SECTION 9 - SENSITIVITY ANALYSIS

OVERVIEW

Given the nature and complexity of the benefit measurement procedures, an unavoidable component of uncertainty is implicit in the estimates of project benefits. A single change to any number of parameter values or assumptions holds the potential for significantly affecting benefit estimates and ultimately, in turn, project formulation. The role of sensitivity analysis is to identify those parameters and assumptions with the greatest potential for project formulation impact and to evaluate the magnitude of those impacts for discrete changes in the key parameters. The parameters identified as potentially significant, and consequently incorporated into the sensitivity analysis, include traffic projections, the discount rate, and alternative design elevations for lock floor/sill construction. In the following paragraphs of this section, the impacts on project benefits and plan formulation resulting from alternative parameter values and assumptions are presented.

ALTERNATIVE TRAFFIC GROWTH

HIGH GROWTH SCENARIO

Projected traffic volumes reflecting the high growth scenario have been developed by raising the traffic volumes projected in the mid growth scenario by 20 percent across the board for all commodity groups. The result of incorporating these projected traffic volumes into the system modeling on Bayou Sorrel lock, accommodated traffic, average delay and system benefits are detailed in tables 9 – 1 through 9 – 3, respectively.

Because of the greater overall system demand, traffic processed at Bayou Sorrel lock, shown in table 9 – 1, is higher for the high growth scenario compared to the mid growth scenario but not substantially higher. As was mentioned earlier in section 7 of this appendix, the reason lies in the fact that since practically all of Bayou Sorrel traffic must pass through Port Allen lock this traffic must still withstand substantial delays (particularly in the later years) at Port Allen lock. The result is that large volumes of traffic continue to be diverted off the system even though improvements at Bayou Sorrel lock have been made.

Table 9 – 2 displays the average delays per tow expected in the without and with-project conditions assuming high traffic growth. As expected, average delays are significantly higher for the without-project condition in the high growth scenario than the mid growth scenario. For the with-project lock improvement plans there are only minor differences in average delay. Throughout the 50 year time frame the percent of utilized capacity remains sufficiently low even with the high growth scenario.

Table 9 – 3 displays the system benefits for the high growth scenario. It reveals that for the with-project alternative lock plans, high growth average annual savings are approximately 60 percent higher than the mid growth average annual savings. The higher level of traffic demand associated with the high growth scenario generates more tons that still experience relatively low delays resulting in the much higher system benefits.

Table 9 – 4 and 9 – 5 displays the average annual benefit summary and the average annual benefit –

Table 9 - 1

High Growth Scenario
Bayou Sorrel Traffic Accomodated
(1,000 Tons)

Condition	1992	2000	2010	2020	2030	2040	2060
Without Project	22,554	29,352	29,544	29,801	30,253	30,559	30,686
1200 x 75 Earthen	22,876	31,852	34,309	34,391	34,798	35,176	34,911
1200 x 75 Concrete	22,890	31,852	34,345	34,425	34,806	35,180	34,913
1200 x 110 Earthen	23,005	31,853	34,385	34,457	34,820	35,182	34,913
1200 x 110 Concrete	23,005	31,853	34,387	34,458	34,821	35,182	34,914

Table 9 - 2

High Growth Scenario
Bayou Sorrel Lock Average Delays
(Hours)

Condition	1992	2000	2010	2020	2030	2040	2060
Without Project	2.3	13.2	15.7	21.3	37.6	84.3	135.1
1200 x 75 Concrete Chamber	0.6	1.0	1.1	1.2	1.2	1.3	1.3
1200 x 75 Earthen Chamber	0.6	1.2	1.5	1.6	1.8	2.0	2.0
1200 x 110 Concrete Chamber	0.4	0.6	0.7	0.7	0.7	0.7	0.7
1200 x 110 Earthen Chamber	0.4	0.6	0.7	0.7	0.7	0.7	0.8

Table 9 - 3

High Growth Scenario
Total and Incremental Transportation Savings
(1997 Prices)

Condition	1992	2000	2010	2020	2030	2040	2060
Without Project	824,183,381	984,499,121	1,079,034,260	1,175,667,099	1,233,241,574	1,075,704,976	996,001,892
1200 x 75 Earthen	826,355,585	1,003,173,003	1,082,596,723	1,193,640,277	1,279,512,454	1,122,146,898	1,017,376,562
	2,172,204	18,673,882	3,562,463	17,973,178	46,270,880	46,441,922	21,374,670
1200 x 75 Concrete	826,457,395	1,003,552,821	1,082,585,244	1,193,626,123	1,279,496,623	1,122,090,397	1,017,287,707
	2,274,014	19,053,700	3,550,984	17,959,024	46,255,049	46,385,421	21,285,815
1200 x 110 Earthen	826,771,039	1,004,239,235	1,082,765,802	1,193,639,869	1,279,488,482	1,122,051,204	1,017,226,391
	2,587,658	19,740,114	3,731,542	17,972,770	46,246,908	46,346,228	21,224,499
1200 x 110 Concrete	826,763,125	1,004,239,235	1,082,766,826	1,193,664,829	1,279,487,874	1,122,046,831	1,017,219,506
	2,579,744	19,740,114	3,732,566	17,997,730	46,246,300	46,341,855	21,217,614

Table 9-4

Average Annual Benefit Summary - High Growth Scenario
(2000 Prices, 5.875 Percent)

Lock Alternative	Base Year	Navigation Benefits	Cost Savings due to Accidents & Assist Boats	Incremental Total Average Annual Benefits
1200 x 75 x 15 Earthen	Mid 2010	24,303,852	1,304,846	25,608,698
1200 x 75 x 15 Earthen w Drain	Mid 2008	23,183,671	1,298,510	24,482,181
1200 x 75 x 15 Concrete	2008	22,197,578	1,297,720	23,495,298
1200 x 110 x 15 Earthen	Mid 2010	24,325,402	1,304,846	25,630,248
1200 x 110 x 15 Earthen w Drain	Mid 2008	23,220,219	1,298,570	24,518,789
1200 x 110 x 15 Concrete	2008	22,276,221	1,297,720	23,573,941

Table 9 - 5

Average Annual Benefit - Cost Summary
High Growth Scenario
(2000 Prices, 5.875 Percent)

	1200 x 75 x 15 Earthen	1200 x 75 x 15 Earthen w Drain	1200 x 75 x 15 Concrete	1200 x 110 x 15 Earthen	1200 x 110 x 15 Earthen w Drain	1200 x 110 x 15 Concrete
Total Annual Cost	1,111,008	2,724,003	976,627	1,263,563	2,865,342	1,480,873
Total Annual Benefits	25,608,698	24,482,181	23,495,298	25,630,248	24,518,789	23,573,941
Net Benefits	24,497,690	21,758,178	22,518,671	24,366,685	21,653,447	22,093,068
BCR	23.0	9.0	24.1	20.3	8.6	15.9
Base Year	Mid 2010	Mid 2008	2008	Mid 2010	Mid 2008	2008
Net Benefits Adj. to 2008	21,239,367	21,145,882	22,518,671	21,125,787	21,044,099	22,093,068

cost summary, respectively for the high traffic growth scenario. The average annual cost summary for the high growth scenario is the same as that in the mid growth scenario described in the previous section. Table 9 - 5 reveals that the high growth scenario causes no change in the NED plan (1200 x 75 x 15 ft concrete lock) as compared to the mid growth projections with average annual net benefits totaling $22.5 million.

LOW GROWTH ("NO GROWTH") SCENARIO

Since the average annual benefit – cost summary results of the mid growth scenario, displayed in table 8 – 3, showed substantial average annual net benefits for all the with – project lock alternatives, it was decided to run a "No Growth" scenario through the GEM in order to determine if this extreme case still produced economically justified with - project plans.

The "No Growth" scenario reflects a condition where the traffic volumes associated with the baseline traffic year of 1992 is held constant throughout the 50 year project life. The Average annual benefit summary, associated with this scenario is displayed in table 9 – 6. As with the high growth scenario, the average annual cost summary is not displayed since it is the same as that of the mid growth scenario. Table 9 – 7 displays the average annual benefit – cost summary for the "No Growth" scenario. As is shown, even with the assumption of no traffic growth, all the with – project lock alternatives are still economically justified and the NED plan continues to be a 1200 x 75 x 15 foot concrete chamber.

NO GROWTH AFTER 20 YEARS

The "No Growth After 20 Years" scenario describes a condition where traffic is projected using the mid growth rates for only twenty years beyond the baseline traffic year. Given the 1992 baseline year, the terminal year of projections was set at 2010 for this scenario, since this was the closest GEM run to the year 2012. Beyond 2010, traffic is held constant at the 2010 level.

Table 9 – 8 displays the average annual benefit summary associated with this scenario and table 9 – 9 displays the average annual benefit – cost summary. As expected, table 9 – 9 shows, once again, that all the with-project plans are economically justified and that the 1200 x 75 x 15 foot concrete chamber remains the NED plan.

INTEREST RATES

Throughout this study an interest rate of 5.875 percent was used in determining average annual costs and benefits. In order to explore the implications of alternative interest rates on NED plan selection, two additional values (5.625 percent and 6.125 percent) will be presented.

Tables 9 – 10, 9 – 11 and 9 – 12 display the average annual cost summary, average annual benefit summary and the average annual benefit – cost summary for 5.625 percent. Tables 9 – 13, 9 – 14 and 9 – 15 display the same information for 6.125 percent. As the tables reveal, for both interest

Table 9 - 6

Average Annual Benefit Summary - Low Growth Scenario
(2000 Prices, 5.875 Percent)

Lock Alternative	Base Year	Navigation Benefits	Cost Savings due to Accidents & Assist Boats	Incremental Total Average Annual Benefits
1200 x 75 x 15 Earthen	Mid 2010	2,235,102	1,008,377	3,243,479
1200 x 75 x 15 Earthen w Drain	Mid 2008	2,235,102	1,008,377	3,243,479
1200 x 75 x 15 Concrete	2008	2,339,860	1,008,377	3,348,237
1200 x 110 x 15 Earthen	Mid 2010	2,662,586	1,008,377	3,670,963
1200 x 110 x 15 Earthen w Drain	Mid 2008	2,662,586	1,008,377	3,670,963
1200 x 110 x 15 Concrete	2008	2,654,443	1,008,377	3,662,820

Table 9 - 7

Average Annual Benefit - Cost Summary
Low Growth Scenario
(2000 Prices, 5.875 Percent)

	1200 x 75 x 15 Earthen	1200 x 75 x 15 Earthen w Drain	1200 x 75 x 15 Concrete	1200 x 110 x 15 Earthen	1200 x 110 x 15 Earthen w Drain	1200 x 110 x 15 Concrete
Total Annual Cost	1,111,008	2,724,003	976,627	1,263,563	2,865,342	1,480,873
Total Annual Benefits	3,243,479	3,243,479	3,348,237	3,670,963	3,670,963	3,662,820
Net Benefits	2,132,471	519,476	2,371,610	2,407,400	805,621	2,181,947
BCR	2.9	1.2	3.4	2.9	1.3	2.5
Base Year	Mid 2010	Mid 2008	2008	Mid 2010	Mid 2008	2008
Net Benefits Adj. to 2008	1,848,841	504,857	2,371,610	2,087,203	782,950	2,181,947

Table 9 - 8

Average Annual Benefit Summary - No Growth After 20 Years
(2000 Prices, 5.875 Percent)

Lock Alternative	Base Year	Navigation Benefits	Cost Savings due to Accidents & Assist Boats	Incremental Total Average Annual Benefits
1200 x 75 x 15 Earthen	Mid 2010	18,896,190	1,270,159	20,166,349
1200 x 75 x 15 Earthen w Drain	Mid 2008	18,814,712	1,268,618	20,083,330
1200 x 75 x 15 Concrete	2008	19,155,706	1,265,621	20,421,327
1200 x 110 x 15 Earthen	Mid 2010	19,986,979	1,270,159	21,257,138
1200 x 110 x 15 Earthen w Drain	Mid 2008	19,902,841	1,268,618	21,171,459
1200 x 110 x 15 Concrete	2008	19,561,209	1,269,621	20,830,830

Table 9 - 9

Average Annual Benefit - Cost Summary
No Growth After 20 Years Scenario
(2000 Prices, 5.875 Percent)

	1200 x 75 x 15 Earthen	1200 x 75 x 15 Earthen w Drain	1200 x 75 x 15 Concrete	1200 x 110 x 15 Earthen	1200 x 110 x 15 Earthen w Drain	1200 x 110 x 15 Concrete
Total Annual Cost	1,111,008	2,724,003	976,627	1,263,563	2,865,342	1,480,873
Total Annual Benefits	20,166,349	20,083,330	20,421,327	21,257,138	21,171,459	20,830,830
Net Benefits	19,055,341	17,359,327	19,444,700	19,993,575	18,306,117	19,349,957
BCR	18.2	7.4	20.9	16.8	7.4	14.1
Base Year	Mid 2010	Mid 2008	2008	Mid 2010	Mid 2008	2008
Net Benefits Adj. to 2008	16,520,880	16,870,819	19,444,700	17,334,324	17,790,966	19,349,957

Table 9 - 10

Average Annual Cost Summary
(2000 Prices, 5.625 Percent)

Lock Alternative	Base Year	Construction Costs With E&D	O&M Costs	Construction Management Costs	Mitigation Costs	Real Estate Costs	Total Average Annual Costs	Incremental Total Average Annual Costs
In-Kind Replacement	Mid 2010	4,798,225	1,522,040	296,788	6,946	8,046	6,632,045	
	Mid 2008						5,944,482	
	2008						5,784,031	
1200 x 75 x 15 Earthen	Mid 2010	5,697,361	1,629,955	359,622	6,946	8,046	7,701,930	1,069,886
1200 x 75 x 15 Earthen w Wick Drain	Mid 2008	6,478,505	1,629,955	414,924	6,946	7,212	8,537,542	2,593,061
1200 x 75 x 15 Concrete	2008	4,908,497	1,463,692	315,800	6,946	6,828	6,701,763	917,732
1200 x 110 x 15 Earthen	Mid 2010	5,968,088	1,480,478	377,303	6,946	8,046	7,840,861	1,208,816
1200 x 110 x 15 Earthen w Wick Drain	Mid 2008	6,739,733	1,480,478	431,376	6,946	7,212	8,665,745	2,721,263
1200 x 110 x 15 Concrete	2008	5,411,096	1,412,305	347,418	6,946	6,828	7,184,593	1,400,562

Table 9 - 11

Average Annual Benefit Summary
(2000 Prices, 5.625 Percent)

Lock Alternative	Base Year	Navigation Benefits	Cost Savings due to Accidents & Assist Boats	Incremental Total Average Annual Benefits
1200 x 75 x 15 Earthen	Mid 2010	14,973,204	1,280,870	16,254,074
1200 x 75 x 15 Earthen w Drain	Mid 2008	14,973,827	1,278,499	16,252,326
1200 x 75 x 15 Concrete	2008	15,162,286	1,274,771	16,437,058
1200 x 110 x 15 Earthen	Mid 2010	15,422,841	1,280,870	16,703,711
1200 x 110 x 15 Earthen w Drain	Mid 2008	15,459,614	1,278,499	16,738,113
1200 x 110 x 15 Concrete	2008	15,425,012	1,274,771	16,699,784

Table 9 - 12

Average Annual Benefit - Cost Summary
Mid Growth Scenario
(2000 Prices, 5.625 Percent)

	1200 x 75 x 15 Earthen	1200 x 75 x 15 Earthen w Drain	1200 x 75 x 15 Concrete	1200 x 110 x 15 Earthen	1200 x 110 x 15 Earthen w Drain	1200 x 110 x 15 Concrete
Total Annual Cost	1,069,886	2,593,061	917,732	1,208,816	2,721,263	1,400,562
Total Annual Benefits	16,254,074	16,252,326	16,437,058	16,703,711	16,738,113	16,699,784
Net Benefits	15,184,188	13,659,265	15,519,326	15,494,895	14,016,850	15,299,222
BCR	15.2	6.3	17.9	13.8	6.2	11.9
Base Year	Mid 2010	Mid 2008	2008	Mid 2010	Mid 2008	2008
Net Benefits Adj. to 2008	13,242,646	13,290,581	15,519,326	13,513,624	13,638,514	15,299,222

Table 9 - 13

Average Annual Cost Summary
(2000 Prices, 6.125 Percent)

Lock Alternative	Base Year	Construction Costs With E&D	O&M Costs	Construction Management Costs	Mitigation Costs	Real Estate Costs	Total Average Annual Costs	Incremental Total Average Annual Costs
In-Kind Replacement	Mid 2010	5,211,203	1,511,232	321,548	7,360	8,862	7,060,205	
	Mid 2008						6,268,764	
	2008						6,085,175	
1200 x 75 x 15 Earthen	Mid 2010	6,186,831	1,620,618	389,505	7,360	8,862	8,213,176	1,152,971
1200 x 75 x 15 Earthen w Wick Drain	Mid 2008	7,041,206	1,620,618	450,453	7,360	7,869	9,127,506	2,858,743
1200 x 75 x 15 Concrete	2008	5,305,812	1,460,706	340,970	7,360	7,415	7,122,264	1,037,089
1200 x 110 x 15 Earthen	Mid 2010	6,481,240	1,473,523	408,688	7,360	8,862	8,379,673	1,319,468
1200 x 110 x 15 Earthen w Wick Drain	Mid 2008	7,325,208	1,473,523	468,323	7,360	7,869	9,282,283	3,013,520
1200 x 110 x 15 Concrete	2008	5,849,182	1,409,198	375,117	7,360	7,415	7,648,272	1,563,097

Table 9 - 14

Average Annual Benefit Summary
(2000 Prices, 6.125 Percent)

Lock Alternative	Base Year	Navigation Benefits	Cost Savings due to Accidents & Assist Boats	Incremental Total Average Annual Benefits
1200 x 75 x 15 Earthen	Mid 2010	14,605,729	1,283,086	15,888,815
1200 x 75 x 15 Earthen w Drain	Mid 2008	14,661,804	1,280,636	15,942,440
1200 x 75 x 15 Concrete	2008	14,896,326	1,276,739	16,173,065
1200 x 110 x 15 Earthen	Mid 2010	15,026,341	1,283,086	16,309,427
1200 x 110 x 15 Earthen w Drain	Mid 2008	15,156,268	1,280,636	16,436,904
1200 x 110 x 15 Concrete	2008	15,169,333	1,276,739	16,446,072

Table 9 -15

Average Annual Benefit - Cost Summary
Mid Growth Scenario
(2000 Prices, 6.125 Percent)

	1200 x 75 x 15 Earthen	1200 x 75 x 15 Earthen w Drain	1200 x 75 x 15 Concrete	1200 x 110 x 15 Earthen	1200 x 110 x 15 Earthen w Drain	1200 x 110 x 15 Concrete
Total Annual Cost	1,152,971	2,858,743	1,037,089	1,319,468	3,013,520	1,563,097
Total Annual Benefits	15,888,815	15,942,440	16,173,065	16,309,427	16,436,904	16,446,072
Net Benefits	14,735,844	13,083,697	15,135,976	14,989,959	13,423,384	14,882,975
BCR	13.8	5.6	15.6	12.4	5.5	10.5
Base Year	Mid 2010	Mid 2008	2008	Mid 2010	Mid 2008	2008
Net Benefits Adj. to 2008	12,700,791	12,700,524	15,135,976	12,919,812	13,030,262	14,882,975

rates of 5.875 percent and 6.375 percent, all with-project plans continue to be economically justified and the 1200 x 75 x 15 foot concrete chamber alternative remains the NED plan.

ALTERNATIVE FLOOR/SILL DEPTHS

The current NED plan involves a 1200 x 75 x 15 foot concrete chamber replacement lock. In order to verify that the 15 foot depth is optimal, one additional floor depth, deeper than 15 feet, was investigated. One more shallow than the 15 foot depth was not considered since this basically represented the limit for shallow draft traffic.

The rational for looking at floor depths deeper than the original 15 foot depth, lies in the fact that deeper chambers generally result in faster fill and emptying times. A faster fill and empty time will produce a lower processing time, which ultimately translates, to a higher level of service. While investigating various floor depths and their corresponding empty and fill times for a 1200 x 75 concrete chamber, it was determined that faster fill and empty times began to occur at a floor depth of 19 feet. On average, the expected value decrease in chambering time was .4 minutes across the range of head differentials.

Comparing the economics of a 1200 x 75 x 19 foot concrete chamber revealed that total average annual benefits increased by only $6,100 over the total average annual benefits associated with the 1200 x 75 x 15 foot NED plan. With such a small increase in the average annual benefits it became obvious that this alternative floor depth would not be economically justified since the average annual cost of lowering the floor depth from 15 feet to 19 feet was expected to increase by $500,000. Consequently, the move to a deeper floor depth is not supported by economic criteria.