

SECTION 10 - PROJECT COSTS, SUMMARY OF BENEFITS, AND ECONOMIC JUSTIFICATION

PROJECT COSTS

FIRST COSTS

Project expenditures by year in 1996 dollars , exclusive of mitigation costs, are displayed in table 10 - 1 for each alternative. Total costs for lock construction alternatives range from \$377.7 million for the 900 x 90 x 22 alternative to \$460.7 million for the 1200 x 110 x 36 alternative. The 1200 foot length plans or the 36 foot sill plans have a 13-year implementation period. The remaining lock construction alternatives require a 12-year implementation period. The Bridge Only alternative, which requires construction of a new mid-level bridge at St. Claude Ave., has a total construction cost of \$42.9 million and a required implementation period of eight years.

In addition to the construction costs described above, total project first costs also include mitigation costs of \$33.0 million for the lock construction alternatives and \$18.2 million for the Bridge Only plan. Mitigation costs by year are identified in table 10 - 2.

Representing a National Economic Development (NED) cost, and included in total project first costs, are navigation losses during construction. Navigation losses during construction represent the loss of existing deep-draft access that would occur during the last two years of construction for all lock construction plans. Depending on the alternative, these last two years of construction are either 2008-2009 or 2009-2010. Mitigation costs and deep-draft losses during construction, along with project construction costs, are summarized in table 10 - 3.

OPERATIONS MAINTENANCE & REPLACEMENT COSTS

Operations, maintenance, and replacement (OM&R) costs for the lock construction scenarios are based on the following schedule of items. Operations costs for all barge and ship locks are \$1,150,000 annually. Minor maintenance for all lock plans is estimated at \$150,000 annually. Dewaterings and major repairs would be required every 15 years at a cost of \$2,250,000 for the ship locks and \$2,200,000 for the barge locks.

Table 10 - 1

Construction Expenditures By Year
Exclusive of Mitigation Cost
(1996 Prices; \$1,000's)

Year	Bridge Only	900 x 90 x 22	900 x 110 x 22	900 x 110 x 36	1200 x 90 x 22	1200 x 110 x 22	1200 x 110 x 36
1998	629.8	5,152.4	5,328.4	5,884.1	5,569.9	5,953.5	6,157.2
1999	629.8	31,773.0	31,972.9	32,604.4	30,577.5	32,683.1	32,914.7
2000	678.3	29,819.4	29,952.3	30,302.3	28,324.3	30,274.8	30,490.4
2001	1,573.9	20,067.2	20,173.4	21,180.3	19,570.0	20,917.6	21,576.4
2002	3,165.8	14,026.2	13,205.3	15,154.2	13,745.5	14,692.0	15,513.0
2003	10,497.4	65,592.2	66,171.9	69,928.9	67,704.0	72,366.2	77,053.6
2004	14,086.4	36,948.5	44,288.6	41,739.9	40,550.9	43,343.3	49,056.0
2005	11,638.6	47,556.5	55,864.5	63,917.0	58,195.7	62,203.1	61,626.3
2006		37,688.5	35,382.4	38,368.3	35,263.8	37,692.1	41,247.4
2007		37,224.1	38,592.0	45,935.3	42,420.2	45,341.3	49,461.7
2008		27,504.2	23,488.7	26,996.5	26,365.2	28,180.8	29,674.9
2009		24,347.8	28,079.6	26,364.7	22,402.2	23,944.8	24,816.7
2010				10,924.1	7,210.8	7,707.4	21,111.7
Total	42,900.0	377,700.0	392,500.0	429,300.0	397,900.0	425,300.0	460,700.0

Table 10 - 2

Mitigation Expenditures By Year
(1996 Prices; \$1,000's)

Year	Bridge Only	900 ft Length and 22 Foot Sill Construction Alternatives	1200 ft Length or 36 foot Sill Construction Alternatives
1999	300.0	6,570.0	6,570.0
2000	37.5	187.5	187.5
2001	4,978.6	187.5	187.5
2002	4,310.3	6,376.8	6,376.8
2003	2,824.8	6,549.2	6,549.2
2004	2,585.8	332.5	332.5
2005	3,119.4	3,042.5	332.5
2006		1,017.5	3,042.5
2007		4,875.9	1,017.5
2008		2,824.9	4,543.4
2009		1,043.0	2,824.9
2010			1,043.0
Total	18,156.4	33,007.3	33,007.3

Table 10 - 3
 Cost Summary
 (1996 \$1,000, 7.375 Percent)

	Remove Bridge Curfews	Bridge Only	900x90x22	900x110x22	900x110x36	1200x90x22	1200x110x22	1200x110x36
Construction Costs	0	42,900	377,700	392,500	429,300	397,900	425,300	460,700
Mitigation Costs	0	18,156	33,007	33,007	33,007	33,007	33,007	33,007
Nav Losses During Const	0	0	2,546	2,546	2,588	2,588	2,588	2,588
Total Costs	0	61,056	413,253	428,053	464,895	433,495	460,895	496,295
P.V. Const Costs	0	49,581	571,002	592,174	686,322	639,102	683,112	730,426
P.V. Mitigation Costs	0	22,407	51,901	51,901	54,677	54,677	54,677	54,677
P.V. Nav Losses	0	0	2,735	2,735	2,780	2,780	2,780	2,780
Total P.V. Costs	0	71,988	625,638	646,810	743,779	696,559	740,569	787,883
Annual Construction Costs	0	3,764	43,346	44,954	52,101	48,517	51,857	55,449
Annual Mitigation Costs	0	1,701	3,936	3,939	4,150	4,150	4,150	4,150
Annual Nav Losses	0	0	208	208	211	211	211	211
Annual Permanent DD Losses	0	0	477	477	0	486	486	0
Annual O&M Costs	0	0	1,382	1,382	1,384	1,382	1,382	1,384
Induced Vehicular Losses	8,581	0	0	0	0	0	0	0
Total Annual Cost	8,581	5,465	49,352	50,960	57,846	54,745	58,086	61,194
Base Year	1998	2006	2010	2010	2011	2011	2011	2011

AVERAGE ANNUAL COSTS

Table 10 - 3 displays the composition of the total first cost estimates for each alternative, the present value cost necessary to calculate average annual costs, and lastly, the average annual cost associated with each cost item. Annual costs include two items not previously discussed, Permanent Deep-Draft Losses and Induced Vehicular Losses. Permanent Deep-Draft Losses represent the reduction in deep-draft service that would occur over the 50-year project life, and applies to all 22-foot sill alternatives. Induced Vehicular Losses represents the net loss to vehicular traffic. This category applies only to the Remove Bridge Curfew alternative.

All costs in table 10 - 3 represent 1996 price levels. Annual costs were calculated using an interest rate of 7.375 percent, a 50-year project life, and an alternative specific base year as indicated in the table.

BENEFIT PRICE LEVEL UPDATING

OVERVIEW

Price level updating must be employed in order to represent all benefit categories, some of which were originally developed at varying price levels, in the same 1996 dollars used for project costs. As detailed in previous sections of this appendix, shallow-draft, deep-draft, and vehicular benefits were initially computed in 1992, 1993, and 1992 prices, respectively. Navigation Losses Prevented from Rehabilitation Closures were also initially computed in 1992 dollars since this benefit category is based on the initial shallow-draft calculations. Savings to Federal Projects, however, require no price level adjustment since the benefit category is based on OM&R and extraordinary maintenance costs which already reflect 1996 prices. The following paragraphs detail the updating procedure used for each category.

SHALLOW-DRAFT

IWR shallow-draft vessel operating costs were used as the basis for updating the price level of the shallow-draft benefits detailed in Section 7 of this appendix. As a first step, FY 91 and FY 95 IWR costs for individual towboat sizes and barge types were compared, and the percent change for each piece of equipment was calculated. These results are displayed in table 10 - 4. As the table indicates, towboat operating costs over the period showed a decrease of approximately 4.9 percent to an increase of 8.3 percent. Barge costs over the same period showed a

Table 10 - 4
IWR Shallow-Draft Vessel Operating Costs
(Total Hourly Cost)

	Towboat Operating Cost										
	Horsepower										
	1200	1400 - 1600	1800 - 2000	2200 - 2400	2800 - 3400	4000 - 4400	5000 - 6000	6100 - 7000	7100 - 8000	8100 - 9000	10,000
FY 1991, Int=8.75%	138.2	152.36	182.98	217.46	264.45	316.34	374.62	431.94	457.08	503.53	568.14
FY 1995, Int=7.75%	132.90	154.00	180.95	206.90	256.84	322.71	397.96	457.37	488.88	540.77	615.10
% Change	-3.8%	1.1%	-1.1%	-4.9%	-2.9%	2.0%	6.2%	5.9%	7.0%	7.4%	8.3%

	Barge Operating Cost										
	Barge Type										
	Deck	Deck	Open Hopper	Open Hopper	Covered Hopper	Tank db skin without coils	Tank db skin without coils	Tank db skin without coils	Tank db skin with coils	Tank db skin with coils	Tank db skin with coils
	130x35	195x35	175x26	195x35	195x35	195x35	240x50	290x50	195x35	240x50	290x50
FY 1991, Int=8.75%	2.82	4.11	2.97	3.77	4.19	9.7	16.41	21.24	10.53	17.46	22.54
FY 1995, Int=7.75%	2.31	3.65	2.5	3.23	3.73	10.16	17.61	21.14	10.69	18.27	21.85
% Change	-18.1%	-11.2%	-15.8%	-14.3%	-16.9%	4.7%	7.3%	-0.5%	1.5%	4.6%	-3.1%

decrease of approximately 18.1 percent to an increase of 7.3 percent.

In order to convert these ranges of values to a single value that could be used as an index value to be applied to shallow-draft benefits, a typical tow was constructed for each of the major commodity groups. Using the cost of each typical tow, a weighted average tow cost for each year, FY 91 and FY 95, was calculated using tons of each commodity as the weighting factor. The ratio of the FY 95 weighted tow cost to the FY 91 weighted tow cost was used as the index factor to convert from 1991 to 1995 prices. The calculated index factor was 0.985 representing a 1.5 percent decrease over the four year period. As previously indicated, shallow-draft benefits were calculated in 1992 prices, therefore, three years of price level updating was required to reflect these benefits in 1995 prices. To accomplish this, a straight line change was assumed for the 1991-1995 period, with a 1.125 percent decrease (1.5 percent times 3/4) therefore, representing the 1992-1995 period. As FY 95 IWR cost represented the latest available data at the time of this writing, it was assumed for the purpose of price level updating that the 1992-1995 change was appropriate to reflect the 1992-1996 change.

DEEP-DRAFT

IWR deep-draft vessel operating costs were used as the basis for updating the price level of the deep-draft benefits detailed in Section 8 of this appendix. FY 1993 and FY 1995 IWR operating costs were compared and the percent change was calculated for each dwt class within the vessel types demanding to use an IHNC Lock with no physical constraints. As table 10 - 5 indicates, operating costs over this period showed a decrease of approximately 7 to 28 percent for dry bulk vessels; an increase of approximately 8 percent to a decrease of 13 percent for general cargo vessels and a decrease of approximately 2 to 17 percent for container vessels. (It should be noted that IWR does not report operating costs for general cargo vessels with a dwt less than 11,000 tons even though there are general cargo vessels of this size demanding to use the IHNC Lock. As a result, a simple regression analysis was performed on the reported cost information to calculate the approximate operating costs associated with a dwt class of 3,000 tons and a dwt class having a range of 3,000 tons to 10,000 tons.)

A weighted average of FY 1993 and FY 1995 operating cost was then developed for each of the three vessel types discussed above. The number of ships demanding a lockage within each dwt class was used as the weighting factor. The

Table 10 - 5

IWR Deep-Draft Vessel Operating Costs
(Total At Sea Hourly Cost; DWT in Thousands)

Vessel Type: Dry Bulk, Foreign Flag	Cost DWT 0 - 10		Cost DWT 10 - 20		Cost DWT 20 - 30		Cost DWT 30 - 40		Cost DWT 40 - 50		Total # Ships	Total Wgtd Cost
	# Ships	Wgt Cost	# Ships	Wgt Cost	# Ships	Wgt Cost	# Ships	Wgt Cost	# Ships	Wgt Cost		
FY 1993	1	\$10.18	4	\$45.16	16	\$198.04	20	\$269.33	4	\$58.31	45	\$581.02
FY 1995	1	\$7.36	4	\$36.27	16	\$172.44	20	\$243.56	4	\$54.18	45	\$513.80
% Change		-27.7%		-19.7%		-12.9%		-9.6%		-7.1%		-11.6%

Vessel Type: General Cargo, Foreign F	Cost DWT 3		Cost DWT 3 - 10		Cost DWT 10 - 20		Cost DWT 20 - 30		Cost DWT 30 - 40		Total # Ships	Total Wgtd Cost
	# Ships	Wgt Cost	# Ships	Wgt Cost	# Ships	Wgt Cost	# Ships	Wgt Cost	# Ships	Wgt Cost		
FY 1993	110	\$254.74	3	\$8.57	20	\$83.76	20	\$72.83	3	\$133.52	133	\$347.07
FY 1995	110	\$275.41	3	\$8.68	20	\$72.83	20	\$72.83	3	\$133.52	133	\$357.03
% Change		8.1%		1.3%		-12.9%		-12.9%		-2.8%		2.8%

Vessel Type: Container, Foreign Flag	Cost DWT 10 - 20		Cost DWT 20 - 30		Cost DWT 30 - 40		Cost DWT 40 - 50		Total # Ships	Total Wgtd Cost
	# Ships	Wgt Cost								
FY 1993	2.4	\$65.83	23	\$792.04	3	\$133.52	3	\$130.40	28.4	\$991.39
FY 1995	2.4	\$54.78	23	\$769.97	3	\$123.52	3	\$130.40	28.4	\$955.16
% Change		-16.8%		-2.8%		-2.3%		-3.7%		-3.7%

Vessel Type	# of Ships	% of % Change		Wgtd Change In Costs
		Total	In Costs	
Dry Bulk	45	21.8%	-11.6%	-2.5%
General Cargo	133	64.4%	2.9%	1.6%
Containers	28.4	13.8%	-3.7%	-0.5%
Total	206.4			-1.2%

ratio of the FY 1995 weighted cost to the FY 1993 weighted cost was used as the index factor to convert from 1993 to 1995 prices for each of the vessel types. As table 10 - 5 shows, this resulted in a decrease in cost of approximately 12 percent for dry bulk vessels; an increase in cost of approximately three percent for general cargo vessels and a decrease in cost of approximately four percent for containers.

In order to convert these three index values to a single value that could be used as an overall index factor to be applied to deep-draft benefits, a weighted average value comprising all vessel types was developed using the total number of unconstrained ship demand within each vessel type as the weighting factor. This resulted in a 1.2 percent decrease in deep-draft vessel operating cost from FY 1993 to FY 1995. As the FY 95 IWR costs represented the latest available data at the time of this writing, it was assumed for the purpose of price level updating that the 1993-1995 change was appropriate to reflect the 1993-1996 change.

VEHICULAR

Vehicular benefits were calculated in 1992 prices. To price level update these benefits to 1996 prices, a 11.0 percent increase in the Consumer Price Index for total vehicular transportation during the period 1992 - 1996 was used.

OTHER

As previously indicated, no price level adjustment is required to represent the Savings to Federal Projects benefit category in 1996 dollars. For the benefit category, Navigation Losses Prevented from Rehabilitation Closure, the appropriate price level adjustment is the same as calculated for the shallow-draft benefit category.

SUMMARY OF BENEFITS

Table 10 - 6 displays the composition of total average annual benefits (1996 price level) for each alternative. Benefit estimates for each lock construction alternative are also displayed for with and without the presence of bridge operating curfews. Both shallow-draft and vehicular benefits are sensitive to these curfews.

For a given lock construction alternative, total annual benefits for the with bridge curfew condition are greater than the without bridge curfew condition. This outcome results from the fact that the positive effect of bridge curfews on vehicular benefits exceeds the negative effect

Table 10 - 6

Annual Benefit Summary
(1996 \$1,000, 7.375 Percent)

	Remove Bridge Curfews	90x90x22		900x110x22		900x110x36		1200x90x22		1200x110x22		1200x110x36	
		Bridge Only w/o Curfews	with Curfews	with Curfews	w/o Curfews	with Curfews	w/o Curfews	with Curfews	with Curfews	w/o Curfews	with Curfews	with Curfews	w/o Curfews
Shallow Draft	9,497	15,378	76,815	81,982	84,589	84,508	86,033	86,880	87,028	87,396	87,493	87,448	87,474
Deep Draft	0	0	0	0	0	979	979	0	0	0	0	979	979
Vehicular	0	5,595	5,814	5,909	2,219	5,899	1,941	6,048	4,560	6,577	6,061	6,563	5,947
Savings to Fed Project	0	0	4,017	4,017	4,017	4,194	4,194	4,194	4,194	4,194	4,194	4,194	4,194
Main Closure - Nav Losses Prevented	0	0	10,471	10,471	10,471	11,243	11,243	11,243	11,243	11,243	11,243	11,243	11,243
Total Annual Benefits	9,497	20,973	97,117	104,379	101,276	106,823	104,390	108,365	107,025	108,410	106,991	110,427	109,837
Base Year	1998	2006	2010	2010	2010	2011	2011	2011	2011	2011	2011	2011	2011

of the curfews on shallow-draft benefits. However, the magnitude of the with curfew advantage diminishes as the scale of the alternative increases. The magnitude of the with curfew advantage falls from approximately \$2.7 million for the 900 x 90 x 22 alternative to approximately \$0.4 million for the 1200 x 110 x 22 alternative.

The with curfew advantage diminishes with project scale for two reasons. First, the negative effect on shallow-draft benefits is less significant with a larger capacity lock. The larger the capacity, the more negligible the effect of losing a fixed amount of processing time. For the 900 x 90 x 22 alternative, the loss of the shallow-draft processing time associated with bridge curfews is more significant than the loss of the same absolute amount of time from the much larger capacity 1200 x 110 x 22 alternative.

Second, the positive effect on vehicular benefits is less significant with a larger capacity lock. With curfews, vehicular benefits don't vary much as project scale increases because the curfews limit bridge open time during peak periods to roughly the same degree for all alternatives. However, without curfews, vehicular benefits increase with project scale. Without curfews bridge openings are not restricted and bridge open time per ton processed becomes less with an increase in project scale.

Annual shallow-draft, deep-draft and vehicular benefits have already been discussed in detail in previous sections. The two remaining benefit categories, Savings to Federal Projects and Navigation Losses Prevented from Rehabilitation Closures, require additional explanation.

The first of these two items, Savings to Federal projects, refers to cost that would be avoided with project implementation. For the lock construction alternatives, the avoided costs would include the OM&R costs on the existing lock and the existing lock extraordinary maintenance costs that are part of the without-project condition. Annual OM&R costs for the existing lock are \$1.6 million, and are claimed from year 2010 or 2011, depending on the alternative, to the end of the 50-year project life. The starting year represents the point when the existing lock would be taken out of service and lock demolition would begin.

The maintenance costs that would be avoided total \$16.1 million and are scheduled over a four-year period beginning in 1999 (the schedule is described in Section 6). In calculating the annual value of these two components of Savings to Federal Projects, the expenditure streams described above were discounted to the appropriate base

year for each alternative and annualized over a 50-year period.

The second benefit category that requires additional explanation is Navigation Losses Prevented from Maintenance Closures. These losses represent the cost to navigation of a total of nine months of closure during the maintenance phase of the existing lock. These costs would amount to approximately \$20.0 million per month and would occur within the 1999-2002 period identified as the time frame for the scheduled maintenance work.

All benefits in table 10 - 6 represent 1996 price levels. Annual benefits were calculated using an interest rate of 7.375 percent, a 50-year project life, and an alternative specific base year as indicated in the table. It should be noted in the previous sections of the appendix detailing shallow-draft, deep-draft, and vehicular benefits, slightly different average annual values are displayed. This is the result of different price level, interest rate, and base year assumptions.

ECONOMIC JUSTIFICATION

Table 10 - 7 summarizes the annual costs, annual benefits, net benefits, and benefit-to-cost ratios (BCR) for each alternative with and without bridge operating curfews. Net benefits represent the difference between total annual benefits and total annual costs. Maximum net benefits define the NED plan.

Because all annual benefits and annual costs reflect the base year (the first year of project operation) of the alternative in question, it is necessary to account for the fact that alternatives have different implementation dates when identifying the alternative that generates the maximum net benefits. To account for this effect of differing base years, the net benefits of each alternative can be shifted forward or backward, using present value techniques, such that all alternatives reflect a common point in time. This adjustment is reflected in table 10 - 7 by using the year 2010 as the common reference point. For NED identification purposes, the result of this common reference adjustment is that alternatives with a base year prior to 2010 show a greater value for net benefits than that associated with its actual base year (net benefits are compounded), and alternatives with a base year after 2010 show a lower value for net benefits (net benefits are discounted). It should be noted that the selection of a different common reference point does not affect the relative standing of alternatives, only the absolute amount of the net benefits would be affected. Net benefits are maximized with the 900

Table 10 - 7
 Mid Growth Scenario
 Alternative Summary
 (1996 \$1,000, 7.375 Percent)

	Remove Bridge Curfews	900x90x22		900x110x22		900x110x36		1200x90x22		1200x110x22		1200x110x36	
		with Curfews	w/o Curfews										
Total Annual Cost	8,581	5,485	49,332	50,960	57,846	57,846	57,846	54,745	54,745	58,086	58,086	61,194	61,194
Total Annual Benefits	9,497	20,973	97,117	104,379	104,390	106,823	104,390	108,365	107,025	109,410	108,991	110,427	109,837
Net Benefits	916	15,508	47,785	53,419	56,544	48,977	46,544	53,620	52,280	51,324	50,905	49,233	48,643
BCR	1.11	3.84	1.97	2.05	1.85	1.85	1.80	1.98	1.95	1.88	1.88	1.80	1.79
Base Year	1998	2008	2010	2010	2010	2011	2011	2011	2011	2011	2011	2011	2011
Net Benefits Adj. to 2010	2,151	20,614	47,765	53,119	56,316	45,613	43,347	49,937	48,689	47,799	47,409	45,851	45,302

x 100 x 22 alternative with bridge operating curfews in place (\$53.4 million). This alternative also produces the highest BCR among the lock construction alternatives (2.05 to 1). The Bridge Only alternative produces a higher BCR (3.8 to 1), but it represents a significantly smaller scale project. As a result, the net benefits of the Bridge Only alternative (\$20.6 million) are considerably lower than any of the lock construction alternatives.