Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Basis of Cost Estimates

Technical Memorandum
Original Date: May 8, 2003
Revision Date: May 31, 2003
Author: Tucker, Young, Jackson, Tull Inc.

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Basis of Cost Estimates

1.1 Purpose

In the development of a master plan for wastewater conveyance and treatment that extends 50 years into the future, it is necessary to utilize a set of common assumptions as to the capital cost of facility construction. These costs must represent both reasonable current estimates of the cost to construct facilities as well as an appropriate projection of the cost to future dates within the planning period. The projected costs will allow the plan to rationally compare cost and benefit of facility construction earlier vs. later in the planning period. Also, the cost assumptions will provide the basis for establishing the estimated annual expenditure in the capital improvement plan (CIP) that will be developed as a component of the Detroit Wastewater Master Plan (WWMP).

The guidelines are intended to provide unit costs for construction and rehabilitation of conveyance and treatment facilities. These unit costs can then be used to establish total costs of planning alternatives for comparative purposes. Unit costs can also be applied to recommended system upgrades, improvements, and rehabilitation projects to develop total project costs for CIP development.

While conveyance facilities are common elements of the DWSD system, the treatment facilities being investigated are each somewhat unique in nature and thus not as readily subjected to the application of generalized unit cost factors. For this reason, a different approach to cost development has been employed for treatment facilities.

1.2 Methodology

Development of component costs for a master plan covering the range of potential project types anticipated within the DWSD planning area over a 50-year time frame required evaluation of historic costs as well as "ground up" estimates. These costs can be applied to proposed projects, with varying site conditions and complexities, throughout the planning area.

1.2.1 Wastewater Conveyance Facilities

To better account for a range of conditions, the unit costs were derived from a convergence of two sources. The cost estimates for wastewater conveyance facilities are based on an assembly and comparison of historical construction costs from multiple cost estimates and reports compiled from 1971 to present, and construction estimates using the *R.S. Means Sitework and Landscaping Data* and methodology.

Since, in many cases, the two methods produced differing results final unit costs were established within the range of estimated costs through review by experienced design construction professionals. Section B.1.5 in Appendix B presents the historical cost development. Section B.1.6 in Appendix B presents the Means method cost development.

It was necessary to establish a time reference for historical data reviewed as part of the cost evaluation, and to provide a base for projection of costs into the 50-year planning period. The year 2003 was selected as this reference point for the CIP development.

The CIP developed for the Wastewater Master Plan (WWMP) uses 2003 as the base year. Section 2 contains the base data for the CIP estimates. Cost data tables for this technical memorandum that were used for the actual CIP estimates are contained in Appendix A. The 2000 costs from these tables were escalated to 2003 costs using the ENR Construction Cost Index (CCI) shown in Table 1.5-1.

Both Means estimates and Historical costs were calculated to use the year 2003 as a base. Historical sources, which are taken from the year in which they were reported, were adjusted to 2003 unit costs using the ENR Construction Cost Index (CCI). Costs for specific items were then averaged to determine the historical unit cost in year 2003 dollars. It should be noted that in some instances where one or more historical value were extremely high or low compared to the majority these were excluded from the average. Some assumptions were made for the historical data due to a lack of detail in the original estimates. For example many of the pipe depths were assumed based on size. For sections where variable depths are shown, the original estimate, based upon a shallower depth, is multiplied by a factor to obtain a number for the deeper depths.

These factors were obtained from the RS Means estimates and then applied to the historical data. Where historical costs were not available, manufacturers estimates were used.

Section B.1.6 in Appendix B shows the estimates based on RS Means costs for the same material and the same assumed conditions as in the cost guidelines section. The RS Means numbers were taken from the 2002 Means data then converted to the year 2000 using the suggested Means factors for year and location (Detroit) adjustment. For example, an item costing $23 in 2002 would be multiplied by the index in 2000 (95.9) then divided by the index for 2002 (100) to obtain $22.06 then adjusted for the location by multiplying by .962, the Means city cost index, to give an adjusted 2000 price of $21.22. These 2000 values were then escalated to 2003 values for the unit costs used in the CIP development.

1.2.2 Wastewater Treatment Facilities

To address the treatment needs within the planning area over the 50-year planning period a series of treatment alternatives were developed by Tetra Tech MPS. These ranged from expansion of treatment capacity at the existing Detroit WWTP; to utilization of existing outlying (satellite) facilities, with upgrade and expansion, in Pontiac, Warren and/or Mt. Clemens; to construction of dedicated facilities to treat wet weather flow and the dewatered flows from CSO and SSO storage facilities. Each of these alternatives has been documented in technical memoranda specific to the alternative type.

The three technical memoranda describing alternative types – Expanded Facilities within the City of Detroit, Technical Feasibility of Satellite Treatment, and Technical Feasibility of a Wet Weather Flow Treatment Facility contain detailed descriptions of the proposed facilities and include, as appendices, the complete cost estimates for each facility. These estimates will be used as part of a cost benefit analysis to establish the most beneficial alternative, or mix of alternatives.

As part of the alternative development, each planner / designer was charged with developing a conceptual (planning level) cost estimate for the facilities being proposed. These estimates would be based on specific facility locations, preliminary facility layouts and defined treatment process capacities. Because this additional detail is available to the cost estimator, more detailed estimates were able to be prepared than could be expected for conveyance facilities.

These estimates used standard construction cost estimating procedures and formats. Designers broke down facilities by each component process and prepared cost estimates at the process level for the specific size and configuration appropriate for each facility.

Appendix C contains the treatment facility unit cost tables derived from the alternatives. Any unit costs for conveyance items used in these alternative estimates, such as pipes, were used with other data in calculating the CIP costs.

1.3 Limitations

Every construction project presents unique conditions with respect to location, site constraints, and soil or geotechnical considerations. Also, construction industry market conditions can greatly affect project costing. By considering both historical costs as well as current cost estimating methods, an attempt was made to account for the range of potential costs. However, no estimates can be considered final until complete construction plans and specifications have been prepared. At the master planning stage, these unit costs, as well project costs derived from them, need to be evaluated appropriately. Thus, these generalized costs are appropriate for comparison of alternative approaches to providing service, but additional detail should be provided for site-specific construction estimates.

1.4 Allowances and Contingencies

At every stage of construction cost estimating certain unknown factors need to be accounted for in the development of estimated costs. This is even true at the time final plans and specifications are completed for a specific project. It is especially critical at the planning stage. The unit costs presented throughout this Technical Memorandum are base construction costs, for the most part. This means that in most cases no allowances or contingencies of any type have been applied. The CIP costs include any contingencies.

The following categories of costs need to be considered in the development of complete cost estimates: Contractor Overhead and Profit; Contingency; and Engineering, Legal, Administrative, and Management.

Contractor Overhead and Profit accounts for the markup contractors employ to cover costs, such as mobilization, and the profit they would expect to garner from the project.

The Contingency markup has two main parts, Planning Level Contingency and Contractor Contingency. The Planning Level Contingency accounts for the uncertainty of the cost estimate due to the basic level of design development appropriate at the planning level. This contingency should be able to be reduced significantly as each project proceeds from the master planning stage through the project plan stage, the preliminary design stage and the final design stage. However, for a master plan looking 50 years into the future, it will be a considerable portion of the total costs. The Contractor Contingency allows for uncertainty in the final contract cost due to market conditions at the time the project is bid, and for potential changes to the project during the construction stage (change orders).

Engineering, Legal, Administrative, and Management markups account for several aspects of the projects. These include providing funds for performing the engineering design calculations, preparing plans and specifications, bidding the construction contract and awarding the work, contractor oversight, shop drawing review and approval, on site inspection services, change order development, development of record drawings, and contract close out. They also account for the costs associated with legal review of construction contracts and, when necessary, the involvement of financial professionals in preparation of bond statements and the sale of bonds.

A review of these contingencies used in other recent DWSD projects led to the use of the following multipliers. For new construction (replacement) or major rehabilitation, the multipliers applied are:

Contractor Overhead and Profit:	25% of base construction costs
Contingency:	30% of total construction cost, including contractor overhead and profit
Engineering, Legal, Administrative, and Management:	20% of total construction cost, including contractor overhead and profit

For all other categories (inspection, cleaning, rehabilitation, etc.), the multipliers applied are:

Contractor Overhead and Profit:	25% of base construction costs
Contingency:	15% of total construction cost, including contractor overhead and profit

Engineering, Legal, Administrative, and Management:	10% of total construction cost, including contractor overhead and profit

The multipliers were reduced or eliminated where not relevant - for example, unit costs for some items already include the engineering contingency.

Most unit costs presented in this technical memorandum are basic construction costs without contingencies. The above contingencies need be added to the base costs as project specific estimates are developed. The estimates that come from past projects already include these contingencies.

1.5 Cost Index

Historical costs have been adjusted using data from the Engineering News Record (ENR) Construction Cost Index History, which provides annual cost indices from 1913 to present. Table 1.5-1 shows the annual cost indices for 1969 to 2002. Extrapolation of this data gives the annual indices for the year 2003.

The actual cost estimates used for the CIP use a 2003 cost. The 2003 costs were obtained by escalating any base data used from their base year to 2003 using the CCI. Using the example for a 1990 estimated cost for 12" sanitary line of $212 per linear foot, convert it to 2003 cost by dividing the unit price by the year's index (212/4732). Then multiply by the year 2003 index (6698) to get the escalated 2003 unit cost of $300.08.

Table 1.5-1
ENR Construction Cost Index (CCI)

Year	Index	Year	Index
1969	1269	1986	4295
1970	1381	1987	4406
1971	1581	1988	4519
1972	1753	1989	4615
1973	1895	1990	4732
1974	2020	1991	4835
1975	2212	1992	4985
1976	2401	1993	5210
1977	2576	1994	5408
1978	2776	1995	5471
1979	3003	1996	5620
1980	3237	1997	5825
1981	3535	1998	5920
1982	3825	1999	6060
1983	4066	2000	6221
1984	4146	2001	6342
1985	4195	2002	6538
		2003	6698**

Index for 2002 was averaged in 12/02 using 11 months of data.
** This number was forecasted

Cost Guideline Summaries

The following pages contain cost guidelines for those items included in the CIP and rate model, including pipe installation, special structures and manholes; pump stations, pipe rehabilitation, miscellaneous repair, and pipeline inspection and cleaning. The categories and layout correspond to the CIP cost estimating spreadsheets.

For each category, the material and assumed construction conditions are identified. These include type and depth of excavation, utility and or pavement restoration anticipated, and number of manholes or other structures included in the estimate. Additionally, a useful life expectancy for the specific type of facility is provided for use in CIP development.

2.1 Program 1: Sewer Infrastructure Program

This section of the CIP development includes the inspection, cleaning, rehabilitation, and replacement of DWSD sewers.

2.1.1 Subprogram No. 1A: Lateral and Connector Sewers – Cleaning, Sediment Disposal & Condition Assessment

Lateral and Connector sewers were defined previously in consultation with DWSD. A lateral sewer collects flows from homes and businesses for discharge into trunk sewers. These sewers range in size from 6" to 24" in diameter, with an average size of 18". A connector sewer is a pipe that carries the wastewater flow from a lateral sewer to a trunk sewer. Connector sewers range from 24" in diameter to a 4' by 6' egg shape, with an average size of 30" in diameter. An assessment of DWSD sewers from the CS-1314 technical memorandum Lateral Sewers and Connection Sewers, revised May 2003 indicates that there are 2,258 miles of laterals and 559 miles of connector sewers in the DWSD sewer system.

2.1.1.1 Inspection

The CIP costs for inspection of lateral and connector sewers were developed with the assumption that this inspection would be accomplished through sewer televising. Sewer televising consists of remote televising of sewers using robotically controlled cameras. The estimate includes mobilization, set up for camera entry, and furnishing of all incidentals. The estimate is unit cost per mile and unit cost per linear foot of pipe.

The actual CIP cost estimation was derived from the CS-1314 technical memorandum entitled Physical Inspection of Lateral and Connector Sewers, revised May 2003, which describes a recent pilot project performed by Inland Waters Pollution Control, Inc. for DWSD. Inspections occurred in June, July, and October of 2002. This project inspected several DWSD sewers in the lateral and connector categories using TV inspection methods. The selected sewers for these inspections included varying pipe diameters as well as material types. The average inspection costs from the pilot project are used for the CIP. Table A-1 in Appendix A shows an alternate cost

estimation for sewer inspections based on historical data. This unit cost does not include contingencies. Note that the CIP estimate is within the ranges set in this table.

2003 Lateral and Connector Sewer Inspection Costs = $2.11 per linear foot ($11,141 per mile)

2.1.1.2 Cleaning

Sewer Cleaning consists of preparatory cleaning (also called light cleaning) or heavy cleaning utilizing a hydraulic sewer jet/vacuum unit. The estimate includes mobilization, set up for jet/vacuum truck, and furnishing of all incidentals. The estimate is unit cost per mile and unit cost per linear foot of pipe.

The CIP costs for the cleaning of lateral and connector sewers were taken from the technical memorandum entitled Physical Inspection of Lateral and Connector Sewers, revised May 2003, which describes a recent pilot project performed by Inland Waters Pollution Control, Inc. for DWSD. Table A-2 in Appendix A shows an alternate cost estimation for sewer cleaning based on historical data. These unit costs do not include contingencies.

2003 Lateral and Connector Sewer Light Cleaning Costs = $3.25 per linear foot ($17,160 per mile)

2003 Lateral and Connector Sewer Heavy Cleaning Costs = $9.00 per linear foot ($47,520 per mile)

2.1.1.3 Sediment Testing

A concern regarding the pipes in the DWSD system is that the buildup of sludge contains toxic materials, such as PCB's or mercury. This sludge should be removed and disposed of in a different manner than the current sewer jet / vacuum unit practices (washing down the sewers to the WWTP). Sludge removal should therefore include a sampling station to test the sludge components and disposal of this hazardous material in a landfill. The cost per truckload comes from CDM and assumes two tests, for PCB's and mercury, would be performed on each load.

2003 Lateral and Connector Sewer Sediment Testing Costs = $200 per truck load (10 truck loads per mile.)

2.1.2 Subprogram No. 1B: Interceptor and Trunk Sewers - Condition Assessment

Interceptor and trunk sewers are defined previously in the CS-1314 Interceptor and Trunk Sewers technical memorandum, revised May 2003, A trunk sewer collects flows from lateral and connector sewers for discharge into interceptor sewers. These sewers are generally large than laterals, ranging in size from 18" to 10' in diameter. An interceptor sewer is a large sewer that carries the wastewater flow from a number of trunk sewers to the wastewater treatment plant. These sewers do not connect to any homes, buildings, or catch basins. Interceptor sewers are generally larger than

trunk sewers (10' or larger). An assessment of DWSD sewers indicates that there are 483 miles of trunk sewers and 83 miles of interceptors (39 miles serving Macomb County only) in the DWSD sewer system.

2.1.2.1 Inspection

The CIP costs for inspection of interceptor and trunk sewers were developed with the assumption that this inspection would be accomplished through sewer televising. As mentioned above, other methods, such as diving, may be more effective because of the larger sizes of pipes. Sewer televising consists of remote televising of sewers using robotically controlled cameras. The estimate includes mobilization, set up for camera entry, and furnishing of all incidentals. The estimate is unit cost per mile of pipe. The CIP costs for the inspection of interceptor and trunk sewers were taken from Table A-1, which is based on historical data. This unit cost does not include contingencies.

2003 Interceptor and Trunk Sewer Inspection Costs = $4.31 per linear foot ($22,747 per mile)

2.1.3 Subprogram No. 1C: Lateral & Connector Sewer Improvements

Costs for improvements to the lateral and connector sewers in the DWSD system were derived. These improvements can be the rehabilitation of the existing sewers or the construction of new sewers to replace existing sewers to enhance the sewer system where there are deficiencies. The CIP only considers the rehabilitation of lateral and connector sewers.

2.1.3.1 Rehabilitation - Lateral and Connector Relining

There are a few different methods of rehabilitating sewers that were considered for lateral and connector sewers. These include chemical grouting of joints, sliplining and cured-in-place-pipe (CIPP). CIPP was the preferred method used for the CIP estimates.

CIPP Lining

CIPP Lining is considered to be major rehabilitation. CIPP Lining installation includes the installation of Cured-In-Place Pipe, mobilization, sewer preparation, and furnishing of all incidentals.

The service life of CIPP Lining is 50 years. The CIP cost estimation for lateral and connector sewer rehabilitation was derived from the recent pilot project performed by Inland Waters for DWSD and found in the technical memorandum entitled Physical Inspection of Lateral and Connector Sewers, revised May 2003. For this project, CIPP was used on several laterals and connectors within the DWSD system. Table A-3 in Appendix A shows an alternate cost estimation for CIPP Lining based on historical data. These unit costs do not include contingencies.

2003 Lateral Sewer CIPP Rehabilitation Costs = $122.35 per linear foot ($646,000 per mile)

2003 Connector Sewer CIPP Rehabilitation Costs = $220.30 per linear foot ($1,163,184 per mile)

2.1.4 Subprogram No. 1D: Interceptor and Trunk Sewer Improvements

Costs for improvements to the interceptor and trunk sewers in the DWSD system were derived. These improvements can be the rehabilitation of the existing sewers, the construction of new sewers to replace existing sewers, or to enhance the sewer system where there are deficiencies.

2.1.4.1 Rehabilitation – Structural Repairs

The rehabilitation of the larger interceptor and trunk sewers requires methods different than for lateral and connector sewers. In addition to a CIPP relining, specific structural repairs can be accomplished because the sewers are large enough to be entered. As a result of recent inspections of some of the interceptors and trunk sewers in the DWSD system, some structural repairs were identified. These can be found in the CS-1158 report called Long Term CSO Plan for the Detroit and Rouge Rivers, 1996. These inspections covered approximately 886,400 linear feet, or about 30% of the system, with structural repair costs (mostly CIPP lining) estimated at $18,000,000. Table A-3 shows the CIPP lining cost estimation based on historical data. This table, however, only goes up to 48" pipe, while the pipes used in this structural repair calculation range from 24" to 177". The unit cost below used for this calculation is an extrapolation of Table A-3 and does not include contingencies.

2003 Interceptor and Trunk Sewer Structural Repair Costs = $1,000 per linear foot

2.1.4.2 Cleaning

Sewer Cleaning of the interceptor and trunk sewers consists of heavy cleaning utilizing a hydraulic sewer jet/vacuum unit. The estimate includes mobilization, set up for jet/vacuum truck, and furnishing of all incidentals. The CIP costs for the cleaning of interceptor and trunk sewers were taken from Table A-2, which is based on historical data. This unit cost does not include contingencies.

2003 Interceptor and Trunk Sewer Heavy Cleaning Costs = $16.41 per linear foot

2.1.4.3 Sludge Removal

An analysis of inspection reports on interceptor and trunk sewers by TYJT calculated that sludge removal and disposal for 30% of the system would cost approximately $1,867,043. These can be found in the CS-1158 report called Long Term CSO Plan for the Detroit and Rouge Rivers, 1996. This sludge removal is considered to be heavy cleaning and uses the costs from the historical data in Table A-2.

2003 Interceptor and Trunk Sewer Sludge Removal Costs = $16.41 per linear foot

2.1.4.4 Sediment Testing

A concern regarding the pipes in the DWSD system is that the buildup of sludge contains toxic materials, such as PCB's or mercury. This sludge should be removed and disposed of in a different manner than the current sewer jet / vacuum unit practices (washing down the sewers to the WWTP). Sludge removal should therefore include a sampling station to test the sludge components and disposal of this hazardous material in a landfill. Sludge amounts were obtained from inspection reports found in the CS-1158 report called Long Term CSO Plan for the Detroit and Rouge Rivers, 1996. The cost per truckload comes from CDM and assumes two tests, for PCB's and mercury, would be performed on each load.

2003 Interceptor and Trunk Sewer Sediment Testing Costs $200 per truck load (10 cu. yds.)

2.1.4.5 New Relief Sewers

DWSD previously identified areas of the system where relief sewers were needed. These areas were defined in Status Report on Storm Relief Sewer Program, by DWSD, issued July 1975, reissued July 1978. The Wastewater Master Plan (WWMP) team has reviewed these relief sewers (CS-1314 Local Alternatives for SSO control technical memorandum, revised May 2003) and concluded that the following may be needed; pending further system inspections and cleaning:

- 7 Mile Road Relief
  - 7,920 ft. of 120" at depth of 30'
  - 13,200 ft. of 120" at depth of 25'
- Fenkell Relief
  - 7,920 ft. of 156" at depth of 25'
  - 13,200 ft. of 192" at depth of 10'
- Schoolcraft Relief
  - 10,560 ft. of 192" at depth of 15'
- Hubbell Relief
  - 10,660 ft. of 144" at depth of 10'
  - 7,920 ft. of 144" at depth of 20'
- Joy / Clark Relief
  - 6,833 ft. of 192" at depth of 25'
  - 27,216 ft. of 192" at depth of 15'
  - 169 ft. of 120" at depth of 10'

The cost of construction of relief sewers was estimated in 1978 and again in 1996 for the CS-1178 Long Term CSO Control Plan for the Detroit and Rouge Rivers, Volume 3, 10.04 C1 Alternative Evaluations (Table C.4 in Alternative 6). Table A-4 shows the 1996 estimates as well as the 2003 costs derived by escalating using the CCI. The costs from this table used for the new relief sewer cost are shown here.

120" at depth of 10' Costs = $1,289 per linear foot

120" at depth of 25' Costs = $1,557 per linear foot

120″ at depth of 30′ Costs = $1,712 per linear foot

144″ at depth of 10′ Costs = $1,389 per linear foot

144″ at depth of 20′ Costs = $1,579 per linear foot

156″ at depth of 25′ Costs = $1,938 per linear foot

192″ at depth of 10′ to 15′ Costs = $2,399 per linear foot

192″ at depth of 25′ Costs = $2,771 per linear foot

2.1.4.6 Future Modeling

The CIP cost estimation has included future modeling of the DWSD sewer system. This modeling of data from the Segmented Facilities plan is scheduled to take place from 2008 to 2010. The estimate, from CDM, is in 2003 dollars includes contingencies.

2003 Future Modeling Costs = $100,000

2.1.4.7 Oakwood Interceptor

This individual project is to install a new redundant sewer system parallel to the Oakwood Interceptor section of the NW Interceptor. This estimate was performed by Tetra Tech MPS and can be found in the CS-1314 technical memorandum entitled Conceptual Plan for Oakwood Northwest Interceptor, revised May 2003. The estimate is in 2003 dollars and does not include contingencies.

2003 Oakwood Redundant Interceptor Costs = $8,700,000

2.1.4.8 Macomb Meter Stop Gates

This project is to install stop gates at meters CV-3 and MB-25 in Macomb County. The estimate, from SDA and found in the CS-1314 technical memorandum entitled Capital Improvement Programs for Macomb County, revised May 2003, is in 2003 dollars and does not include contingencies.

2003 Stop Gate Installation Costs = $1,700,000 each

2.1.4.9 North Gratiot Interceptor

This project is to install the new North Gratiot Interceptor Sewer (NGIS) in Macomb County. The estimate, from SDA and found in the CS-1314 technical memorandum entitled Capital Improvement Programs for Macomb County, revised May 2003, is in 2003 dollars and includes contingencies.

2003 NGIS Installation Costs = $40,000,000

2.1.4.10 Northwest Interceptor Improvements

This project is for improvements to the Northwest Interceptor Sewer (NWIS) from 8 Mile Road to the WWTP. This estimate was performed by Tetra Tech MPS and can be found in the CS-1314 technical memorandum entitled Conceptual Plan for Oakwood Northwest Interceptor, revised May 2003. The estimate is in 2003 dollars and does not include contingencies.

2003 10' Diameter Lining Costs = $1,000 per linear foot

2003 10' Diameter Replacement Sewer Costs = $2,500 per linear foot

2.1.5 Subprogram No. 1E: Manholes and Catch Basin Improvements

Inspection and repair of sewer structures in the DWSD system are required to ensure the system operates efficiently. Therefore, the CIP estimated costs for the inspection and repair of manholes and catch basins.

2.1.5.1 Manhole Inspections

Manhole inspection consists of either topside inspection or full inspection. Table A-5 shows the estimate in unit cost per manhole inspection based on historical data. The CIP estimate for manhole inspections assumes 5% of the manholes in the system will undergo topside inspection every year. This unit cost does not include contingencies.

2003 Manhole Inspection Costs = $52 per structure

2.1.5.2 Manhole Repairs

Manhole repairs consists of:

- Manhole wrapping
- External chemical grout
- Manhole shelf repair
- Manhole channel repair
- Pipe connection repair
- Raising / replacing manhole frames

Each repair is separate. The CIP estimate assumes that the quantity of manholes needing the above categories of repairs varies, with the amounts per inspection cycle as follows:

- 5% need manhole wrapping
- 8% need external chemical grout
- 10% need manhole shelf repair
- 10% need manhole channel repair
- 10% need pipe connection repair
- 15% need raising / replacing manhole frames

2003 Manhole Wrapping Costs = $215 per structure

2003 External Chemical Grouting Costs = $1,938 per structure

2003 Manhole Shelf Repair Costs = $646 per structure

2003 Manhole Channel Repair Costs = $646 per structure

2003 Pipe Connection Repair Costs = $538 per structure

2003 Manhole Frame Replacement / Repair Costs = $646 per structure

2.1.5.3 Manhole Replacement

Manhole installation (replacement) includes:

- Pre-cast reinforced concrete manholes risers and cones, cast-in-place bases, frames, castings, steps
- Excavation and backfill of common earth
- Sheeting, shoring bracing and dewatering
- Up to 6" of bituminous pavement removal and replacement
- And furnishing of all incidentals.

Tables A-6 shows the estimate in unit cost per vertical linear foot of installation. The CIP cost for manhole replacement was taken from Table A-6 This estimate for manhole replacement assumes that manholes are 4' in diameter and 15' deep and that 2% would need to be replaced for each inspection cycle (20 years). This unit cost does not include contingencies.

2003 Manhole Replacement Costs = $ 6,053 per manhole

2.1.5.4 Catch Basin Cleaning

The CIP cost estimations assume that all 200,000 catch basins will be cleaned every cycle. Table A-7 shows the cost per catch basin. Catch basin cleaning includes labor, trucks, and disposal. This unit cost does not include contingencies.

2003 Catch Basin Cleaning Costs = $ 59 per catch basin

2.1.5.5 Catch Basin Repair

The CIP cost estimation for catch basin repair assumes that the repairs will be pipe connection repair and frame replacement as shown in Section 2.2.5.2 for manholes. These unit costs do not include contingencies.

2003 Catch Basin Pipe Connection Repair Costs = $ 538 per catch basin

2003 Catch Basin Frame Replacement Costs = $ 646 per catch basin

2.1.6 Subprogram No. 1F: Regulators, Outfalls, Backwater Gates, and In-System Storage

2.1.6.1 Outfall Flow Regulators Inspection

Outfall regulator inspection includes inspection and report writing.

The cost estimate assumes that a five-person crew can dive and inspect two outfall regulators each day. The cost per day for a five-person crew is $6,000/day, as shown in an invoice for the installation of backwater gate sensors for the Baby Creek outfall. It should be noted that some outfall regulators might cost more to inspect than others, depending on regulator accessibility and condition. This unit cost does not include contingencies.

2003 Outfall Regulator Inspection Costs = $3,000 per average outfall regulator

2.1.6.2 Outfall Flow Regulators Rehabilitation

Outfall regulator rehabilitation includes cleaning and inspection of the regulator, float, and sump chamber; removal of existing regulator gates and associated components; removal of flap gates and sluice gates, rehabilitation of regulator, float; replacement of access manhole frames and covers; installation of new slide gates and flexible flap gates and temporary diversion of sewage flow.

Regulator rehabilitation was performed under Contract PC-695 Regulator / Remote Flow Control Structures and Dam Rehabilitation. This project rehabilitated 40 gates for a total cost of $7,708,000. The average cost of $192,700 per gate is rounded to $200,000 per gate. This contract ended in 2000, so the cost is escalated to $218,000 using a CCI escalation factor of 1.077. It should be noted that some outfall regulators might cost more to rehabilitate than others, depending on regulator accessibility and condition. This cost estimate includes any contingencies.

2003 Outfall Regulator Rehabilitation Costs = $218,000 per average outfall regulator

2.1.6.3 Outfall Flow Regulators Replacement

Outfall regulator replacement includes the mechanical work described in the outfall regulator rehabilitation work described above and, additionally, replacement of the concrete regulator chamber.

As noted above, the cost for the mechanical equipment replacement is $218,000 per outfall regulator. It is assumed that the regulator junction chamber replacement costs would be similar to the influent junction chamber construction costs for the St. Aubin Screening and Disinfection Facility, Contract PC-731. The contractor has provided a detailed cost estimate, which indicates that the construction cost for this junction chamber would be $105,000. An additional $10,000 is added for destruction and removal of the existing regulator chamber. In summary, the regulator replacement costs are:

Installation of mechanical components = $218,000

Construction of new regulator chamber = $105,000

Destruction/removal of existing regulator chamber = $10,000

Total = $333,000

Although the mechanical components portion includes some contingencies, the unit cost here does not include contingencies.

2003 Outfall Regulator Replacement Costs = $333,000 per average outfall regulator

2.1.6.4 Outfall, Backwater Gate, and Diversion Dam Inspection

Outfall inspection includes inspection and report writing. Backwater gates and diversion dams are inspected at the same time as outfalls, and do not require any additional costs. The cost estimate assumes that a five-person crew can dive and inspect two outfalls each day.

The cost per day for a five-person crew is $6,000/day as shown in an invoice for the installation of backwater gate sensors for the Baby Creek outfall. It should be noted that some outfalls might cost more to inspect than others, depending on outfall size, depth, number of conduits, and condition. This unit cost does not include contingencies.

2003 Outfall Inspection Costs = $3,000 per average outfall

2.1.6.5 Outfall Rehabilitation

Outfall rehabilitation includes repair work at each outfall, as needed.

The cost estimate is based on outfall rehabilitation costs budgeted for the DWSD contract DWS 849/850, Inspection and In-place Rehabilitation of Outfalls. The cost for this project is $15,540,000 for rehabilitation of twelve outfalls. This results in an average cost of $1,295,000 per outfall. The cost shown is an average amount for all outfalls. Outfall rehabilitation costs can vary widely, because the work involved could range from nothing to significant structural repairs. This unit cost does include contingencies.

2003 Outfall Rehabilitation Costs = $1,295,000 per average outfall

2.1.6.6 Outfall Replacement

Outfall replacement includes removal of the existing outfall and installation of a new outfall from the junction chamber to the river.

Outfall replacement costs are estimated based on the equivalent installation of a sewer line for the average size, length, and depth outfall. The average outfall calculations assume that outfalls with multiple barrels can be represented by a longer length of single barrel outfall. For example, a double barrel outfall with a length of 15 ft. can be considered a single barrel outfall with length 30 ft. Similarly, outfalls with box, egg,

or arch shapes are converted to cylinders with equivalent diameters. For example, a 10 ft. x 10 ft. box sewer is considered equivalent to an 11.3 ft. diameter cylinder. These considerations are used to calculate the average length and diameter for all outfalls. The average outfall is 8.5 ft. in diameter and 1,280 ft. in length. Outfall depth is not readily available and is assumed to be 10 ft.

The replacement cost for the average size and length outfall can then be calculated based on the cost of installation of a new sewer with these dimensions. The costs for sewer installation as a function of size and depth are displayed in Table A-4. This table indicates that the replacement cost for an 8.5 ft. diameter, 1,280 ft. long, and 10 ft. deep outfall would be about $12,600,000. It should be noted that outfall replacement costs would vary significantly because of differences in size, number of conduits, and depth below the surface. This unit cost does not include contingencies.

2003 Outfall Replacement Costs = $12,619,680 per average outfall

2.1.6.7 Backwater Gate Rehabilitation

Backwater gate rehabilitation includes cleaning, leak repair, repair/replacement of rotted or deteriorated timber, and repair/replacement of hardware.

The estimated total cost for repair of twelve backwater gates under Contract CS-1158 Long Term CSO Control Plan for the Detroit and Rouge Rivers (1996) is $182,000. This results in an average cost of $15,200 per gate. This cost is then multiplied by a CCI escalation factor, resulting in an average 2003 cost of $18,100 per gate. This cost is then rounded to $20,000 for the estimate. Actual backwater gate rehabilitation costs will vary considerably depending on the condition and accessibility of the gate. This unit cost does include contingencies.

2003 Backwater Gate Rehabilitation Costs = $20,000 per average backwater gate

2.1.6.8 Backwater Gate Replacement

Backwater gate replacement includes replacement of the backwater gates and associated stop logs.

The cost for installation of two backwater gates and associated stop logs at the St. Aubin Screening and Disinfection Facility is $336,000, according to the detailed cost breakdown for Contract PC-731 St. Aubin Screening and Disinfection Facility. It is assumed that removal of the existing gates and other site work would cost approximately $14,000. This results in a total cost of $350,000 for the installation of two gates at one location. There are 154 gates at 54 locations, or an average of 2.81 gates per location. It is assumed that the cost of gate replacement is proportional to the total number of gates. Hence, the cost for replacing all of the gates would be:

*$350,000/ 2 gates * 154 gates/ all locations = $26,460,000*

$26,460,000/ 54 locations = $490,000 per location

This cost was then multiplied by a CCI escalation factor to obtain a 2003 average cost of $517,000 per location. It should be noted that the cost at each location would vary based on the number and size of backwater gates and stop logs. This unit cost does not include contingencies.

2003 Backwater Gate Replacement Costs = $517,000 per average backwater gate

2.1.6.9 Diversion Dam Rehabilitation

Diversion dam rehabilitation includes cleaning and repair of deteriorated dam surfaces, restoration of connection between dam surface and bottom of flashboards, and repair/replacement of associated stop logs.

The needed repairs are identified in the CS-1314 Review of Collection System Regulators and Outfalls technical memorandum, revised May 2003. The cost for diversion dam rehabilitation is based on simple cost estimates for a three man crew working two days. The average cost for diversion dam rehabilitation based on three locations is $1,000 per dam. It should be noted that diversion dam rehabilitation costs will vary based on the size, type, and condition of the diversion dam. This unit cost does not include contingencies.

2003 Diversion Dam Rehabilitation Costs = $1,000 per average diversion dam

2.1.6.10 Diversion Dam Replacement

Diversion dam replacement includes the installation of a new inflatable dam at the existing location. This cost also includes the cost of removing the existing diversion dam.

The cost for diversion dam replacement is based on the detailed cost breakdown for Contract PC-731 St. Aubin Screening and Disinfection Facility. The installation cost for an inflatable diversion dam, according to this contract, is $70,000. This cost is multiplied by a CCI escalation factor to get a 2003 installation cost of $74,000. It is assumed that there is an additional cost of $10,000 for destruction and removal of the existing diversion dam and other site work. The total cost for diversion dam replacement is $84,000 per dam. The cost of each diversion dam will vary based on dam size and accessibility. This unit cost does not include contingencies.

2003 Diversion Dam Replacement Costs = $84,000 per average diversion dam

2.1.6.11 In-System Storage Devices & System Gate Inspection

In-system storage device (ISSD) inspection includes inspection and report writing. The cost estimate assumes that a three-person crew can inspect one ISSD each day. The cost for one three-person crew should be about $3,000. This unit cost does not include contingencies.

2003 ISSD Inspection Costs = $3,000 per ISSD

2.1.6.12 In-System Storage Devices & System Gate Rehabilitation

ISSD rehabilitation includes removal of existing regulator gates and associated components; removal of existing operating systems for the regulator gates; installation of new slide gates with self-enclosed hydraulic operating systems; installation of instrumentation and control systems for remote operation of the slide gates from the SCC.

This type of work was performed under Contract PC-695 Regulator / Remote Flow Control Structures and Dam Rehabilitation. This project rehabilitated 40 gates for a total cost of $7,708,000. The average cost of $192,700 per gate was rounded to $200,000 per gate. This contract ended in 2000, so the cost was then escalated to $218,000 using a construction cost escalation factor. It should be noted that some ISSDs cost more to rehabilitate than others, depending on ISSD type, accessibility, and condition. This unit cost does include contingencies.

2003 ISSD Rehabilitation Costs = $218,000 per ISSD

2.1.6.13 In-System Storage Devices & System Gate Replacement

ISSD replacement includes removal of all existing ISSD mechanical, electrical, and instrumentation components and replacement with new components.

ISSD replacement costs are based on Contract PC-747 In-System Storage. Under this contract, thirteen new ISSDs were installed for a total cost of $26,400,000. This would result in an average cost of $2,030,000 per ISSD. It is assumed that this installation cost is comparable to the average ISSD replacement cost. It should be noted that ISSD replacements would vary depending on the size, type, and accessibility of the device. This unit cost does include contingencies.

2003 ISSD Replacement Costs = $2,030,000 per ISSD

2.1.7 Subprogram No. 1G: Pump Stations

2.1.7.1 Inspections

Pump station inspection includes inspection of the structural condition of the station and wet well (if equipped), pump testing, and inspection of the instrumentation and control devices.

The pump station inspection costs are estimated to run about $1,000 per pump for testing, based on a cost breakdown from Contract PC-744 Wastewater Treatment Plant Rehabilitation and Program Management. It was assumed that it would take an engineer about 2.5 weeks to inspect the pump station and write a report. At $100 per hour, this would cost $10,000 per pump station. This unit cost does not include contingencies. In summary, pump station inspection costs include:

Pump testing = $1,000 per pump

Pump station inspection and report writing = $10,000 per pump station

2003 Pump Station Inspection Costs = $10,000 per pump station + $1,000 per pump

2.1.7.2 Rehabilitation

Pump station rehabilitation includes pump and motor testing; station cleaning, painting, and repair; repair/replacement of damaged pump, motor, control panel parts; and minor pump station structural repairs.

The pump station rehabilitation costs can be estimated based on the total pump station rehabilitation costs, estimated for Contract PC-744 Wastewater Treatment Plant Rehabilitation and Program Management. In the PC-744 report, the total cost for immediate, short-term, and long term rehabilitation; routine and long lead time spare parts: CMMS system; and motor repair/replacement was $7,737,500. It is assumed that this cost is representative of pump rehabilitation needs for each five-year interval. This cost does not include contingencies.

2003 Pump Station Rehabilitation Costs = $7,737,500 for rehabilitation of all pump stations

2.1.7.3 Major Rehabilitation

Major rehabilitation of pump stations includes the capital cost of renovating a wastewater pump station, including all pumps and related equipment.

The cost for pump station major rehabilitation was estimated by CDM and for the Tetra Tech MPS alternatives development (technical memoranda Expanded Facilities within the City of Detroit, Technical Feasibility of Satellite Treatment, and Technical Feasibility of a Wet Weather Flow Treatment Facility) and is found in Table A-9a. Pump station major rehabilitation will vary considerably depending pump station and wet well condition, number and capacity of pumps, and instrumentation and control requirements. Table A-9b shows the breakdown of these costs into low or high flow categories. The average flow of DWSD pump stations is more than 500 MGD, so the high flow cost is used for the CIP. This unit cost does not include contingencies.

2003 Pump Station Major Rehabilitation Costs (500 + MGD)= $20,000,000 for the average pump station

2.1.7.4 Energy Management

The CIP estimates reflect the need for better energy management in terms of pumps at the pump stations. This is expected to be accomplished through the installation of variable-frequency drives (VFD) on these pumps. The CIP considers the VFD installation at the Clintondale and Woodmere Pump Stations. The estimate, based on the May 2003 CS-1314 technical memorandum entitled Energy Management, was made by TYJT and did not include contingencies. The following estimate has had contingencies added.

2003 Energy Management Costs (VFD at Clintondale and Woodmere) = $682,500

2.1.8 Subprogram No. 1H: Meters

2.1.8.1 Inspection and Maintenance

Flow meter maintenance includes maintenance, repair and some replacement (mostly mechanical, but some structural) of current meters; billing and database management; and dye testing/flow accuracy. The costs shown are based on the maintenance budget for CS-1249 Greater Detroit Regional Sewer System Model – Billing Meter Program. This project maintains 50 meters with an annual budget of $2,000,000. This unit cost does include contingencies.

2003 Meter Maintenance Costs = $40,000/average meter

2.1.8.2 Replacement

Flow meter replacement includes meter equipment and installation costs, as well as meter vault replacement. The CIP cost is based on a CDM estimate from the CS-1249 Greater Detroit Regional Sewer System Model – Billing Meter Program and is representative of the average meter. Meter replacement costs may vary considerably depending on the type and location of the meter. This unit cost does not include contingencies.

2003 Meter Replacement Costs = $500,000/average meter

2.1.8.3 Macomb Odor Control

Some additional specific projects were included in the CIP estimation. These involve odor control measures at 12 Macomb County meter chambers through the installation of carbon adsorption units. The estimates are based on the CS-1292 Task Order Nos. 33 and 34 Final Draft Report and did not include contingencies. The following estimate has had contingencies added.

2003 Macomb County Odor Control Costs = $772,500

2.2 Program 2: CSO and SSO Control Program

2.2.1 Ongoing CIP Projects

The WWMP CIP estimation has identified several projects included in the current CIP that has carry-over costs. These rollover CIP costs are as shown in Table A-8 and include any contingencies.

2003 Ongoing CIPRollover Costs = $617,759,000

2.2.2 New Projects

The WWMP CIP estimation has identified some new CSO projects. These CIP costs are as shown below and include any contingencies. The Detroit River CSO is based on an estimate of $25,000,000 per outfall, assuming the construction of a screening and disinfection facility.

Table 2.2-1: New CSO Project Costs

Project	CIP Cost
Lower Rouge River Outfalls	$25,000,000
Detroit River CSO's – Upper Range	$750,000,000
Detroit River CSO's – Lower Range*	$375,000,000

* Based on half as many outfalls constructed

2.2.3 CSO Rehabilitation

The WWMP also considered the rehabilitation of the CSO's in the DWSD system. The upper range estimate assumes that the rehabilitation costs would be approximately 1% of the CSO construction costs. The table below shows these construction and CIP rehabilitation costs, without contingencies. The CIP's assume that each facility will be rehabilitated annually from 2008 to 2050. The lower range estimate assumes a yearly rehabilitation cost.

Table 2.2-2: Upper Range CSO Rehabilitation Costs

Facility	Construction Cost	Rehabilitation Cost (each)
Conner Creek CSO	$199,049,172	$1,990,492
Fox Creek CSO	$11,582,891	$ 115,829
Leib CSO	$31,327,898	$ 313,279
St. Aubin CSO	$21,540,250	$ 215,403
Upper Rouge CSO	$418,000,000	$4,180,000
Baby Creek CSO	$50,389,000	$ 503,890
7 Mile CSO	$17,638,861	$ 176,389
Fenkell CSO	$22,281,777	$ 222,818
Hubbell Southfield CSO	$67,975,783	$ 679,758
Belle Isle CSO	$14,960,000	$ 149,600

2003 Lower Range CSO Rehab Costs = $6,000,000 per year

2.3 Program 3: System Control and Wastewater Treatment Program

2.3.1 Wastewater Treatment Plant Ongoing and Major Rehabilitation

The DWSD Wastewater Treatment Plant (WWTP) is the largest feature in the DWSD sewer system. An overall assessment of funding needed for the Wastewater Treatment Plant Program was developed for planning purposes from a summary of the current funding for wastewater treatment plant programs. The data on these expenditures summarized in the following table:

Table 2.3-1: Summary of CIP Proposed Expenditures on the DWSD Wastewater Treatment Plant and System Control

CIP	Total Proposed CIP Expenditures (over 5 years)	Yearly Expenditure Average (averaged over 5 years)
2002/3 to 2006/7	$878M	$175M
2002/3 to 2006/7 (deleting non-WWTP projects)	$670M	$134M
2001/2 to 2005/6	$973M	$194M
1997/8 to 2001/2	$493M	$99M
**See Appendix B, Program 3 for a detailed list of projects from the current CIP Source: Sewage Disposal System Capital Improvement Program, Financial Planning Division, DWSD		

From this summary, and from Figure 2.3-1, which shows the actual capital expenditures on the WWTP over the last 10 years, the planning level estimates for expenditures on the plant are as follows:

- Total Wastewater Treatment Plant yearly estimated CIP funding needs:

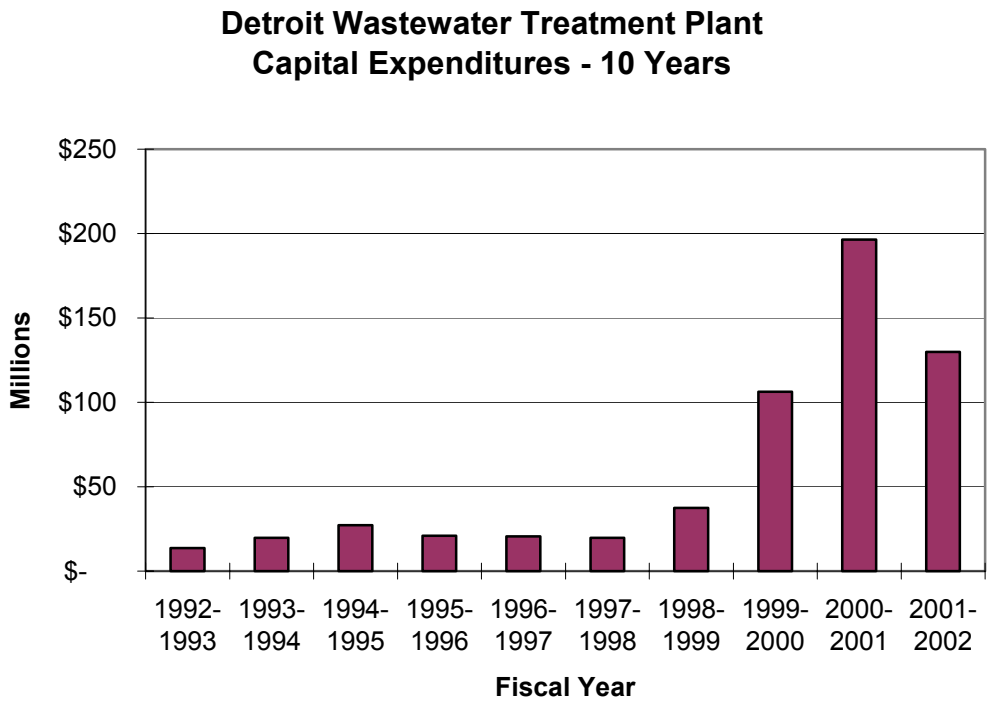
	Average Cost/Year
WWTP Major Renovation	$40,000,000
WWTP Ongoing Renovation	$80,000,000
Regional Operations	$30,000,000
TOTAL	$150,000,000

- Yearly needs assessment and inspection: $100-200,000 per year. If not done yearly, the cost would be higher.

Detroit Wastewater Partners (Malcolm Pirnie) also reported that expenditures on renewal and replacement of wastewater treatment plant components are typically 3% of the value of the wastewater plant per year for large plants. An estimated value for the Detroit Wastewater Plant is about $5 billion. Expenditures of 3% of the plant value result in an estimate of $150 million per year as a reasonable target to maintain a functioning plant.

CDM investigated the plant components and estimates that the yearly rehabilitation costs are $150,000,000 for the years 2008 through 2030 and $75,000,000 for 2031 through 2040, including any contingencies.

Figure 2.3-1



2003 WWTP Rehab Costs = $150,000,000 per year

Appendix A:
Data Tables Used for CIP

Appendix A – Data Tables Used for CIP

The April 2002 version of this technical memo contained several tables that were used for the actual CIP cost estimates for the WWMP. These tables use 2000 costs, sometimes based on historical data escalated using the BCI instead of the CCI. The CIP estimates use 2003 data with CCI escalations. This section contains these original tables, as well as the recalculated tables. The sources listed in these tables are shown in table B-10 in section B.1.5.

Sewer Inspection Costs

The only number from Table A-1 used for the CIP estimation is the unit cost for the 54-90″ category. Table A-1 shows this data escalated using the CCI. The averages from the 2003 CCI category are used for the CIP.

Table A-1
Historical Sewer Inspection Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
8" - 24"	$1.30	1982	$2.28	5
	$1.25	2000	$1.35	15
	$0.80	1988	$1.19	8
	$1.50	2000	$1.62	21
Avg.			**$1.61**	
27" - 48"	$1.00	1999	$1.11	2
	$2.25	1999	$2.49	11
	$2.25	1996	$2.68	13
	$2.00	2000	$2.15	21
Avg.			**$2.11**	
54" - 90"	$3.00	2000	$3.23	21
	$5.00	2000	$5.38	21
Avg.			**$4.31**	

Sewer Cleaning Costs

All 2000 data used for Table A-2 comes from historical sources from 1988 to 2000. The averages from the 2003 CCI category are used for the CIP.

Table A-2
Historical Sewer Cleaning Costs

Task	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
Prep Cleaning	$0.85	1988	$1.26	8
	$1.25	2000	$1.35	15
	$2.00	2000	$2.15	21
	$3.00	2000	$3.23	21
	$4.00	2000	$4.31	21
	$5.00	2000	$5.38	21
Avg.			**$2.95**	
Heavy Cleaning	$17.50	1999	$19.34	2
	$12.00	2000	$12.92	20
	$15.00	2000	$16.15	20
	$16.00	2000	$17.23	20
Avg.			**$16.41**	

CIPP Lining Costs

All 2000 data used for Table A-3 comes from historical sources from 1988 to 2000 and was escalated to 2000 using the BCI. The averages from the 2003 CCI category are used for the CIP.

Table A-3
Historical CIPP Lining Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
8"	$58.00	1982	$101.56	5
	$60.00	1982	$105.07	5
	$65.00	1999	$71.84	6
Avg.			**$92.82**	
10"	$80.00	1999	$88.42	6
	$86.00	1988	$127.47	8
Avg.			**$107.95**	

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
12"	$60.00	1982	$105.07	5
	$95.00	1999	$105.00	6
	$128.00	1988	$189.72	8
	$94.00	1988	$139.33	8
Avg.			**$134.78**	
15"	$128.00	1988	$189.72	8
	$108.00	1988	$160.08	8
Avg.			**$174.90**	
18"	$128.00	1988	$189.72	8
Avg.			**$189.72**	
21"	$105.00	1982	$183.87	5
	$230.00	2000	$247.64	20
Avg.			**$215.75**	
24"	$163.00	1988	$241.60	8
	$273.00	2000	$293.93	20
Avg.			**$267.76**	
27"	$300.00	2000	$323.00	20
Avg.			**$323.00**	
30"	$360.00	2000	$387.60	20
Avg.			**$387.60**	
36"	$445.00	2000	$479.12	20
Avg.			**$479.12**	
42"	$533.00	2000	$573.87	20
Avg.			**$573.87**	
48"	$620.00	2000	$667.54	20
Avg.			**$667.54**	

Table A-4
New Relief Sewer Installation Costs

Cost of Sewers-in-Place per Linear Foot at Various Depth Ranges												
Depth	0 – 10 Ft.		10 – 15 Ft.		15 – 20 Ft.		20 – 25 Ft.		25 – 30 Ft.		30 – 35 ft.	
Size	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**
21"	$174	$207	$226	$269	$281	$335	$341	$406	$395	$471	$478	$570
24"	$218	$260	$278	$331	$333	$397	$393	$468	$470	$560	$535	$638
27"	$262	$312	$330	$393	$385	$459	$445	$530	$503	$599	$592	$706
30"	$306	$365	$382	$455	$437	$521	$497	$592	$557	$664	$649	$773
36"	$350	$417	$434	$517	$489	$583	$549	$654	$611	$728	$706	$841
42"	$394	$470	$486	$579	$541	$645	$601	$716	$665	$793	$763	$909
48"	$438	$522	$538	$641	$593	$707	$653	$778	$719	$857	$820	$977
54"	$482	$574	$590	$703	$645	$769	$705	$840	$773	$921	$877	$1,045
60"	$530	$632	$641	$764	$698	$832	$755	$900	$830	$989	$938	$1,118
66"	$567	$676	$686	$818	$744	$887	$802	$956	$882	$1,051	$998	$1,189
72"	$604	$720	$731	$871	$790	$942	$849	$1,012	$934	$1,113	$1,027	$1,224
78"	$641	$764	$776	$925	$836	$996	$896	$1,068	$986	$1,175	$1,085	$1,293
84"	$678	$808	$821	$978	$882	$1,051	$943	$1,124	$1,037	$1,236	$1,141	$1,360
90"	$715	$852	$866	$1,032	$928	$1,106	$990	$1,180	$1,089	$1,298	$1,198	$1,428

Cost of Sewers-in-Place per Linear Foot at Various Depth Ranges												
Depth	0 – 10 Ft.		10 – 15 Ft.		15 – 20 Ft.		20 – 25 Ft.		25 – 30 Ft.		30 – 35 ft.	
Size	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**	**1996**	**2003**
96"	$753	$897	$911	$1,086	$974	$1,161	$1,037	$1,236	$1,140	$1,359	$1,254	$1,495
102"			$953	**$1,136**	$1,018	$1,213	$1,084	$1,292	$1,181	$1,408	$1,299	$1,548
108"			$995	$1,186	$1,063	$1,267	$1,131	$1,348	$1,222	$1,456	$1,344	$1,602
114"			$1,037	$1,236	$1,107	$1,319	$1,178	$1,404	$1,263	$1,505	$1,389	$1,655
120"			$1,081	**$1,288**	$1,153	$1,374	$1,225	$1,460	$1,306	**$1,557**	$1,437	**$1,713**
132"			$1,123	$1,338	$1,197	$1,427	$1,272	$1,516	$1,372	$1,635	$1,509	$1,798
144"			$1,165	**$1,388**	$1,245	$1,484	$1,325	**$1,579**	$1,439	$1,715	$1,583	$1,887
156"					$1,407	$1,677	$1,497	$1,784	$1,626	**$1,938**	$1,789	$2,132
168"					$1,590	$1,895	$1,692	$2,017	$1,837	$2,189	$2,022	$2,410
180"					$1,797	$2,142	$1,912	$2,279	$2,076	$2,474	$2,285	$2,723
192"					$2,013	**$2,399**	$2,141	$2,552	$2,325	**$2,771**	$2,559	$3,050
204"					$2,254	$2,686	$2,398	$2,858	$2,604	$3,103	$2,866	$3,416

Table A-5
Manhole Inspection Costs

Repair Type	2000 Unit Cost	2003 Unit Cost
Topside Inspection	$50	$52
Full Inspection	$150	$162

Manhole Replacement Costs

All 2000 data used for Table A-6 comes from historical sources from 1971 to 2000 and was escalated to 2003 for the CIP.

Table A-6
Historical Manhole Replacement Costs

Size	Source Unit Cost/VLF	Year	2003 Unit Cost/VLF (CCI)
4'	$120.00	1985	$191.60
	$225.00	1999	$248.69
	$162.50	1999	$179.61
	$100.00	1971	$423.66
	$180.00	1999	$198.95
	$104.00	1971	$440.60
	$109.00	1971	$461.78
	$103.00	1971	$436.37
	$187.50	1990	$265.40
	$125.00	1990	$176.93
	$162.50	1971	$688.44
	$175.00	1971	$741.40
	$187.00	1971	$792.24
Avg.			**$403.51**
5'	$250.00	1990	$353.87
	$187.50	1990	$265.40
	$187.50	1999	$207.24
	$220.00	1999	$243.16
Avg.			**$267.42**

Size	Source Unit Cost/VLF	Year	2003 Unit Cost/VLF (CCI)
6'	$290.00	1999	$320.53
	$212.50	1999	$234.87
Avg.			**$277.70**
7'	$260.00	1998	$294.17
	$350.00	1998	$396.00
	$187.50	1985	$299.37
	$250.00	1985	$399.17
	$370.00	1999	$408.95
Avg.			**$359.53**
8'	$1,187.50	1999	$1,312.52
	$950.00	1996	$1,132.22
Avg.			**$1,222.37**

The manhole replacement for the CIP assumes the average manhole is 4' in diameter and 15' deep. This calculates as follows: *Each manhole installation = $403.51 X 15 = $6,052.65*

Table A-7
Catch Basin Cleaning Costs

Item	Quantity	Unit	Cost	Total	Per Year
Labor Cost	33	each	$50 per hour	$3,432,000	$3,432,000
Truck Cost	12	each	$350,000	$4,200,000	$420,000
Disposal Cost	66,667	each	$1	$66,667	$66,667
				Cost per Catch Basin	$59

Table A-8
CSO CIP Rollover Costs

Project	Total Cost	CIP Rollover Cost
Upper Rouge River Complete CSO Facility	$481,000,000	$362,000,000
City of Detroit Downspout Disconnects (current CIP runs through 2008; estimate for 2008 to 2050)	$208,000,000	$165,000,000
Oakwood Pump Station/CSO Basin	N/A	$86,000,000
LTCSO Program Management (current CIP runs through 2008; estimate for 2008 to 2050)	N/A	$4,759,000

Pump Station Replacement / Major Rehabilitation

Pump Stations installation includes the capital cost of constructing a wastewater pump station, including all pumps and related equipment. The CIP estimate does not reflect the replacement of any pump station, as major rehabilitation is thought to be adequate. Tables A-9a shows the major rehabilitation estimate in unit cost x $1,000 per pump station, dependent on the size of the station. Table A-9b shows the breakdown of these costs into low or high flow categories.

Table A-9a
Pump Station Replacement Costs

Size	2000 Unit Cost	2003 Unit Cost
175 GPM	$65	$70
300 GPM	$65	$70
350 GPM	$65	$70
700 GPM	$85	$92
750 GPM	$90	$97
1,250 GPM	$140	$151
1,800 GPM	$190	$205
2,400 GPM	$250	$269
4,200 GPM	$395	$425
5,700 GPM	$495	$533
18,056 GPM		$359
27,778 GPM		$512
33,333 GPM		$615
34,722 GPM		$666
38,889 GPM		$717

Size	2000 Unit Cost	2003 Unit Cost
49,000 GPM	$1,080	$2,380
59,722 GPM		$1,127
66,667 GPM		$1,229
78,472 GPM		$1,434
700,000 GPM	$12,000	$12,920

Table A-9b
Pump Station Replacement Costs

Size	2003 Unit Cost
0 - 500 GPM	$1,567,000
500 + GPM	$20,000,000

Appendix B:
Data Tables Not Used for CIP

Appendix B – Data Tables Not Used for CIP

The April 2002 version of this technical memo contained several tables that were not used for the actual CIP cost estimates for the WWMP. The CIP either used different data sources or did not include the categories covered in these tables.

B.1 Alternate Data Category Tables

B.1.1 Chemical Grouting of Joints

Chemical Grouting of Joints consists of utilizing chemical products to eliminate leaks in pipe joints. The estimate includes mobilization, set up, and furnishing of all incidentals. The estimate is shown and is in unit cost per pipe joint. All 2000 data used for Table B-1 comes from historical sources from 1982 to 1999 and was escalated to 2003 using the CCI.

Table B-1
Historical Chemical Grouting of Joints Costs

Size	Source Unit Cost/Joint	Year	2003 Unit Cost/Joint (CCI)	Source
All	$60.00	1985	$95.80	1
	$35.00	1982	$61.29	5
	$24.00	1988	$35.57	8
	$35.00	1999	$38.68	11
	$35.00	1996	$41.71	13
Avg.			**$54.61**	

B.1.2 Sliplining

Sliplining is considered to be a light rehabilitation method. Sliplining installation includes:

- Installation of HPDE Pipe into existing sewer pipe
- Excavation and backfill of insertion pits in common earth
- Annular space grouting
- Mobilization
- Sewer preparation
- And furnishing of all incidentals.

The service life of Sliplining is 50 years. Sizes are the ID of the Slipliner pipe; for example, to reline a 20" sewer, use the cost for the 16" Slipliner. The estimate in Table B-2 is unit cost x $1,000 per mile of installation.

Table B-2
Sliplining Costs

Size	2003 Unit Cost / Mile
4”	$20
6”	$50
8”	$90
10”	$130
12”	$190
14”	$230
16”	$290
18”	$370
20”	$460
22”	$560
24”	$660
26”	$780
28”	$900
30”	$1,040
32”	$1,180
36”	$1,490
42”	$2,030
48”	$2,650
52”	$3,060
54”	$3,360

B.1.3 Sewer Pipe Replacement

It has been determined that the improvements to the DWSD sewer system would not include the replacement of any sewer pipes. However, the costs for the construction of new sewers were investigated. The results of this investigation follow. Note that the costs included in these tables (Table B-3 through B-13) are the recommended costs from Table 5.1-1.

Ductile Iron Force Main

Ductile Iron Force Main installation includes:

- Cement lined ductile iron pipe (6-24")
- Excavation and backfill of common earth
- 3 – 3.5 feet of cover to crown of the pipe
- Minimum utility relocation
- Up to 6” of bituminous pavement removal and replacement
- Furnishing of all incidentals.

Table B-3 shows the ductile iron force main installation estimate in unit cost x $1,000 per mile of pipe installation, escalated using the CCI. The service life of ductile iron force mains is 30 years.

Table B-3
Historical New Ductile Iron Force Main Installation Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
4"	$10.00	1985	$15.97	1
	$15.00	1985	$23.95	1
Avg.			**$19.96**	
6"	$16.00	1985	$25.55	1
	$19.00	1985	$30.34	1
	$27.00	2000	$29.07	10
	$18.40	1971	$77.95	14
	$16.00	1971	$67.78	14
Avg.			**$46.14**	
8"	$30.00	2000	$32.30	10
Avg.			**$32.30**	
10"	$33.00	2000	$35.53	10
Avg.			**$35.53**	
12"	$37.00	2000	$39.84	10
	$16.00	1971	$67.78	14
	$28.00	1990	$39.63	16
Avg.			**$49.09**	
14"	$41.00	2000	$44.14	10
Avg.			**$44.14**	
16"	$45.00	2000	$48.45	10
Avg.			**$48.45**	

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
18"	$42.00	1990	$59.45	16
Avg.			**$59.45**	
20"	$53.00	2000	$57.06	10
	$47.50	1971	$201.24	14
Avg.			**$129.15**	
24"	$60.00	2000	$64.60	10
Avg.			**$64.60**	
48"	$107.00	2000	$115.20	10
Avg.			**$115.20**	

Service Leads

Service Lead installation includes:

- 6" SDR 35 PVC pipe and fittings
- Excavation and backfill of common earth
- Min. 4′ cover to crown of the pipe
- Tie-in to existing sewer
- Reseeding
- Furnishing of all incidentals.

Table B-4 shows the estimate for service lead installation in unit cost per foot of pipe with the historical data escalated using the CCI. The service life of service leads is 25 years.

Table B-4
Historical New Service Lead Installation Costs

Size	Source unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
6"	$14.00	1971	$59.31	14
	$15.60	1971	$66.09	14
Avg.			**$62.70**	

Sanitary Laterals

Sanitary Lateral installation includes:

- Plain concrete pipe (8-12")
- Excavation and backfill of common earth, including trench shield or box
- 48″ diameter manholes at 300 feet
- Minimum utility relocation
- Up to 6″ of bituminous pavement removal and replacement
- Furnishing of all incidentals.

Table B-5 shows the estimate for sanitary laterals in unit cost x $1,000 per mile of pipe installation, with the historical data escalated using the CCI. The service life of sanitary laterals is 50 years.

Table B-5
Historical New Sanitary Lateral Installation Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
8"	$22.50	1985	$35.92	1
	$35.00	1999	$38.68	6
	$29.00	1971	$122.86	14
	$26.00	1971	$110.15	14
	$25.40	1971	$107.61	14
	$32.60	1971	$138.11	14
	$35.00	1990	$49.54	16
	$35.00	1990	$49.54	19
Avg.			**$77.06**	
10"	$24.00	1985	$38.32	1
	$25.00	1985	$39.92	1
	$40.00	1999	$44.21	6
	$56.00	2000	$60.29	10
	$30.00	1971	$127.10	14
	$57.00	1971	$241.48	14
Avg.			**$91.89**	
12"	$55.00	1999	$60.79	6
	$45.00	1990	$63.70	16
Avg.			**$62.24**	

Storm and Combined Laterals
Storm and combined lateral installation includes:

- Reinforced concrete pipe (12-24")
- Excavation and backfill of common earth
- Sheeting, shoring and bracing. Trench shield or box at 8'
- 48" Diameter manholes at 300 feet
- Min. bury to the crown of the pipe as listed below
- Minimum utility relocation
- Up to 6" of bituminous pavement removal and replacement
- And furnishing of all incidentals.

Tables B-6 shows the estimates for storm and combined laterals in unit cost x $1,000 per mile of pipe installation at various depths, with the historical data escalated using the CCI. However, the depth of installation is unknown. The service life of storm and combined laterals is 50 years.

Table B-6
Historical New Storm and Combined Lateral Installation Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
12"	$25.00	1985	$39.92	1
	$30.00	1985	$47.90	1
	$45.00	1989	$65.31	9
	$61.00	2000	$65.68	10
	$43.50	1971	$184.29	14
	$39.00	1971	$165.23	14
	$27.00	1990	$38.22	16
	$48.90	1971	$207.17	14
	$45.00	1990	$63.70	16
	$45.00	1990	$63.70	19
	$27.00	1990	$38.22	19
Avg.			**$81.61**	
15"	$27.50	1985	$43.91	1
	$67.00	2000	$72.14	10
	$49.00	1971	$207.59	14
	$33.75	1990	$47.77	16
	$56.25	1990	$79.62	16
	$33.75	1990	$47.77	19

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
15"	$56.25	1990	$79.62	19
	$31.00	1999	$34.26	11
Avg.			**$68.08**	
18"	$30.00	1985	$47.90	1
	$73.00	2000	$78.60	10
	$32.55	1990	$46.07	16
	$40.50	1990	$57.33	16
	$40.50	1990	$57.33	19
	$67.50	1990	$95.54	19
Avg.			**$63.79**	
21"	$80.00	2000	$86.13	10
	$52.00	1971	$220.30	14
	$48.00	1971	$203.35	14
	$47.00	1971	$199.12	14
	$47.25	1990	$66.88	16
	$47.20	1990	$66.81	19
Avg.			**$140.43**	
24"	$88.00	2000	$94.75	10
	$54.00	1971	$228.77	14
	$50.60	1971	$214.37	14
	$44.30	1990	$62.71	16
	$54.00	1990	$76.44	19
	$54.00	1990	$76.44	16
Avg.			**$125.58**	

Trunk Sewers
Trunk Sewer installation includes:

- Reinforced concrete pipe (27-66")
- Excavation and backfill of common earth
- Sheeting, shoring and bracing.
- Manholes at 300 feet. Diameters as follows:
  - Pipe size 27″ – 36″; 60″ diameter manholes

  - Pipe size 42″- 48″; 72″ diameter manholes
  - Pipe size 54″ – 66″; 84″ diameter manholes
- Min. bury to the crown of the pipe as listed below
- Minimum utility relocation
- Up to 6″ of bituminous pavement removal and replacement
- And furnishing of all incidentals

Table B-7 shows the estimates in unit cost x $1,000 per mile of pipe installation at various depths, with the historical data escalated using the CCI. However, the depth of installation is unknown. The service life of trunk sewers is 50 years.

Table B-7
Historical New Trunk Sewer Installation Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
27"	$96.00	2000	$103.36	10
	$50.00	1971	$211.83	14
Avg.			**$157.59**	
30"	$104.00	2000	$111.97	10
	$135.00	1996	$160.90	13
Avg.			**$136.43**	
36"	$93.00	1982	$162.85	5
	$275.00	1998	$311.14	3
	$275.00	1997	$316.21	7
	$270.00	1999	$298.43	11
	$145.00	1996	$172.81	13
Avg.			**$252.29**	
42"	$290.00	1997	$333.46	7
	$330.00	1999	$364.74	11
	$132.00	2000	$142.12	10
Avg.			**$280.11**	
48"	$300.00	1997	$344.96	7
	$285.00	1999	$315.00	11
Avg.			**$329.98**	

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
54"	$310.00	1997	$356.46	7

Avg.			**$356.46**	
60"	$340.00	1997	$390.96	7
Avg.			**$390.96**	
66"	$470.00	1998	$531.77	3
	$500.00	1998	$565.71	3
Avg.			**$548.74**	

Interceptors / Tunnels
Interceptor / tunnel installation includes:

- Reinforced concrete pipe (78-120")
- Excavation and backfill of common earth
- Sheeting, shoring and bracing
- 8′ Diameter manholes at 600 feet
- Min. bury to the crown of the pipe as listed below
- Minimum utility relocation
- Up to 6″ of bituminous pavement removal and replacement
- And furnishing of all incidentals.

Table B-8 shows the estimates in unit cost x $1,000 per mile of pipe installation at various depths, with the historical data escalated using the CCI. However, the depth of installation is unknown. The service life of interceptors / tunnels is 50 years.

Table B-8
Historical New Interceptors / Tunnels Installation Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
78"	$600.00	1998	$678.85	3
Avg.			**$678.85**	
84"	$620.00	1998	$701.48	3
Avg.			**$701.48**	
96"	$700.00	1998	$791.99	3
Avg.			**$791.99**	
Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
102"	$750.00	1998	$848.56	3

Avg.			**$848.56**	
108"	800.00	1998	$905.14	3
Avg.			**$905.14**	
120"	$900.00	1985	$1,437.00	1
Avg.			**$1,437.00**	

B.1.4 Miscellaneous Repairs

This cost estimating technical memorandum reviewed the costs for various sewer system repairs that were not scheduled or included in the WWMP CIP development. This section contains the results of this repair cost review.

Sump Pump Disconnection

Sump Pump Disconnection consists of removal of sump, valves electrical connections and restoration. These costs, in unit cost per connection, are estimated at $6,720 in 2000 dollars.

Root Control

Root Control consists of utilizing chemical methods. The estimate includes mobilization, set up, and furnishing of all incidentals. Table B-9 shows the estimate in unit cost per linear foot of pipe, with the historical data escalated using the CCI.

Table B-9
Historical Root Control Costs

Size	Source Unit Cost/LF	Year	2003 Unit Cost/LF (CCI)	Source
All	$2.00	1982	$3.50	5
	$2.00	1988	$2.96	8
	$1.40	1989	$2.03	9
	$2.00	2000	$2.15	20
	$2.25	2000	$2.42	20
	$2.75	2000	$2.96	20
Avg.			**$2.67**	

B.1.5 Historical References

Shown on each spreadsheet is a reference code to the source of individual unit prices. Table B-10 shows the references used for the historical estimates in Appendices A and B.

Table B-10
Historical References

Source	Title	Date
1	Unidentified CDM Documents	1985
2	Beaconsfield Relief Sewer Cleaning, Manholes Inspection for South Macomb Sanitary District	1999
3	SOCSDS Project Plan	1998
4	Cost Effective Analysis	1998
5	Grosse Pointe Infrastructure	1982
6	City of Rochester Hills / SDA	1999
7	HRC Detailed Cost Estimates	1997
8	Beverly Hills Local Sewer Study / Rehabilitation Program	1988
9	Unidentified CDM Documents	1989
10	Unidentified Construction Cost Estimate	
11	South Macomb Sanitary District	1999
12	City of Rochester Hills Sanitary Sewer Evaluation Survey	1996
13	South Macomb Sanitary District, Appendix J	1996
14	Clinton-Oakland Sewage Disposal System	1971
15	City of Hazel Park, MI	
16	Farmington, MI, Sewer Seperation / Improvements	1990
17	Basic Requirements Report Evergreen-Farmington Relief	1985
18	Cost Estimate	1975
19	Pre-Rehabilitation Local Sewer Costs	1990
20	Ann Arbor SSO Prevention Task Force	2000

B.1.6 Means and Manufacturers' Estimates

The calculation of construction costs using the R.W. Means methodology requires prices for component materials and construction activities (i.e. excavation or backfilling). The following table presents the component costs used in the development of construction cost guidelines.

Table B-11
Component Costs for Means and Manufacturers' Estimates

Item	Size	Description	Unit Cost	Units	Source
Excavation		Excavation, common earth, hauling away fill up to 4 mi.	$15.49	CY	Means
Backfill		Common earth, front-end loader, Compaction 12" lifts	$8.82	CY	Means
Select Fill		Crushed bank run gravel, compaction 6" lifts	$26.50	CY	Means
Sheeting	8' Deep	Wood solid sheeting incl. Wales, braces and spacers. Drive & Extract	$6.68	SF	Means
	16' Deep	Wood solid sheeting incl. Wales, braces and spacers. Drive & Extract	$8.76	SF	Means
	24' Deep	Wood solid sheeting incl. Wales, braces and spacers. Drive & Extract	$10.74	SF	Means
	32" Deep	Wood solid sheeting incl. Wales, braces and spacers. Drive & Extract	$11.99	SF	Means
Pavement Removal		Bituminous 4" to 6" thick	$5.72	SY	Means
Saw Cutting		Asphalt 6" thick	$2.81	LF	Means
Pavement Replacement		Over Trench 6" thick	$43.33	SY	Means
Non-Reinforced Concrete Pipe	8"	Bell and Spigot Joints, Extra strength	$12.31	LF	Means
	10"	Bell and Spigot Joints, Extra strength	$13.05	LF	Means
	12"	Bell and Spigot Joints, Extra strength	$14.80	LF	Means
Reinforced Concrete Pipe	12"	Class 3, B&S or T&G Joints, w/gaskets	$18.90	LF	Means
	15"	Class 3, B&S or T&G Joints, w/gaskets	$21.67	LF	Means
	18"	Class 3, B&S or T&G Joints, w/gaskets	$25.36	LF	Means

Item	Size	Description	Unit Cost	Units	Source
Reinforced Concrete Pipe	21"	Class 3, B&S or T&G Joints, w/o gaskets	$31.35	LF	Means
	24"	Class 3, B&S or T&G Joints, w/gaskets	$35.04	LF	Means
	27"	Class 3, B&S or T&G Joints, w/o gaskets	$53.02	LF	Means
	30"	Class 3, B&S or T&G Joints, w/gaskets	$65.92	LF	Means
	36"	Class 3, B&S or T&G Joints, w/gaskets	$89.90	LF	Means
	42"	Class 3, B&S or T&G Joints, w/o gaskets	$92.20	LF	Means
	48"	Class 3, B&S or T&G Joints, w/gaskets	$131.85	LF	Means
	54"	Class 3, B&S or T&G Joints, w/gaskets	$148.45	LF	Means
	60"	Class 3, B&S or T&G Joints, w/o gaskets	$165.04	LF	Means
	66"	Class 3, B&S or T&G Joints, w/o gaskets	$230.04	LF	Means
	72"	Class 3, B&S or T&G Joints, w/gaskets	$295.04	LF	Means
	78"	Class 3, B&S or T&G Joints, w/o gaskets	$325.00	LF	Means
	84"	Class 3, B&S or T&G Joints, w/o gaskets	$354.97	LF	Means
	96"	Class 3, B&S or T&G Joints, w/gaskets	$437.95	LF	Means
	102"	Class 3, B&S or T&G Joints, w/o gaskets	$460.00	LF	Means
	108"	Class 3, B&S or T&G Joints, w/o gaskets	$483.00	LF	Means
	120"	Class 3, B&S or T&G Joints, w/o gaskets	$530.00	LF	Means

Item	Size	Description	Unit Cost	Units	Source
Ductile Iron Pipe	4"	Class 50, Cement Lined, Mech. Joint	$19.82	LF	Means
	6"	Class 50, Cement Lined, Mech. Joint	$23.05	LF	Means
	8"	Class 50, Cement Lined, Mech. Joint	$28.12	LF	Means
	10"	Class 50, Cement Lined, Mech. Joint	$34.58	LF	Means
	12"	Class 50, Cement Lined, Mech. Joint	$41.03	LF	Means
	14"	Class 50, Cement Lined, Mech. Joint	$46.56	LF	Means
	16"	Class 50, Cement Lined, Mech. Joint	$56.70	LF	Means
	18"	Class 50, Cement Lined, Mech. Joint	$67.31	LF	Means
	20"	Class 50, Cement Lined, Mech. Joint	$77.45	LF	Means
	24"	Class 50, Cement Lined, Mech. Joint	$99.58	LF	Means
	48"	Class 50, Cement Lined, Mech. Joint	$232.34	LF	Est.
PVC Pipe (SDR35)	6"	SDR 35, B&S	$5.12	LF	Means
	6"	SDR 35, B&S 45 Degree Bend	$73.76	LF	Means
HDPEPipe for Sliplining	4"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$4.42	LF	Manufact.
	6"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$9.58	LF	Manufact.
	8"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$16.23	LF	Manufact.
	10"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$25.21	LF	Manufact.
	12"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$35.47	LF	Manufact.

Item	Size	Description	Unit Cost	Units	Source
HDPEPipe for Sliplining	14"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$42.76	LF	Manufact.
	16"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$55.86	LF	Manufact.
	18"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$70.69	LF	Manufact.
	20"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$87.28	LF	Manufact.
	22"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$105.60	LF	Manufact.
	24"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$125.67	LF	Manufact.
	26"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$147.49	LF	Manufact.
	28"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$171.06	LF	Manufact.
	30"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$196.37	LF	Manufact.
	32"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$223.42	LF	Manufact.
	36"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$282.77	LF	Manufact.
	42"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$384.88	LF	Manufact.
	48"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$502.70	LF	Manufact.
	52"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$578.69	LF	Manufact.
	54"	HDPE Pipe, PE3408, DR21 (80 psi), price installed.	$636.23	LF	Manufact.
Manholes	4' Dia.	Precast Concrete, not incl. Excav, backfill, frame, cover, sheeting	$179.79	VLF	Means
	5' Dia.	Precast Concrete, not incl. Excav, backfill, frame, cover, sheeting	$188.09	VLF	Means

Item	Size	Description	Unit Cost	Units	Source
Manholes	6' Dia.	Precast Concrete, not incl. Excav, backfill, frame, cover, sheeting	$285.82	VLF	Means
	7' Dia.	Precast Concrete, not incl. Excav, backfill, frame, cover, sheeting	$383.55	VLF	Means
	8' Dia.	Precast Concrete, not incl. Excav, backfill, frame, cover, sheeting	$481.28	VLF	Means

B.1.7 Mean's Unit Cost Estimates

Table B-12 contains a sample estimating sheet for calculating each component cost using the material and labor costs identified in the previous section.

Table B-12
Sample Component Costs Estimator

Quick Sewer Estimator

Force Mains

Dimensions

Pipe Size	14 in.		
Trench Width	4 Ft.	not less than	3.2
Trench Depth	6 Ft.		
Length	1 Ft.		

Material Costs

Pipe Cost/LF	66	$/LF
Excav. Cost/CY	13	$/CY
Backfill Cost/ CY	10	$/CY
Select Fill Cost/CY	12	$/CY
Pavament Demo.Cost / SY	7	$/SY
New Pavement Cost / SY	29	$/SY
Saw Cut Per LF	4	$/LF
Sheeting Cost / SF *	0	$/SF

* May not be required for excavations under 5' deep

Pavement	A (sy)=	0.44		
Vexcav (cy) =	Vbfill (cy) =			
0.89		0.49		Hbfill (ft)
Sheeting (sf)	Common Fill			3.33333
12				
	Vsfill (cy) =			
		0.36		Hsfill (ft)
	Select Fill			2.66667
	W (ft) =	4		

Total Costs

Pipe	$66.00	
Excav.	$6.22	
Backfill	$4.94	
Select Fill	$4.27	
Pavement Demo	$3.11	
New Pavement	$12.89	
Saw Cut	$8.00	
Sheeting Cost	$0.00	
Total Price	$105.43	
Price Per Foot	$105.43	/LF

Appendix C:
Unit Costs for Treatment Facilities

Appendix C – Unit Costs for Treatment Facilities

The following tables outline the unit costs for treatment facilities derived from project cost estimates. These unit costs are provided for future estimating of these facilities and are the total cost X 1,000. They are base construction costs only and do not include engineering fees, allowances or contingencies.

Table C-1
Influent Pump Station Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
39.4	mgd	$1,960	$2,320	$2,820	$3,320	$3,820	$4,320
40.0	mgd	$3,810	$4,520	$5,490	$6,460	$7,430	$8,400
49.1	mgd	$2,060	$2,440	$2,970	$3,490	$4,010	$4,530
61.5	mgd	$2,510	$2,980	$3,620	$4,260	$4,900	$5,540
61.5	mgd	$2,510	$2,980	$3,620	$4,260	$4,900	$5,540
61.5	mgd	$3,050	$3,620	$4,400	$5,180	$5,960	$6,740
61.9	mgd	$3,150	$3,740	$4,550	$5,350	$6,150	$6,950
86.0	mgd	$4,440	$5,270	$6,410	$7,540	$8,670	$9,800
104.0	mgd	$5,940	$7,040	$8,560	$10,070	$11,580	$13,090
108.0	mgd	$3,790	$4,490	$5,460	$6,420	$7,380	$8,340
113.0	mgd	$6,090	$7,220	$8,780	$10,330	$11,880	$13,420
126.0	mgd	$4,510	$5,350	$6,500	$7,650	$8,800	$9,940
158.0	mgd	$6,020	$7,140	$8,680	$10,210	$11,740	$13,270
189.0	mgd	$6,350	$7,530	$9,150	$10,770	$12,390	$14,000
253.5	mgd	$7,030	$8,340	$10,140	$11,930	$13,720	$15,500
310.5	mgd	$7,030	$8,340	$10,140	$11,930	$13,720	$15,500

Table C-2
Screening and Grit Chamber Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.6	mgd	$1,530	$1,810	$2,200	$2,590	$2,980	$3,370
14.3	mgd	$2,030	$2,410	$2,930	$3,450	$3,970	$4,490
21.6	mgd	$2,210	$2,620	$3,180	$3,740	$4,300	$4,860
22.1	mgd	$3,490	$4,140	$5,030	$5,920	$6,810	$7,700
22.6	mgd	$3,490	$4,140	$5,030	$5,920	$6,810	$7,700
32.2	mgd	$4,500	$5,340	$6,490	$7,640	$8,790	$9,930
32.2	mgd	$4,500	$5,340	$6,490	$7,640	$8,790	$9,930
36.8	mgd	$3,240	$3,840	$4,670	$5,490	$6,320	$7,140
40.9	mgd	$3,700	$4,390	$5,340	$6,280	$7,220	$8,160
47.1	mgd	$6,190	$7,340	$8,920	$10,500	$12,080	$13,650
47.1	mgd	$5,940	$7,040	$8,560	$10,070	$11,580	$13,090
55.4	mgd	$4,520	$5,360	$6,510	$7,660	$8,810	$9,960
57.6	mgd	$5,190	$6,160	$7,490	$8,810	$10,130	$11,450
63.6	mgd	$5,600	$6,640	$8,070	$9,500	$10,930	$12,350
100.0	mgd	$9,770	$11,590	$14,090	$16,580	$19,070	$21,550
125.0	mgd	$11,300	$13,400	$16,290	$19,170	$22,050	$24,920

Table C-3
Aeration Basin with Nitrification Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.3	mgd	$10,400	$12,330	$14,990	$17,640	$20,290	$22,930
14.0	mgd	$11,200	$13,280	$16,140	$18,990	$21,840	$24,680
21.1	mgd	$17,300	$20,520	$24,940	$29,350	$33,760	$38,150
21.1	mgd	$17,300	$20,520	$24,940	$29,350	$33,760	$38,150
21.1	mgd	$16,000	$18,980	$23,070	$27,150	$31,230	$35,290
30.8	mgd	$22,600	$26,800	$32,570	$38,320	$44,080	$49,810
30.8	mgd	$22,600	$26,800	$32,570	$38,320	$44,080	$49,810
35.9	mgd	$24,200	$28,700	$34,880	$41,040	$47,210	$53,350
40.0	mgd	$22,600	$26,800	$32,570	$38,320	$44,080	$49,810
45.0	mgd	$32,300	$38,310	$46,560	$54,780	$63,010	$71,200
45.0	mgd	$31,800	$37,710	$45,830	$53,930	$62,040	$70,110
54.0	mgd	$35,300	$41,860	$50,880	$59,870	$68,870	$77,830
56.3	mgd	$36,800	$43,640	$53,040	$62,410	$71,790	$81,130
62.2	mgd	$39,300	$46,610	$56,650	$66,660	$76,680	$86,650

Table C-4
Primary Clarifiers Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.6	mgd	$1,530	$1,810	$2,200	$2,590	$2,980	$3,370
14.3	mgd	$2,030	$2,410	$2,930	$3,450	$3,970	$4,490
21.6	mgd	$2,210	$2,620	$3,180	$3,740	$4,300	$4,860
22.1	mgd	$3,490	$4,140	$5,030	$5,920	$6,810	$7,700
22.6	mgd	$3,490	$4,140	$5,030	$5,920	$6,810	$7,700
32.2	mgd	$4,500	$5,340	$6,490	$7,640	$8,790	$9,930
32.2	mgd	$4,500	$5,340	$6,490	$7,640	$8,790	$9,930
36.8	mgd	$3,240	$3,840	$4,670	$5,490	$6,320	$7,140
40.9	mgd	$3,700	$4,390	$5,340	$6,280	$7,220	$8,160
47.1	mgd	$6,190	$7,340	$8,920	$10,500	$12,080	$13,650
47.1	mgd	$5,940	$7,040	$8,560	$10,070	$11,580	$13,090
55.4	mgd	$4,520	$5,360	$6,510	$7,660	$8,810	$9,960
57.6	mgd	$5,190	$6,160	$7,490	$8,810	$10,130	$11,450
63.6	mgd	$5,600	$6,640	$8,070	$9,500	$10,930	$12,350
100.0	mgd	$9,770	$11,590	$14,090	$16,580	$19,070	$21,550
125.0	mgd	$11,300	$13,400	$16,290	$19,170	$22,050	$24,920

Table C-5
Complete Mix Activated Sludge Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
100	mgd	$21,800	$25,850	$31,420	$36,970	$42,530	$48,060
125	mgd	$25,300	$30,000	$36,460	$42,900	$49,350	$55,770

Table C-6
Iron Feed System Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.3	mgd	$152	$180	$220	$260	$300	$340
14.0	mgd	$152	$180	$220	$260	$300	$340
21.1	mgd	$152	$180	$220	$260	$300	$340
21.1	mgd	$152	$180	$220	$260	$300	$340
21.1	mgd	$152	$180	$220	$260	$300	$340
30.8	mgd	$156	$190	$230	$270	$310	$350
30.8	mgd	$156	$190	$230	$270	$310	$350
35.9	mgd	$175	$210	$260	$310	$360	$410
40.0	mgd	$164	$190	$230	$270	$310	$350
45.0	mgd	$182	$220	$270	$320	$370	$420
45.0	mgd	$182	$220	$270	$320	$370	$420
54.0	mgd	$208	$250	$300	$350	$400	$450
56.3	mgd	$189	$220	$270	$320	$370	$420
62.2	mgd	$197	$230	$280	$330	$380	$430
100.0	mgd	$205	$240	$290	$340	$390	$440
125.0	mgd	$225	$270	$330	$390	$450	$510

Table C-7
Coagulation-Flocculation Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
100	mgd	$19,700	$23,360	$28,390	$33,410	$38,430	$43,430
125	mgd	$24,100	$28,580	$34,740	$40,880	$47,020	$53,130

Table C-8
Secondary Clarifiers Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.3	mgd	$3,050	$3,620	$4,400	$5,180	$5,960	$6,740
14.0	mgd	$3,800	$4,510	$5,480	$6,450	$7,420	$8,380
21.1	mgd	$4,430	$5,250	$6,380	$7,510	$8,640	$9,760
21.1	mgd	$4,430	$5,250	$6,380	$7,510	$8,640	$9,760
21.1	mgd	$4,870	$5,780	$7,030	$8,270	$9,510	$10,750
30.8	mgd	$5,800	$6,880	$8,360	$9,840	$11,320	$12,790
30.8	mgd	$5,800	$6,880	$8,360	$9,840	$11,320	$12,790
35.9	mgd	$7,120	$8,440	$10,260	$12,070	$13,880	$15,680
40.0	mgd	$6,280	$7,450	$9,050	$10,650	$12,250	$13,840
45.0	mgd	$8,070	$9,570	$11,630	$13,680	$15,740	$17,790
45.0	mgd	$8,070	$9,570	$11,630	$13,680	$15,740	$17,790
54.0	mgd	$10,400	$12,330	$14,990	$17,640	$20,290	$22,930
56.3	mgd	$11,500	$13,640	$16,580	$19,510	$22,440	$25,360
62.2	mgd	$12,400	$14,710	$17,880	$21,040	$24,200	$27,350
100.0	mgd	$13,700	$16,250	$19,750	$23,240	$26,730	$30,210
125.0	mgd	$15,200	$18,030	$21,910	$25,780	$29,650	$33,510

Table C-9
Intermediate Pumping Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
25.3	mgd	$734	$870	$1,060	$1,250	$1,440	$1,630
35.0	mgd	$1,060	$1,260	$1,530	$1,800	$2,070	$2,340
40.0	mgd	$1,220	$1,450	$1,760	$2,070	$2,380	$2,690
44.6	mgd	$1,380	$1,640	$1,990	$2,340	$2,690	$3,040
45.2	mgd	$1,410	$1,670	$2,030	$2,390	$2,750	$3,110
52.9	mgd	$1,680	$1,990	$2,420	$2,850	$3,280	$3,710
61.1	mgd	$1,680	$1,990	$2,420	$2,850	$3,280	$3,710
66.9	mgd	$1,860	$2,210	$2,690	$3,170	$3,650	$4,120
74.3	mgd	$2,090	$2,480	$3,010	$3,540	$4,070	$4,600
84.9	mgd	$2,430	$2,880	$3,500	$4,120	$4,740	$5,360
94.2	mgd	$2,470	$2,930	$3,560	$4,190	$4,820	$5,450
104.0	mgd	$2,770	$3,290	$4,000	$4,710	$5,420	$6,120
105.0	mgd	$2,810	$3,330	$4,050	$4,770	$5,490	$6,200
113.0	mgd	$3,040	$3,610	$4,390	$5,170	$5,950	$6,720

Table C-10
Filtration Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.3	mgd	$3,930	$4,660	$5,660	$6,660	$7,660	$8,660
14.0	mgd	$5,040	$5,980	$7,270	$8,550	$9,830	$11,110
21.1	mgd	$6,210	$7,360	$8,950	$10,530	$12,110	$13,680
21.1	mgd	$6,220	$7,380	$8,970	$10,550	$12,140	$13,720
30.8	mgd	$7,900	$9,370	$11,390	$13,400	$15,410	$17,410
35.9	mgd	$8,440	$10,010	$12,170	$14,320	$16,470	$18,610
40.0	mgd	$9,190	$10,900	$13,250	$15,590	$17,930	$20,260
45.0	mgd	$10,400	$12,330	$14,990	$17,640	$20,290	$22,930
54.0	mgd	$11,800	$13,990	$17,000	$20,000	$23,010	$26,000
56.3	mgd	$12,200	$14,470	$17,590	$20,700	$23,810	$26,910
62.2	mgd	$13,500	$16,010	$19,460	$22,900	$26,340	$29,770

Table C-11
Ultraviolet Disinfection Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
25.9	mgd	$912	$1,080	$1,310	$1,540	$1,770	$2,000
35.1	mgd	$1,280	$1,520	$1,850	$2,180	$2,510	$2,840
40.0	mgd	$1,530	$1,810	$2,200	$2,590	$2,980	$3,370
45.2	mgd	$2,040	$2,420	$2,940	$3,460	$3,980	$4,500
45.2	mgd	$3,310	$3,930	$4,780	$5,620	$6,460	$7,300
45.2	mgd	$1,750	$2,080	$2,530	$2,980	$3,430	$3,880
61.9	mgd	$1,750	$2,080	$2,530	$2,980	$3,430	$3,880
61.9	mgd	$2,280	$2,700	$3,280	$3,860	$4,440	$5,020
67.9	mgd	$2,550	$3,020	$3,670	$4,320	$4,970	$5,620
86.0	mgd	$3,830	$4,540	$5,520	$6,500	$7,480	$8,450
86.0	mgd	$3,060	$3,630	$4,410	$5,190	$5,970	$6,750
95.6	mgd	$3,400	$4,030	$4,900	$5,770	$6,640	$7,500
103.6	mgd	$3,830	$4,540	$5,520	$6,500	$7,480	$8,450
112.6	mgd	$4,100	$4,860	$5,910	$6,950	$7,990	$9,030
175.0	mgd	$8,270	$9,810	$11,920	$14,030	$16,140	$18,240
200.0	mgd	$8,620	$10,220	$12,420	$14,610	$16,810	$19,000

Table C-12
Post Aeration Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.3	mgd	$114	$140	$170	$200	$230	$260
14.0	mgd	$134	$160	$190	$220	$250	$280
21.1	mgd	$142	$170	$210	$250	$290	$330
21.1	mgd	$142	$170	$210	$250	$290	$330
21.1	mgd	$167	$200	$240	$280	$320	$360
30.8	mgd	$182	$220	$270	$320	$370	$420
30.8	mgd	$182	$220	$270	$320	$370	$420
35.9	mgd	$260	$310	$380	$450	$520	$590
40.0	mgd	$273	$320	$390	$460	$530	$600
45.0	mgd	$237	$280	$340	$400	$460	$520
45.0	mgd	$237	$280	$340	$400	$460	$520
54.0	mgd	$363	$430	$520	$610	$700	$790
56.3	mgd	$358	$420	$510	$600	$690	$780
62.2	mgd	$388	$460	$560	$660	$760	$860
100.0	mgd	$455	$540	$660	$780	$900	$1,020
125.0	mgd	$554	$660	$800	$940	$1,080	$1,220

Table C-13
Blower System Unit Cost

Capacity	2000	2010	2020	2030	2040	2050
17.0 mgd	$718	$850	$1,030	$1,210	$1,390	$1,570
21.0 mgd	$786	$930	$1,130	$1,330	$1,530	$1,730
31.7 mgd	$1,120	$1,330	$1,620	$1,910	$2,200	$2,490
31.7 mgd	$1,120	$1,330	$1,620	$1,910	$2,200	$2,490
31.7 mgd	$1,060	$1,260	$1,530	$1,800	$2,070	$2,340
46.2 mgd	$7,440	$8,820	$10,720	$12,610	$14,510	$16,400
46.2 mgd	$7,440	$8,820	$10,720	$12,610	$14,510	$16,400
53.9 mgd	$7,440	$8,820	$10,720	$12,610	$14,510	$16,400
60.0 mgd	$6,430	$7,630	$9,270	$10,910	$12,550	$14,180
67.5 mgd	$8,920	$10,580	$12,860	$15,130	$17,400	$19,660
67.5 mgd	$8,840	$10,480	$12,740	$14,990	$17,240	$19,480
81.0 mgd	$8,950	$10,610	$12,900	$15,180	$17,460	$19,730
84.5 mgd	$8,600	$10,200	$12,400	$14,590	$16,780	$18,960
93.3 mgd	$8,950	$10,610	$12,900	$15,180	$17,460	$19,730
150.0 mgd	$6,370	$7,550	$9,180	$10,800	$12,420	$14,040
187.5 mgd	$7,670	$9,100	$11,060	$13,010	$14,970	$16,920

Table C-14
Gravity Thickening Unit Cost

Capacity	2000	2010	2020	2030	2040	2050
11.3 mgd	$278	$330	$400	$470	$540	$610
14.0 mgd	$319	$380	$460	$540	$620	$700
21.1 mgd	$693	$820	$1,000	$1,180	$1,360	$1,540
21.1 mgd	$555	$660	$800	$940	$1,080	$1,220
21.1 mgd	$396	$470	$570	$670	$770	$870
30.8 mgd	$708	$840	$1,020	$1,200	$1,380	$1,560
30.8 mgd	$723	$860	$1,050	$1,240	$1,430	$1,620
35.9 mgd	$609	$720	$880	$1,040	$1,200	$1,360
40.0 mgd	$581	$690	$840	$990	$1,140	$1,290
45.0 mgd	$927	$1,100	$1,340	$1,580	$1,820	$2,060
45.0 mgd	$944	$1,120	$1,360	$1,600	$1,840	$2,080
54.0 mgd	$830	$980	$1,190	$1,400	$1,610	$1,820
56.3 mgd	$768	$910	$1,110	$1,310	$1,510	$1,710
62.2 mgd	$830	$980	$1,190	$1,400	$1,610	$1,820
100.0 mgd	$723	$860	$1,050	$1,240	$1,430	$1,620
125.0 mgd	$845	$1,000	$1,220	$1,440	$1,660	$1,880

Table C-15
Centrifugation Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.3	mgd	$2,050	$2,430	$2,950	$3,470	$3,990	$4,510
14	mgd	$2,440	$2,890	$3,510	$4,130	$4,750	$5,370
21.1	mgd	$2,930	$3,470	$4,220	$4,970	$5,720	$6,460
21.1	mgd	$2,220	$2,630	$3,200	$3,770	$4,340	$4,900
21.1	mgd	$4,160	$4,930	$5,990	$7,050	$8,110	$9,160
30.8	mgd	$2,990	$3,550	$4,310	$5,070	$5,830	$6,590
30.8	mgd	$3,040	$3,610	$4,390	$5,170	$5,950	$6,720
35.9	mgd	$6,200	$7,350	$8,930	$10,510	$12,090	$13,660
40	mgd	$6,150	$7,290	$8,860	$10,430	$12,000	$13,560
45	mgd	$4,420	$5,240	$6,370	$7,500	$8,630	$9,750
45	mgd	$4,500	$5,340	$6,490	$7,640	$8,790	$9,930
54	mgd	$9,210	$10,920	$13,270	$15,610	$17,960	$20,300
56.3	mgd	$10,700	$12,690	$15,420	$18,140	$20,870	$23,580
62.2	mgd	$11,900	$14,110	$17,150	$20,180	$23,210	$26,230
100	mgd	$15,000	$17,790	$21,620	$25,440	$29,260	$33,060
125	mgd	$17,900	$21,230	$25,800	$30,360	$34,920	$39,460

Table C-16
Hauling and Landfilling Unit Cost

Capacity		2000	2010	2020	2030	2040	2050
11.3	mgd	$438	$520	$630	$740	$850	$960
14.0	mgd	$546	$650	$790	$930	$1,070	$1,210
21.1	mgd	$1,060	$1,260	$1,530	$1,800	$2,070	$2,340
21.1	mgd	$788	$930	$1,130	$1,330	$1,530	$1,730
21.1	mgd	$810	$960	$1,170	$1,380	$1,590	$1,800
30.8	mgd	$1,090	$1,290	$1,570	$1,850	$2,130	$2,410
30.8	mgd	$1,100	$1,300	$1,580	$1,860	$2,140	$2,420
35.9	mgd	$1,400	$1,660	$2,020	$2,380	$2,740	$3,100
40.0	mgd	$1,370	$1,620	$1,970	$2,320	$2,670	$3,020
45.0	mgd	$1,530	$1,810	$2,200	$2,590	$2,980	$3,370
45.0	mgd	$1,560	$1,850	$2,250	$2,650	$3,050	$3,450
54.0	mgd	$2,150	$2,550	$3,100	$3,650	$4,200	$4,750
56.3	mgd	$2,030	$2,410	$2,930	$3,450	$3,970	$4,490
62.2	mgd	$2,220	$2,630	$3,200	$3,770	$4,340	$4,900
100.0	mgd	$2,360	$2,800	$3,400	$4,000	$4,600	$5,200
125.0	mgd	$2,950	$3,500	$4,250	$5,000	$5,750	$6,500