BOSTON HARBOR SDEIS

BASELINE INFORMATION: ENGINEERING/CONSTRUCTION COSTS

Prepared for

U.S. Environmental Protection Agency

Region I

Environmental Evaluation Section

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1.0 SUMMARY

1.1 Introduction

This report describes the basis of the preliminary cost estimates for the wastewater treatment facility alternatives being proposed for Boston Harbor. It identifies the method followed for initial development of costs being studied in the Supplemental Draft EIS (SDEIS) for a wide range of options considered by the MDC or proposed by others during the EIS process, and explains the methods and assumptions applied to revise these initial cost estimates once a smaller set of alternatives was reached. At the conclusion of this report is a description of the impact analysis to be made in the SDEIS which will further refine these costs to reflect such factors as sludge disposal methods, barging of equipment, site constraints, and mitigation measures.

1.2 SDEIS Alternatives Considered

The preparation of a Supplemental Draft EIS of proposed wastewater treatment facilities in Boston Harbor began with a review of the facility engineering requirements and the development of associated preliminary costs for all viable treatment alternatives. The determination of which alternatives were to be considered in the SDEIS required the review of all potential siting alternatives for Boston Harbor wastewater treatment facilities.

This review was comprised of:

- Alternatives studied by the MDC and their consultants in the Nut Island Site Options Study (1982) report;

- Other siting alternatives and treatment options which were previously studied; and

- New alternatives not previously considered which have been identified.

Preliminary analysis of these siting alternatives defined such criteria as the level of treatment, acreage required, site environment (including the neighboring community), and the number of sites and facilities involved. Costs for construction and for operation and maintenance (O&M) were developed initially as a means of comparing the alternatives within a single level of treatment.

To compare the relative viability of the options at this stage of analysis, a general screening process was used to reduce the number of alternatives for further, more detailed study. Costs of the options were found not to be a principal determinant in the screening process. A separate report describes the screening process and its results.

Eight alternatives were selected from the screening process and were then reanalyzed to independently affirm in greater detail capital costs and O&M costs for both primary and secondary options. In certain

instances, revisions were made to the preliminary costs based on the findings of this reanalysis. Table 1, which follows, summarizes these costs as they now stand, recognizing that further revisions will be made as the data from the impact analysis is developed and factored into the SDEIS.

2.0 DEVELOPMENT OF ENGINEERING AND SITING ALTERNATIVES

2.1 Evaluation of MDC Alternatives from the Nut Island Site Options Study (1982)

The MDC Nut Island Site Options Study (1982) report was the principal source of facility design criteria and cost data applicable to the possible sites being considered. It presented capital and O&M cost tables for 12 options analyzed in detail for the MDC by their consultants, Metcalf & Eddy, Inc. The review process required the examination of each alternative to verify the level of treatment proposed, acreage required, site environment (including the neighboring community), and the number and type of facilities involved. Evaluation of facilities siting also included the determination of individual unit processes requirements, the treatment facilities for north and south system flows, and the overall usage and characteristics of the sites.

For example, the Nut Island Site Options Study (1982) "Option 5" provides secondary treatment. Under this option, a primary-secondary treatment facility for the north system flows would be located on Deer Island, a primary treatment facility for south system flows would be

TABLE 1

BOSTON HARBOR SDEIS: SUMMARY OF OPTIONS AND THEIR COSTS

Option No.	Sites, Level of Treatment, and (Acreage Required)				Costs in $Millions		Annualized Costs*** ($Millions)
	Nut Island	Deer Island	Long Island	Other Island**	Capital	O&M	
Secondary Options							
1c	● ■ (36)	● ■ (104)					
1a	■ (2)	● ■ (115)			668.28	43.7	112.4
1b *	● (18)	● ■ (115)			752.97	45.2	122.6
2b.1	■ (2)	■ (2)	● ■ (115)		820.40	42.7	127.0
2b.3	■ (2)	● (52)	● ■ (81)		830.85	48.5	133.9
Primary Options							
4a.2 D	■ (2)	● (62)			757.08	21.1	98.9
4b.2*D	● (18)	● (52)			834.91	22.0	107.8
5a.2 D	■ (2)	● (52)	● (18)		827.72	21.7	106.8
5b.2 D	■ (2)	■ (2)	● (62)		917.82	20.5	114.9

KEY: ■ = headworks only ● = primary treatment ■ = secondary treatment

D = deep ocean outfall * = MDC's preferred options

*** = Assumes 8-1/8% interest rate over 20 years.

1. Revised costs reflect baseline construction factors with reduction in previously estimated secondary treatment costs and deletion (for the time being) of sludge handling and disposal costs; see discussion in section 5.0 of this report. These revised costs will increase upon addition of costs for sludge facilities, as well as added costs for barging, workforce transportation, other construction practices, and mitigation measures. These total costs by option will be presented in the SDEIS.

Source: CE Maguire, Inc. (July 6, 1984)

located on Nut Island, and a companion secondary treatment facility for south system flows would be located on Long Island. Therefore, three distinct sites with varying levels of treatment would be involved under this option. The use of Deer Island could impact neighboring Port Shirley in Winthrop, the use of Nut Island could impact neighboring Houghs Neck in Quincy, and the use of Long Island could impact neighboring Squantum also in Quincy. Such combinations of wastewater treatment engineering and siting considerations were evaluated during the initial review of alternatives.

In general, the alternatives presented in the Nut Island Site Options Study (1982) involved both primary and secondary treatment. They involved the use of Deer and Nut Islands to varying degrees in all cases, and the use of Long Island for three options, all of which are secondary treatment options. Subsequent developments, notably the opportunity to apply for a waiver from secondary treatment, resulted in the need to reconsider these MDC facility plan options, and in certain instances, develop new ones as described in Section 2.3 below.

2.2 Alternatives Considered from Other Studies

Other studies conducted prior to the MDC Nut Island Site Options Study (1982) also examined options for wastewater treatment facilities siting in Boston Harbor. These included:

- MDC, Wastewater Engineering and Management Plan for Boston Harbor - Eastern Massachusetts Metropolitan Area, EMMA Study, Metcalf & Eddy, Inc., March, 1976.

- EPA, Draft Environmental Impact Statement on the Upgrading of the Boston Metropolitan Area Sewerage System, Greeley and Hansen and Environmental Assessment Council, Inc., August, 1978.

The MDC EMMA Study (1976) recommended a plan which provided wastewater treatment at four sites. Secondary and advanced treatment facilities would be located at Deer Island, Nut Island, the Middle Charles River, and Upper Neponset River. The study also considered siting along the Aberjona River.

The EPA Draft EIS (1978) written in response to the EMMA Study plan, initially considered eleven sites in the vicinity of Boston Harbor for the location of wastewater treatment facilities. These sites were: Deer Island, Spectacle Island, Long Island, Moon Island, Squantum, Peddocks Island, Nut Island, Broad Meadows, Kings Cove, Lower Neck, and Broad Cove. Of these sites, only Deer Island, Long Island, Squantum Point, Nut Island and Broad Meadows were found to be suitable for further consideration.

As is apparent, conditions had changed sufficiently from the date of these studies, and particularly the Draft EIS, to warrant a new facility planning effort by the MDC, as evidenced by the Nut Island

Site Options Study (1982), and a supplemental environmental review by EPA in the SDEIS.

Chief among the options developed in these prior plans to be analyzed in the SDEIS were the proposal from the EMMA Study to site "satellite" advanced treatment facilities on the Charles and Neponset Rivers, and the recommendation from the Draft EIS for consolidated secondary treatment facilities on Deer Island.

2.3 New Alternatives Not Previously Studied

After reviewing the range of alternatives presented in the MDC Nut Island Site Options Study (1982), the MDC EMMA Study (1976), and the EPA Draft EIS (1978), public and agency comment was invited during the EPA scoping period for the SDEIS. It became apparent from the comments received that several additional options should also be considered. Some of these options involved variations of treatment process locations for both primary and secondary treatment. Sites considered were primarily those at Deer, Nut, and Long Islands. These included:

- Primary treatment at Deer and Nut Island with a combined secondary facility on Long Island,

- Converting Nut Island to a headworks and providing primary treatment at Long Island,

- Converting both Deer and Nut Islands to either headworks or pumping facilities and providing either primary or secondary treatment facilities on Long Island.

Other new alternatives considered looked at utilization of other sites in Boston Harbor including Thompson Island, Lovell Island, or the Brewster Islands.

Besides the presentation of new options relating to siting of facilities, the comments received suggested optional treatment processes as possible additional alternatives to be examined. For example, an intermediate level of treatment greater than primary, but less than secondary, could be achieved through chemically assisted primary treatment (or advanced primary). Though initially considered, these intermediate treatment levels were dropped because no proposal to utilize such treatment had been made.

After reviewing all of the existing and new siting and treatment alternatives, twenty-two options (including some similar options having only slight variations in their facility layout)were analyzed for preliminary screening. This screening reduced the number of viable alternatives to eight. A separate report describing the screening process and the results was distributed in June, 1984. These eight were then reanalyzed to establish independent and revised costs as appropriate.

3.0 FACILITIES DESIGN CRITERIA

The Nut Island Site Options Study (1982) presented in detail the individual facility components required for each treatment alternative. These components are designed to provide optimum removal of coarse solids, suspended and floating solids, grease, and organic matter. Other components also provide for disinfection and odor control. Land acquisition and other associated site development costs were also developed in the prior study.

After reviewing established design guidelines, the generalized design criteria presented in the Nut Island Site Options Study (1982) were found to be accurate for the treatment alternatives presented. These design criteria applied to such treatment components as screens, grit chambers, primary tanks, aeration tanks and equipment, secondary tanks, sludge pumps and thickeners, and digesters.

Design criteria used to determine the individual component dimensions were shown in Table 5-5 of the Nut Island Site Options Study (1982) for each option presented. In order to facilitate the comparison of the treatment alternatives in the SDEIS, the component dimensions established for a given volume were carried over to the new options, when applicable. Otherwise, new component dimensions were derived based on the established design criteria and assumptions presented in the MDC study. The dimensions of these major treatment facility components utilized in the SDEIS are presented in Table 2. A general comparison of treatment components is presented in Figure 1.

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DIGITALLY

WASTEWATER TREATMENT COMPONENTS BY TREATMENT LEVEL

	COMPONENT	FLOWS		
		NORTH SYSTEM	SOUTH SYSTEM	COMBINED
Head-works	Aerated Grit Chambers	4(1)	4	8(1)
Primary	Primary Sedimentation Tanks	20(2)	12	28(2)
Primary	Gravity Sludge Thickeners	8(3)	2	10(3)
Primary	Anaerobic Digestors	8(3)	4(4)	12(5)
Secondary	Aeration Tanks	16	6	22
Secondary	Secondary Sedimentation Tanks	38	12	50

(1) 2 of these are existing at Deer Island
(2) 8 of these are existing at Deer Island
(3) 4 of these are existing at Deer Island (4) 4 of these are existing at Nut Island
(5) 4 of these are existing at Deer Island and 4 at Nut Island

Source: Based on MDC, Nut Island Site Options Study (1982) Volume 1, Table 5-5.

Figure 1

4.0 DEVELOPMENT OF INITIAL PRELIMINARY COSTS OF ALTERNATIVES

4.1 Capital and O&M Costs Update

The Nut Island Site Options Study (1982) included a table of capital costs for each option. The cost table presented detailed costs for each option component, as well as other construction-related costs such as removal of unsuitable materials and land acquisition. Since this study was completed in June 1982, the costs presented in that report were based on an Engineering News Record (ENR) Construction Cost Index of 3600, reflecting then current prices.

In order to facilitate the presentation of relative costs for all of the options under consideration in the SDEIS, the Nut Island Site Options Study (1982) cost table was first updated to an ENR Construction Cost Index of 4200, reflecting 1984 prices. Table 3 presents these costs for all options considered.

Operation and maintenance (O&M) cost tables were similarly presented in the Nut Island Site Options Study (1982) to reflect prices then in effect. Therefore, these costs were also updated to 1984 prices. Table 4 presents these costs by option.

4.2 Costs of New Alternatives

In developing costs for new options, individual component characteristics for each option were compared with those presented in the

UPDATED OPTION CAP COSTS **Table 3**

	Option 1a		Option 1b		Option 1c		Option 2a.1*		
	Deer	Nut	Deer	Nut	Deer	Nut	Deer	Nut	Long
Influent Pump Station	29,677	-	29,677	2,993	16,881	2,993	16,881	2,993	10,432
Screens & Grit Chambers	315	9,129	315	9,129	315	9,129	315	9,129	-
Primary Sedimentation Tanks	30,051	-	18,031	17,918	18,031	17,918	18,031	-	17,918
Gravity Thickeners	3,506	-	2,921	1,169	2,337	1,169	2,337	-	1,169
Anaerobic Digesters	22,059	-	12,920	-	12,920	-	12,920	-	12,920
Gas Storage	3,150	-	3,150	-	3,150	-	3,150	-	3,150
Secondary Aeration Tanks	80,317	-	80,317	-	59,012	21,307	59,012	-	21,307
Blower Building	44,743	-	44,743	-	31,319	13,422	31,319	-	13,422
Secondary Sedimentation Tanks	248,614	-	248,614	-	183,974	64,639	183,974	-	64,639
Electrical Generator Building	2,066	-	-	1,540	-	1,540	-	-	2,066
Engine Generators	6,080	-	1,216	4,864	1,216	4,864	1,216	-	4,864
Administration & Maintenance Building	7,560	-	6,615	4,442	6,615	5,355	6,615	-	6,615
Scum Incinerator	7,245	-	3,623	3,885	3,623	3,885	3,623	-	3,623
Odor Control Facilities	17,073	741	-	17,814	-	17,814	-	741	17,073
Chlorination Equipment	3,443	1,402	3,443	1,402	2,835	1,591	2,835	1,402	2,066
Chlorine Contact Tanks	13,857	-	13,857	-	10,409	3,469	10,409	-	3,469
Utility Company Power to Site	-	1,772	-	1,969	-	2,048	-	1,772	-
Pier Facilities	11,528	-	11,528	8,892	11,528	8,892	11,528	-	8,234
Interisland Wastewater Tunnel	-	82,819	-	82,819	-	-	-	46,459	-
Effluent Pump Station	29,413	-	29,413	-	22,411	8,710	22,411	-	8,710
Outfalls	47,723	-	47,723	-	41,265	49,397	41,265	-	53,019
Miscellaneous Civil	756	-	709	-	599	552	599	-	552
Channels and Dikes	3,141	275	3,141	6,297	3,141	15,666	3,141	275	1,245
Removal Unsuitable Materials	27,353	-	26,514	-	20,731	-	20,731	-	973
Earth Fill	-	-	-	2,442	-	13,262	-	-	2,008
Foundation Preparation	-	-	-	15,730	-	49,167	-	-	5,689
Demolition	-	2,835	-	1,575	-	1,575	-	2,835	-
Subtotal by Site	639,670	98,973	588,470	184,880	452,312	318,364	452,312	65,606	265,163
Capital Cost	738,643		773,350		770,676			783,081	
Land Acquisition	2,077		2,077		1,820		1,820		1,050
Sludge Processing	111,924		111,924		111,924		111,924		
Total Capital Cost	852,644		887,351		884,420			897,875	

	Option 2a.2*			ion 2b.1*			Option 2b.2*		
	Deer	Nut	Long	Deer	Nut	Long	Deer	Nut	Long
Influent Pump Station	16,881	2,993	10,432	16,881	2,993	37,589	16,881	2,993	37,589
Screens & Grit Chambers	315	9,129	-	315	9,129	-	315	9,129	-
Primary Sedimentation Tanks	18,031	17,918	-	-	-	45,077	18,031	17,918	-
Gravity Thickeners	2,337	1,169	810	-	-	4,675	2,337	1,169	2,429
Anaerobic Digesters	12,920	-	-	-	-	33,089	12,920	-	-
Gas Storage	3,150	-	-	-	-	3,150	3,150	-	-
Secondary Aeration Tanks	59,012	-	21,307	-	-	80,317	-	-	80,317
Blower Building	31,319	-	13,423	-	-	44,743	-	-	44,743
Secondary Sedimentation Tanks	183,974	-	64,639	-	-	248,614	-	-	248,614
Electrical Generator Building	-	1,540	-	-	-	2,066	-	1,540	-
Engine Generators	1,216	4,864	-	-	-	6,080	1,216	4,864	-
Administration & Maintenance Building	6,615	4,442	4,725	-	-	8,978	5,670	4,442	8,978
Scum Incinerator	3,623	3,885	-	-	-	7,245	3,623	3,886	-
Odor Control Facilities	-	17,814	-	223	741	17,073	-	17,814	-
Chlorination Equipment	2,835	1,402	2,066	189	1,402	3,443	189	1,402	3,443
Chlorine Contact Tanks	10,409	-	3,469	-	-	13,857	-	-	13,857
Utility Company Power to Site	-	1,969	-	-	1,772	-	-	1,969	-
Pier Facilities	11,528	8,892	8,234	-	-	8,234	11,528	8,892	8,234
Interisland Wastewater Tunnel	-	45,892	-	68,156	46,459	-	68,156	44,990	-
Effluent Pump Station	22,411	-	8,710	-	-	29,413	-	-	29,413
Outfalls	41,265	-	53,019	-	-	91,855	-	-	91,855
Miscellaneous Civil	599	158	394	-	-	630	410	158	630
Channels and Dikes	3,141	6,297	687	642	275	11,118	1,260	6,297	11,118
Removal Unsuitable Materials	20,731	-	973	-	-	2,270	1,462	-	-
Earth Fill	-	2,442	2,008	-	-	4,679	-	2,442	-
Foundation Preparation	-	15,730	5,689	-	-	11,359	-	15,730	11,359
Demolition	-	1,575	-	6,606	2,835	-	-	1,575	-
Subtotal by Site	452,312	148,111	200,585	93,012	65,606	715,554	147,148	147,210	592,579
Capital Cost		801,008			874,172			886,937	
Land Acquisition	1,820		735			2,450	607		2,380
Sludge Processing	111,924					111,924	111,924		
Total Capital Cost		915,487			998,546			1,001,848	

*See footnotes

	Option 3a*			Option 3b*			Option 4a.1		Opti	.2
	Deer	Nut	Lovell	Deer	Nut	Brewsters	Deer	Nut	Deer	Nut
Influent Pump Station	16,881	2,993	37,589	16,881	2,993	37,589	29,677	-	29,677	-
Screens & Grit Chambers	315	9,129	-	315	9,129	-	315	9,129	315	9,129
Primary Sedimentation Tanks	-	-	45,077	-	-	45,077	30,051	-	30,051	-
Gravity Thickeners	-	-	4,675	-	-	4,675	3,506	-	3,506	-
Anaerobic Digesters	-	-	33,089	-	-	33,089	22,059	-	22,059	-
Gas Storage	-	-	3,150	-	-	3,150	3,150	-	3,150	-
Secondary Aeration Tanks	-	-	80,317	-	-	80,317	-	-	-	-
Blower Building	-	-	44,743	-	-	44,743	-	-	-	-
Secondary Sedimentation Tanks	-	-	248,614	-	-	248,614	-	-	-	-
Electrical Generator Building	-	-	2,066	-	-	2,066	2,066	-	2,066	-
Engine Generators	-	-	6,080	-	-	6,080	6,080	-	6,080	-
Administration & Maintenance Building	-	-	8,978	-	-	8,978	6,615	-	6,615	-
Scum Incinerator	-	-	7,245	-	-	7,245	7,245	-	7,245	-
Odor Control Facilities	223	741	17,073	223	741	17,073	17,073	741	17,073	741
Chlorination Equipment	189	1,402	3,443	189	1,402	3,443	3,443	1,402	3,443	1,402
Chlorine Contact Tanks	-	-	13,857	-	-	13,857	13,857	-	6,940	-
Utility Company Power to Site	-	1,772	*	-	1,772	*	2,363	1,772	2,363	1,772
Pier Facilities	-	-	11,528	-	-	11,528	11,528	-	11,528	-
Interisland Wastewater Tunnel	45,375	67,200	-	102,850	86,400	-	-	82,819	-	82,819
Effluent Pump Station	-	-	29,413	-	-	29,413	29,413	-	41,252	-
Outfalls	-	-	91,855	-	-	91,855	47,723	-	411,847	-
Miscellaneous Civil	-	-	*	-	-	*	457	-	457	-
Channels and Dikes	642	275	11,118	642	275	11,118	1,517	275	1,517	275
Removal Unsuitable Materials	-	-	*	-	-	*	2,190	-	2,190	-
Earth Fill	-	-	547,500	-	-	992,500	-	-	-	-
Foundation Preparation	-	-	*	-	-	*	-	-	-	-
Demolition	6,606	2,835	-	6,606	2,835	-	-	2,835	-	2,835
Subtotal by Site	70,231	86,347	1,247,410	127,706	105,547	1,692,410	240,328	98,973	609,374	98,973
Capital Cost		1,403,988			1,925,663	-	339,301		708,347	
Land Acquisition			*			*	840		840	
Sludge Processing			111,924			111,924	50,388		50,388	
Total Capital Cost		1,515,912			2,037,587	-	390,529		759,575	

	Option 4b.1		Option 4b.2		Option 5a.1*			Option 5a		
	Deer	Nut	Deer	Nut	Deer	Nut	Long	Deer	Nut	Long
Influent Pump Station	16,881	2,993	16,881	2,993	16,881	2,993	10,432	16,881	2,993	10,432
Screens & Grit Chambers	315	9,129	315	9,129	315	9,129	-	315	9,129	-
Primary Sedimentation Tanks	18,031	17,918	18,031	17,918	18,031	-	17,918	18,031	-	17,918
Gravity Thickeners	2,337	1,169	2,337	1,169	2,337	-	1,169	2,337	-	1,169
Anaerobic Digesters	12,920	-	12,920	-	12,920	-	12,920	12,920	-	12,920
Gas Storage	3,150	-	3,150	-	3,150	-	3,150	3,150	-	3,150
Secondary Aeration Tanks	-	-	-	-	-	-	-	-	-	-
Blower Building	-	-	-	-	-	-	-	-	-	-
Secondary Sedimentation Tanks	-	-	-	-	-	-	-	-	-	-
Electrical Generator Building	-	1,540	-	1,540	-	-	2,066	-	-	2,066
Engine Generators	1,216	4,864	1,216	4,864	1,216	-	4,864	1,216	-	4,864
Administration & Maintenance Building	5,670	4,442	5,670	4,442	5,670	-	6,615	5,670	-	6,615
Scum Incinerator	3,623	3,886	3,623	3,886	3,623	-	3,623	3,623	-	3,623
Odor Control Facilities	-	17,814	-	17,814	-	741	17,073	-	741	17,073
Chlorination Equipment	2,835	1,591	2,835	1,591	2,835	1,402	2,066	2,835	1,402	1,402
Chlorine Contact Tanks	10,409	3,469	6,940	-	10,409	-	3,469	6,940	-	-
Utility Company Power to Site	2,363	2,204	2,363	1,772	2,363	1,772	-	2,363	1,772	-
Pier Facilities	11,528	8,892	11,528	8,892	11,528	-	8,234	11,528	-	8,234
Interisland Wastewater Tunnel	-	-	-	77,433	-	46,459	-	-	46,459	36,049
Effluent Pump Station	22,411	8,710	41,462	-	22,411	-	8,710	41,462	-	-
Outfalls	41,265	49,397	411,847	-	41,265	-	53,019	411,847	-	-
Miscellaneous Civil	410	158	394	158	410	-	158	394	-	158
Channels and Dikes	1,260	6,297	1,260	6,297	1,260	275	1,245	1,260	275	1,245
Removal Unsuitable Materials	1,359	-	1,359	-	1,359	-	487	1,359	-	487
Earth Fill	-	3,256	-	2,442	-	-	1,004	-	-	1,004
Foundation Preparation	-	15,730	-	15,730	-	-	2,849	-	-	2,849
Demolition	-	1,575	-	1,575	-	2,835	-	-	2,835	-
Subtotal by Site	157,983	165,034	544,131	179,645	157,983	65,606	161,071	544,131	65,606	131,258
Capital Cost	323,017		723,776			384,660			740,995	
Land Acquisition	607		607		607		525	607		525
Sludge Processing	50,388		50,388		50,388			50,388		
Total Capital Cost	374,012		774,771			436,180			792,515	

*See footnotes

	5b.1*			5b.2*	
	Deer	Nut	Long	Deer	Nut	Long
Influent Pump Station	16,881	2,993	37,589	16,881	2,993	37,589
Screens & Grit Chambers	315	9,129	-	315	9,129	-
Primary Sedimentation Tanks	-	-	45,077	-	-	45,077
Gravity Thickeners	-	-	4,675	-	-	4,675
Anaerobic Digesters	-	-	33,089	-	-	33,089
Gas Storage	-	-	3,150	-	-	3,150
Secondary Aeration Tanks	-	-	-	-	-	-
Blower Building	-	-	-	-	-	-
Secondary Sedimentation Tanks	-	-	-	-	-	-
Electrical Generator Building	-	-	2,066	-	-	2,066
Engine Generators	-	-	4,864	-	-	4,864
Administration & Maintenance Building	-	-	6,615	-	-	6,615
Scum Incinerator	-	-	3,623	-	-	3,623
Odor Control Facilities	223	741	17,073	223	741	17,073
Chlorination Equipment	189	1,402	3,443	189	1,402	3,443
Chlorine Contact Tanks	-	-	13,857	-	-	6,940
Utility Company Power to Site	-	1,772	-	-	1,772	-
Pier Facilities	-	-	8,234	-	-	8,234
Interisland Wastewater Tunnel	68,156	46,459	-	68,156	46,459	-
Effluent Pump Station	-	-	29,413	-	-	41,252
Outfalls	-	-	91,855	-	-	411,857
Miscellaneous Civil	-	-	368	-	-	368
Channels and Dikes	642	275	11,118	642	275	11,118
Removal Unsuitable Materials	-	-	1,135	-	-	1,135
Earth Fill	-	-	2,339	-	-	2,339
Foundation Preparation	-	-	6,638	-	-	6,638
Demolition	6,606	2,835	-	6,606	2,835	-
Subtotal by Site	93,012	65,606	326,221	93,012	65,606	651,145
Capital Cost		484,839			809,763	
Land Acquisition			1,225			1,225
Sludge Processing			50,388			50,388
Total Capital Cost		536,452			861,376	

*See footnotes

Annual Operation & Maintenance Costs[1] **Table 4**
(thousands of dollars per year)

Option	1a.1&.2		1b.1&.2		1c.		2a.1			2a.2			2b.1			2b.2		
Item/Site	Deer	Nut	Deer	Nut	Deer	Nut	Deer	Nut	Long	Deer	Nut	Long	Deer	Nut	Long	Deer	Nut	Long
Power	24,700	279	24,382	363	19,927	2,693	19,927	279	4,748	19,927	363	4,339	650	279	24,050	9,377	279	17,019
Chlorine[2][5]	2,454	480	2,454	480	2,030	879	2,030	480	399	2,030	480	399	1,120	480	1,334	1,120	480	1,334
Labor[3]	6,977	607	6,522	2,518	5,642	3,761	5,642	607	3,428	5,642	2,518	1,790	208	607	5,772	3,579	2,518	4,429
Materials and Supplies	1,353	212	1,320	512	1,117	674	1,117	212	470	1,117	579	268	319	212	1,035	807	512	845
Subtotal by Site	35,484	1,578	34,678	3,873	28,716	8,007	28,716	1,578	9,045	28,716	3,940	6,796	2,297	1,578	32,191	14,833	3,789	23,627
Subtotal by Option	37,062		38,551		36,723		39,339			39,452			36,066			42,299		
Solids Handling	6,633		6,633		6,633		6,633			6,633			6,633			6,633		
TOTAL	43,695		45,184		43,356		45,972			46,085			42,699			48,932		

(1) Based on Site Options Study, Table 7-13; Updated to ENR 4200.
(2) Based on a unit cost of chlorine at $350/ton.
(3) Based on Site Options Study, Table 7-13 and Table 7-15, revised to reflect updated facility components.
(4) Does not include the anticipated additional cost of transporting workers.
(5) These chlorine costs reflect seasonal post-chlorination for deep ocean options.

Option Item/Site	2b.3 Deer	2b.3 Nut	Long	3a. Deer	3a. Nut	Lovell	3b. Deer	3b. Nut	Brewster	4a.1 Deer	4a.1 Nut	4a.2 Deer	4a.2 Nut	4b.1 Deer	4b.1 Nut	4b.2 Deer	4b.2 Nut
Power	9,377	279	17,229	650	279	24,050	650	279	24,050	9,423	279	9,423	279	7,632	489	8,633	363
Chlorine[2][5]	1,120	480	982	1,120	480	1,334	1,120	480	1,334	4,319	480	2,717	480	3,360	1,439	2,237	959
Labor[3]	3,579	607	6,067	208	607	5,772[4]	208	2,518	5,772[4]	4,125	607	4,125	607	3,579	2,518	3,579	2,518
Materials and Supplies	807	212	1,145	319	212	1,035	319	512	1,035	995	203	995	203	807	512	933	512
Subtotal by Site	14,883	1,578	25,423	2,297	1,578	32,191	2,297	1,578	32,191	18,862	1,569	17,260	1,569	15,378	4,958	15,382	4,352
Subtotal by Option		41,884			36,066			36,066		20,431		18,829		20,336		19,734	
Solids Handling		6,633			6,633			6,633		2,275		2,275		2,275		2,275	
TOTAL		48,517			42,699			42,699		22,706		21,104		22,611		22,009	

Option	5a.1			5a.2			5b.1			5b.2		
Item/Site	Deer	Nut	Long	Deer	Nut	Long	Deer	Nut	Long	Deer	Nut	Long
Power	7,632	279	210	8,633	279	84	650	279	8,750	650	279	8,750
Chlorine[2][5]	3,360	480	959	2,237	480	480	1,120	480	3,199	1,120	480	1,598
Labor[3]	3,579	607	1,638	3,579	607	1,638	208	607	3,328	208	607	3,328
Materials and Supplies	807	212	300	933	212	300	319	212	677	319	212	677
Subtotal by Site	15,378	1,578	3,107	15,382	1,578	2,502	2,297	1,578	15,954	2,297	1,578	14,353
Subtotal by Option		20,063			19,462			19,829			18,228	
Solids Handling		2,275			2,275			2,275			2,275	
TOTAL		22,338			21,737			22,104			20,503	

Nut Island Site Options Study (1982). When an identical process capacity was involved, the cost from the MDC study (updated) was carried over and assigned to that component for the new option. For cases where identical process capacities did not exist, costs were developed utilizing the MDC study data applied as a ratio of volume to costs. In such cases, the resultant figures were examined to assure consistency. It was determined that for this stage of preliminary conceptual design and associated cost analysis such an approach was reasonable.

For example, under SDEIS Option 2b.1 at Long Island, the influent pump station would be identical to that required for "Option 11" of the Site Options Study (1982). Therefore, the costs were assumed to be the same. However, under Option 2b.1 at Long Island, 30 primary tanks would be required. The greatest number of tanks to be constructed at any location for any MDC study alternative was twenty; therefore, the estimated preliminary cost for primary tanks at Long Island was calculated based on a proportionate cost.

Some cost items from the Nut Island Site Options Study (1982) did not have associated sizes or quantities specified, such as removal of unsuitables. Therefore, the cost for removal of unsuitables and other similar site requirements was estimated based on comparative facility sizing and/or land area. In all cases, at this stage of the analysis, no unique site problems which affect estimation of preliminary construction costs were established for any of the new alternatives developed (with the exception of the man-made island option which was

dropped from further consideration due to higher costs and construction problems).

It was recognized, further, that certain cost items established could be more dependent on site-specific conditions. For example, removal of the drumlin at Deer Island would increase the cost of site preparation in relation to the resultant acreage. At Nut Island, construction on piles would increase the cost of foundation preparation there. Therefore, cost comparisons for individual components were made with those for the same site whenever possible to reflect such known conditions or circumstances. Where base costs were utilized to establish costs at other sites, adjustment was made to provide consistent estimating or reflect known variations in sites. Again, such adjustment was made within the broad limits of accuracy for preliminary costs developed in the Nut Island Site Options Study.

In the case of Long Island, some uncertainty exists with regard to site subsurface conditions and construction/foundation requirements. Because access to the site has not been forthcoming, it has not been possible to investigate these conditions in order to verify their existence. Since the Site Options Study located secondary treatment facilities on Long Island in the same general location as the options now being considered, it is assumed that such facilities are, in general, feasible at this site with no special problems that could significantly affect site costs. When access is granted, this condition will be verified.

4.3 Assumptions Made on Engineering Cost Analysis

Reflecting the preliminary nature of the cost estimates being made, as noted above, many basic assumptions were made in order to estimate the costs of these alternatives. The foremost assumption is that costs for new options can be reasonably developed, at this stage of the analysis, based on a comparative ratio of design criteria involving flow, acreage, or quantity (of tanks) to a given cost as developed in the prior MDC study. Other assumptions which were made, involving elements of site or operations, are described in Attachment 1 to this report.

4.4 Operations and Maintenance Costs

Operation and maintenance (O&M) costs for the new options were developed similarly to the capital costs. That is, each cost item under a new or different option was compared to those for the Nut Island Site Options Study (1982) alternatives, and costs were developed based on applicable ratios. Revised operation and maintenance costs are presented in Table 4. The following description highlights the key elements of O&M costs.

4.4.1 Chlorine

Costs established in the Site Options Study (1982) for chlorine were found to be inconsistent with the description of the chlorine volume estimates at the given price per ton. These were therefore

adjusted to reflect the corrected and updated estimates. Preliminary O&M costs were established based on the further assumption that post-chlorination will take place 6 months per year for deep ocean outfalls.

4.4.2 Staffing

Operation costs for each option are directly related to the number of personnel required, which in turn is dependent upon the size of the facility and number of locations involved. Staffing requirements were estimated for the new alternatives based on the staffing requirements and costs presented in Nut Island Site Options Study (Table 7-15).

4.4.3 Power

Costs presented for power are based on those presented in the Site Options Study (1982) updated to ENR 4200. Power costs for new options were calculated by proportioning flows for similar facilities.

4.4.4 Materials and Supplies

Cost estimates for this item were also based on those presented in the Site Options Study updated to ENR 4200. Estimates for new options were calculated by proportioning flows for similar facilities.

5.0 REVISED COSTS FOR SCREENED ALTERNATIVES

5.1 Updated Costs from Nut Island Site Options Study(1982)

In reviewing the preliminary component list and associated cost estimates (as shown in Table 3) for the various options being considered in the SDEIS, it was not feasible to study each of the more than twenty alternatives in detail. Therefore, as described in previous sections of this report, initial review focused only on updating of these costs from the previous MDC study or developing comparable facility costs where necessary with minimal recosting of components. The costs developed in the Site Options Study (1982) were, therefore, accepted as reasonable at this stage of preliminary analysis. These were found, moreover, to be comparable within treatment levels and thus not a major screening criteria.

5.2 Use of EXEC/OP Computer Model for Verification

Once the alternatives were screened down to eight options--four primary and four secondary--more detailed analysis and verification of the cost estimates could proceed. One method of cost verification used was a computer model entitled "EXEC/OP". This model was applied to develop independent, hypothetical construction costs for the key unit processes involved in both primary and secondary treatment facilities. The model was developed by the EPA Municipal Environmental Research Laboratory in Cincinnati and utilized as its basis the experience of more than sixty separate treatment facilities across the country (see

Bibliography). EXEC/OP was used to compare such treatment component costs as settling tanks, digesters, thickeners, and screening/degritting facilities. It was also considered for site-specific issues like foundation work, excavation, and energy costs. Odor control, sludge disposal, and land acquisition was not an output of the model.

The first step in using EXEC/OP is the preparation of a multi-option flow diagram of the system being analyzed. Such a typical multi-option flow diagram is shown in Figure 2.

From this, the EXEC/OP model then develops costs based on data from selected recently built treatment plants in the U.S. Costs are developed using input such as current construction cost index (ENR 4200 used), wholesale price index, interest rate (a rate of 8-1/8% was used), and cost escalator for engineering and contingencies (a rate of 35% was used). Other input parameters include flow quantity plus wastewater quality indicators such as BOD_5, suspended solids, nitrogen, phosphorus, and alkalinity. While these latter inputs can vary, the parameters applied were not expected to significantly affect the basic focus of comparing such hypothetical costs with the estimates made in the MDC study.

EXEC/OP can be utilized in two ways. When the specific unit processes at a location are known, the model can supply a detailed performance report of the facility in terms of facility output in volume or costs or energy produced. If, however, it is questionable as to the benefits of utilizing a particular unit process, or if two processes

TYPICAL MULTI-OPTION FLOW DIAGRAM

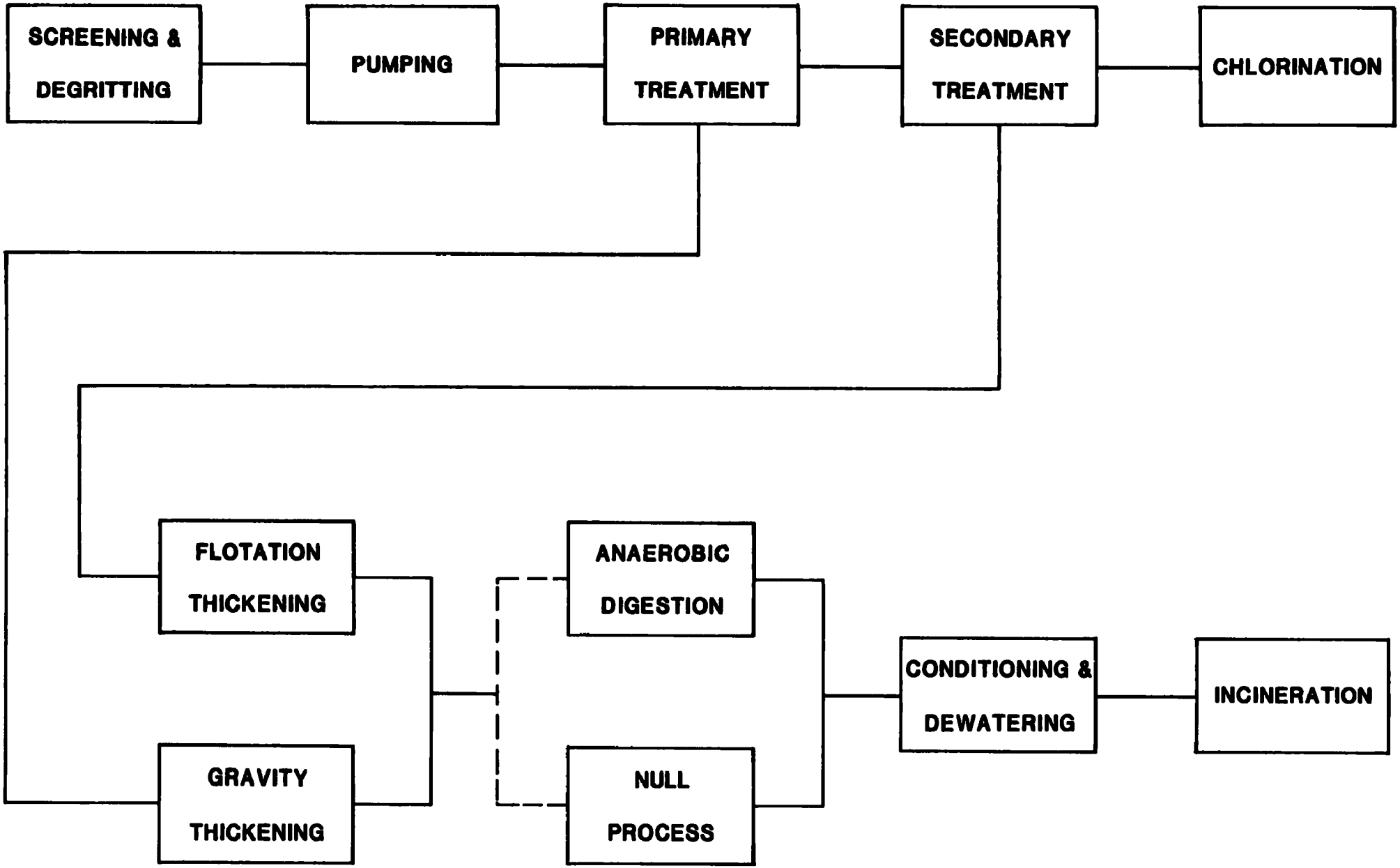

Figure 2

are to be compared, EXEC/OP will select the combination of unit processes that best meets a stipulated set of prioritized criteria of cost, energy, land utilization, a subjective index of system desirability, and/or effluent quality. Sample outputs of both of these situations are shown in Attachment 2 and 3. These are provided as examples of the model's output only. Not every value derived from EXEC/OP is applicable to the costing process.

Because the basis of the EXEC/OP model was treatment facilities between 1 and 100 MGD of flow and since not all components identified by the MDC study are covered by EXEC/OP, it was decided to apply the model solely as a method of initial cost comparison with the MDC facility costs. None of the other performance parameters of EXEC/OP were considered, although, as the examples of the model's output show, these are readily produced and provide useful indications of a facility's performance.

While some bias in results may be introduced from the case studies used in the model due to their smaller size, the application of a cost comparison based on unit processes should, it was felt, still provide reasonably comparable costs for the process components being compared. It should be pointed out, moreover, that cost graphs developed for the wastewater treatment facilities which were the basis of the model, showed that facility process costs become linear for plants over 20 MGD. Therefore, the assumption of the model's applicability to larger facilities was considered valid.

Utilizing the model, cost comparisons were generated for the facility process components as noted above. In most cases, the costs provided from EXEC/OP were within a reasonable range (about 25%) of the original cost estimates from the MDC study. Where the updated MDC costs were within this range, the figures derived from the Site Options Study were utilized. In a few cases, however, the variation between the two cost sources was greater than this limit indicating the need for additional review and clarification from the MDC and their consultants, as well as further verification of costs from other sources.

5.3 Survey of Existing Facilities and Other Sources

As a follow-up to the EXEC/OP model, several telephone surveys were made of other secondary and primary facilities to establish their actual construction costs for the most significant discrepancies found to exist. One item that was signalled by the comparison with EXEC/OP to be a significant discrepancy involved the costs of secondary sedimentation tanks. The information compiled from the survey of treatment plants (most of which varied in size, yet were smaller than the proposed 1,240 MGD plant of the MDC) indicated a range of consistent and comparable costs well below the initial MDC estimates. A summary of these costs plus those developed from the Site Options Study are as follows:

Facility Location	Primary or Secondary Flow in MGD	Secondary Settling Tank Unit Cost 1984
Providence, R.I.	210P, 77 S	$ 40/Sq. Ft.
Meriden, Conn.	10 S	$ 51/Sq. Ft.
Philadelphia, Pa.	210 S	$ 89/Sq. Ft.
1978 EPA DEIS (Greeley & Hansen)	1240 S	$112/Sq. Ft.
1982 MDC Site Options Study (Metcalf & Eddy)	1240 S	$230/Sq. Ft.

Recognizing the variability of these facilities, their characteristics, and their construction costs, it is possible, nonetheless, to consider the range of costs shown above versus the significantly higher magnitude of costs represented by the costs estimated for the MDC. The range of costs for other plants did include projects with unique construction and siting problems which resulted in higher costs than usual at the cited facilities. A higher cost approaching the cost developed in Site Options Study may, in fact, be generated when such factors as barging, construction schedule delays, other special contingencies, or mitigation measures are applied to the costs of the project overall. However, it was deemed not appropriate to include such outside costs in the preliminary estimate of sedimentation tank costs. Any such additional cost factors should be factored in separately to show their specific influence on costs at all levels of treatment.

Based on a review of the information available, it was estimated that a total cost of $241.5 million for secondary treatment be used. This estimated total cost is derived from the data developed in the 1978 Draft EIS based on secondary sedimentation tanks valued at $116.5

million (updated costs equal to $112/sq. ft.) and aeration tanks and blower building valued at $125 million. The costs utilized for settling tanks are derived from an established method of engineering estimating which independently sizes the tanks, their volume of concrete and steel, and cost per cubic yard. The costs for aeration tanks and blower building remain consistent with the estimates from the Site Options Study.

In addition to this source, other component costs considered to be a significant variation were reexamined. Such costs were revised utilizing similar engineering approaches as noted above for the sedimentation tanks as well as established cost tables (see Bibliography). The specific components thus revised are discussed in the following section.

5.4 Revised Cost Estimates

Based on the reanalysis and revision of costs for the remaining eight options, as described above, a final set of "revised" preliminary costs was developed. Table 5 presents these costs consolidated for all sources utilized. Table 1 summaries these same construction costs, adds annual O&M, and the calculates amortized annual costs for these eight options. As apparent from a comparison pf Tables 3 and 5 (and as noted below), in most cases MDC derived costs were used with only a few instances of costs developed from other sources.

TABLE 5

Revised Capital Costs (Mill $)[1]

	Option 1a.2		Option 1b.2	
	Deer	Nut	Deer	Nut
Prechlorination*	3.43	1.47	3.43	1.47
Screen & Degrit*	1.86	9.94	1.86	9.94
Influent Pumping*	81.81	--	81.81	23.76
Primary Settling	30.05	--	18.03	17.92
Secondary Settling*	116.38	--	116.38	--
Aeration	80.32	--	80.32	--
Blower Building	44.74	--	44.74	--
Chlorination	17.11	--	17.11	--
Piers*	11.81	--	11.81	12.49
Tunnels	--	82.82	--	82.82
Outfalls	47.72	--	47.72	--
Channels & Dikes	3.14	.28	3.14	6.30
Power to Site	--	1.77	--	1.97
Demolition	--	2.84	--	1.58
Remove Unsuitables	27.35	--	26.51	--
Generators & Bldg.	8.15	--	1.22	6.40
Admin. Bldg.	7.56	--	6.62	4.44
Effluent Pumping*	59.83	--	59.83	--
Misc. Civil	.76	--	.71	--
Earth Fill	--	--	--	2.44
Foundations	--	--	--	15.73
Land	2.08	--	2.08	--
Odor Control	17.07	.74	17.07	17.81
Scum Incinerator	7.25	--	3.62	3.89
Subtotal by Site	568.42	99.86	544.01	208.96
Option Total	668.28		752.97	

*These costs were revised based on initial review of EXEC/OP estimates followed by verification or substitution using other sources (see Bibliography).

[1] Costs originally estimated in the Site Options Study for sludge handling and disposal facilities which appeared in Table 3 are no longer being carried due to the current range of sludge options being considered by the State. These costs will be estimated separately and added to the total costs of each option under the impact assessment in the SDEIS.

Capital Costs (Mill $) July, 1984

	Option 2b.1			Option 2b.3		
	Deer	Nut	Long	Deer	Nut	Long
Prechlorination*	3.43	1.47	--	3.43	1.47	--
Screen & Degrit*	1.86	9.94	--	1.86	9.94	--
Influent Pumping*	58.05	--	74.76	58.05	--	74.76
Primary Settling	--	--	45.08	18.03	--	17.92
Secondary Settling*	--	--	116.38	--	--	116.38
Aeration	--	--	80.32	--	--	80.32
Blower Building	--	--	44.74	--	--	44.74
Chlorination	--	--	17.11	--	--	17.11
Piers*	--	--	13.93	11.81	--	13.93
Tunnels	68.16	46.46	--	68.16	46.46	--
Outfalls	--	--	91.86	--	--	91.86
Channels & Dikes	.64	.28	11.12	1.26	.28	11.12
Power to Site	--	1.77	--	--	1.77	--
Demolition	6.61	2.84	--	--	2.84	--
Remove Unsuitables	--	--	2.23	1.46	--	.97
Generators & Bldg.	--	--	8.15	--	--	6.93
Admin. Bldg.	--	--	8.98	--	--	8.98
Effluent Pumping*	--	--	59.83	--	--	59.83
Misc. Civil	--	--	.63	.41	--	.63
Earth Fill	--	--	4.68	--	--	2.01
Foundations	--	--	11.36	--	--	11.36
Land	--	--	2.45	--	--	2.38
Odor Control	.22	.74	17.07	17.07	.74	17.07
Scum Incinerator	--	--	7.25	3.62	--	3.89
Subtotal by Site	138.97	63.50	617.93	185.16	63.50	582.19
Option Total	820.40			830.85		

Capital Costs (Mill $) July, 1984

	Option 4a.2		Option 4b.2	
	Deer	Nut	Deer	Nut
Prechlorination*	3.43	1.47	3.43	1.47
Screen & Degrit*	1.86	9.94	1.86	9.94
Influent Pumping*	81.81	--	81.81	23.76
Primary Settling	30.05	--	18.03	17.92
Secondary Settling*	--	--	--	--
Aeration	--	--	--	--
Blower Building	--	--	--	--
Chlorination	10.19	--	9.59	--
Piers*	11.81	--	11.81	12.49
Tunnels	--	82.82	--	77.43
Outfalls	411.85	--	411.85	--
Channels & Dikes	1.52	.28	1.26	6.30
Power to Site	2.36	1.77	2.36	1.77
Demolition	--	2.84	--	1.58
Remove Unsuitables	2.19	--	1.36	--
Generators & Bldg.	8.15	--	1.22	6.40
Admin. Bldg.	6.62	--	5.67	4.44
Effluent Pumping*	59.83	--	59.83	--
Misc. Civil	--	.39	.16	--
Earth Fill	--	--	--	2.44
Foundations	--	--	--	15.73
Land	.84	--	.61	--
Odor Control	17.07	.74	17.07	17.81
Scum Incinerator	7.25	--	3.62	3.89
Subtotal by Site	656.83	100.25	631.54	203.37
Option Total	757.08		834.91	

Capital Costs (Mill $) July, 1984

	Option 5a.2			Option 5b.2		
	Deer	Nut	Long	Deer	Nut	Long
Prechlorination*	3.43	1.47	--	3.43	1.47	--
Screen & Degrit*	1.86	9.94	--	1.86	9.94	--
Influent Pumping*	81.81	--	23.76	58.05	--	74.76
Primary Settling	18.03	--	17.92	--	--	45.08
Secondary Settling*	--	--	--	--	--	--
Aeration	--	--	--	--	--	--
Blower Building	--	--	--	--	--	--
Chlorination	9.59	--	--	--	--	10.19
Piers*	11.81	--	13.93	--	--	13.93
Tunnels	--	46.46	36.05	68.16	46.46	--
Outfalls	411.85	--	--	--	--	450.85
Channels & Dikes	1.26	.28	1.25	.64	.28	11.12
Power to Site	2.36	1.77	--	--	1.77	--
Demolition	--	2.84	--	6.61	2.84	--
Remove Unsuitables	1.36	--	.49	--	--	1.14
Generators & Bldg.	1.22	--	6.93	--	--	6.93
Admin. Bldg.	5.67	--	6.62	--	--	6.62
Effluent Pumping*	59.83	--	--	--	--	59.83
Misc. Civil	.39	--	.16	--	--	.37
Earth Fill	--	--	1.00	--	--	2.34
Foundations	--	--	2.85	--	--	6.64
Land	.61	--	.53	--	--	1.23
Odor Control	17.07	.74	17.07	.22	.74	17.07
Scum Incinerator	3.62	--	3.89	--	--	7.25
Subtotal by Site	631.77	63.50	132.45	138.97	63.50	715.35
Option Total	827.72			917.82		

Upon comparison of EXEC/OP cost estimates with those from the updated Site Options Study, several component categories were found to vary. Chief among these were the following: prechlorination, screening and degritting, influent pumping, secondary sedimentation tanks, digestion, flotation thickening, and effluent pumping. Upon consideration of the reasons for these variations, it was determined that the EXEC/OP figure or some other available cost basis (see Bibliography) was a more reasonable estimate. For example, the following factors influenced the revision of costs in some of the more significant component categories:

- Influent and Effluent Pumping, Prechlorination - The costs from the MDC study included "credit" for reuse of existing treatment facilities. In order to maintain consistency among siting options at this stage of analysis, such site-specific influences (as well as others) are not being included as part of the option capital costs. It is assumed for comparative purposes that all sites will be evaluated on an equalized facility cost basis. Any further revisions to this assumption will be made in the assessment of impacts by option.

- Secondary Settling - A major difference in the estimate of the cost of secondary settling tanks is a result of differing cost factors as described in the previous section. As a result of further analysis, a revised cost was arrived at.

- Piers--These costs were increased at Nut Island to reflect the view that added dredging would be needed due to the shallower depths encountered there.

- Screening and Degritting--The original estimates were found to be somewhat lower than other sources indicated were appropriate. This difference was relatively small overall; however, to maintain consistency, the costs were adjusted.

In addition, based on the State's newly proposed sludge disposal alternatives, several component categories costed originally in the Site Options Study and carried in the preliminary SDEIS cost update (Table 3) were subsequently eliminated because they no longer would be required under some of the disposal choices. This resulted in further revisions to costs (as now shown in Table 5) from the preliminary figures released previously. These component costs were previously among those revised due to differences shown between EXEC/OP and Site Options Study estimates. Even though these components have now been deleted from the base cost table, the revisions made to their costs are being retained so that they can be reinserted in the option total costs under the impact assessment.

For example, if either ocean dumping or composting were selected as the method of sludge disposal, sludge thickening, digestion, and gas storage facilities would not be required. Therefore, final cost estimates for the options including sludge handling and disposal will vary according to the sludge disposal method to be selected. At this

stage of the analysis, each of the possible sludge handling and disposal methods will be costed separately, and this cost will be added to the overall cost of the treatment facilities by option.

At this stage of the analysis, as the figures summarized in Table 1 show, the primary treatment options are estimated to cost between $757.08 million and $917.82 million; the secondary treatment options are estimated to cost between $668.28 million and $830.85 million. Annualized costs combining O&M costs with the amortized construction debt payback are estimated to be between $99 million and $134 million for all the options remaining.

This range of costs should not be compared between treatment levels since, as has been stated from the outset of this project, the decision on whether secondary or primary treatment would be required rests solely with the review by EPA of the 301(h) waiver application of the MDC. However, some clarification of these estimated costs is needed.

The significant reduction in secondary treatment costs for all options is a result of two factors: reduction of estimated costs for secondary sedimentation tanks as noted in the previous section, and the elimination of additional sludge handling components due to influence of the range of sludge disposal options other than incineration. By comparison, primary treatment costs are not as significantly reduced since the question of sedimentation tank costs did not affect the primary options as the original estimates of primary tanks were con-

sidered reasonable. Moreover, the added costs of a long outfall--estimated to be $411.85 million--affecting only the primary options increases these alternatives' costs dramatically relative to the secondary options.

It must be remembered that the costs for all options will increase from those presented in Table 5 by the addition of costs for the various sludge disposal facilities involving either composting, incineration, ocean disposal, landfilling, or some combination of these (plus any associated handling components). Likewise, there may be added contingency costs from the need to barge equipment and materials, stagger the construction work force, provide shuttle bus service for workers, or otherwise mitigate potential adverse impacts during facility construction and operations. These costs will be added to each option's total estimated project cost during the impact analysis of the options. At the present time, the costs presented in Table 5 are intended to reflect updated and revised facility costs equalized across all sites and consistent with the assumptions noted in Attachment 1. Such a baseline analysis was a necessary preparation for the SDEIS in order to verify the costs presented in Site Options Study, establish a consistent cost basis for all options being studied in detail, and provide a framework for the upcoming impact assessment.

5.5 Costs to be Developed During Impact Assessment

The types of costs to be developed further involve several key parameters. Foremost among these is the estimate of costs for the two

major sludge disposal options being considered by the State involving incineration or composting. Final costs of this option will be made as part of a later EPA supplemental environmental review and MDC facility plan. The SDEIS will establish a preliminary cost estimate of each sludge option as it influences siting of treatment plants only.

Costs for landfilling or ocean disposal are not well developed at this stage since no plans for such operations have been developed by the MDC, and the permitting uncertainties for either option are numerous. Costs to be estimated for these operations will therefore consider only the sludge handling portions associated with conveyance from a treatment plant site.

Other costs to be examined in a preliminary fashion given the limited facility plans presented involve an estimate of additional costs resulting from construction and operation mitigation measures for an MDC treatment plant located in Boston Harbor. These could encompass such things as major barging operations to reduce the need for trucking through local communities, other traffic measures such as roadway repaving, new traffic signals, or added safety measures, possible financial compensation or payments in lieu of taxes to local communities, improvements to land areas around the treatment plants including buffer areas and screening, possible varied construction schedules, or special worker transportation. All such applicable costs will be factored into the cost estimates and presented under each applicable option.

BIBLIOGRAPHY

1. Rossman, Lewis A., "Computer-Aided Synthesis of Wastewater Treatment and Sludge Disposal Systems", EPA-600/2-79-158, U.S Environmental Protection Agency, Municipal Environmental Research Laboratory, Cincinnati, Ohio (1979):

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3. Patterson, W.L. and Banker, R.F., "Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities", Water Pollution Control Research Series 17090 DAN 10/71, U.S. Environmental Protection Agency, (1971).

4. Huang, Dr. Wen H., et al., "Construction Costs for Municipal Wastewater Treatment Plants: 1973-1978", EPA/430/9-80-003, U.S. Environmental Protection Agency, Office of Water Program Operations, Washington, D.C. (April 1980).

5. Metcalf & Eddy, Inc., "Wastewater Engineering - Treatment, Disposal, Reuse" Second Edition, (1972).

6. Metcalf & Eddy, Inc., "Nut Island Wastewater Treatment Plant, Facilities Planning Project, Phase I, Site Options Study." Volumes I and II, Commonwealth of Massachusetts, Metropolitan District Commission, (June 1982).

7. Havens & Emerson, Inc., "Wastewater Sludge Management Update, Summary Report", Metropolitan District Commission, (August, 1982).

8. Technical Advisory Board of the New England Interstate Water Pollution Control Commission, "Guides for the Design of Wastewater Treatment Works", TR-16, (1980).

Attachment 1

ASSUMPTIONS MADE IN COSTING THE ALTERNATIVES

1. MDC Nut Island Site Options Study (1982) hereafter referred to as the Site Options Study, is the basis for the preliminary engineering and cost analysis carried out by CE Maguire, Inc. in the initial review of available information leading to the first-tier screening of alternatives. All inherent assumptions and engineering factors in the MDC's facility planning for the sites considered by their consultants are maintained in the assessment of new sites and/or facilities.

2. Capital costs developed by the MDC's facility planner, as presented in Section 7 of the Site Options Study (and appearing in Table 7-12) which utilized an ENR of 3600, have been updated to ENR of 4200.

3. For alternatives being considered which were also considered previously (by MDC or EPA), the approach used was to review the basic engineering and cost parameters presented in order to verify available criteria and assumptions utilized previously. Once accepted, these factors were updated as necessary and then utilized to develop the list of both established and new alternatives.

4. Construction costs utilized are based on wastewater flow volumes and capacities developed by the MDC in the Site Options Study; any

changes to the assumptions on volumes and capacities for treatment facilities will affect those costs accordingly either up or down.

5. Costing of facilities associated with new options assumes that construction of similar treatment facilities at different locations will be of a comparable nature; no abnormal variations in surface/subsoil/geologic conditions or other factors are factored in unless these are stated in the Site Options Study. Any such variations if identified will be factored into the impact analysis.

6. Costs for power to the site of treatment facilities is not added unless it was included in the criteria used in the Site Options Study.

7. Costs utilized for channels, and dikes in all alternatives where applicable are based on conservative costs developed and presented in the Site Options Study for these construction elements.

8. Inter-island tunnel costs for transport of effluent were developed from Site Options Study based on a unit cost of appproximately $3,200/ft for 10-foot diameter and $6,050/ft for 16-foot diameter tunnels. These costs will be updated in the impact analysis.

9. Construction costs of new facilities on Long Island assume no additional costs for foundation preparation beyond those utilized in Site Options Study.

10. Costs do not reflect any additional land acquisition costs, should these prove necessary, beyond those assumed in the Site Options Study.

11. Costs do include movement of materials by barge (based on assumptions in Site Options Study); however, they do not include movement of personnel by barge.

12. Assumptions on manpower and staffing contained in the Site Options Study have been maintained in the update of alternatives.

13. Assumptions in the Site Options Study regarding staff vehicle trips and construction worker vehicle trips are maintained in the analysis carried out for the screening. Similarly, construction truck trips per day are carried forward based on the presentations in the MDC study.

14. Costs for chlorine contact tanks are carried forward from the Site Options Study based on the apparent facility criteria utilized.

15. Costs for chlorine (annual) are likewise carried forward based on the assumptions presented in the MDC study; however, there is an apparent inconsistency in the unit cost factor used by the facility planner which has been adjusted to be consistent with the volumes presented.

16. Apparent instances of errors in the presentation of data in the MDC Site Options Study have not as yet been verified or corrected; this will be done at the earliest opportunity.

ATTACHMENT 2

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**************
*            *
*   EXEC/OP  *
*            *
* VERSION 1.2 *
*            *
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EXECUTIVE PROGRAM
(OPTIMIZATION VERSION)
FOR
PRELIMINARY SYNTHESIS OF WASTE TREATMENT SYSTEMS

U.S. ENVIRONMENTAL PROTECTION AGENCY
MUNICIPAL ENVIRONMENTAL RESEARCH LABORATORY
SYSTEMS AND ECONOMIC ANALYSIS SECTION
CINCINNATI, OHIO 45268

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**********************************************************************
*                                                                    *
* OPTION 1B & 4B.2  - NUT ISLAND PRIMARY                             *
*                                                                    *
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PROCESS ALTERNATIVE

OPTION NO.	PROCESS NO.	STAGE NO.	SIDESTREAM DESTINATION	REMARKS
1	12	1	5	PRECHLORINATION
2	1	2	5	PRELIMINARY TREATMENT
3	15	3	5	RAW WASTEWATER PUMPING
4	2	4	5	PRIMARY SEDIMENTATION
5	8	5	4	GRAVITY THICKENING
6	6	6	4	DIGESTION OF PRIMARY SLUDGE

EFFLUENT DISCHARGE ST 5

5-DAY BOD, MG/L	200.00
SUSPENDED SOLIDS, MG/L	200.00
AMMONIA - N, MG/L	10000.00
NITRATE - N, MG/L	10000.00
PHOSPHORUS, MG/L	10000.00

SELECTION CRITERIA

	CRITERION	WEIGHT	LIMIT
1.	INITIAL CONSTR. COST, M$	.00	10000.00
2.	ANNUAL O & M COST, $/MG	.00	100000.00
3.	TOTAL ANNUAL COST, $/MG	.00	100000.00
4.	ENERGY CONSUMED, KWH/MG	.00	10000.00
5.	ENERGY PRODUCED, KWH/MG	.00	.00
6.	NET ENERGY CONSUMED, KWH/MG	.00	10000.00
7.	LAND REQUIRED, ACRES	.00	10000.00
8.	UNDESIREABILITY INDEX	.00	10000.00

ECONOMIC DATA

CONSTRUCTION COST INDEX	2.1770
WHOLESALE PRICE INDEX	3.0630
DIRECT HOURLY WAGE, $/HR	45.0000
FRACTION CHARGED TO INDIRECT WAGES	.6667
COST ESCALATOR FOR MISC. FEES	1.3500
COST OF ELECTRICITY, $/KWH	.0720
BTU TO KWH CONVERSION EFF.	.0900
DISCOUNT RATE	.0812
CAPITAL RECOVERY FACTOR	.1028

STAGE NO.	PROCESS OPTION	SLUDGE TONS/DAY	CONSTR COST M$	ANN O&M COST $/MG	TOTAL ANN COST $/MG	ENER USE KWH/MG	ENER PROD KWH/MG	NET ENER KWH/MG	LAND REQD ACRES	UNDESIRE-ABILITY
1 Prechlor	1	.00	1.4699	38.26	41.02	34.71	.00	34.71	.00	.00
2 Scr+Deg	2	.00	3.2734	37.38	43.52	1.74	.00	1.74	.00	.00
3 Pump	3	.00	23.7575	12.14	56.75	42.85	.00	42.85	.00	.00
4 Primary	4	91.12	7.8493	21.10	35.83	7.64	.00	7.64	.00	.00
5 Grav	5	91.12	.6822	1.84	3.12	.26	.00	.26	.00	.00
6 Dig	6	88.38	11.9435	29.87	52.29	111.71	459.01	-347.30	.00	.00
SYSTEM VALUES		91.12	48.98	140.58	232.54	198.91	459.01	-260.09	.00	.00

PRIMARY AND SECONDARY SLUDGES MIXED AT STAGE 15

PROCESS PERFORMANCE CHARACT ICS

VOLUME FLOW, MGD
CONCENTRATION, MG/L
CONSULT PROGRAM REFERENCE MANUAL FOR MEANING OF PROCESS INPUT AND OUTPUT DESIGN DATA.

STAGE 1 PROCESS OPTION 1

INPUT DESIGN DATA:

1	2	3	4	5	6	7	8
12.000	.500	320.000	.000	.000	.000	.000	.000
9	10	11	12	13	14	15	16
.000	.000	.000	.000	.000	.000	2.070	1.000

OUTPUT DESIGN DATA:

1	2	3	4	5	6	7	8	9	10
6963.013	2736.405	.000	.000	.000	.000	.000	.000	.000	.000
11	12	13	14	15	16	17	18	19	20
.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

INFLUENT / EFFLUENT / SIDESTREAM CHARACTERISTICS:

	Q	SOC	SNBC	SON	SOP	SFM	SBOD	VSS	TSS
INFLUENT:	150.000	105.000	30.000	15.000	3.000	55.000	150.000	205.000	220.000
EFFLUENT:	150.000	105.000	30.000	15.000	3.000	55.000	150.000	205.000	220.000
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000
	DOC	DNBC	DN	DP	DFM	ALK	DBOD	NH3	NO3
INFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
EFFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000

STAGE 2 PROCESS OPTION 2

INPUT DESIGN DATA:

1	2	3	4	5	6	7	8
1.000	.000	.000	.000	.000	.000	.000	.000
9	10	11	12	13	14	15	16
.000	.000	.000	.000	.000	.000	.000	2.070

OUTPUT DESIGN DATA:

1	2	3	4	5	6	7	8	9	10
.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
11	12	13	14	15	16	17	18	19	20
.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

INFLUENT / EFFLUENT / SIDESTREAM CHARACTERISTICS:

	Q	SOC	SNBC	SON	SOP	SFM	SBOD	VSS	TSS
INFLUENT:	150.000	105.000	30.000	15.000	3.000	55.000	150.000	205.000	220.000
EFFLUENT:	150.000	105.000	30.000	15.000	3.000	55.000	150.000	205.000	220.000
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000
	DOC	DNBC	DN	DP	DFM	ALK	DBOD	NH3	NO3
INFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
EFFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000

STAGE 3 PROCESS OI 3

INPUT DESIGN DATA:

1	2	3	4	5	6	7	8
10.200	.000	.000	.000	.000	.000	.000	.000
9	10	11	12	13	14	15	16
.000	.000	.000	.000	.000	.000	.000	2.600

OUTPUT DESIGN DATA:

1	2	3	4	5	6	7	8	9	10
178.823	.000	.000	.000	.000	.000	.000	.000	.000	.000
11	12	13	14	15	16	17	18	19	20
.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

INFLUENT / EFFLUENT / SIDESTREAM CHARACTERISTICS:

	Q	SOC	SNBC	SON	SOP	SFM	SBOD	VSS	TSS
INFLUENT:	150.000	105.000	30.000	15.000	3.000	55.000	150.000	205.000	220.000
EFFLUENT:	150.811	106.512	30.432	15.216	3.043	55.792	152.160	207.952	223.168
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000
	DOC	DNBC	DN	DP	DFM	ALK	DBOD	NH3	NO3
INFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
EFFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000

STAGE 4 PROCESS OPTION 4

NOTE: INFLUENT (EFFLUENT FROM PREVIOUS STAGE) INCLUDES RETURN SIDESTREAMS FROM SLUDGE TREATMENT

INPUT DESIGN DATA:

1	2	3	4	5	6	7	8
.650	2.000	168.000	.000	.000	.000	.000	.000
9	10	11	12	13	14	15	16
.000	.000	.000	.000	.000	.000	2.400	1.000

OUTPUT DESIGN DATA:

1	2	3	4	5	6	7	8	9	10
645.876	233.498	1823.036	.000	.000	.000	.000	.000	.000	.000
11	12	13	14	15	16	17	18	19	20
.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

INFLUENT / EFFLUENT / SIDESTREAM CHARACTERISTICS:

	Q	SOC	SNBC	SON	SOP	SFM	SBOD	VSS	TSS
INFLUENT:	150.811	106.512	30.432	15.216	3.043	55.792	152.160	207.952	223.168
EFFLUENT:	149.717	37.551	10.729	5.365	1.073	19.670	53.645	73.315	78.679
SIDESTRM:	1.094	9545.455	2727.273	1363.637	272.727	5000.001	13636.367	18636.367	20000.004
	DOC	DNBC	DN	DP	DFM	ALK	DBOD	NH3	NO3
INFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
EFFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
SIDESTRM:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000

STAGE 5 PROCESS (5

INPUT DESIGN DATA:

1	2	3	4	5	6	7	8
.970	800.000	7.500	.000	.000	25.000	.000	.000
9	10	11	12	13	14	15	16
7.500	25.000	.000	.000	.000	.000	.000	1.900

OUTPUT DESIGN DATA:

1	2	3	4	5	6	7	8	9	10
13849.529	.000	7.500	25.000	.000	.000	.000	.000	.000	.000
11	12	13	14	15	16	17	18	19	20
.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

INFLUENT / EFFLUENT / SIDESTREAM CHARACTERISTICS:

	Q	SOC	SNBC	SON	SOP	SFM	SBOD	VSS	TSS
INFLUENT:	1.094	9545.455	2727.273	1363.637	272.727	5000.001	13636.367	18636.367	20000.004
EFFLUENT:	.283	35795.445	10227.273	5113.637	1022.727	18750.000	51136.367	69886.359	75000.000
SIDESTRM:	.811	386.282	110.366	55.183	11.037	202.338	551.832	754.170	809.353
	DOC	DNBC	DN	DP	DFM	ALK	DBOD	NH3	NO3
INFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
EFFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
SIDESTRM:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000

STAGE 6 PROCESS OPTION 6

INPUT DESIGN DATA:

1	2	3	4	5	6	7	8
15.000	32.000	1.000	.000	1.000	.300	.500	7.500
9	10	11	12	13	14	15	16
.500	15.000	.000	.000	.000	.000	.000	1.500

OUTPUT DESIGN DATA:

1	2	3	4	5	6	7	8	9	10
.500	15.000	851.075	809964.250	425373.250	.000	.000	.000	.000	.000
11	12	13	14	15	16	17	18	19	20
.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

INFLUENT / EFFLUENT / SIDESTREAM CHARACTERISTICS:

	Q	SOC	SNBC	SON	SOP	SFM	SBOD	VSS	TSS
INFLUENT:	.283	35795.445	10227.273	5113.637	1022.727	18750.000	51136.367	69886.359	75000.000
EFFLUENT:	.283	17897.723	10227.273	3451.705	511.364	18750.000	15340.904	34943.180	53693.180
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000
	DOC	DNBC	DN	DP	DFM	ALK	DBOD	NH3	NO3
INFLUENT:	43.000	11.000	25.000	5.000	300.000	100.000	55.000	25.000	.000
EFFLUENT:	2567.816	11.000	1686.932	516.364	300.000	6033.097	4394.527	1686.932	.000
SIDESTRM:	.000	.000	.000	.000	.000	.000	.000	.000	.000

ATTACHMENT 3

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**************
*            *
*   EXEC/OP  *
*            *
* VERSION 1.2 *
*            *
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EXECUTIVE PROGRAM
(OPTIMIZATION VERSION)
FOR
PRELIMINARY SYNTHESIS OF WASTE TREATMENT SYSTEMS

U.S. ENVIRONMENTAL PROTECTION AGENCY
MUNICIPAL ENVIRONMENTAL RESEARCH LABORATORY
SYSTEMS AND ECONOMIC ANALYSIS SECTION
CINCINNATI, OHIO 45268

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**********************************************************************************
*                                                                                *
* OPTION 1A - DEER ISLAND SECONDARY WITH DIGESTION OPTION W/ECF                  *
*                                                                                *
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PROCESS ALTERNATIVE

OPTION NO.	PROCESS NO.	STAGE NO.	SIDESTREAM DESTINATION	REMARKS
1	2	1	5	PRIMARY SEDIMENTATION
2	3	2	4	ACTIVATED SLUDGE - FINAL SETTLING
3	12	3	0	CHLORINATION
4	13	4	2	FLOTATION THICKENING
5	8	5	2	GRAVITY THICKENING
6	6	6	2	DIGESTION OF PRIMARY AND SECONDARY SLUDGES
9	0	6	2	NULL PROCESS
7	7	7	2	CONDITIONING AND DEWATERING
8	14	8	2	INCINERATION

EFFLUENT DISCHARGE STA

5-DAY BOD, MG/L	30.00
SUSPENDED SOLIDS, MG/L	30.00
AMMONIA - N, MG/L	10000.00
NITRATE - N, MG/L	10000.00
PHOSPHORUS, MG/L	10000.00

SELECTION CRITERIA

	CRITERION	WEIGHT	LIMIT
1.	INITIAL CONSTR. COST, M$	.00	10000.00
2.	ANNUAL O & M COST, $/MG	.00	100000.00
3.	TOTAL ANNUAL COST, $/MG	1.00	100000.00
4.	ENERGY CONSUMED, KWH/MG	.00	10000.00
5.	ENERGY PRODUCED, KWH/MG	.00	.00
6.	NET ENERGY CONSUMED, KWH/MG	.00	10000.00
7.	LAND REQUIRED, ACRES	.00	10000.00
8.	UNDESIREABILITY INDEX	.00	10000.00

ECONOMIC DATA

CONSTRUCTION COST INDEX	2.1770
WHOLESALE PRICE INDEX	3.0630
DIRECT HOURLY WAGE, $/HR	45.0000
FRACTION CHARGED TO INDIRECT WAGES	.6667
COST ESCALATOR FOR MISC. FEES	1.3500
COST OF ELECTRICITY, $/KWH	.0720
BTU TO KWH CONVERSION EFF.	.0900
DISCOUNT RATE	.0812
CAPITAL RECOVERY FACTOR	.1028

2 BEST DESIGNS

DESIGN 1

EXACT SYSTEM VALUE 374.297

STAGE NO.	PROCESS OPTION	SLUDGE TONS/DAY	CONSTR COST M$	ANN O&M COST $/MG	TOTAL ANN COST $/MG	ENER USE KWH/MG	ENER PROD KWH/MG	NET ENER KWH/MG	LAND REQD ACRES	UNDESIRE-ABILITY
1 Prim	1	297.80	22.5798	11.14	23.86	8.87	.00	8.87	.00	.00
2 Sec	2	164.95	69.5697	26.62	65.81	135.89	.00	135.89	.00	.00
3 Clar	3	.00	17.3294	15.62	25.38	14.81	.00	14.81	.00	.00
4 Flot	4	164.95	19.1220	34.28	45.05	62.38	.00	62.38	.00	.00
5 Grav	5	297.80	2.0189	1.16	2.30	.20	.00	.20	.00	.00
6 Dig	6	440.62	51.9390	31.49	60.74	163.93	607.84	-443.91	.00	.00
7 Dew	7	283.40	10.0349	96.36	102.01	24.25	.00	24.25	.00	.00
8 Inc	8	339.08	18.8882	38.51	49.15	58.17	184.71	-126.54	.00	.00
SYSTEM VALUES		462.75	211.48	255.17	374.30	468.50	792.55	-324.05	.00	.00

PRIMARY AND SECONDARY SLUDGES MIXED AT STAGE 6

DESIGN 2

Use these Costs

EXACT SYSTEM VALUE 387.110

STAGE NO.	PROCESS OPTION	SLUDGE TONS/DAY	CONSTR COST M$	ANN O&M COST $/MG	TOTAL ANN COST $/MG	ENER USE KWH/MG	ENER PROD KWH/MG	NET ENER KWH/MG	LAND REQD ACRES	UNDESIRE-ABILITY
1 Prim	1	297.80	22.5798	11.14	23.86	8.87	.00	8.87	.00	.00
2 Sec	2	154.53	68.0367	26.06	64.39	130.15	.00	130.15	.00	.00
3 Clar	3	.00	17.3259	15.62	25.38	14.80	.00	14.80	.00	.00
4 Flot	4	154.53	17.9701	31.76	41.89	59.16	.00	59.16	.00	.00
5 Grav	5	297.80	2.0189	1.16	2.30	.20	.00	.20	.00	.00
7 Dew	7	431.03	6.5737	119.63	123.33	15.47	.00	15.47	.00	.00
8 Inc	8	478.72	23.2223	92.89	105.98	46.40	397.99	-351.59	.00	.00
SYSTEM VALUES		452.32	157.73	298.26	387.11	275.05	397.99	-122.94	.00	.00

PRIMARY AND SECONDARY SLUDGES MIXED AT STAGE 6

BEST DESIGN IS NUMBER 1

SEARCH EFFORT WAS 369.7369% OF TOTAL ENUMERATION