

APPENDIX-6

Project Cash Flow of the State Government

Appendix-6 Project Cash Flow of the State Government

Unit: R\$ 000

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cash Flow from Investing Activities																		
Investment	-4,706	-5,594	-37,659	-98,058	-62,547	208,564	0	0	0	0	0	-1,398	-26,590	26,545	-27,448	28,891	0	0
Cash Flow from Financing Activities																		
Federal Government	2,353	2,797	18,830	49,029	31,273	0	0	0	0	0	0	559	10,636	577	10,979	0	0	0
Soft Loan	2,353	2,797	18,830	49,029	31,273	0	0	0	0	0	0	839	15,954	866	16,469	0	0	0
Repayment of Loan	0	0	0	0	0	0	0	-5,793	-5,793	-5,793	-5,793	-5,793	-5,793	-5,793	-5,793	-5,793	-5,793	-5,793
Interest Payment	-29	-94	-364	-1,212	-2,216	-2,607	-2,607	-2,577	-2,432	-2,287	-2,143	-2,008	-2,073	-2,139	-2,211	-2,272	-2,127	-1,982
Disbursement of Capital	0	0	0	0	0	-208,564	0	0	0	0	0	0	0	-27,988	0	-28,891	0	0
Dividend Received	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,004	7,004	7,004
Total	4,677	5,500	37,295	96,846	60,331	-211,171	-2,607	-8,371	-8,226	-8,081	-7,936	-6,403	18,723	-34,477	19,444	-29,952	-916	-771
Cash Increase/Decrease	-29	-94	-364	-1,212	-2,216	-2,607	-2,607	-8,371	-8,226	-8,081	-7,936	-7,802	-7,867	-7,933	-8,004	-1,061	-916	-771
Cash Beginning	0	-29	-123	-487	-1,700	-3,916	-6,523	-9,130	-17,501	-25,726	-33,807	-41,743	-49,545	-57,412	-65,344	-73,348	-74,409	-75,325
Cash Closing	-29	-123	-487	-1,700	-3,916	-6,523	-9,130	-17,501	-25,726	-33,807	-41,743	-49,545	-57,412	-65,344	-73,348	-74,409	-75,325	-76,097

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	Total
Cash Flow from Investing Activities																			
Investment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow from Financing Activities																			
Federal Government	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	127,033
Soft Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138,410
Repayment of Loan	-7,689	-7,689	-7,689	-7,689	-7,689	-7,689	-7,689	-1,896	-1,896	-1,896	-1,896	-1,896	-1,896	-1,896	-1,896	-1,896	-1,896	-1,896	-1,896
Interest Payment	-1,837	-1,645	-1,453	-1,260	-1,068	-876	-684	-521	-474	-427	-379	-332	-284	-237	-190	-142	-95	-47	-45,332
Disbursement of Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-265,443
Dividend Received	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	21,012	399,235
Total	11,486	11,678	11,870	12,063	12,255	12,447	12,639	18,595	18,642	18,690	18,737	18,785	18,832	18,879	18,927	18,974	19,022	19,069	215,492
Cash Increase/Decrease	11,486	11,678	11,870	12,063	12,255	12,447	12,639	18,595	18,642	18,690	18,737	18,785	18,832	18,879	18,927	18,974	19,022	19,069	
Cash Beginning	-76,097	-64,611	-52,933	-41,063	-29,000	-16,745	-4,298	8,341	26,936	45,578	64,268	83,005	101,790	120,622	139,501	158,428	177,402	196,424	
Cash Closing	-64,611	-52,933	-41,063	-29,000	-16,745	-4,298	8,341	26,936	45,578	64,268	83,005	101,790	120,622	139,501	158,428	177,402	196,424	215,492	

APPENDIX-7

Financial Statements of the Domestic and Industrial Water Supply Company

Appendix-7 Financial Statements of the Domestic and Industrial Water Supply Company

(1) Profit and Loss

		Unit: RS 000																												
Items	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Operating Revenue	860	1,664	2,536	3,478	6,407	9,398	12,454	15,572	18,754	21,951	27,537	32,058	36,663	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339
Operating Expenses																														
OC&N Expenses	1,605	1,605	1,605	2,181	3,297	3,297	3,982	5,242	6,395	7,148	7,832	8,516	9,200	9,884	10,568	11,252	11,936	12,620	13,304	13,988	14,672	15,356	16,040	16,724	17,408	18,092	18,776	19,460	20,144	20,828
Water Right Charge	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Depreciation	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621	3,621
Total	5,311	5,311	5,311	5,887	7,003	7,003	7,688	10,186	12,258	14,330	16,402	18,474	20,546	22,618	24,690	26,762	28,834	30,906	32,978	35,050	37,122	39,194	41,266	43,338	45,410	47,482	49,554	51,626	53,698	55,770
Non-operating Expenses																														
Interest paid	-106	-120	-46	-46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income before Tax	-1,551	-7,247	-2,445	-2,468	-596	2,395	5,450	7,885	8,509	11,765	16,279	20,046	23,809	27,572	31,335	35,098	38,861	42,624	46,387	50,150	53,913	57,676	61,439	65,202	68,965	72,728	76,491	80,254	84,017	87,780
Income Tax (25%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income	-1,551	-7,247	-2,445	-2,468	-596	2,395	5,450	7,885	8,509	11,765	16,279	20,046	23,809	27,572	31,335	35,098	38,861	42,624	46,387	50,150	53,913	57,676	61,439	65,202	68,965	72,728	76,491	80,254	84,017	87,780
Dividend	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retained Earnings at beginning	0	-4,551	-8,298	-11,142	-13,611	-14,207	-11,812	-6,361	1,523	7,950	16,774	21,979	30,009	40,982	41,467	40,963	40,460	39,956	39,453	38,950	38,447	37,944	37,441	36,938	36,435	35,932	35,429	34,926	34,423	33,920
Retained Earnings at end	-4,551	-8,298	-11,142	-13,611	-14,207	-11,812	-6,361	1,523	7,950	16,774	21,979	30,009	40,982	41,467	40,963	40,460	39,956	39,453	38,950	38,447	37,944	37,441	36,938	36,435	35,932	35,429	34,926	34,423	33,920	33,417

(2) Balance Sheet

Items		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Current Assets																																
Cash & Bank		70	144	320	872	3,897	9,913	18,984	30,480	41,774	55,456	65,440	78,249	94,000	99,363	91,679	92,272	102,865	108,437	113,917	119,417	124,785	130,152	131,130	136,610	137,371	142,634	147,897	153,161	158,424	163,687	168,950
Fixed Assets																																
Investment less Depreciation		79,582	75,962	72,341	68,720	65,100	61,479	57,858	54,237	77,567	72,989	96,621	91,843	87,064	82,286	89,366	83,270	77,174	71,078	65,032	59,787	54,591	49,395	48,232	42,606	37,552	32,773	27,995	23,216	18,438	13,659	
Total Assets		79,652	76,106	72,661	69,593	68,996	71,391	76,842	84,726	119,141	127,965	162,061	170,092	181,064	181,549	181,046	180,542	180,039	179,535	179,031	178,527	178,023	177,519	177,015	176,511	176,007	175,503	175,000	174,496	173,992	173,488	
Liabilities																																
Bank Loan		1,000	1,200	600	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Equity																																
Paid-in Capital		85,203	85,203	85,203	85,203	85,203	85,203	85,203	85,203	111,191	111,191	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	140,082	
Retained Earnings		-4,551	-8,298	-11,142	-13,611	-14,207	-11,812	-6,361	1,523	7,950	16,774	21,979	30,009	40,982	41,467	40,963	40,460	39,956	39,453	38,950	38,447	37,944	37,441	36,938	36,435	35,932	35,429	34,926	34,423	33,920	33,417	
Total		79,652	76,106	72,661	69,593	68,996	71,391	76,842	84,726	119,141	127,965	162,061	170,092	181,064	181,549	181,046	180,542	180,039	179,535	179,031	178,527	178,023	177,519	177,015	176,511	176,007	175,503	175,000	174,496	173,992	173,488	
Total of Liabilities & Equity		79,652	76,106	72,661	69,593	68,996	71,391	76,842	84,726	119,141	127,965	162,061	170,092	181,064	181,549	181,046	180,542	180,039	179,535	179,031	178,527	178,023	177,519	177,015	176,511	176,007	175,503	175,000	174,496	173,992	173,488	

(3) Cash Flow

		Unit: R5,000																														
	Items	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Cash Flow from Operating Activities	Operating Revenue	860	1,664	2,426	3,478	6,407	9,398	12,454	15,572	18,754	21,951	27,537	32,058	36,663	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339	41,339
	Cost of Sales	-1,605	-1,605	-1,605	-2,181	-3,297	-3,297	-3,982	-5,242	-6,395	-7,148	-7,832	-8,516	-9,200	-9,884	-10,568	-11,252	-11,936	-12,620	-13,304	-13,988	-14,672	-15,356	-16,040	-16,724	-17,408	-18,092	-18,776	-19,460	-20,144	-20,828	
	Water Right Charge	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	
	Income Tax Paid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Income Tax Paid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Total	-800	-1,026	-1,074	-1,212	-1,174	-1,184	-1,224	-1,292	-1,452	-1,824	-2,700	-3,960	-5,920	-7,160	-8,360	-9,560	-10,760	-11,960	-13,160	-14,360	-15,560	-16,760	-17,960	-19,160	-20,360	-21,560	-22,760	-23,960	-25,160	-26,360	
Cash Flow from Investing Activities	Capital Expenditures	-48,320	0	0	0	0	0	0	-27,988	0	0	-28,891	0	0	0	-13,176	0	0	0	0	0	0	0	-4,502	0	-4,502	0	0	0	0	0	0
	Capital Expenditures	-48,320	0	0	0	0	0	0	-27,988	0	0	-28,891	0	0	0	-13,176	0	0	0	0	0	0	0	-4,502	0	-4,502	0	0	0	0	0	0
Cash Flow from Financing Activities	Loan Borrowing	1,000	1,200	600	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Repayment of Loan	0	-1,000	-1,200	-1,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Interest Payment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Capital Injection	83,203	0	0	0	0	0	0	27,988	0	0	28,891	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dividend Paid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	84,203	200	-600	-600	0	0	0	0	27,988	0	27,988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Increase/Decrease	Cash Increase/Decrease	170	194	236	612	3,024	6,016	9,007	11,905	11,295	13,682	16,987	19,813	22,755	26,276	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605	26,605
	Cash Beginning	0	170	364	600	1,212	4,237	10,253	19,324	30,829	42,114	55,796	65,780	78,589	94,340	99,603	92,019	97,612	103,205	108,797	114,277	119,757	125,125	130,492	131,470	136,950	137,711	142,974	148,237	153,501	158,764	164,027
	Cash Ending	170	364	600	1,212	4,237	10,253	19,324	30,829	42,114	55,796	65,780	78,589	94,340	99,603	92,019	97,612	103,205	108,797	114,277	119,757	125,125	130,492	131,470	136,950	137,711	142,974	148,237	153,501	158,764	164,027	
	Cash Ending	170	364	600	1,212	4,237	10,253	19,324	30,829	42,114	55,796	65,780	78,589	94,340	99,603	92,019	97,612	103,205	108,797	114,277	119,757	125,125	130,492	131,470	136,950	137,711	142,974	148,237	153,501	158,764	164,027	

APPENDIX-8

Financial Statement of the Irrigation Water Supply Company

Appendix-8 Financial Statement of the Irrigation Water Supply Company

(1) Profit and Loss

(1) Profit and Loss																																Unit: \$5,000
Items	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Operating Revenue	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	
Operating Expenses	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623	1,623
Costs and Training Expenses	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290
Water Right Charge	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615
Depreciation	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-operating Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest paid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income before Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Income Tax (25%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dividend	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retained Earnings at beginning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retained Earnings at end	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

(2) Balance Sheet

(2) Balance Sheet																																Unit: \$5,000
Items	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Current Assets																																
Cash & Bank	1,615	3,230	4,845	6,460	8,075	9,690	11,305	12,920	14,535	16,150	17,765	19,380	20,995	22,610	24,225	25,840	27,455	29,070	30,685	32,300	33,915	35,530	37,145	38,760	40,375	41,990	43,605	45,220	46,835	48,450	50,065	
Fixed Assets																																
Investment less Depreciation	41,479	39,864	38,249	36,634	35,019	33,404	31,789	30,174	28,559	26,944	25,329	23,714	22,100	20,485	18,870	17,255	15,640	14,025	12,410	10,795	9,180	7,565	5,950	4,335	2,720	1,105	-40	-200	-360	-520		
Total Assets	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094		
Liabilities																																
Bank Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Equity																																
Paid-up Capital	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	
Retained Earnings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	
Total of Liabilities & Equity	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	43,094	

(3) Cash Flow

(3) Cash Flow		Unit: RMB 000																														
Items	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Cash Flow from Operating Activities																																
Operating Revenue	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	3,517	
Costs and Expenses Paid	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	-1,623	
Water Right Charge	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	-290	
Income Tax Paid	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	
Total																																
Cash Flow from Investing Activities																																
Capital Expenditures	-43,094	0	0	0	0	0	0	0	0	0	-2,120	0	0	0	0	0	0	0	0	0	-15,176	0	0	0	0	0	0	0	0	0	-2,116	
Cash Flow from Financing Activities																																
Loan Borrowing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Repayment of Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Interest Payment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Capital Injection	43,094	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Dividend Paid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	43,094	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Increase/Decrease	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	-1,505	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	-13,701	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	-5,901	
Cash Beginning	0	1,615	3,230	4,845	6,460	8,075	9,690	11,305	12,920	14,535	16,150	14,645	16,260	17,875	19,490	21,105	22,720	24,335	25,950	27,565	29,180	30,795	32,410	34,025	35,640	37,255	38,870	40,485	42,100	43,715	45,330	
Cash Ending	1,615	3,230	4,845	6,460	8,075	9,690	11,305	12,920	14,535	16,150	14,645	16,260	17,875	19,490	21,105	22,720	24,335	25,950	27,565	29,180	30,795	32,410	34,025	35,640	37,255	38,870	40,485	42,100	43,715	45,330	46,945	

APPENDIX-9

Financial Evaluation of Irrigation Models



Appendix-9 (1) Financial Evaluation of Irrigation Model A

Model A (3 ha)

IRR	20.8
NPV	7,807

Year	Incremental Cost					Incremental Revenue	Incremental Net Cash Flow
	Investment	Product Cost	Water charge	Others	Total		
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	7,500	0	0	0	7,500	0	-7,500
2007		7,367	4,865	1,741	13,973	9,640	-4,333
2008		7,367	4,865	2,132	14,364	11,940	-2,424
2009		15,006	4,865	5,067	24,938	29,205	4,267
2010		15,006	4,865	5,067	24,938	29,205	4,267
2011		15,006	4,865	5,067	24,938	29,205	4,267
2012		15,006	4,865	5,067	24,938	29,205	4,267
2013		15,006	4,865	5,067	24,938	29,205	4,267
2014		15,006	4,865	5,067	24,938	29,205	4,267
2015		15,006	4,865	5,067	24,938	29,205	4,267
2016	7,500	15,006	4,865	5,067	32,438	29,205	-3,233
2017		15,006	4,865	5,067	24,938	29,205	4,267
2018		15,006	4,865	5,067	24,938	29,205	4,267
2019		15,006	4,865	5,067	24,938	29,205	4,267
2020		15,006	4,865	5,067	24,938	29,205	4,267
2021		15,006	4,865	5,067	24,938	29,205	4,267
2022		15,006	4,865	5,067	24,938	29,205	4,267
2023		15,006	4,865	5,067	24,938	29,205	4,267
2024		15,006	4,865	5,067	24,938	29,205	4,267
2025		15,006	4,865	5,067	24,938	29,205	4,267
2026	7,500	15,006	4,865	5,067	32,438	29,205	-3,233
2027		15,006	4,865	5,067	24,938	29,205	4,267
2028		15,006	4,865	5,067	24,938	29,205	4,267
2029		15,006	4,865	5,067	24,938	29,205	4,267
2030		15,006	4,865	5,067	24,938	29,205	4,267
2031		15,006	4,865	5,067	24,938	29,205	4,267
2032		15,006	4,865	5,067	24,938	29,205	4,267
2033		15,006	4,865	5,067	24,938	29,205	4,267
2034		15,006	4,865	5,067	24,938	29,205	4,267
2035		15,006	4,865	5,067	24,938	29,205	4,267
2036	7,500	15,006	4,865	5,067	32,438	29,205	-3,233
2037		15,006	4,865	5,067	24,938	29,205	4,267
2038		15,006	4,865	5,067	24,938	29,205	4,267
2039		15,006	4,865	5,067	24,938	29,205	4,267
2040		15,006	4,865	5,067	24,938	29,205	4,267
2041		15,006	4,865	5,067	24,938	29,205	4,267
2042		15,006	4,865	5,067	24,938	29,205	4,267
2043		15,006	4,865	5,067	24,938	29,205	4,267
2044		15,006	4,865	5,067	24,938	29,205	4,267
2045		15,006	4,865	5,067	24,938	29,205	4,267
2046	7,500	15,006	4,865	5,067	32,438	29,205	-3,233
2047		15,006	4,865	5,067	24,938	29,205	4,267
2048		15,006	4,865	5,067	24,938	29,205	4,267
2049		15,006	4,865	5,067	24,938	29,205	4,267
2050		15,006	4,865	5,067	24,938	29,205	4,267
2051		15,006	4,865	5,067	24,938	29,205	4,267
2052		15,006	4,865	5,067	24,938	29,205	4,267
2053		15,006	4,865	5,067	24,938	29,205	4,267

Appendix-9 (2) Financial Evaluation of Irrigation Model B

Model B1 (5 ha)

IRR	29.6
NPV	35,398

Year	Incremental Cost					Incremental Revenue	Incremental Net Cash Flow
	Investment	Product Cost	Water charge	Others	Total		
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	16,000	0	0	0	16,000	0	-16,000
2007		4,830	4,222	-279	8,773	-1,645	-10,418
2008		10,777	4,222	2,725	17,724	16,025	-1,699
2009		9,248	4,222	4,770	18,240	28,055	9,815
2010		8,428	4,222	5,110	17,760	30,055	12,295
2011		8,850	4,222	5,790	18,862	34,055	15,193
2012		9,246	4,222	5,790	19,258	34,055	14,797
2013		9,633	4,222	5,790	19,645	34,055	14,410
2014		9,771	4,222	5,790	19,783	34,055	14,272
2015		9,771	4,222	5,790	19,783	34,055	14,272
2016	16,000	9,771	4,222	5,790	35,783	34,055	-1,728
2017		9,771	4,222	5,790	19,783	34,055	14,272
2018		9,771	4,222	5,790	19,783	34,055	14,272
2019		9,771	4,222	5,790	19,783	34,055	14,272
2020		9,771	4,222	5,790	19,783	34,055	14,272
2021		9,771	4,222	5,790	19,783	34,055	14,272
2022		9,771	4,222	5,790	19,783	34,055	14,272
2023		9,771	4,222	5,790	19,783	34,055	14,272
2024		9,771	4,222	5,790	19,783	34,055	14,272
2025		9,771	4,222	5,790	19,783	34,055	14,272
2026	16,000	9,771	4,222	5,790	35,783	34,055	-1,728
2027		9,771	4,222	5,790	19,783	34,055	14,272
2028		9,771	4,222	5,790	19,783	34,055	14,272
2029		9,771	4,222	5,790	19,783	34,055	14,272
2030		9,771	4,222	5,790	19,783	34,055	14,272
2031		9,771	4,222	5,790	19,783	34,055	14,272
2032		9,771	4,222	5,790	19,783	34,055	14,272
2033		9,771	4,222	5,790	19,783	34,055	14,272
2034		9,771	4,222	5,790	19,783	34,055	14,272
2035		9,771	4,222	5,790	19,783	34,055	14,272
2036	16,000	9,771	4,222	5,790	35,783	34,055	-1,728
2037		9,771	4,222	5,790	19,783	34,055	14,272
2038		9,771	4,222	5,790	19,783	34,055	14,272
2039		9,771	4,222	5,790	19,783	34,055	14,272
2040		9,771	4,222	5,790	19,783	34,055	14,272
2041		9,771	4,222	5,790	19,783	34,055	14,272
2042		9,771	4,222	5,790	19,783	34,055	14,272
2043		9,771	4,222	5,790	19,783	34,055	14,272
2044		9,771	4,222	5,790	19,783	34,055	14,272
2045		9,771	4,222	5,790	19,783	34,055	14,272
2046	16,000	9,771	4,222	5,790	35,783	34,055	-1,728
2047		9,771	4,222	5,790	19,783	34,055	14,272
2048		9,771	4,222	5,790	19,783	34,055	14,272
2049		9,771	4,222	5,790	19,783	34,055	14,272
2050		9,771	4,222	5,790	19,783	34,055	14,272
2051		9,771	4,222	5,790	19,783	34,055	14,272
2052		9,771	4,222	5,790	19,783	34,055	14,272
2053		9,771	4,222	5,790	19,783	34,055	14,272

Appendix-9 (3) Financial Evaluation of Irrigation Model B2

Model B2 (5 ha)

IRR	21.5
NPV	19,026

Year	Incremental Cost					Incremental Revenue	Incremental Net Cash Flow
	Investment	Product Cost	Water charge	Others	Total		
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	14,950	0	0	0	14,950	0	-14,950
2007		1,025	2,802	-1,516	2,311	-8,920	-11,231
2008		5,063	2,802	541	8,406	3,180	-5,226
2009		2,464	2,802	2,156	7,422	12,680	5,258
2010		2,781	2,802	3,655	9,238	21,500	12,262
2011		3,454	2,802	3,499	9,755	20,580	10,825
2012		3,800	2,802	3,499	10,101	20,580	10,479
2013		4,242	2,802	3,499	10,543	20,580	10,037
2014		4,450	2,802	3,499	10,751	20,580	9,829
2015		4,450	2,802	3,499	10,751	20,580	9,829
2016	14,950	4,450	2,802	3,499	25,701	20,580	-5,121
2017		4,450	2,802	3,499	10,751	20,580	9,829
2018		4,450	2,802	3,499	10,751	20,580	9,829
2019		4,450	2,802	3,499	10,751	20,580	9,829
2020		4,450	2,802	3,499	10,751	20,580	9,829
2021		4,450	2,802	3,499	10,751	20,580	9,829
2022		4,450	2,802	3,499	10,751	20,580	9,829
2023		4,450	2,802	3,499	10,751	20,580	9,829
2024		4,450	2,802	3,499	10,751	20,580	9,829
2025		4,450	2,802	3,499	10,751	20,580	9,829
2026	14,950	4,450	2,802	3,499	25,701	20,580	-5,121
2027		4,450	2,802	3,499	10,751	20,580	9,829
2028		4,450	2,802	3,499	10,751	20,580	9,829
2029		4,450	2,802	3,499	10,751	20,580	9,829
2030		4,450	2,802	3,499	10,751	20,580	9,829
2031		4,450	2,802	3,499	10,751	20,580	9,829
2032		4,450	2,802	3,499	10,751	20,580	9,829
2033		4,450	2,802	3,499	10,751	20,580	9,829
2034		4,450	2,802	3,499	10,751	20,580	9,829
2035		4,450	2,802	3,499	10,751	20,580	9,829
2036	14,950	4,450	2,802	3,499	25,701	20,580	-5,121
2037		4,450	2,802	3,499	10,751	20,580	9,829
2038		4,450	2,802	3,499	10,751	20,580	9,829
2039		4,450	2,802	3,499	10,751	20,580	9,829
2040		4,450	2,802	3,499	10,751	20,580	9,829
2041		4,450	2,802	3,499	10,751	20,580	9,829
2042		4,450	2,802	3,499	10,751	20,580	9,829
2043		4,450	2,802	3,499	10,751	20,580	9,829
2044		4,450	2,802	3,499	10,751	20,580	9,829
2045		4,450	2,802	3,499	10,751	20,580	9,829
2046	14,950	4,450	2,802	3,499	25,701	20,580	-5,121
2047		4,450	2,802	3,499	10,751	20,580	9,829
2048		4,450	2,802	3,499	10,751	20,580	9,829
2049		4,450	2,802	3,499	10,751	20,580	9,829
2050		4,450	2,802	3,499	10,751	20,580	9,829
2051		4,450	2,802	3,499	10,751	20,580	9,829
2052		4,450	2,802	3,499	10,751	20,580	9,829
2053		4,450	2,802	3,499	10,751	20,580	9,829

Appendix-9 (4) Financial Evaluation of Irrigation Model C

Model C (10 ha)

IRR	57.2
NPV	118,551

Year	Incremental Cost					Incremental Revenue	Incremental Net Cash Flow
	Investment	Product Cost	Water charge	Others	Cost Total		
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	31,300	0	0	0	31,300	0	-31,300
2007		15,077	5,605	12,323	33,005	31,960	-1,045
2008		19,475	5,605	22,523	47,603	65,960	18,357
2009		17,010	5,605	27,863	50,478	83,760	33,282
2010		18,250	5,605	33,923	57,778	93,160	35,382
2011		19,117	5,605	36,323	61,045	98,760	37,715
2012		20,258	5,605	36,323	62,186	98,760	36,574
2013		21,060	5,605	36,323	62,988	98,760	35,772
2014		21,198	5,605	36,323	63,126	98,760	35,634
2015		21,198	5,605	36,323	63,126	98,760	35,634
2016	31,300	21,198	5,605	36,323	94,426	98,760	4,334
2017		21,198	5,605	36,323	63,126	98,760	35,634
2018		21,198	5,605	36,323	63,126	98,760	35,634
2019		21,198	5,605	36,323	63,126	98,760	35,634
2020		21,198	5,605	36,323	63,126	98,760	35,634
2021		21,198	5,605	36,323	63,126	98,760	35,634
2022		21,198	5,605	36,323	63,126	98,760	35,634
2023		21,198	5,605	36,323	63,126	98,760	35,634
2024		21,198	5,605	36,323	63,126	98,760	35,634
2025		21,198	5,605	36,323	63,126	98,760	35,634
2026	31,300	21,198	5,605	36,323	94,426	98,760	4,334
2027		21,198	5,605	36,323	63,126	98,760	35,634
2028		21,198	5,605	36,323	63,126	98,760	35,634
2029		21,198	5,605	36,323	63,126	98,760	35,634
2030		21,198	5,605	36,323	63,126	98,760	35,634
2031		21,198	5,605	36,323	63,126	98,760	35,634
2032		21,198	5,605	36,323	63,126	98,760	35,634
2033		21,198	5,605	36,323	63,126	98,760	35,634
2034		21,198	5,605	36,323	63,126	98,760	35,634
2035		21,198	5,605	36,323	63,126	98,760	35,634
2036	31,300	21,198	5,605	36,323	94,426	98,760	4,334
2037		21,198	5,605	36,323	63,126	98,760	35,634
2038		21,198	5,605	36,323	63,126	98,760	35,634
2039		21,198	5,605	36,323	63,126	98,760	35,634
2040		21,198	5,605	36,323	63,126	98,760	35,634
2041		21,198	5,605	36,323	63,126	98,760	35,634
2042		21,198	5,605	36,323	63,126	98,760	35,634
2043		21,198	5,605	36,323	63,126	98,760	35,634
2044		21,198	5,605	36,323	63,126	98,760	35,634
2045		21,198	5,605	36,323	63,126	98,760	35,634
2046	31,300	21,198	5,605	36,323	94,426	98,760	4,334
2047		21,198	5,605	36,323	63,126	98,760	35,634
2048		21,198	5,605	36,323	63,126	98,760	35,634
2049		21,198	5,605	36,323	63,126	98,760	35,634
2050		21,198	5,605	36,323	63,126	98,760	35,634
2051		21,198	5,605	36,323	63,126	98,760	35,634
2052		21,198	5,605	36,323	63,126	98,760	35,634
2053		21,198	5,605	36,323	63,126	98,760	35,634

Appendix-9 (5) Financial Evaluation of Irrigation Model D

Model D (20 ha)

IRR	37.2
NPV	215,172

Year	Incremental Cost					Incremental Revenue	Incremental Net Cash Flow
	Investment	Product Cost	Water charge	Others	Cost Total		
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	69,200	0	0	0	69,200	0	-69,200
2007		29,511	10,712	12,946	53,169	24,920	-28,249
2008		31,465	10,712	30,406	72,583	83,120	10,537
2009		35,799	10,712	40,486	86,997	116,720	29,723
2010		33,193	10,712	54,346	98,251	162,920	64,669
2011		41,552	10,712	59,746	112,010	180,920	68,910
2012		37,610	10,712	63,346	111,668	192,920	81,252
2013		45,450	10,712	63,346	119,508	192,920	73,412
2014		39,740	10,712	63,346	113,798	192,920	79,122
2015		39,740	10,712	63,346	113,798	192,920	79,122
2016	69,200	39,740	10,712	63,346	182,998	192,920	9,922
2017		39,740	10,712	63,346	113,798	192,920	79,122
2018		39,740	10,712	63,346	113,798	192,920	79,122
2019		39,740	10,712	63,346	113,798	192,920	79,122
2020		39,740	10,712	63,346	113,798	192,920	79,122
2021		39,740	10,712	63,346	113,798	192,920	79,122
2022		39,740	10,712	63,346	113,798	192,920	79,122
2023		39,740	10,712	63,346	113,798	192,920	79,122
2024		39,740	10,712	63,346	113,798	192,920	79,122
2025		39,740	10,712	63,346	113,798	192,920	79,122
2026	69,200	39,740	10,712	63,346	182,998	192,920	9,922
2027		39,740	10,712	63,346	113,798	192,920	79,122
2028		39,740	10,712	63,346	113,798	192,920	79,122
2029		39,740	10,712	63,346	113,798	192,920	79,122
2030		39,740	10,712	63,346	113,798	192,920	79,122
2031		39,740	10,712	63,346	113,798	192,920	79,122
2032		39,740	10,712	63,346	113,798	192,920	79,122
2033		39,740	10,712	63,346	113,798	192,920	79,122
2034		39,740	10,712	63,346	113,798	192,920	79,122
2035		39,740	10,712	63,346	113,798	192,920	79,122
2036	69,200	39,740	10,712	63,346	182,998	192,920	9,922
2037		39,740	10,712	63,346	113,798	192,920	79,122
2038		39,740	10,712	63,346	113,798	192,920	79,122
2039		39,740	10,712	63,346	113,798	192,920	79,122
2040		39,740	10,712	63,346	113,798	192,920	79,122
2041		39,740	10,712	63,346	113,798	192,920	79,122
2042		39,740	10,712	63,346	113,798	192,920	79,122
2043		39,740	10,712	63,346	113,798	192,920	79,122
2044		39,740	10,712	63,346	113,798	192,920	79,122
2045		39,740	10,712	63,346	113,798	192,920	79,122
2046	69,200	39,740	10,712	63,346	182,998	192,920	9,922
2047		39,740	10,712	63,346	113,798	192,920	79,122
2048		39,740	10,712	63,346	113,798	192,920	79,122
2049		39,740	10,712	63,346	113,798	192,920	79,122
2050		39,740	10,712	63,346	113,798	192,920	79,122
2051		39,740	10,712	63,346	113,798	192,920	79,122
2052		39,740	10,712	63,346	113,798	192,920	79,122
2053		39,740	10,712	63,346	113,798	192,920	79,122

Appendix-9 (6) Financial Evaluation of Irrigation Model E

Model E (50 ha)

IRR	33.1
NPV	504,470

Year	Incremental Cost					Incremental Revenue	Incremental Net Cash Flow
	Investment	Product Cost	Water charge	Others	Cost Total		
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	185,000	0	0	0	185,000	0	-185,000
2007		67,109	26,779	24,116	118,004	34,800	-83,204
2008		72,615	26,779	50,516	149,910	122,800	-27,110
2009		67,554	26,779	96,266	190,599	275,300	84,701
2010		76,361	26,779	131,962	235,102	394,288	159,186
2011		82,060	26,779	146,961	255,800	444,284	188,484
2012		88,501	26,779	155,110	270,390	471,280	200,890
2013		93,762	26,779	155,110	275,651	471,280	195,629
2014		95,147	26,779	155,110	277,036	471,280	194,244
2015		95,147	26,779	155,110	277,036	471,280	194,244
2016	185,000	95,147	26,779	155,110	462,036	471,280	9,244
2017		95,147	26,779	155,110	277,036	471,280	194,244
2018		95,147	26,779	155,110	277,036	471,280	194,244
2019		95,147	26,779	155,110	277,036	471,280	194,244
2020		95,147	26,779	155,110	277,036	471,280	194,244
2021		95,147	26,779	155,110	277,036	471,280	194,244
2022		95,147	26,779	155,110	277,036	471,280	194,244
2023		95,147	26,779	155,110	277,036	471,280	194,244
2024		95,147	26,779	155,110	277,036	471,280	194,244
2025		95,147	26,779	155,110	277,036	471,280	194,244
2026	185,000	95,147	26,779	155,110	462,036	471,280	9,244
2027		95,147	26,779	155,110	277,036	471,280	194,244
2028		95,147	26,779	155,110	277,036	471,280	194,244
2029		95,147	26,779	155,110	277,036	471,280	194,244
2030		95,147	26,779	155,110	277,036	471,280	194,244
2031		95,147	26,779	155,110	277,036	471,280	194,244
2032		95,147	26,779	155,110	277,036	471,280	194,244
2033		95,147	26,779	155,110	277,036	471,280	194,244
2034		95,147	26,779	155,110	277,036	471,280	194,244
2035		95,147	26,779	155,110	277,036	471,280	194,244
2036	185,000	95,147	26,779	155,110	462,036	471,280	9,244
2037		95,147	26,779	155,110	277,036	471,280	194,244
2038		95,147	26,779	155,110	277,036	471,280	194,244
2039		95,147	26,779	155,110	277,036	471,280	194,244
2040		95,147	26,779	155,110	277,036	471,280	194,244
2041		95,147	26,779	155,110	277,036	471,280	194,244
2042		95,147	26,779	155,110	277,036	471,280	194,244
2043		95,147	26,779	155,110	277,036	471,280	194,244
2044		95,147	26,779	155,110	277,036	471,280	194,244
2045		95,147	26,779	155,110	277,036	471,280	194,244
2046	185,000	95,147	26,779	155,110	462,036	471,280	9,244
2047		95,147	26,779	155,110	277,036	471,280	194,244
2048		95,147	26,779	155,110	277,036	471,280	194,244
2049		95,147	26,779	155,110	277,036	471,280	194,244
2050		95,147	26,779	155,110	277,036	471,280	194,244
2051		95,147	26,779	155,110	277,036	471,280	194,244
2052		95,147	26,779	155,110	277,036	471,280	194,244
2053		95,147	26,779	155,110	277,036	471,280	194,244

JAPAN INTERNATIONAL COOPERATION AGENCY

**STATE SECRETARIAT OF PLANNING, SCIENCE AND TECHNOLOGY
THE STATE OF SERGIPE, THE FEDERATIVE REPUBLIC OF BRAZIL**

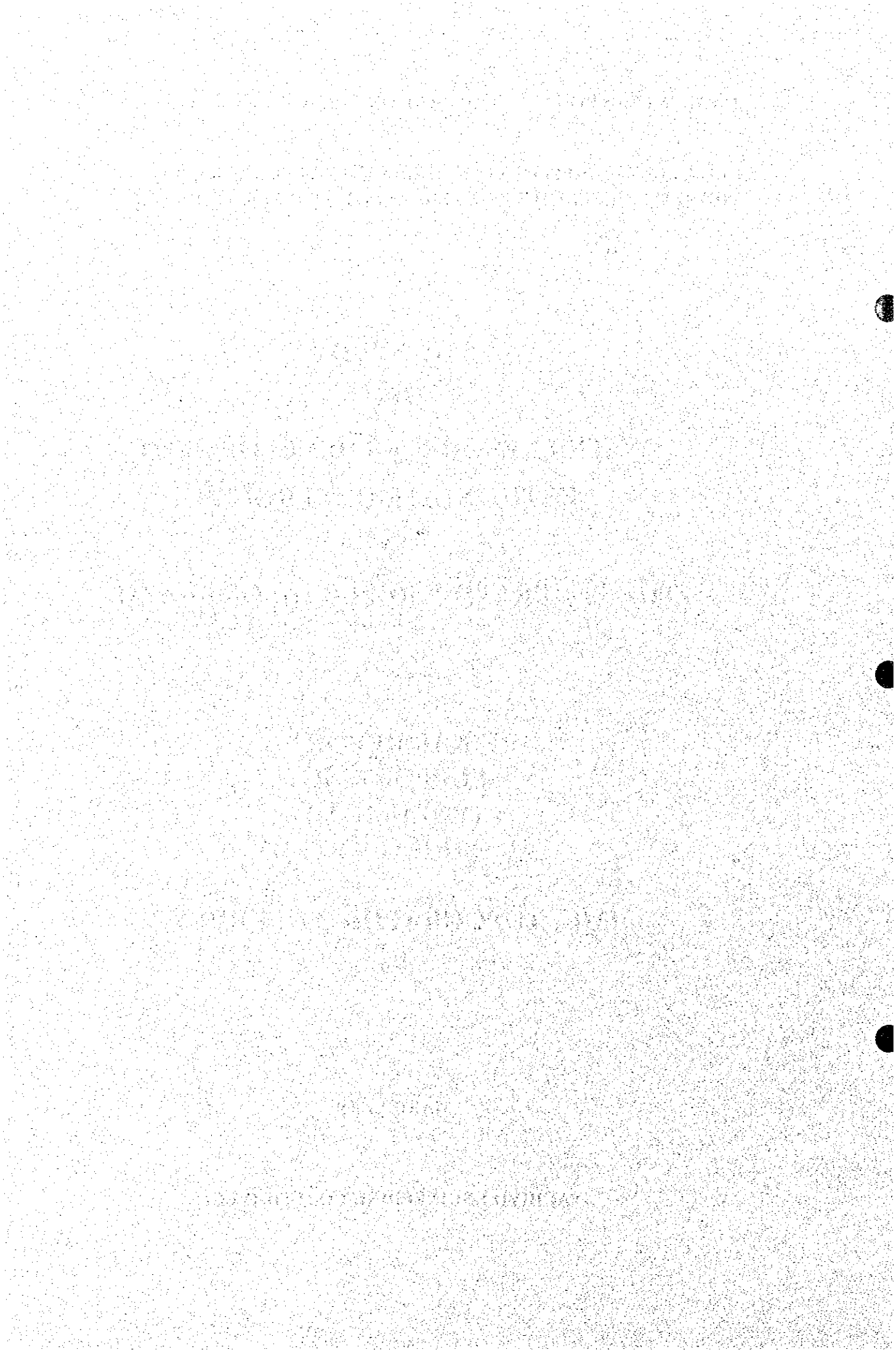
**THE STUDY
ON
WATER RESOURCES DEVELOPMENT
IN THE STATE OF SERGIPE
IN
THE FEDERATIVE REPUBLIC OF BRAZIL**

**FINAL REPORT
SUPPORTING
(VOLUME II)
FEASIBILITY STUDY**

[M] TOPOGRAPHICAL SURVEY

MARCH 2000

YACHIYO ENGINEERING CO., LTD. (YEC)



**THE STUDY ON WATER RESOURCES DEVELOPMENT
IN THE STATE OF SERGIPE
IN THE FEDERATIVE REPUBLIC OF BRAZIL**

**SUPPORTING REPORT (M)
TOPOGRAPHICAL SURVEY**

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CHAPTER 1 INTRODUCTION

1.1 Work Area

The work area covered in Vaza-Barris Dam site, Spillway site and Check dam site is as shown in Figure-1.1. Area for each site is as follows:

- | | |
|-------------------------|-------------------------------|
| 1) Vaza Barris Dam site |: 525,000 m ² |
| 2) Spillway site |: 465,000 m ² |
| 3) Check dam site |: 120,000 m ² |

1.2 Scope of Works

The Work is consisted of the following items:

- 1) Preparation and Mobilization
- 2) Topographic survey
- 3) River cross section survey
- 4) Fair drawings

1.3 Contractor

Kazutoshi SHIBUYA Servicos Tecnicos De Agrimensura Ltda.

Office : Rua Coronel Lisboa, 274/278, Sao Paulo, Brazil

President : Kazutoshi SHIBUYA

TEL : (0xx11) 549-8322

FAX : (0xx11) 572-6100

1.4 Period of the Work

- 1) Contract date : June 21, 1999
- 2) Field work : From June 22, 1999 to August 20, 1999
- 3) Office work : From July 12, 1999 to September 1, 1999
- 4) Completion date : September 3, 1999

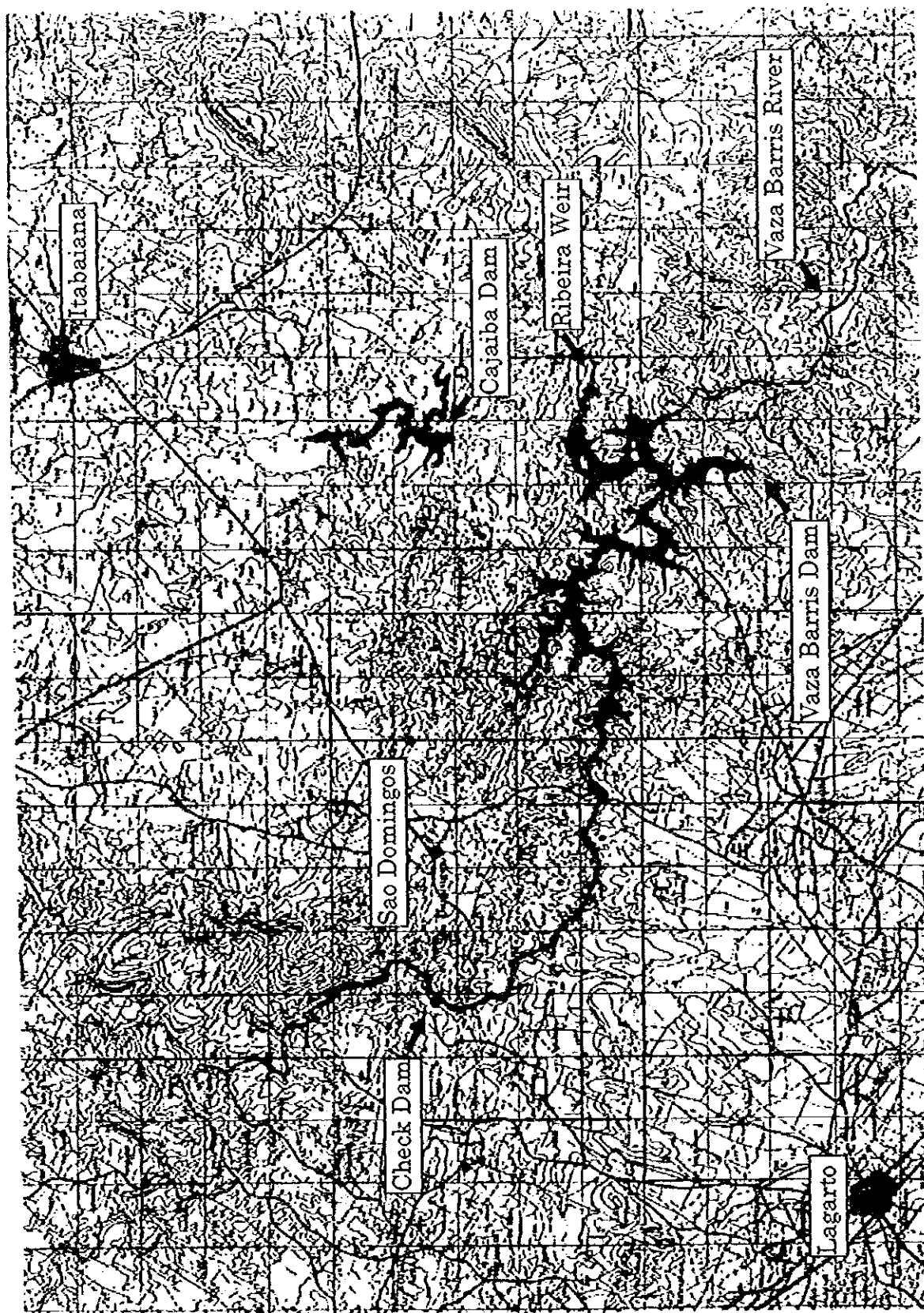


Figure-1.1 **Location Map of Topographic Survey Site**

CHAPTER 2 DESCRIPTION OF WORKS

2.1 Preparation and Mobilization

The contractor performed preparation and mobilization work furnishing all engineers, technical staff, materials, necessary equipment and all other utilities required for the Work prior to the commencement of the Work.

2.2 Topographic Survey

2.2.1 General

The Work covers horizontal and vertical ground control point survey, spot leveling and field completion.

The spheroid was based on WGS-84. Map projection was executed in accordance with the Universal Transverse Mercator (UTM) and the coordinates system UTM Zone 48. The horizontal coordinates and elevations were referred from those of the existing traverse points at CAJUEIRO and MIABA Stations near the Sites, as shown in Figure-2.1.

2.2.2 Description of Existing Traverse Points

(1) CAJUEIRO Station

Location : At the highest part of an elevation which is located further Southwest of a small hill chain near Ribeira location, 15 km South from Itabaiana city.

Description : The Center Mark is a plaque written CAJUEIRO-1955, crusted on a rock almost at ground level. The Reference Marks are also plaques crusted on rocks. The Azimuth Mark is a plaque crusted on a concrete cylindrical mark with 25 cm of diameter and almost at ground level.

(2) MIABA Station

Location : At the highest and most Northeastern elevation of a group of other elevations which extend on the Southwest direction. An elevation covered with rocks and with a big wooden cross on its top, at approximately 10 km west from the city of Campo do Brito.

Description : The Center Mark is a plaque written MIABA-1955, crusted on a rock close to ground level. The Reference Marks are also plaques crusted on rock. The Azimuth Mark is a plaque crusted on a concrete cylindrical mark with 20 cm of diameter and almost to ground level.

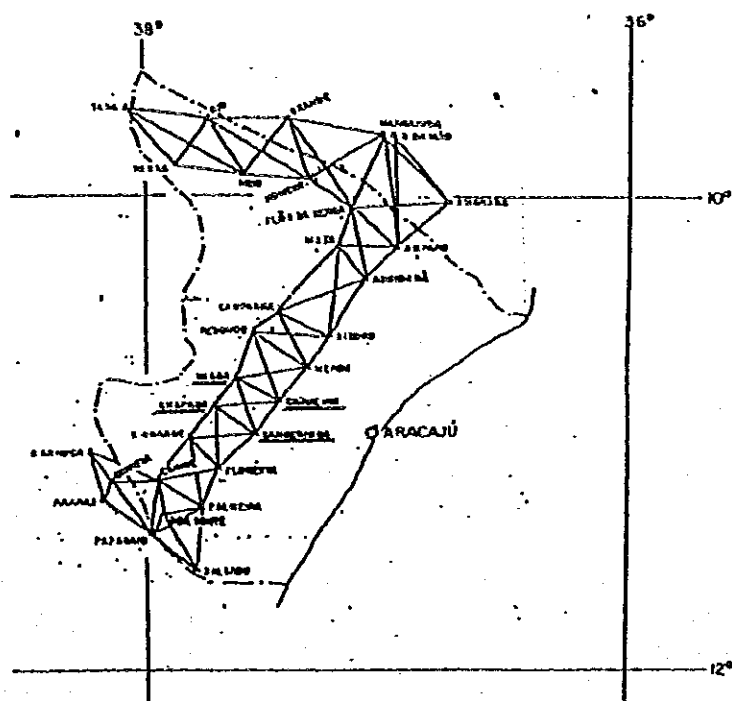


Figure-2.1 Existing Traverse Points in the State of Sergipe

Placing the main Monumentation points around the site and secondary points made possible to pick every necessary dates; (Every each hectare was picked up about 90 Points)

The observation method was the differential GPS. GPS receivers set up at several points including reference points and the observation was carried out simultaneously on a set of these points.

Units of the observation were mm for baseline vectors and for the antenna height. A standard observation time was as follows:

- Number of session* : 1
- Observation time of one (1) session : Over two (2) hours for four (4) satellites and over one (1) hour for five (5) satellites
- Observation interval within one (1) session : 15 seconds
- Misclosure between sessions : Within 30 mm in distance and within 50 mm in elevation

* One (1) session means several GPS receivers were operated simultaneously and continuously at a specified interval of time.

Satellites from which GPS signals were received over 15 degrees of their altitudes and four (4) or more of such satellites were used for the observation.

GPS signal receivers with data processors and adequate software were used for the observation. The receivers equipped with L1 and L2 of two (2) bands receiving capacity and accuracy of $\pm (20 \text{ mm} + D \times 1 \text{ ppm})$, where D is measuring distance and ppm means parts per million (1/1,000,000).

Acquired data was checked and their misclosures, ds , were computed immediately after the termination of the observation. When the misclosures exceeded the allowable range, the observation was carried out again.

The ionospheric correction shall be applied to the base lines analysis. The allowable range of the misclosures shall be as follows:

$$ds < \Sigma D \times 2 \text{ ppm, where } \Sigma D \text{ is a total distance.}$$

Adjustment of the horizontal network and transformation from WGS-84 coordinates into UTM coordinates shall be made.

The accuracy to be assured for the differential GPS shall be as follows:

$$\begin{array}{ll} \text{Horizontal} & : \pm \text{Distance} \times 2 \text{ ppm} \\ \text{Vertical} & : \pm \text{Distance} \times 5 \text{ ppm} \end{array}$$

14 main concrete monumentations were placed. The monumentation is made of plain concrete directly cast into excavated hollow in the ground of 20cm of diameter and 50 cm of depth with a brass pin on the top inscribing "JICA-SHIBUYA MC##" as shown Figure-2.2.



Figure-2.2 Main Concrete Monumentation

Coordinates and elevations of ground control points established on the top of monumentation with a brass pin are as follows:

Vaza Barris Dam Site

MC01:	N= 8,796,402.6740	E= 668,234.3317	Z= 94.689m
MC02:	N= 8,796,337.5030	E= 668,666.7010	Z= 71.019m
MC03:	N= 8,796,794.0042	E= 668,301.9407	Z= 53.472m
MC04:	N= 8,797,192.2314	E= 668,866.9050	Z= 87.411m
MC05:	N= 8,797,089.0250	E= 668,940.4237	Z= 90.355m
MC06:	N= 8,796,988.7696	E= 668,852.8751	Z= 91.165m

Spillway Site

MC07:	N= 8,797,846.8623	E= 669,131.9008	Z= 81.729m
MC08:	N= 8,797,831.2282	E= 668,855.9728	Z= 78.849m
MC09:	N= 8,798,194.6591	E= 669,930.1643	Z= 73.466m
MC10:	N= 8,798,123.5245	E= 670,273.1159	Z= 55.644m
MC11:	N= 8,798,114.4172	E= 668,804.3041	Z= 76.413m

Check Dam Site

MC14:	N= 8,806,004.0410	E= 651,658.3028	Z= 85.525m
MC15:	N= 8,806,104.2205	E= 651,649.3657	Z= 97.725m
MC16:	N= 8,806,102.2684	E= 651,308.3095	Z= 97.766m

(3) Cross Section Survey

The start point of cross section was placed using portable GPS referring the existing 1:5,000 scale maps. Every cross section points were linked to the GPS survey points, so that leveling could be done. 6 main concrete monumentations were placed with coordinates and elevations as shown below:

MC12:	N= 8,800,834.7990	E= 661,973.3871	Z= 40.819m
MC13:	N= 8,800,899.4525	E= 661,831.2970	Z= 39.393m
MC17:	N= 8,807,673.3086	E= 653,062.0100	Z= 65.998m
MC18:	N= 8,807,889.0404	E= 653,089.8700	Z= 67.405m
MC19:	N= 8,815,996.5058	E= 650,656.7373	Z= 70.859m
MC20:	N= 8,815,996.1008	E= 650,369.6544	Z= 72.312m

Cross Section leveling in total of 113 sections in the mapping area was carried out referring to the ground control points already installed at the site.

Equipment used for the direct leveling was as follows:

Automatic levels	: 30"/2 mm second order levels
Metric staffs	: 3 m or 5 m wooden or metal staff with base plates

The accuracy of the direct leveling was as follows:

Misclosures in double run or in loop	: within $10 \text{ mm} \sqrt{S}$ on the primary leveling
	: within $20 \text{ mm} \sqrt{S}$ on the secondary leveling
	(S is leveling distance in km)

(4) Fair Drawings

Fair drawings were prepared using Auto-CAD for the original 1:1,000 scale topographic maps and River cross section drawings. The fair drawings were drawn on transparent premium base sheet. Titles and numbering of Topographic maps and River cross section drawings were as follows:

1)	General Plot Plan	SE-TPS-GE-01 to 06
2)	Plan Survey of Dam Site	SE-TPS-DS-01
3)	Plan Survey of Spillway Site	SE-TPS-SS-01
4)	Plan Survey of Check Dam Site	SE-TPS-CS-01
5)	Cross Section Survey in Vaza Barris River	SE-TPS-TS-01 to 37

The topographical drawings are attached in DATA BOOK DB-1.

(5) Quantities of The work

The quantities of the work were as shown in Table-2.1.

Table-2.1 Work Items and Quantities.

Work Items		Specification	Quantities	
1. Topographic Survey				
	(1) Vaza-Barris Dam site	Scale = 1/1,000	525,000	m ²
	(2) Spillway site	Scale = 1/1,000	465,000	m ²
	(3) Check dam site	Scale = 1/1,000	120,000	m ²
		<Total>	1,110,000	m ²
2. Monumentation				
	(1) Vaza-Barris Dam site	Concrete (Φ 20 cm × 50 cm)	6	Points
	(2) Spillway site	Concrete (Φ 20 cm × 50 cm)	5	Points
	(3) Check dam site	Concrete (Φ 20 cm × 50 cm)	3	Points
	(4) Cross Section Survey	Concrete (Φ 20 cm × 50 cm)	6	Points
		<Total>	20	Points
3. Cross Section Survey				
	(1) Vaza-Barris Dam Axis	Scale = 1/1,000	1	Section
	(2) River Cross Section	Scale = 1/1,000	112	Sections
		<Total>	113	Sections
4. Fair Drawing				
	(1) General Plot Plan	Size A1	6	Sheets
	(2) Plan Survey of Dam site	Size A0	1	Sheet
	(3) Plan Survey of Spillway site	Size A1 (Oblong)	1	Sheet
	(4) Plan Survey of Check dam site	Size A1	1	Sheet
	(5) Cross Section Survey	Size A1 (1-4 Sec. within 1 Sheet)	37	Sheets
		<Total>	46	Sheets

The location and area of the topographic survey is shown in Figure-2.3.

2.3 Evaluation of Accuracy of Existing 1:5000 Scale Maps

The existing 1:5000 scale maps available in the State of Sergipe were prepared by FUNDASE in 1985 under the National Land System Development Project. The result of comparison between the cross sections of Vaza Barris River obtained by the Topographic Survey and the sections drawn based on the existing 1:5000 scale maps shows good coincidence with some negligible differences in elevation. Therefore, the existing 1:5000 scale maps which cover Vaza Barris Dam and reservoir area can be used for the purpose of design without any significant error.

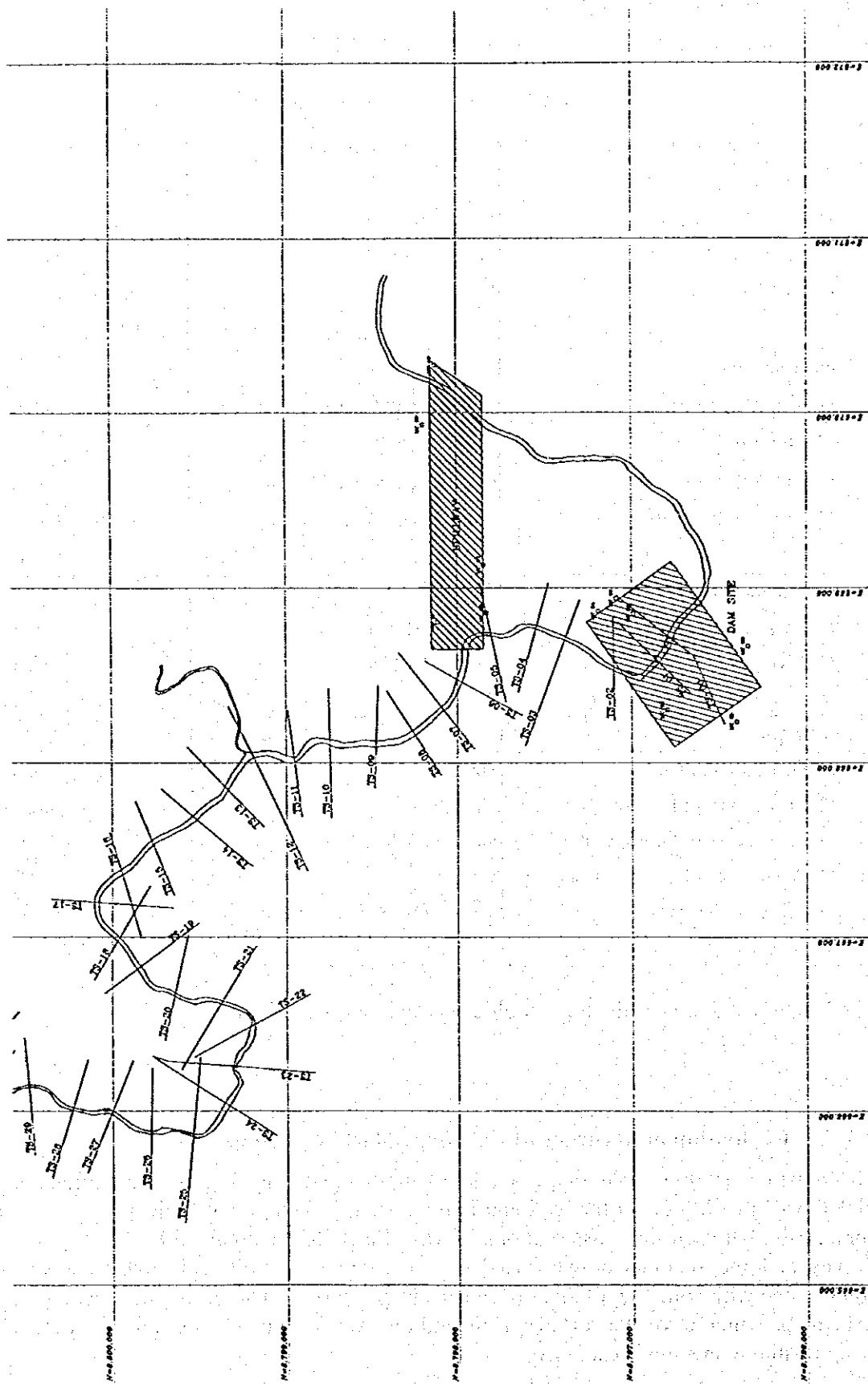


Figure-2.3 (1/6) Location and Area of the Topographic Survey

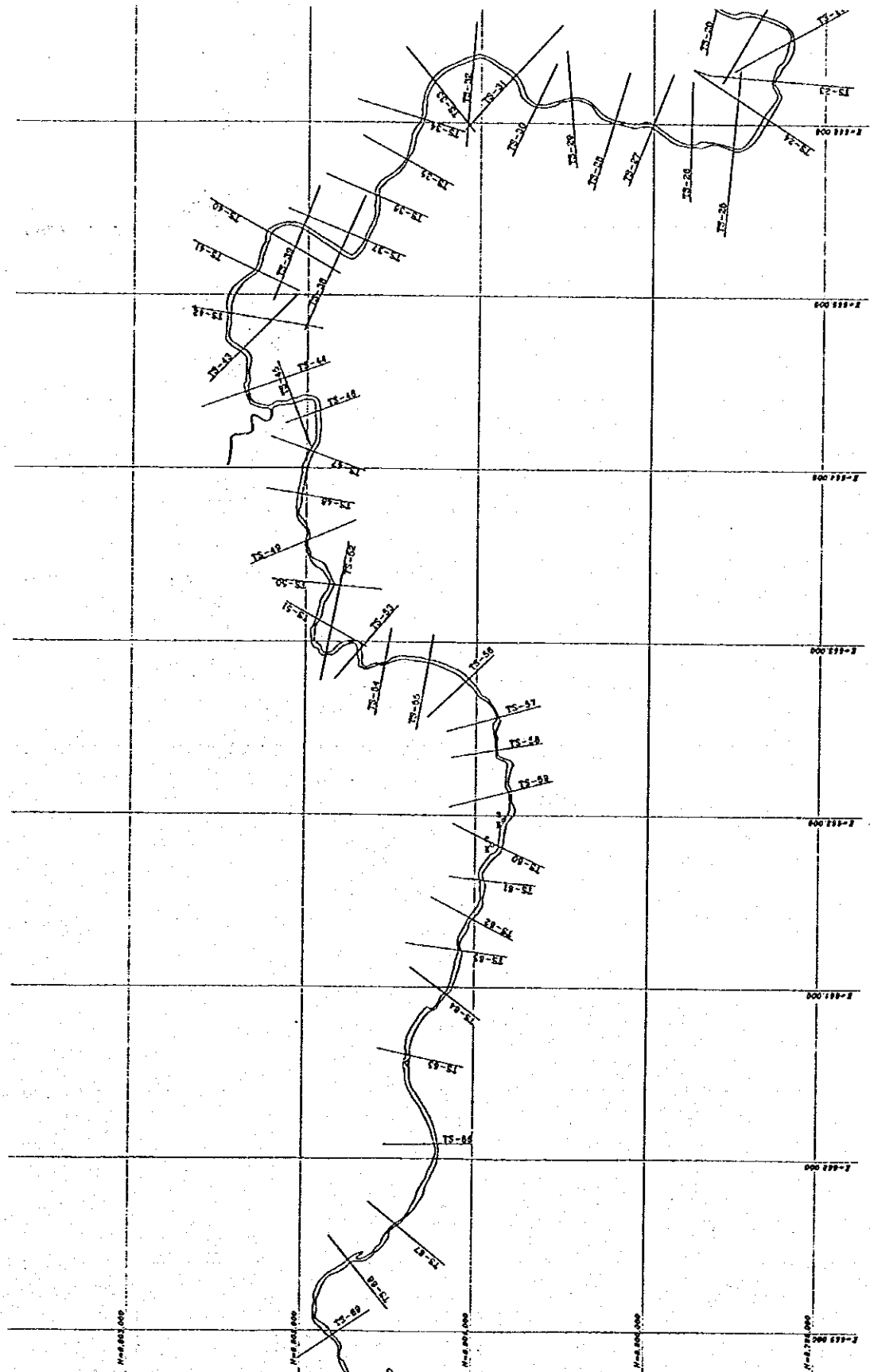


Figure-2.3 (2/6) Location and Area of the Topographic Survey

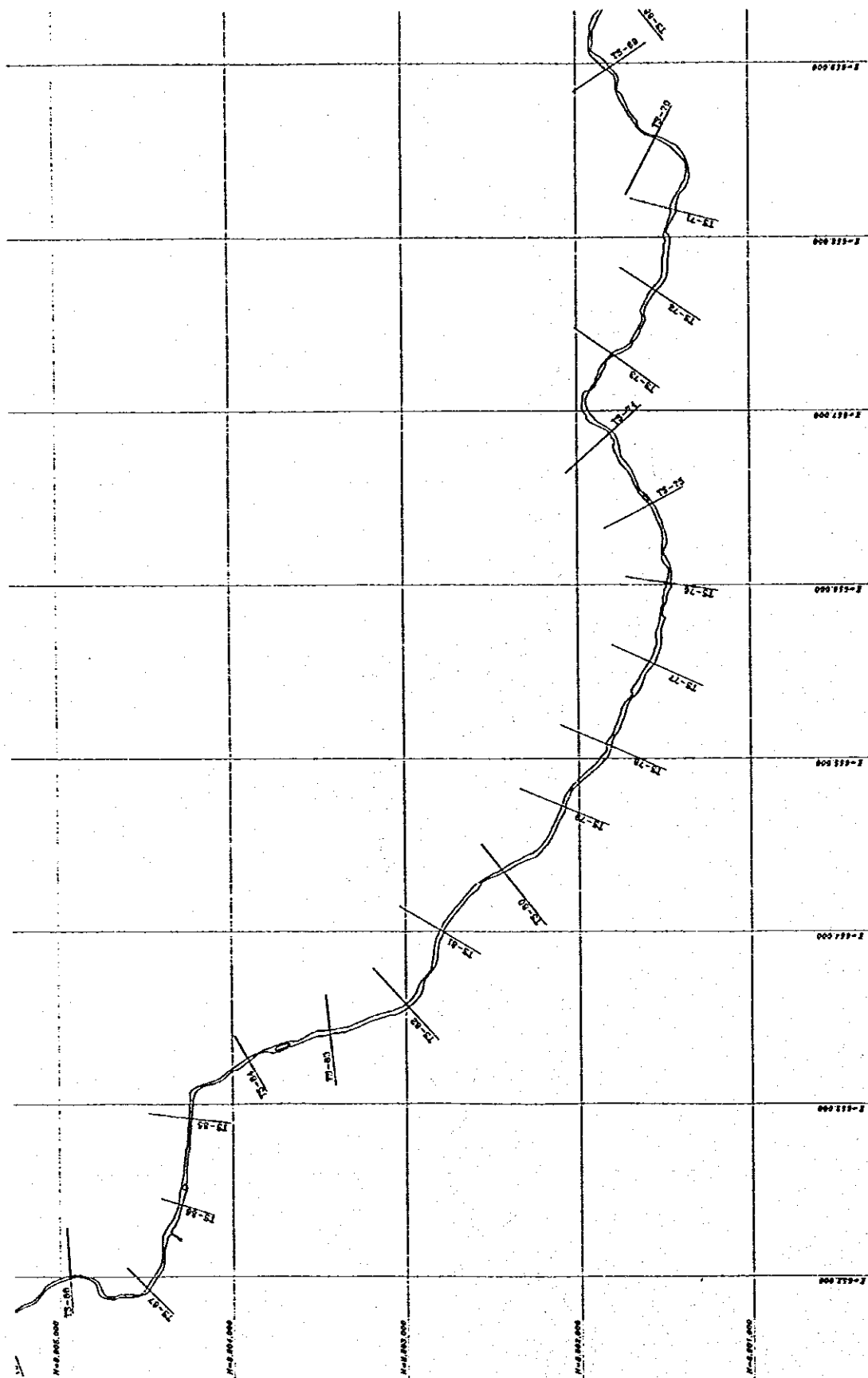


Figure-2.3 (3/6) Location and Area of the Topographic Survey

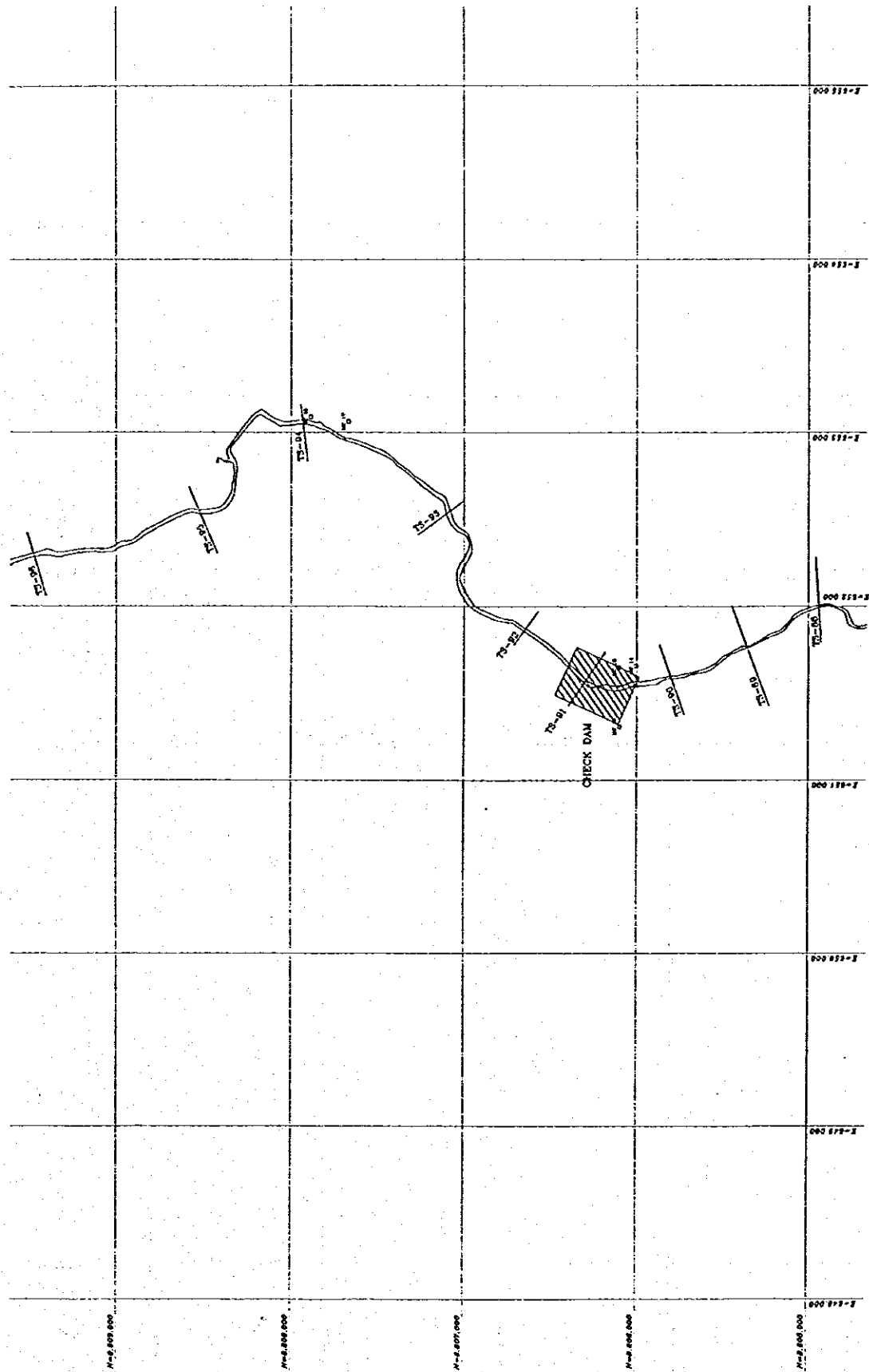


Figure-2.3 (4/6) Location and Area of the Topographic Survey

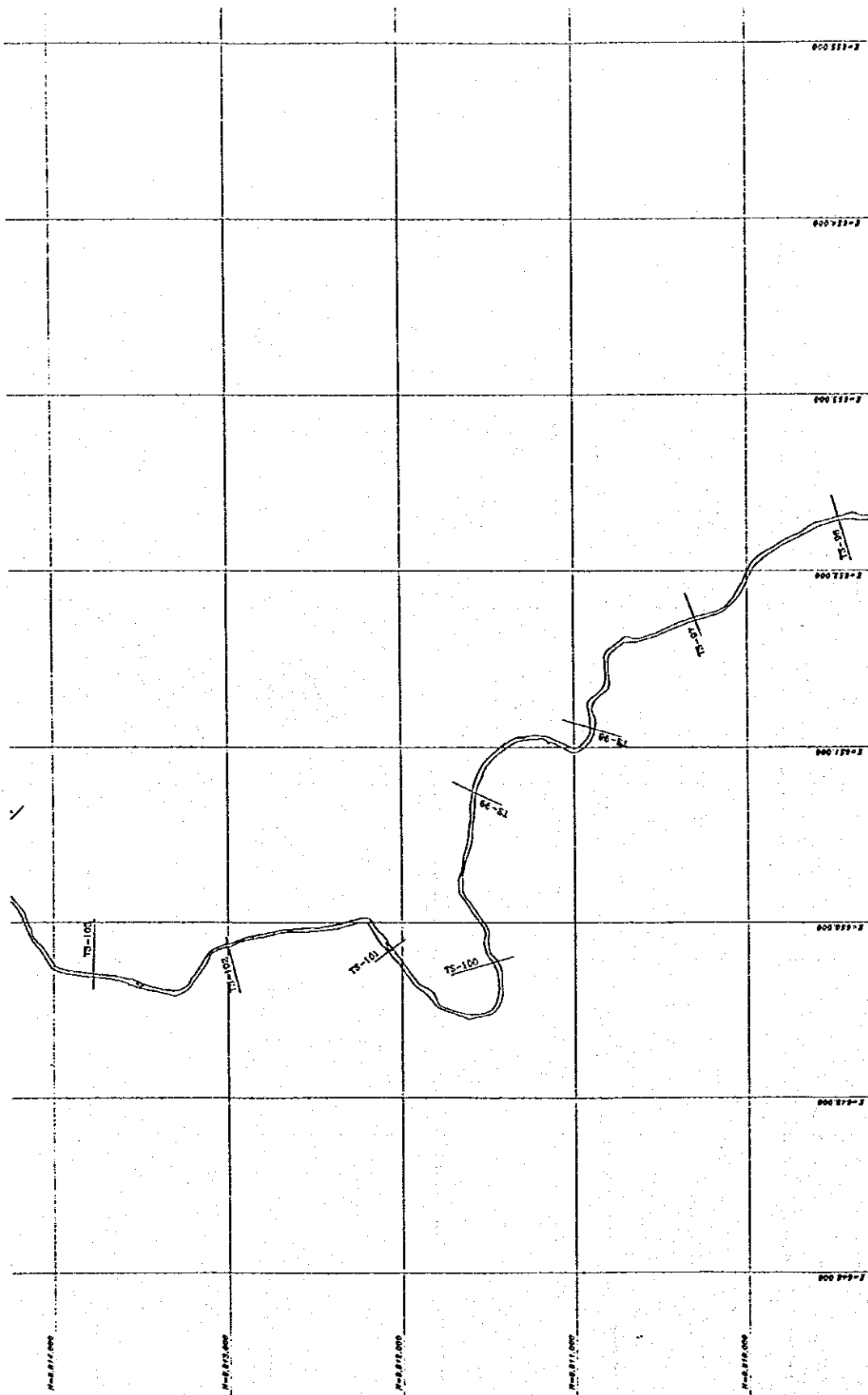


Figure-2.3 (5/6) Location and Area of the Topographic Survey

Supporting Report: Feasibility Study

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