# 6

# THE ROLE OF TIME IN NATURAL RESOURCE DAMAGE ASSESSMENT

## 6.1 INTRODUCTION

In many cases natural resource damages will occur over an extended period of time. For example, the release of hazardous contaminants from an uncontrolled waste disposal site may have resulted in the loss of natural resource services in the past. In addition, these losses may be expected to continue into the future, pending full restoration of the resource. Similarly, trustees may have incurred natural resource damage assessment costs in the past, and may expect to incur costs associated with resource restoration in the future. Under DOI's final rule and NOAA's proposed rule, trustees are expected to present a single, "present value" damage claim to the responsible party. Thus, in many cases, it will be necessary for trustees to apply the concept of "discounting" to a damage claim. The application of appropriate discounting rules is necessary to assure that the public is appropriately compensated for compensable losses, made whole for the cost of conducting the damage assessment, and provided with sufficient funds for the completion of necessary restoration actions.

The purpose of this chapter is to provide a general introduction to discounting and capital budgeting for purposes of natural resource damage assessment. Specifically addressed are:

- The need to discount past and future compensable losses in developing a present value damage claim;[1]
- The need to put damage assessment costs in present value terms; and,
- The capitalization of future restoration costs.[2]

[1] Discounting values from the past to the present is often referred to as "compounding."

[2] Additional discussion of the importance of time in generating restoration cost estimates is presented in Chapter 3.

This chapter is divided into six sections. Section 6.2 provides a brief introduction to the key concepts in discounting. Section 6.3 reviews DOI's and NOAA's guidance on discounting in the context of natural resource damage assessments. Section 6.4 presents an approach for discounting past and future compensable losses, and Section 6.5 an approach for calculating the present value of past and expected future damage assessment costs. Section 6.6 provides guidance on capital budgeting for purposes of generating a present value restoration cost claim.

## 6.2 Key Concepts in Discounting

Discounting is a widely used economic procedure that allows individuals and organizations to convert flows of sums into single, present value dollar amounts. The principal behind discounting is that there is a "time value of money" -- that is, a dollar paid two years from now is worth less than a dollar paid today, all else held equal. Future dollars are worth less than current dollars, all else equal, since the individual receiving the dollar in two years will have to forego consumption (or investment) opportunities for that time period. Discount rates are analogous to interest rates paid by banks to attract depositors; banks must pay interest to get consumers to forego current consumption, and instead deposit their money in the bank. Thus, the present value of an economic benefit (or damage) depends on when that benefit is received.

### Why Discount?

Given the effort required to do so, some trustee representatives may ask: why should we bother to discount past and future damages (i.e., "wouldn't it be easier to simply add-up the damages")? Discounting is required to assure that the public is as well off at the time of claim presentation as they would have been, but for the discharge. As described in this chapter, a dollar owed from some point in time in the past, or not owed until some point in time in the future, is not worth the same as a dollar owed today. The failure to compound past damages will result in the public being under-compensated for their losses, while the failure to discount expected future damages means the public will be over-compensated for their losses. Thus, the application of appropriate discounting rules is necessary to assure that the public is fairly compensated for damages to trust natural resources, and to assure that a cost-effective restoration program is selected.

Discounting is commonly applied in financial transactions. For example, a business might offer an investor a bond that promises to pay $100 per year for 10 years. In order to determine the right price to pay for the bond, the investor must "discount" the promised future payments to a single, present value. The "discount rate" used by the investor in this example is the rate the business must offer the investor to forgo some other investment opportunity.

The formula for calculating the present value of a series of future payments is as follows:

$$\text{Present Value of Payment}_{(\text{Current Year})} = \text{Payment}_{(\text{Year N})} * (1 + \text{Assumed Interest Rate})^{(\text{Current Year} - \text{Year N})}$$

In Exhibit 6-1 we apply this formula to calculate the present value of the bond described above, assuming a 10 percent discount rate. For example, the present value of $100 to be paid in the year 2000 is approximately $62, established using the formula:

$$\text{Present Value of Payment}_{(1995)} = \$100 * (1 + 0.10)^{(1995\text{-}2000)}$$

$$\text{Present Value of Payment}_{(1995)} = \$62.09$$

**Exhibit 6-1**

**EXAMPLE APPLICATION OF DISCOUNTING TO CALCULATE THE PRESENT VALUE OF A SERIES OF FUTURE PAYMENTS**

| Year | Payment | Discount Calculation[1] | Present Value of Payment (1995 $) |
|---|---|---|---|
| 1995 | $100 | $* (1 + 0.10)^{(1995\text{-}1995)} =$ | $100.00 |
| 1996 | $100 | $* (1 + 0.10)^{(1995\text{-}1996)} =$ | $90.91 |
| 1997 | $100 | $* (1 + 0.10)^{(1995\text{-}1997)} =$ | $82.64 |
| 1998 | $100 | $* (1 + 0.10)^{(1995\text{-}1998)} =$ | $75.13 |
| 1999 | $100 | $* (1 + 0.10)^{(1995\text{-}1999)} =$ | $68.30 |
| 2000 | $100 | $* (1 + 0.10)^{(1995\text{-}2000)} =$ | $62.09 |
| 2001 | $100 | $* (1 + 0.10)^{(1995\text{-}2001)} =$ | $56.45 |
| 2002 | $100 | $* (1 + 0.10)^{(1995\text{-}2002)} =$ | $51.32 |
| 2003 | $100 | $* (1 + 0.10)^{(1995\text{-}2003)} =$ | $46.65 |
| 2004 | $100 | $* (1 + 0.10)^{(1995\text{-}2004)} =$ | $42.41 |
| TOTAL | | | $675.90 |

[1] Example assumes a 10 percent discount rate.

As shown in Exhibit 6-1, assuming an annual discount rate of 10 percent, the investor would offer no more than approximately $675 for this bond, which equals the sum of the present values of each of the expected payments associated with the bond.

This same formula can be used to "compound" payments due from the past. For example, imagine a case in which an individual was to have received $100 per year from 1985 to 1990, but for some reason was not provided these payments. That income stream, if paid in one lump sum in 1995, would be worth $1,242.60, assuming a 10 percent discount rate, as detailed in Exhibit 6-2. That is, a single payment of $1,242.60 in 1995 is the financial equivalent of having received $100 each year from 1985 to 1990 and of having invested and earned 10 percent interest on that money.

### 6.2.1 Discounting in Damage Assessment

The present value formula presented in the previous section can be used to estimate the present value of each component of a natural resource damage claim (i.e., compensable losses, assessment costs and restoration costs). What varies between these components is the discount rate used. Specifically:

- The appropriate discount rate for converting past and future compensable losses to present value terms is represented by an aggregated measure of individual rates of time preference.

- Assessment costs incurred by the trustees should be converted to present values using the trustee's cost of funds (i.e., the interest rate on funds borrowed by trustees to conduct the assessment).

- The present value of expected restoration costs should be estimated using a discount rate equal to the expected rate of return on recovered funds.

The remainder of this chapter discusses these guidelines further and provides example calculations for each damage category. This discussion begins with definitions of several key terms used in discounting: individual rate of time preference and "real" and "nominal" discount rates.

## 6.2.2 Individual Rate of Time Preference

An individual's rate of time preference is the rate of interest at which that individual is indifferent between consuming goods now and postponing consumption to a later date. For example, an individual may be indifferent between a guaranteed payment of $100 today and a guaranteed payment of $110 in one year, implying an individual rate of time preference of 10 percent. The appropriate discount rate for purposes of discounting past and future compensable losses can be thought of as the aggregate of individual rates of time preference.

**Exhibit 6-2**

**EXAMPLE APPLICATION OF COMPOUNDING TO CALCULATE THE PRESENT VALUE OF A SERIES OF MISSED PAYMENTS**

| Year | Payment | Discount Calculation[1] | Present Value of Payment (1995 $) |
|---|---|---|---|
| 1985 | $100 | $* (1 + 0.10)^{(1995-1985)} =$ | $259.37 |
| 1986 | $100 | $* (1 + 0.10)^{(1995-1986)} =$ | $235.79 |
| 1987 | $100 | $* (1 + 0.10)^{(1995-1987)} =$ | $214.35 |
| 1988 | $100 | $* (1 + 0.10)^{(1995-1988)} =$ | $194.87 |
| 1989 | $100 | $* (1 + 0.10)^{(1995-1989)} =$ | $177.16 |
| 1990 | $100 | $* (1 + 0.10)^{(1995-1990)} =$ | $161.05 |
| TOTAL | | | $1,242.59 |

[1]Example assumes a 10 percent discount rate.

There are, however, no published estimates of aggregate measures of individual rates of time preference -- that is, we cannot look up the current social discount rate as we might mortgage rates or government bond rates. This rate must be inferred from individual behavior, and as such is not a fixed or known value. Researchers and government agencies have attempted to define this value using various techniques and assumptions. For example, the Congressional Budget Office (CBO) accepted the principle of discounting the costs and benefits of government programs according to individual rates of time preference and specified two percent as the best estimate of this rate. Professor A. Myrick Freeman, in his widely-referenced book on environmental economics, states that a rate of two to three percent is appropriate for discounting streams of benefits and costs that accrue to people in the same generation (Freeman 1993). DOI and NOAA have selected different discount rates for use in damage assessment, as described in Section 6.3.

## 6.2.3 Real and Nominal Discount Rates

In order to properly discount past and future values, trustees must first determine whether the values being discounted are expressed in "real" or "nominal" terms. Simply put, real values are values that have been adjusted for inflation, while nominal values are expressed in un-inflated terms. For example, the nominal cost of a movie ticket in Boston in 1980 was $4.00, while the nominal cost in 1995 was $7.50. In order to compare these values in real terms (i.e., adjusted for inflation), we must "inflate" the 1980 value to 1995 dollars. Using the Gross Domestic Product (GDP) implicit price deflator we find that the price of a movie ticket in 1980, expressed in 1995 dollars, is $7.20.[3] Thus, the price of a movie ticket increased from 1980 to 1995 relative to the average price increase of all goods sold in the economy.

This same type of calculation is performed in converting nominal natural resource damage estimates into real terms. For example, a trustee may wish to apply a recreational fishing day value, reported in 1985 dollars, to a case involving lost fishing opportunities in 1995. In this case the analyst needs to adjust for inflation by converting the 1985 value to a 1995 value, using an index such as the GDP price deflator. Exhibit 6-3 reports the GDP implicit price deflator for the years 1970 to 1995, and provides the formula that is used to convert values expressed in past dollars into current dollars.

For damages expected to occur in the future, trustees can assume a 3.0 percent annual increase in this index (i.e., assume that

**Exhibit 6-3**

**GDP IMPLICIT PRICE DEFLATOR**

| Year | Implicit Price Deflator (1987=100) | Year | Implicit Price Deflator (1987=100) |
|---|---|---|---|
| 1970 | 35.2 | 1983 | 87.2 |
| 1971 | 37.1 | 1984 | 91.0 |
| 1972 | 38.8 | 1985 | 94.4 |
| 1973 | 41.3 | 1986 | 96.9 |
| 1974 | 44.9 | 1987 | 100.0 |
| 1975 | 49.2 | 1988 | 103.9 |
| 1976 | 52.3 | 1989 | 108.5 |
| 1977 | 55.9 | 1990 | 113.3 |
| 1978 | 60.3 | 1991 | 117.6 |
| 1979 | 65.5 | 1992 | 120.9 |
| 1980 | 71.7 | 1993 | 123.5 |
| 1981 | 78.9 | 1994 | 126.1 |
| 1982 | 83.8 | 1995* | 129.7 |

To inflate past (i.e., nominal) dollars into current (i.e., real) dollars:

$$Past\ Value * \frac{Current\ Year\ Index}{Base\ Year\ Index}$$

For example, to convert $100, expressed in 1974 dollars, into 1995 dollars:

$$\$100 * \frac{129.7}{44.9} = \$288.36$$

* Estimated by Industrial Economics, Incorporated using Administration forecast; for future years, assume 3% Inflation.

Source: *Economic Report of the President*, Feb. 1995.

[3] Economists use the term "deflator" to refer to indices used to inflate or deflate dollar values to a given base year. The GDP implicit price deflator is an index commonly used to measure inflation.

inflation will be 3.0 percent annually).[4] For example, if a trustee expects compensable damages to be $500 in 1999, in nominal terms, the trustee can calculate a real value, in 1995 dollars, using the formula:

$$\text{Real Value} = \$500 * (1+0.03)^{(1995-1999)}$$

$$= \$444.24$$

In addition to real and nominal prices, economists define real and nominal discount rates. A nominal discount rate has not been adjusted for inflation, while a real discount rate has been adjusted for inflation. For example, the average rate of return on three month U.S. Treasury Bills during 1994, expressed in nominal terms, was 4.29 percent. Since the rate of inflation in 1994 was about 2.9 percent (as measured by the GDP implicit price deflator), the real rate of return on three month U.S. Treasury bills during this period was 1.39 percent.

In calculating the present value of the various components of a damage claim, trustees must express damage estimates and discount rates consistently in either real or nominal terms. That is, trustees must apply real discount rates to discount damages expressed in real terms (i.e., when damage estimates have been adjusted for inflation), and nominal discount rates to discount damages expressed in nominal dollars (i.e., when the damage estimates have not been adjusted for past or potential future inflation). As discussed below, trustees are encouraged to adjust for inflation first, and then apply real discount rates to calculate present value compensable losses to assure this consistency.

## 6.3 DOI AND NOAA GUIDANCE ON DISCOUNTING

DOI's final rule and NOAA's proposed rule for damage assessment provide guidelines to trustees for discounting, and suggest appropriate discount rates. Under both rules trustees are directed to discount all components of the damage claim. However, the recommended discount rates differ between these two rules.

DOI's rule on discounting for purposes of natural resource damage assessment, provided at 43 CFR 11.84(e), are as follows:

> (e) Discounting. (1) Where possible, damages should be estimated in the form of an expected present value dollar amount. In order to perform this calculation, a discount rate must be selected.
>
> (2) The discount rate to be used is that specified in "Office of Management and Budget (OMB) Circular A-94 Revised."

The March 1972 OMB circular referenced in DOI's final rule (issued March 25, 1994), specified a real discount rate of 10 percent. This circular has since been revised to state that the

[4] Economic Report of the President, 1995.

appropriate real discount rate for public investments is seven percent [Office of Management and Budget, Circular No. A-94, Revised, Transmittal Memorandum No. 64, 29 October 1992, p. 9]. In addition, the revised circular states that analyses should be conducted to show the sensitivity of the outcomes of the analysis to the discount rate. In its October 19, 1994 advanced notice of proposed rulemaking, DOI solicited comment on whether use of a seven percent discount rate is appropriate, or if trustees should be able to use different discount rates [59 FR 52749, Oct. 19, 1994]. In this notice of proposed rulemaking DOI cited NOAA's proposed guidelines (described below) as one possible alternative to its 1994 guidance on this issue.

DOI recognized in its final, March 1994, rule that in order to estimate total present value damages, trustees need to place all expected restoration costs and compensable losses in present value terms. Specifically, DOI's March 1994 rule stated that a discount rate should be used to calculate the present value benefits of any possible restoration actions [43 CFR 11.84(g)(iii)], and to calculate the expected present value losses of services not received as a result of the release [43 CFR 11.84(g)(iv)]. The present value of the expected total loss in services due to the release (assuming no restoration actions are undertaken), minus the present value of the total expected benefit of the proposed restoration actions represents economic damages [43 CFR 11.84(g)(v)].

In its proposed rule, NOAA also directs trustees to discount all damage estimates into present value terms, and provides guidance for the appropriate discount rates to use in these calculations. Specifically [990.79(e), 59 FR 1184, Jan. 7, 1994]:

> (e) Discounting. (1) The trustees should discount the three components of the damage claim: Compensable values; future restoration costs; and assessment and restoration costs already incurred. NOAA recommends that the trustee(s) use the U.S. Treasury borrowing rate on marketable securities of comparable maturity to the period of analysis for discounting the value of each of the components. The reference date for the discounting calculation is the date at which the claim is presented. Section 9.14 of the proposed rule, as required by section 1005(b) of OPA, provides for pre-judgment interest and post-judgment interest to be paid at a commercial paper rate, starting from 30 calendar days from the date a claim is presented until the date the claim is paid.
>
> (2) Trustees are referred to Appendix C of OMB Circular A-94 for information about nominal and real U.S. Treasury rates of various maturities and for further guidance in calculation procedures. Copies of the Appendix, which is regularly updated, and of the Circular are available from the OMB Publications Office (202-395-7332).

## 6.4 Discounting Compensable Losses for Purposes of Natural Resource Damage Assessment

As noted above, the rules on discounting provided in DOI's March 1994 final rule and NOAA's 1994 proposed rule differ. In addition, DOI announced in its October 1994 notice of proposed rulemaking that it was considering revising its earlier guidance as part of the biennial review of these rules. Given these facts, the following guidance is provided to trustees:

- First, trustees should adjust all compensable value estimates for inflation (i.e., convert all compensable loss estimates to real dollars prior to applying a real discount rate.

- Second, a real rate of seven percent should be used for discounting and compounding compensable value losses. This analysis should be viewed as a "base case" that is in keeping with DOI's final rule.

- Third, trustees should estimate compensable losses assuming a three percent real discount rate. If this analysis indicates that the results are sensitive to the assumed rate, and if the damages are of a magnitude to warrant further consideration of this factor, the trustees may wish to consider presenting a damage claim based on an alternative real discount rate.[5]

This approach is in keeping with the current DOI guidelines, while recognizing the fact that a lower real discount rate may be appropriate for purposes of natural resource damage assessment.

## EXAMPLE: DISCOUNTING COMPENSABLE LOSSES TO GENERATE A PRESENT VALUE DAMAGE CLAIM

An example application of discounting to generate a present value compensable losses damage claim is provided in Exhibit 6-4. This example involves the following scenario:

> Releases from an uncontrolled hazardous waste site have resulted in the contamination of a creek with PCBs and other toxics. As a result, the state health agency has posted warnings at the site, recommending that anglers not eat the fish they catch. As a result, fishing pressure (i.e., number of fishing trips to the site) declines. The warnings were first issued in 1985, and are expected to be lifted in 2000, following remediation of the site and recovery of the resource. A state resource management agency has estimated the number of fishing days lost at the site, and has estimated the total value of these trips for each year that the restrictions will be in place (see Exhibit 6-4). The trustees now want to calculate a present value damage claim for these losses, for presentation to the responsible party.

As shown on Exhibit 6-4, the first step in generating a present value damage claim is converting the estimated economic damages, expressed in nominal terms, into real terms (using the data and formula presented in Exhibit 6-3). The results of this calculation are provided in the fourth

[5] In most cases "significance" will be determined by the magnitude of the difference in the damage estimates generated using different discount rates, and the relative importance of this factor compared to other sources of uncertainty in the damage estimate.

**Exhibit 6-4**

**EXAMPLE APPLICATION OF DISCOUNTING TO GENERATE A PRESENT VALUE DAMAGE CLAIM**
**(damages expressed in thousands of dollars)**

| | Year | Economic Damage (Nominal $) | Adjustment for Inflation | Economic Damage (1995 $) | Calculation to Compound (Past)/ Discount (Future) Damages | Present Value Damages |
|---|---|---|---|---|---|---|
| Compounding Past Damages | 1985 | $600 | $* \left(\frac{129.7}{94.4}\right) =$ | $824 | $* (1 + 0.10)^{(1995-1985)} =$ | $2,138 |
| | 1986 | $700 | $* \left(\frac{129.7}{96.9}\right) =$ | $937 | $* (1 + 0.10)^{(1995-1986)} =$ | $2,209 |
| | 1987 | $900 | $* \left(\frac{129.7}{100.0}\right) =$ | $1,167 | $* (1 + 0.10)^{(1995-1987)} =$ | $2,502 |
| | 1988 | $800 | $* \left(\frac{129.7}{103.9}\right) =$ | $999 | $* (1 + 0.10)^{(1995-1988)} =$ | $1,946 |
| | 1989 | $1,000 | $* \left(\frac{129.7}{108.5}\right) =$ | $1,195 | $* (1 + 0.10)^{(1995-1989)} =$ | $2,118 |
| | 1990 | $1,100 | $* \left(\frac{129.7}{113.3}\right) =$ | $1,259 | $* (1 + 0.10)^{(1995-1990)} =$ | $2,028 |
| | 1991 | $1,000 | $* \left(\frac{129.7}{117.6}\right) =$ | $1,103 | $* (1 + 0.10)^{(1995-1991} =$ | $1,615 |
| | 1992 | $1,200 | $* \left(\frac{129.7}{120.9}\right) =$ | $1,287 | $* (1 + 0.10)^{(1995-1992)} =$ | $1,713 |
| | 1993 | $1,100 | $* \left(\frac{129.7}{123.5}\right) =$ | $1,155 | $* (1 + 0.10)^{(1995-1993)} =$ | $1,398 |
| | 1994 | $1,400 | $* \left(\frac{129.7}{126.1}\right) =$ | $1,440 | $* (1 + 0.10)^{(1995-1994)} =$ | $1,584 |
| | 1995 | $1,500 | $* \left(\frac{129.7}{129.1}\right) =$ | $1,500 | $* (1 + 0.10)^{(1995-1995)} =$ | $1,500 |
| Discounting Future Damages | 1996 | $1,700 | $* (1 + 0.03)^{(1995-1996)} =$ | $1,650 | $* (1 + 0.10)^{(1995-1996)} =$ | $1,500 |
| | 1997 | $1,800 | $* (1 + 0.03)^{(1995-1997)} =$ | $1,697 | $* (1 + 0.10)^{(1995-1997)} =$ | $1,402 |
| | 1998 | $2,000 | $* (1 + 0.03)^{(1995-1998)} =$ | $1,830 | $* (1 + 0.10)^{(1995-1998)} =$ | $1,375 |
| | 1999 | $2,200 | $* (1 + 0.03)^{(1995-1999)} =$ | $1,955 | $* (1 + 0.10)^{(1995-1999)} =$ | $1,335 |
| | 2000 | $2,500 | $* (1 + 0.03)^{(1995-2000)} =$ | $2,157 | $* (1 + 0.10)^{(1995-2000)} =$ | $1,339 |
| | **TOTAL** | | | | | $27,703 |

column of Exhibit 6-4.[6] For example, nominal damages in 1989 were $1 million. These are converted to 1995 values using the formula:

$$\text{Real Damages}_{1995\,\$} = \text{Nominal Damages}_{1989\,\$} * (\text{GDP price deflator}_{1995}/\text{GDP price deflator}_{1989})$$

$$= \$1{,}000{,}000_{(1989\,\$)} * (129.7/108.5)$$
$$= \$1{,}195{,}392$$

The next step is to calculate the present values of the real annual economic damage estimates. These values are then summed to get a total present value damage estimate. For example, the 1995 present value of 1989 damages is expressed by:

$$\text{Present Value of Damages}_{(1995)} = \$1{,}195{,}392 * (1 + 0.07)^{(1995-1989)}$$
$$= \$1{,}793{,}961$$

The total present value damages in this example are $25,450,000. This damage estimate assumes a seven percent real discount rate. For this example, damages given a three percent real discount rate would be $23,254,000. In this case the trustees might decide to use an alternative rate, or given the relatively small difference in these values and other sources of uncertainty in the estimate, simply make a claim based on DOI's suggested discount rate of seven percent.

## 6.5 Expressing Damage Assessment Costs in Present Value Terms

Both DOI's final rule and NOAA's proposed rule for damage assessment direct trustees to calculate interest on costs incurred in completing the damage assessment [43 CFR 11.15(a)(4) and 15 CFR 990.14]. Specifically, CERCLA and OPA allow for the collection of pre- and post-judgement interest from the later of (1) the point in time the claim is presented to the responsible party, and (2) the point in time assessment costs are incurred. In some cases responsible parties will be willing to pay for the conduct of damage assessment activities as they occur. In many cases, however, trustee agencies will effectively need to "borrow" the required funds pending settlement with the responsible party. For example, a Fish and Wildlife field office may request funds from Interior's Natural Resource Damage Assessment Fund to conduct a preassessment screen at a site. Thus, it is appropriate for trustees to recover interest on those funds expended for damage assessment activities.

For DOI and other federal agencies, one approximation of the cost of funds used for damage assessment activities is the federal funds rate. The federal funds rate represents the interest rate charged by banks with excess reserves in the Federal Reserve Bank system to banks needing overnight loans to meet their reserve requirements. This rate is considered the most sensitive indicator of the direction of interest rates, since it is set daily by the market.

[6] Had these values been expressed in real terms, this first step would be unnecessary.

Exhibit 6-5 reports equivalent annual rates for the time period 1980 to the present.[7] In order to calculate the present value (PV) amount due on funds expended for purposes of damage assessment, trustees should apply the following formula:

$$\text{PV of Costs}_{(\text{Current Year})} = \text{Costs}_{(\text{Year N})} * (1 + \text{Federal Funds Rate}_{(\text{Year N})})^{(\text{Current Year - Year N})}$$

**Exhibit 6-5**

**FEDERAL FUNDS RATE**

| Year | Equivalent Annual Yield to 1995 |
|---|---|
| 1980 | 8.22% |
| 1981 | 7.86% |
| 1982 | 7.23% |
| 1983 | 6.83% |
| 1984 | 6.62% |
| 1985 | 6.27% |
| 1986 | 6.07% |
| 1987 | 5.98% |
| 1988 | 5.88% |
| 1989 | 5.60% |
| 1990 | 4.89% |
| 1991 | 4.11% |
| 1992 | 3.58% |
| 1993 | 3.61% |
| 1994 | 4.21% |

Source: U.S. Federal Reserve

Thus, a present value would be calculated for each year in which costs were incurred, and summed to generate a total present value assessment cost estimate, as demonstrated in the following example. Note that these equivalent annual rates are expressed in nominal terms; thus, trustees should report assessment costs in nominal terms (i.e., trustees should not adjust these costs for inflation) and apply the rates reported to generate a present value damage claim. This guidance differs from that suggested for discounting past and future compensable damages, since the appropriate nominal discount rates used in these calculations are known, and past assessment costs are generally expressed in nominal terms.

## Example: Calculation of Present Value Damage Assessment Costs

Exhibit 6-6 provides an example application of discounting principles to estimate the present value of costs incurred by trustees during a natural resource damage assessment. This example is an extension of the one presented above, in which the release of PCBs and other toxics from an uncontrolled hazardous waste site has resulted in the contamination of a creek. The trustees undertook several studies in order to assess damages at this site. In addition, the trustees incurred costs while completing a preassessment screening document and preliminary damage assessment for this site, and while planning for and administering the injury and economic damage studies. These costs are summarized in the first column of Exhibit 6-6. Note again that these costs are expressed in nominal terms.

Using the equivalent annual yields shown in Exhibit 6-5, we estimate the total present value assessment costs for this case to be approximately $439,000. Since the equivalent annual yields reported in Exhibit 6-5 are expressed in nominal terms, there is no need to convert the assessment cost estimates to real values.

[7] The federal funds rate has varied through time; to reduce the number of calculations that trustees would need to perform we have calculated "equivalent annual rates," which if paid every year, would yield the same value at the end of a period as would be obtained by applying the actual annual rates for each relevant year during the period.

## 6.6 Capital Budgeting for Purposes of Restoration Costing

The final component of the natural resource damage claim for which a present value damage estimate must be established is the cost of planned restoration activities. The question trustees must ask is: what level of funds, if invested today, will yield a flow of funds sufficient to cover expected costs of the selected restoration program? This section describes the approach that should be followed in estimating this component of the claim.

### 6.6.1 Interest on Recovered Funds

In order to develop a single, present value damage claim, and to compare the present value cost of two or more restoration options, trustees need to consider the expected rate-of-return on recovered funds. This analytic step in the costing process involves calculating the dollar amount which, if paid and invested today, will yield a flow of funds sufficient to cover the expected cost of the restoration action. The rate of return assumed for this analysis should reflect the rate of interest the trustees expect to receive on the invested funds.

**Exhibit 6-6**

**EXAMPLE CALCULATION OF PRESENT VALUE ASSESSMENT COSTS**

| Year | Assessment Costs Incurred | Present Valu Calculation[1] | | Present Value |
|---|---|---|---|---|
| 1992 | $60,000 | $*(1+0.0358)^{(1995-1992)}$ | = | $66,677 |
| 1993 | $240,000 | $*(1+0.0361)^{(1995-1993)}$ | = | $257,641 |
| 1994 | $110,000 | $*(1+0.0421)^{(1995-1994)}$ | = | $114,631 |
| TOTAL | | | | $438,949 |

[1]Note: Calculation expresses costs in nominal dollars, and thus applies nominal discount rates.

There are a wide-range of investment opportunities available in the market, paying a wide-range of interest rates. Two questions relevant to a damage assessment are: what investments are available to trustees for recovered damages, and what are the expected interest rates on those investments? Trustees in natural resource damage cases must invest recovered funds to ensure a reliable flow of funds to cover anticipated costs of restoration actions. Thus, a low-risk investment with a steady and predictable yield is appropriate.

One type of account that is widely used for the investment of damages recovered in court is the United States Courts, Court Registry Investment System (CRIS). The CRIS is a cash management system for handling court registry funds. The Registry pools funds from a number of individual cases, which are then deposited in the Federal Reserve Bank or invested in U.S. Treasury securities with maturities of less than 100 days. From March of 1991 through March of 1992 the average return on CRIS investments was 4.95 percent (which is a nominal rate). This return is comparable to the rate of return received on commercial money market funds during this same period. Given the nature of this investment, the CRIS appears to be one reasonable and conservative investment strategy for natural resource trustees.[8]

[8] A second investment option is the Department of Interior's Natural Resource Damage Assessment and Restoration (NRDAR) Fund. Service personnel should consult with the case solicitor to determine whether this fund is an

In order to calculate the present value damage claim in a case, trustees will need to forecast the expected rate of return on funds recovered for the purpose of funding proposed restoration activities. For example, CRIS funds are invested in U.S. Treasury securities with maturities of less than 100 days (e.g., 90-day Treasury Bills). Thus, to determine the expected yield on an investment in the CRIS account, trustees need to consider the expected yield on 90- day Treasury bills over the time period during which funds will be required to accomplish the restoration objectives. Future yields on Treasury Bills are obviously unknown, but trustees can look at past yields as a general indication of likely future yields. For example, trustees might consider the last ten years as a reasonable base period (i.e., 1985 to 1994) for predicting returns over the next ten years. The average return in 90-day Treasury bills during this period of time was approximately 5.77 percent. This rate must be adjusted to reflect some transactions costs associated with the management of these funds. For example, historical costs indicate that investments in the CRIS account for more than 15 years will be charged a fee of 2.5 percent on all earned income. This 2.5 percent must be subtracted from the rate earned by the investment to provide the true yield available to the trustees. Thus, the trustees would receive an expected average yield of 5.63 percent on their investments in the CRIS account.[9] It is this rate that would be applied to calculate the present value of the claim.

The CRIS account example is provided for illustrative purposes only; trustees should consider the expected rate of return on recovered funds on a case-by-case basis. In many instances, the DOI solicitor assigned to the case will be able to provide guidance on the types of investment options available for recovered funds, and thus the rate-of-return to assume in establishing a damage claim. It is important to note, however, that the rate of interest assumed in estimating the present value cost of capital should not be assumed to be the discount rate suggested in the DOI rule.

## EXAMPLE: ESTIMATING THE PRESENT VALUE OF A RESTORATION COST CLAIM

Chapter 3 considers an example budget for a bird recolonization project. The question facing the trustees in this example is: What level of funds, if recovered and invested today, would yield a flow of funds sufficient to cover the expected costs of the selected restoration action? This project was expected to extend over 10 years, beginning three years from the assumed settlement date of 1994, as shown in Exhibit 6-7.

The discount rate used in this example (i.e., the expected rate-of-return on recovered funds) is 5.63 percent. For example, the total expected cost of all required activities in 2004 is $609,114. The present value of this amount, in 1994 dollars, is $352,230, calculated as:

$$\text{Present Value}_{(1994)} = \text{Cost of Project}_{(2004)} * (1 + \text{Assumed Interest Rate})^{(1994\text{-}2004)}$$

Thus, in the example given, the calculation was:

$$\text{Present Value}_{(1994)} = \$609{,}114 * (1.0563)^{-10},$$
$$\text{Present Value}_{(1994)} = \$352{,}230.$$

appropriate investment vehicle for recovered damages.

[9] 5.77% - (2.5% * 5.77%) = 5.63%

That is, $352,230 deposited in 1994 at 5.63 percent interest, compounded annually, will be worth $609,114 in 2004.[39]

This same calculation was performed for each of the years in which costs were expected. The total cost of this project, expressed in present value terms, was approximately $4.5 million. Thus, if the trustees successfully recovered $4.5 million from the responsible party, and deposited this amount in an account that pays an annual interest rate of 5.63 percent, they would have sufficient funds to pay for the planned restoration program.

**Exhibit 6-7**

**A CAPITAL BUDGETING EXAMPLE**

| Year | Restoration Funds Required | Present Value Calculation | Present Value of Annual Restoration Costs (1994 $) |
|---|---|---|---|
| 1997 | $898,522 | $*(1 + .0563)^{(1994-1997)} =$ | $762,372 |
| 1998 | $614,922 | $*(1 + .0563)^{(1994-1998)} =$ | $493,936 |
| 1999 | $638,953 | $*(1 + .0563)^{(1994-1999)} =$ | $485,884 |
| 2000 | $622,947 | $*(1 + .0563)^{(1994-2000)} =$ | $448,464 |
| 2001 | $688,986 | $*(1 + .0563)^{(1994-2001)} =$ | $469,569 |
| 2002 | $712,569 | $*(1 + .0563)^{(1994-2002)} =$ | $459,757 |
| 2003 | $584,503 | $*(1 + .0563)^{(1994-2003)} =$ | $357,027 |
| 2004 | $609,114 | $*(1 + .0563)^{(1994-2004)} =$ | $352,230 |
| 2005 | $633,483 | $*(1 + .0563)^{(1994-2005)} =$ | $346,797 |
| 2006 | $660,223 | $*(1 + .0563)^{(1994-2006)} =$ | $342,171 |
| Total Present Value, 1997-2006 (1994 $) | | | $4,518,207 |

[39] Readers should note that, since the restoration costs presented in this example are expressed in nominal terms, we apply a nominal discount rate.