United States
Department of
Agriculture

Soil
Conservation
Service

Northeast NTC
160 E. 7th Street
Chester, PA 19013

August 1, 1985

ECONOMICS TECHNICAL NOTE NO. N1
200-VI

SUBJECT: ECN - COMPUTING PROJECT BENEFITS DUE TO SAVINGS IN FUTURE COSTS

Purpose. To transmit Economics Technical Note No. N1 - Computing Project Benefits Due to Savings in Future Costs - and cancel TSC Technical Note Watersheds UD-6.

Effective Date. When received.

Filing Instructions. File the enclosure with NENTC Economics Technical Notes. Remove and destroy TSC Technical Note - Watersheds UD-6, including revision.

Scott Hoag Jr

Scott Hoag, Jr.
Acting Head, Economics, Social Science
and Evaluation Staff

Enclosure

DIST: N, T, NE-S

United States
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TECHNICAL NOTE

ECONOMICS NO. N1

COMPUTING PROJECT BENEFITS DUE TO SAVINGS IN FUTURE COSTS

This technical note presents a procedure for calculating savings in future costs, other than costs incurred for repairing flood damages, and suggests how the benefits are to be treated in project benefit-cost analysis.

Benefits due to savings in future costs are the reductions in future installation or replacement costs and in ordinary flood-free operating and maintenance costs. Savings in future costs may occur due to a project that permits the installation of a cheaper facility that provides the same purpose as would a more expensive installation without the project. Estimated savings in future costs may be evaluated in monetary terms and used for the justification of the project measures that bring about these savings. An acceptable procedure for determining the reductions in future expenditures attributable to the project is to subtract the expected "with project" future expenditures from the "without project" future expenditures.

The following example, using a bridge to represent future costs, illustrates an acceptable way to evaluate project benefits due to savings in future costs:

Situation

A bridge located downstream from a proposed flood water retarding structure is planned to be replaced in 20 years. Without a project, it will be replaced in 20 years and again in 95 years at an estimated installation cost of $1,000,000. Annual O&M cost of the new bridge is $1,000. With a project installed, the bridge can be replaced with a culvert in 20 years and again 65 years hence, at a cost of $100,000 for replacement and an annual O&M cost of $200.

Revised by: Scott Hoag, Jr.
Economist
April 1985

DIST: NE S, T, N

Problem

What is the average annual benefit provided by a project which permits a bridge to be replaced with a culvert?

Solution

a. Determine the present value of the future "without project" bridge installation and O&M expenditures.

   For Example:

   1. $1,000,000 x .20018 1/ = $200,178
   2. $1,000,000 x .00048 2/ = $480
   3. $1,000 x 11.92113 3/ x .20018 1/ = $2,386
   4. Total = $203,044

b. Similarly, determine the present value of the future "with project" bridge (culvert) expenditures.

   For Example:

   1. $100,000 x .20018 1/ = $20,018
   2. $100,000 x .00537 4/ = $537
   3. $200 x 11.92113 3/ x .20018 1/ = $477
   4. Total present value = $21,032

c. Determine the benefit as an average annual value of the savings in future costs by subtracting "b" from "a" and amortizing over the project evaluation period. The hydrology should be checked for remaining damages.

   For Example:

   1. $203,044 - 21,032 = $182,012
   2. $182,012 x .08378 5/ = $15,248

The evaluation of savings in future costs does not affect the evaluation of flood water stage-damage reduction. These savings are treated as damage reduction benefits and are added to the "without project" damages based on Stage-Damage, Stage-Discharge, and Discharge-Frequency data to determine the total "without project" damages. The remaining damage "with project" is deducted from the total "without project" damage to determine the total damage reduction benefit.

These procedures can apply to affects of watershed protection projects as well.

1/ Present value of 1, 20 years hence, at 8 3/8 percent interest.

2/ Present value of 1, 95 years hence, at 8 3/8 percent interest.

3/ Present value of an annuity of 1, 80 years, at 8 3/8 percent interest.

4/ Present value of 1, 65 years, 8 3/8 percent interest.

5/ Amortization factor for 100 years, at 8 3/8 percent interest.

(1)

EXAMPLE

Computing Benfits and Costs in Present Value Terms

Economics Division, NO
February, 1980

AVAILABLE DATA--MIDWEST AGRIC. W/S
(50 yr. evaluation period @ 7 1/8%)

Construction Period Yr.	Structure	Costs (Installation)	Costs (O&M)	Benefits (Avg. Ann.)
		FLOOD PREVENTION		
1	*3-A	225,000	(6,800)	24,800
2	4-B, 5-A	800,000	(24,000)	88,300
		800,000	(24,000)	88,300
3	5-A	825,000	(24,800)	91,000
4	1-B, 6-C	450,000	(13,500)	49,700
		450,000	(13,500)	49,700
5	4-C, 7-A	400,000	(12,000)	44,200
		360,000	(10,800)	39,700
		4,310,000	(129,400)	475,700
		RECREATION		
1	*3-A	225,000	(6,800)	---
2	---	---	---	---
3	---	---	---	---
4	*Facilities	300,000	(9,000)	57,900
5	---	---	---	---
		525,000	(15,800)	57,900

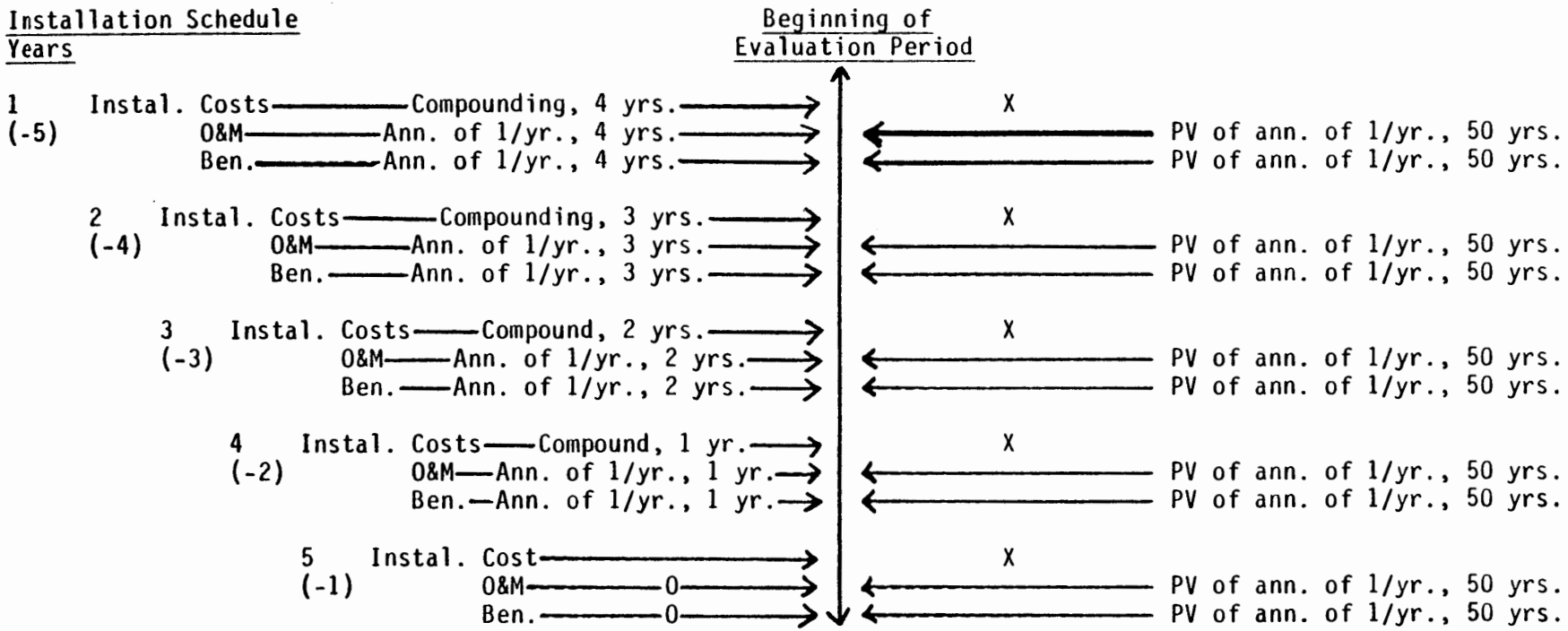
PRESENT VALUE COSTS
(beginning of evaluation period)

		FLOOD PREVENTION	
1	*3-A	225,000 X 1.31693 1/ =	296,300
		6,800 X 4.44816 2/ =	30,200
		6,800 X13.58564 3/ =	92,400
		Sub total	418,900

* Multi-purpose structure

1/ Compound interest, 4 yrs.
2/ Ann. of 1/yr., 4 yrs.
3/ PV, ann. of 1/yr., 50 yrs.
4/ Compound interest, 3 yrs.
5/ Ann. of 1/yr., 3 yrs.
6/ Compound interest, 2 yrs.
7/ Ann. of 1/yr., 2 yrs.
8/ Compound interest, 1 yr.

COMPUTING BENEFITS AND COSTS AT A COMMON POINT IN TIME



		FLOOD PREVENTION CONT.	
2	4-B	800,000 X 1.22935[4/] =	983,500
		24,000 X 3.21882[5/] =	77,300
		24,000 X 13.58564[3/] =	326,100
		Sub total	1,386,900
	5-A	800,000 X 1.22935[4/] =	983,500
3	5-A	825,000 X 1.14758[6/] =	946,800
		48,800 X 2.07124[7/] =	101,100
		48,800 X 13.58564[3/] =	663,000
		Sub total	2,694,400
4	1-B	450,000 X 1.07125[8/] =	482,100
		13,500 X 1.00[9/] =	13,500
		13,500 X 13.58564[3/] =	183,400
		Sub total	679,000
	6-C	450,000 X 1.07125[8/] =	482,100
		13,500 X 1.00[9/] =	13,500
		13,500 X 13.58564[3/] =	183,400
		Sub total	679,000
5	4-C	400,000 X 1.00[9/] =	400,000
		12,000 X 13.58564[3/] =	163,000
		Sub total	563,000
	7-A	360,000 X 1.00[9/] =	360,000
		10,800 X 13.58564[4/] =	146,700
		Sub total	506,700
		RECREATION	
1	*3-A	225,000 X 1.31693[1/] =	296,300
		6,800 X 4.44816[2/] =	30,200
		6,800 X 13.58564[3/] =	92,400
		Sub total	418,900
4	*Facilities	300,000 X 1.07125[8/] =	321,400
		9,000 X 1.00[9/] =	9,000
		9,000 X 13.58564[3/] =	122,300
		Sub total	452,700
		Grand total	7,799,500

Present Value Benefits (beginning of evaluation period)

		Flood Prevention	
1	*3-A	24,800 X 4.44816[2/] =	110,300
		24,800 X 13.58564[3/] =	336,900
		Sub total	447,200
2	4-B	88,300 X 3.21882[5/] =	284,200
		88,300 X 13.58564[3/] =	1,199,600
		Sub total	1,483,800
3	5-A	179,300 X 2.07124[7/] =	371,400
		179,300 X 13.58564[3/] =	2,435,900
		Sub total	2,807,300
4	1-B	49,700 X 1.00[9/] =	49,700
		49,700 X 13.58564[3/] =	675,200
		Sub total	724,900
	6-C	49,700 X 1.00[9/] =	49,700
		49,700 X 13.58564[3/] =	675,200
		Sub total	724,900
5	4-C	44,200 X 13.58564[3/] =	600,500
		Sub total	600,500
	7-A	39,700 X 13.58564[3/] =	539,300
		Sub total	539,300
		Recreation	
4	*Facilities	57,900 X 1.00[9/] =	57,900
		57,900 X 13.58564[3/] =	786,600
			844,500
		Grand Total	8,172,400

Present Value--Benefits = $8,172,400

Present Value--Costs = $7,799,500

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Regional Technical Service Center
Upper Darby, Pennsylvania

June 21, 1966

TSC TECHNICAL NOTES - WATERSHEDS UD-6

To: State Conservationists, Northeast States

From: Head, Engineering and Watershed Planning Unit

Re: Economics - Computing Project Benefits due to Savings in Future Costs

This technical note cancels Watersheds-Economics Memorandum EWP-7 (UD). This note presents a procedure for converting savings in future costs, other than those costs incurred for repairing flood damages, into equivalent average annual values and how the benefits are to be treated in watershed work plans.

Benefits due to savings in future costs are the reductions in future installation or replacement costs and in the ordinary flood-free operating and maintenance costs. Savings in future costs may occur due to a project that permits the installation of a cheaper facility to provide the same purpose as would a more expensive installation without the project. Estimated savings in future costs may be evaluated in monetary terms and used for the justification of the project measures that bring about these savings. An acceptable procedure for determining the reductions in future expenditures attributable to the project is to subtract the expected "with project" future expenditures from the "without project" future expenditures.

The following example, using a bridge to represent future costs, illustrates an acceptable way to evaluate project benefits due to savings in future costs:

Situation

A bridge located downstream from a proposed floodwater retarding structure is planned to be replaced in 20 years. Without a project, it will be replaced in 20 years and again in 95 years at an estimated installation cost of $100,000. The annual O&M cost of the bridge is $100, which does not include any costs for repairing damages due to flooding. With a project installed, the bridge can be replaced with a culvert in 20 years and again 65 years hence at a cost of $10,000 for replacement and with an annual O&M cost of $20.

Problem

What is the average annual benefit provided by a project which permits a bridge to be replaced with a culvert?

Solution:

a. Determine the present value of the future "without project" bridge installation and O&M expenditures by discounting for the lag period.

For Example:

1. $100,000 x .55368 [1] = $55,368
2. $100,000 x .06032 [2] = $6,032
3. $100 x 30.20076 [3] x .55368 [1] = $1,672
4. Total present value = $63,072

b. Similarly, determine the present worth value of the future "with project" bridge (culvert) expenditures.

For Example:

1. $10,000 x .55368 [1] = $5,537
   $10,000 x .14641 [4] = $1,464
2. $20 x 30.20076 [3] x .55368 [1] = $334
3. Total present value = $7,335

c. Determine the benefit as an average annual value of the savings in future costs by subtracting "b" from "a" and amortizing over the project evaluation period.

For Example:

1. $63,072 - $7,335 = $55,737
2. $55,737 x .03165 [5] = $1,764

An alternative evaluation procedure is to measure the difference between the annual costs of a bridge without a project and a culvert with a project. The annual costs are the sum of the amortized installation costs, based on life expectancy, plus the average annual operation and maintenance costs. The annual benefit due to the project is computed by subtracting the annual costs with a project from the annual costs without a project, and discounting for lag in accrual.

For Example:

Employing the same data as above, the benefits would be computed as follows:

a. Determine the annual bridge costs "without project"

1. Amortized installation costs = $100,000 x .03367 [6/] = $3,367
2. O&M costs = $100
3. Total annual costs = $3,467

b. Similarly, determine the annual costs (culvert) "with project"

1. Amortized installation cost = $10,000 x .04079 [7/] = $408
2. O&M costs = $20
3. Total annual costs = $428

c. Determine the average annual benefit due to savings in future costs and discounting for lag in accrual

1. Annual costs "without project" = $3,467
2. Annual costs "with project" = $428
3. Savings in future costs = $3,039
4. Discounted for lag in accrual = $3,039 x .55368 [1/] = $1,683

The evaluation of savings in future costs in no way affects the evaluation of floodwater stage-damage reduction which is a reduction in the extra costs incurred over and above ordinary operating and maintenance costs. The "without project" situation is the common basis from which all "with project" effects are evaluated, whether it be the reduction in the extra repair costs of a bridge due to floods or a reduction in future installation and O&M costs.

The savings in future costs are treated as damage reduction benefits. The savings in future costs, which represent extra costs due to "without project" flood flows as compared to flows "with project" are <u>added</u> to the "without project" damages based on Stage-Damage, Stage-Discharge, and Discharge-Frequency data to determine the total "without project" damages. The remaining damage "with project" is <u>deducted</u> from the total "without project" damage to determine the total damage reduction benefit.

1/ Present value of 1, 20 years hence, at 3 percent interest.

2/ Present value of 1, 95 years hence, at 3 percent interest.

3/ Present value of an annuity of 1 per year, for 80 years, at 3 percent interest.

4/ Present value of 1, 65 years hence, at 3 percent interest.

5/ Amortization factor for 100 years, at 3 percent interest.

6/ Amortization factor for 75 years, at 3 percent interest.

7/ Amortization factor for 45 years, at 3 percent interest.

The following example illustrates the above procedure and how the data is recorded in Table 5 of watershed work plans:

Evaluated Data: Roads and Bridges

	Project Effects to Roads and Bridges	
	Without Project	With Project
Damages based on Stage-Damage, Stage-Discharge, and Discharge-Frequency Data	400	50
Savings in future costs as representing extra costs	1,764	-
Total	$2,164	$ 50

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

David Creek Watershed, Middlestate

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
(1)	(2)	(3)	(4)
Floodwater			
Crop and Pasture	-	-	-
Nonagricultural			
Road and Bridge	2,164	50	2,114
Subtotal	-	-	-

Generally, the effects of land treatment measures are not sufficient to induce savings in future costs. Therefore, damage reduction benefits attributed to land treatment measures are limited to reductions in damages due to reduced flood stages. In the above example, the effects of land treatment measures are included in the $350 reduction ($400 to $50) in damages.

Distribution:
Northeast States - 5
C. J. Francis - 1
H. O. Ogrosky - 3
E. C. Ford - 1
H. L. Porter - 1
Other EWP Units - 2

Harold M. Kaeck