments from taxpayers). The NED account also does not address environmental benefits that may be difficult to monetize, such as restored wildlife habitat.

NED Costs

As described in the P&G, a project's NED account includes two categories of costs: implementation outlays and other direct costs. Implementation outlays are those costs that require the direct expenditure of money. The first category includes all payments made to construct, operate, and maintain a project. The major subcategories of implementation costs described in the P&G are planning and design costs (that are post-congressional construction authorization); construction costs; construction contingency costs; administrative services costs; fish and wildlife

[60] The term *external economies* refers to the "cost-saving benefits of locating near factors (of production) which are external to the firm, such as locally available skilled labor, training, and resource and development facilities." Principles and Guidelines, p. 8.

[61] Ibid., p. 9.

[62] Ibid., p. 91. To the extent possible, the value of these goods and services is equal to their market price.

habitat mitigation costs; relocation costs; historical and archaeological salvage operations costs; and land, water, and mineral rights costs.[63]

The second cost category−other direct costs−includes "the costs of resources directly required for a project or plan" but for which no dollars are expended.[64] These nonmarket costs fall generally into three categories: (1) implicit costs of displaced resources, (2) uncompensated NED losses, and (3) negative externalities.[65] The implicit costs category includes resources used for project completion for which no money is expended (e.g., land or other resources donated for the project). Uncompensated NED losses result when the installation, operation, maintenance, or replacement of a project reduces the economic output (e.g., loss of recreation user days from temporary decrease in water releases). These losses differ from implicit costs in that they are not necessarily associated with project construction. Negative externalities are the implicit or explicit costs for affected third parties (e.g., loss of commercial or sport fishing).

Although the NED account may include a wide variety of direct costs, it does not address some qualitative equity concerns regarding the distribution of a project's costs. For example, the NED cost calculation does not distinguish between construction costs that are spread widely (e.g., over many tax payers) and those that are borne by a few people (e.g., commercial fishermen). Likewise, the NED account does not identify projects whose costs will be paid by people with specific age, income, or other demographic characteristics.

Evaluating NED Benefits and Costs

In addition to describing the types of benefits and costs that may be included in the NED account, the P&G outline the methods for evaluating the magnitude of these benefits and costs. Specifically, the P&G state that benefits and costs should be expressed in real, as opposed to nominal, prices.[66] This rule means that the Corps' estimates of future costs and benefits are based on today's price levels (i.e., they are adjusted to remove the influence of expected inflation).[67]

Calculating real (constant-value) dollar values for some of the aforementioned benefits and costs varies in difficulty. Whenever possible, the Corps values benefits and costs using market prices for the good or service. For example, the value of protecting structures from flood damage is based on the structures' market values. However, the valuation process becomes more challenging and controversial as the good in question becomes further removed from one that is traded in an actual market or will be traded in the future. For example, valuing a project's recreational benefits or environmental costs is more difficult than valuing a project's electricity benefits. For this reason, economists, environmentalists, and fiscal conservatives have criticized this approach. However, the Corps is working to improve its nonmarket valuation methodologies. A discussion of these methods is beyond the scope of this report.

[63] Ibid.

[64] *Principles and Guidelines*, p. 99.

[65] Corps NED Manual – Costs 1993.

[66] See Principles and Guidelines §1.4.1(b), which read: "The general level of prices for outputs and inputs prevailing during or immediately preceding the period of planning is to be used for the entire period of analysis."

[67] Specifically, all prices used to value benefits and costs are expressed in constant dollars.

Evolution of Federal Water Planning Guidance

The first major implementation guidance for federal water project planning was a 1950 report entitled *Proposed Practices for Economic Analysis of River Basin Projects*.[68] This document, which is known as the Green Book, states that the objective of benefit-cost analysis should be to maximize general economic welfare and economic efficiency from a comprehensive public viewpoint. Furthermore, the Green Book recommends that this broad objective include both market and nonmarket benefits and costs. For example, the benefits from a flood control project should include nonmarket benefits, such as saving human lives, as well as market benefits, such as protecting physical property. Although implementing the Green Book was voluntary, many of its procedures became mandatory in 1952, when they were incorporated into a document of the Bureau of the Budget (predecessor to the Office of Management and Budget) entitled "Budget Circular A-47."[69] Through Circular A-47, benefit-cost analysis became the dominant component of project evaluation. Circular A-47 states that, "except for unusual cases where adequate justification is presented," a project's estimated benefits must exceed its estimated costs. Throughout the 1950s, the Bureau of the Budget would not approve Corps projects that did not have a BCR of at least 1.0, in terms of monetized benefits and costs. Although Circular A-47 states that benefits and costs should be estimated in monetary terms or in the most quantitative terms possible, a BCR includes only values measured in dollars. Nonmarket benefits and costs are included only when they are estimated in dollars. Because monetization of nonmarket benefits and costs can be difficult or controversial, the Corps' implementation of Circular A-47 emphasized market over nonmarket benefits and costs.

Throughout the 1950s, legislation was proposed to broaden water project evaluation procedures. In 1962, the Kennedy Administration, acting on a 1960 recommendation of the Senate Select Committee on Water Resources, further revised the guidance for water project planning and evaluation by preparing *Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources*.[70] These guidelines were printed as S.Doc. 97. This document replaced the strict BCR test with more general objectives. It stated that the basic purpose of project formulation is to provide the "best use, or combination of uses, of water and related land resources to meet all foreseeable short or long-term needs." To achieve this goal, S.Doc. 97 recommended that the Corps pursue multiple objectives, including economic development, preservation, and the well-being of people.[71]

The Corps' evaluation process began changing again in 1968, when the then-active Water Resources Council (WRC) began to revise the mandatory guidelines printed in S.Doc. 97.[72] In July 1970, a special task force of the WRC proposed a new set of Principles and Standards (P&S)

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[68] Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs, *Proposed Practices for Economic Analysis of River Basin Projects* (Washington, DC: May 1950).

[69] Circular A-47.

[70] U.S. Congress, "Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources," prepared under the direction of the President's Water Resources Council, 87th Cong., 2nd sess., S.Doc. 97 (Washington, DC: GPO, 1962). These policies were reissued in 1986; see 33 *Federal Register* 19170 (Dec. 24, 1968) and 18 C.F.R. §704.39.

[71] H.W. Shen, ed., "Chapter 20: Federal Guidelines for Water Resource Project Evaluation" in *Environmental Impact on Rivers* (Fort Collins, CO: Colorado State University, 1973).

[72] The Water Resources Planning Act of 1965 (P.L. 89-80, 78 Stat. 245; 42 U.S.C. 1952) created the Water Resources Council (WRC) within the Executive Office of the President and gave it responsibility for establishing benefit-cost guidelines. The Reagan Administration abolished the active program of the WRC in the early 1980s; however, statutory authority for the agency remains.

to supplant S.Doc. 97 for evaluating water resource projects. This proposal stated that the Corps should quantify a project's benefits and costs in terms of national economic development, quality of the environment, regional development, and social factors. Furthermore, it made clear that national economic efficiency should no longer be considered the primary objective. This proposal never went into effect. After review of the proposal and consultation with the Office of Management and Budget, the WRC published a revised version of the P&S for public comment.[73] In contrast to the proposal of the WRC's special task force, the final version of the P&S,[74] which took effect in 1973, was much narrower in its approach to selecting feasible water projects. Specifically, it focused on a single national economic development objective.

The 1973 P&S remained in effect only a few months before being revised at the direction of Congress. In 1974, the first in a series of Water Resource Development Acts (WRDAs) were enacted.[75] Section 80(c) of the Water Resources Development Act of 1974 (WRDA 1974; P.L. 93-251) authorized the President to study and revise the P&S, inclusive of interest rates, cost sharing, and the multiple objectives suggested by the WRC's special task force in 1970. One of the most significant features of the newly revised P&S under WRDA 1974 was that environmental matters were placed on a footing equal to economic development. As reissued in 1980, the P&S relied on four coequal accounts: national economic development, quality of the environment, regional development, and social factors. Although these accounts were in effect for water resources planning, they failed to gain political acceptance during an extended legislative and executive debate over water policy.

In September 1982, the WRC repealed the P&S and established the Principles and Guidelines (P&G),[76] which were approved by President Reagan in February 1983.[77] The P&G establish four accounts, similar to the objectives under the P&S. The four accounts are NED, Regional Economic Development (RED), Environmental Quality (EQ), and Other Societal Effects (OSE).[78] Unlike the P&S, however, the P&G did not equally weigh the four accounts. According to the P&G, "the federal objective of water and related land resources project planning is to contribute to the national economic development" consistent with national environmental law and other federal planning requirements. Therefore, the NED account is the only mandatory account used to evaluate federal water projects under the P&G.[79] The P&G further emphasizes the importance of the NED account by instructing the Corps to choose the NED-maximizing alternative unless "there are overriding reasons for recommending another plan, based on other Federal, State, local

[73] 36 *Federal Register* 24144 (Dec. 21, 1971).

[74] The final version of the Principles and Standards (P&S) was published in 38 Fed.Reg 24778 (September 10, 1973).

[75] WRDA 1974 amended the Federal Water Project Reclamation Act (16 U.S.C. §460).

[76] The P&G were established pursuant to 42 U.S.C. §1962-a-2 and replaced the P&S (18 C.F.R., Parts 711, 713, 714, and 716).

[77] 38 *Federal Register* 30993 (November 7, 1973).

[78] The NED account "displays changes in the economic value of the national output of goods and services." The Regional Economic Development (RED) account "registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using national consistent projections of income, employment, output, and population." The Environmental Quality (EQ) account "displays non-market effects on significant natural and cultural resources." The Other Societal Effects (OSE) account "registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts." *Economic and Environmental Principles for Water and Related Land Resources Implementation Studies*. April 22, 2000, established pursuant to the Water Resources Planning Act of 1965 (P.L. 89-80) as amended (42 U.S.C. §1962a-2 and d-1).

[79] If the RED and NED accounts were both considered equally, for example, the regional distribution of costs and benefits would be taken into consideration. Under the P&G, benefits to one region can offset the costs in another region. Likewise, economic benefits can offset any measurable environmental costs.

or international concerns." Therefore, under the P&G, the identification of a preferred alternative and the recommendation to proceed with a project largely depends on calculations of NED benefits and NED costs; pursuant to WRDA 1974, these calculations are performed using the water planning discount rate established therein.

In the Water Resources Development Act of 2007 (P.L. 110-114), Congress instructed the Secretary of the Army to develop new planning guidance for the Corps. In March 2013, the Obama Administration released and updated *Principles and Requirements for Federal Investments in Water Resources.* In December 2014, it published the final interagency guidelines regarding implementation of the updated Principles and Requirements. The updated Principles, Requirements, and Guidelines (PR&G) use a broader definition of social benefits, encompassing environmental, economic, and social goals, each with equal weight. The PR&G also include monetary and nonmonetary effects, as well as quantified and unquantified measures of benefits.[80] By contrast, the 1983 P&G emphasized a focus on quantifiable, monetary NED benefits. Congress has prevented the Corps from using the PR&G; the 1983 P&G remain in effect for the Corps.[81]

Evolution in Water Planning Discount Rate

The evolution in planning guidance was accompanied by an evolution in the discount rate used for water resources planning. As shown in **Table B-1** provides the discount rates used from 1975 through 2016.

Table B-1. Water Planning Discount Rate for Federal Water Project Investments

Year(s)	A-47 (%)	S.Doc. 97 (%)	WRC 1986 (%)	P&S (%)	WRDA 1974 (%)
1957-1960	2.500	—	—	—	—
1961	2.625	—	—	—	—
1962	—	2.625	—	—	—
1963	—	2.875	—	—	—
1964	—	3.000	—	—	—
1965	—	3.125	—	—	—
1966	—	3.125	—	—	—
1967	—	3.125	—	—	—
1968	—	3.250	—	—	—
1969	—	3.250	4.625	—	—
1970	—	—	4.875	—	—
1971	—	—	5.125	—	—
1972	—	—	5.375	—	—
1973	—	—	5.500	—	—

[80] Council on Environmental Quality, *Principles and Requirements for Federal Investments in Water Resources*, March 2013, at https://www.whitehouse.gov/sites/default/files/final_principles_and_requirements_march_2013.pdf.

[81] For more information on the 2013 Principles and Requirements, see CRS In Focus IF10221, *Principles, Requirements, and Guidelines (PR&G) for Federal Investments in Water Resources*, by Nicole T. Carter and Betsy A. Cody.

Year(s)	A-47 (%)	S.Doc. 97 (%)	WRC 1986 (%)	P&S (%)	WRDA 1974 (%)
1974	—	—	5.625	6.875	5.625
1975	—	—	—	—	5.875
1976	—	—	—	—	6.125
1977	—	—	—	—	6.375
1978	—	—	—	—	6.625
1979	—	—	—	—	6.875
1980	—	—	—	—	7.125
1981	—	—	—	—	7.375
1982	—	—	—	—	7.625
1983	—	—	—	—	7.875
1984	—	—	—	—	8.125
1985	—	—	—	—	8.375
1986	—	—	—	—	8.625
1987	—	—	—	—	8.875
1988	—	—	—	—	8.625
1989	—	—	—	—	8.875
1990	—	—	—	—	8.875
1991	—	—	—	—	8.750
1992	—	—	—	—	8.500
1993	—	—	—	—	8.250
1994	—	—	—	—	8.000
1995	—	—	—	—	7.750
1996	—	—	—	—	7.625
1997	—	—	—	—	7.375
1998	—	—	—	—	7.152
1999	—	—	—	—	6.875
2000	—	—	—	—	6.625
2001	—	—	—	—	6.375
2002	—	—	—	—	6.125
2003	—	—	—	—	5.875
2004	—	—	—	—	5.625
2005	—	—	—	—	5.375
2006	—	—	—	—	5.125
2007	—	—	—	—	4.875
2008	—	—	—	—	4.875
2009	—	—	—	—	4.625

Year(s)	A-47 (%)	S.Doc. 97 (%)	WRC 1986 (%)	P&S (%)	WRDA 1974 (%)
2010	—	—	—	—	4.375
2011	—	—	—	—	4.125
2012	—	—	—	—	4.000
2013	—	—	—	—	3.750
2014	—	—	—	—	3.500
2015	—	—	—	—	3.375
2016	—	—	—	—	3.125

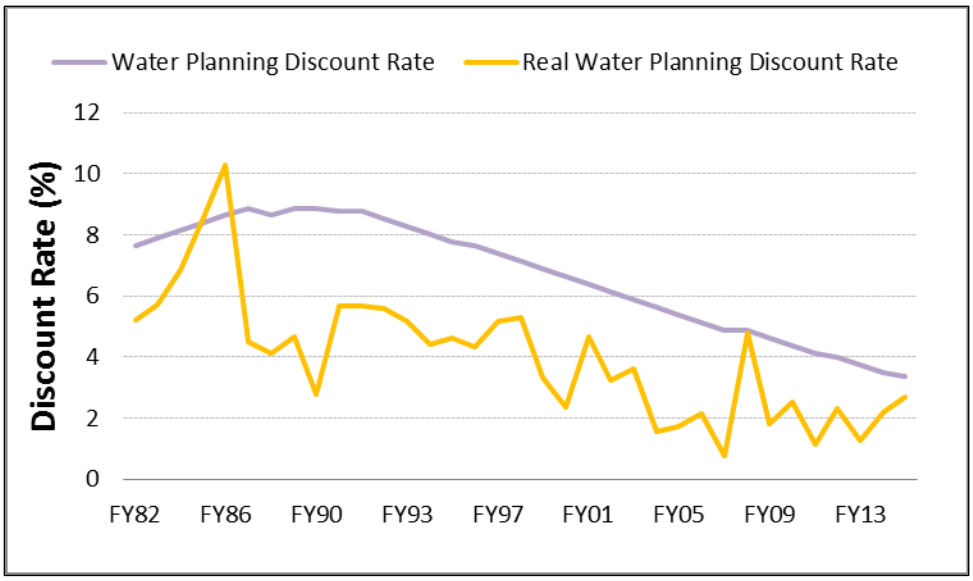
Source: Carlson, 2015.

Appendix C. Real Water Planning Discount Rate

As described above, the Corps currently discounts real dollars using a nominal discount rate. Specifically, the 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Principles and Guidelines, or P&G) stipulates that benefits and costs be measured in real dollars. By contrast, the discount rate formula, established in the WRDA 1974, is a nominal discount rate.

One way to remedy this problem would be to transform the water planning discount rate into a real discount rate,[82] which could be accomplished by adjusting the water planning discount rate for inflation. In **Figure C-1**, the real water planning project discount rate is approximated by subtracting the inflation rate from the water planning discount rate.[83] The resulting *real rate* approximates what the Corps project discount rate would be if it were adjusted for inflation and were not constrained to an annual change of 0.25%. As depicted in **Figure C-1**, the real rate is generally lower than the water planning discount rate. In 1986, if the water planning rate had not been capped, the real project discount rate also would have been lower than the water planning discount rate.

Figure C-1. Calculated Real Water Planning Discount Rate from FY1982 to FY2015



Sources: CRS using Carlson, 2015, and Federal Reserve Bank of St. Louis, Consumer Price Index for All Urban Consumers (CPI-U), at http://www.economagic.com/em-cgi/data.exe/var/inflation-cpiu-dec2dec.

[82] Alternatively, a change to executive branch planning guidance could allow a project's benefits and costs to be measured in nominal dollars to go with the nominal discount rate stipulated by WRDA 1974.

[83] The real water planning project discount rate is an approximation because an accurate real discount rate would use expected inflation rate for the time period in question rather than actual inflation rates. The real rate is the water planning rate (without the 0.25% cap) minus inflation, measured by the Consumer Price Index. The water planning rate (without the 0.25% cap) is equal to the "Hydropower Interest Rates for Fiscal Year 2016" from Carlson, 2015. Annual inflation rates were calculated as changes in the Consumer Price Index for All Urban Consumers (CPI-U) from the Federal Reserve Bank of St. Louis, at http://www.economagic.com/em-cgi/data.exe/var/inflation-cpiu-dec2dec.

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