

CITY OF CLOVIS, CALIFORNIA

SE CLOVIS SEWAGE TREATMENT -
WATER REUSE FACILITY

WASTEWATER SYSTEM INFRASTRUCTURE
COST COMPARISON ANALYSIS FOR
THREE ALTERNATIVE SITES

MARCH 10, 2004

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1. SUMMARY AND FINDINGS

A cost comparison analysis was performed for wastewater system infrastructure necessary for three alternative Sewage Treatment – Water Reuse Facility (ST-WRF) sites.

These sites, identified as SC (for South Central), SE (for South East) and E (for East) are shown on Figure 1-1.

The Clovis Wastewater Collection System Master Plan, currently in draft form, was modified to integrate the specific location of each of the alternative ST-WRF sites. A separate plan was developed for each alternative. Criteria for the master planning effort and alternative models are presented in Section 3. Criteria set forth for development of the alternatives dictated that where the location of an alternate ST-WRF site would require trunk sewers or collector sewers to be constructed at depths significantly exceeding 25 feet over significant distances, pumping facilities were to be included in the plan to minimize construction at excessive depths. Consequently, Alternative E included an influent pump station remote from ST-WRF Site E, interconnected by 30-inch diameter force main.

Included in the comparison analysis were the costs of construction, and the annual costs of operations, maintenance and replacement (O,M&R) of the constructed facilities, through year 2030. A present value analysis was performed to determine the comparative cost, in 2004 dollars, of the three alternatives.

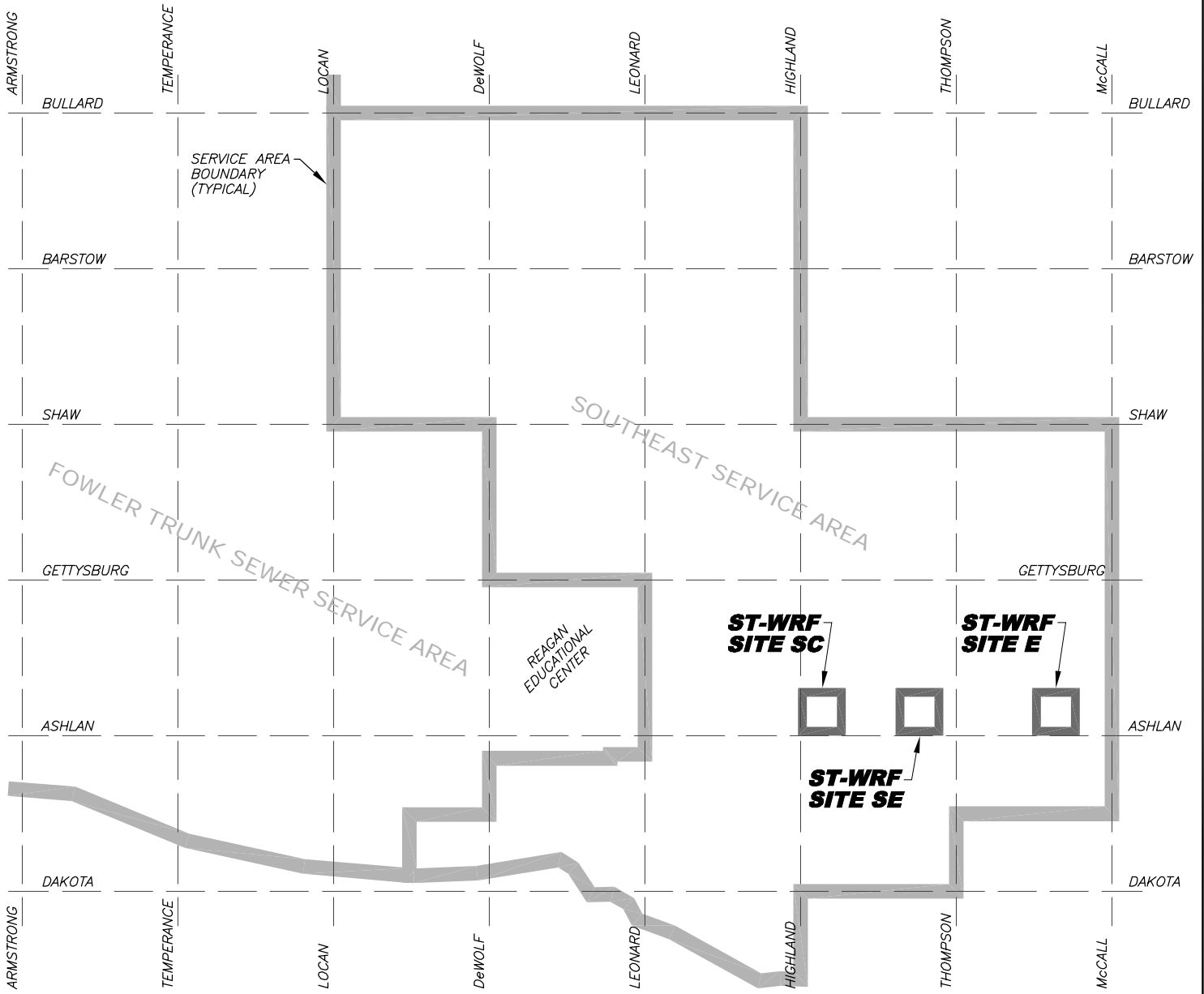
The results of the cost comparison analysis are summarized in Table 1-1 below.

	ALTERNATIVE SC	ALTERNATIVE SE	ALTERNATIVE E
TOTAL ESTIMATED COST (2004 \$)	\$89,485,000	\$90,577,000	\$91,127,000
DIFFERENCE FROM BASE ALTERNATIVE SC (2004 \$)	\$0	+\$1,092,000	+\$1,642,000
DIFFERENCE FROM BASE ALTERNATIVE SC (%)	0.0%	+ 1.2%	+ 1.8%

The estimates of construction cost for each alternative include the cost of trunk sewers and minor lift stations, pump stations and force mains, and the ST-WRF's. The estimated costs of the ST-WRF's were extracted from the City of Clovis Wastewater Master Plan Update, Phase 1-B, November 20, 1996. These costs were then adjusted for inflation and for any differences in influent pump station configuration (integrated with ST-WRF or remote).

Summaries of the various elements of the cost comparison estimates and the present value cost analysis are located in Sections 4, 5 and 6.

FIGURE 1-1
ALTERNATIVE ST-WRF SITES



0 0.5 MILE

The study took into consideration the major sewer infrastructure facilities necessary for implementation of the alternatives. This also included facilities necessary to provide potential interim service to development that might occur prior to the construction of the ST-WRF, and those facilities required to divert a quantity of flow from the Fowler Trunk Sewer to the ST-WRF at startup of the facility. Probable phases of construction and implementation were developed.

The figures listed below and found in Appendix A provide schematic flow diagrams for the contemplated implementation stages for each alternative, as follows:

ALTERNATIVE SC	
Figure SC-1	Stage 1: Potential Interim Service Prior to ST-WRF Startup
Figure SC-2	Stage 2: Flow Diversion from Fowler Trunk Sewer to ST-WRF at Startup
Figure SC-3	Stage 3: Flow Diversion from Fowler Trunk Sewer to ST-WRF No Longer Needed
ALTERNATIVE SE	
Figure SE-1	Stage 1: Potential Interim Service Prior to ST-WRF Startup
Figure SE-2	Stage 2: Flow Diversion from Fowler Trunk Sewer to ST-WRF at Startup
Figure SE-3	Stage 3: Flow Diversion from Fowler Trunk Sewer to ST-WRF No Longer Needed
ALTERNATIVE E	
Figure E-1	Stage 1: Potential Interim Service Prior to ST-WRF Startup
Figure E-2	Stage 2: Flow Diversion from Fowler Trunk Sewer to ST-WRF at Startup
Figure E-3	Stage 3: Flow Diversion from Fowler Trunk Sewer to ST-WRF No Longer Needed

A number of system implementation and operational differences are described in Section 7.

2. BACKGROUND

Figure 2-1 depicts the Clovis Wastewater Collection System Master Plan service areas. Wastewater collection systems for the Southeast Service Area, generally bounded by Locan Avenue, Bullard Avenue, McCall Avenue and the Gould Canal (see Figure 2-1 for boundaries), together with the Northwest Service Area and future Northeast Service Area (not shown on Figure 2-1 and outside of the boundaries of the current Clovis Sphere of Influence), are planned to discharge to a Clovis Sewage Treatment – Water Reuse Facility to be located within the Southeast Service Area. Specific site locations have been narrowed down to three alternative sites, Site SC, Site SE and Site E, as shown on Figure 2-1 and Figure 2-2.







The purpose of this study is to estimate the differences in wastewater system infrastructure costs associated with each of the alternatives, and to identify any system implementation and/or operational differences which may not necessarily lend themselves to workable economic comparison.

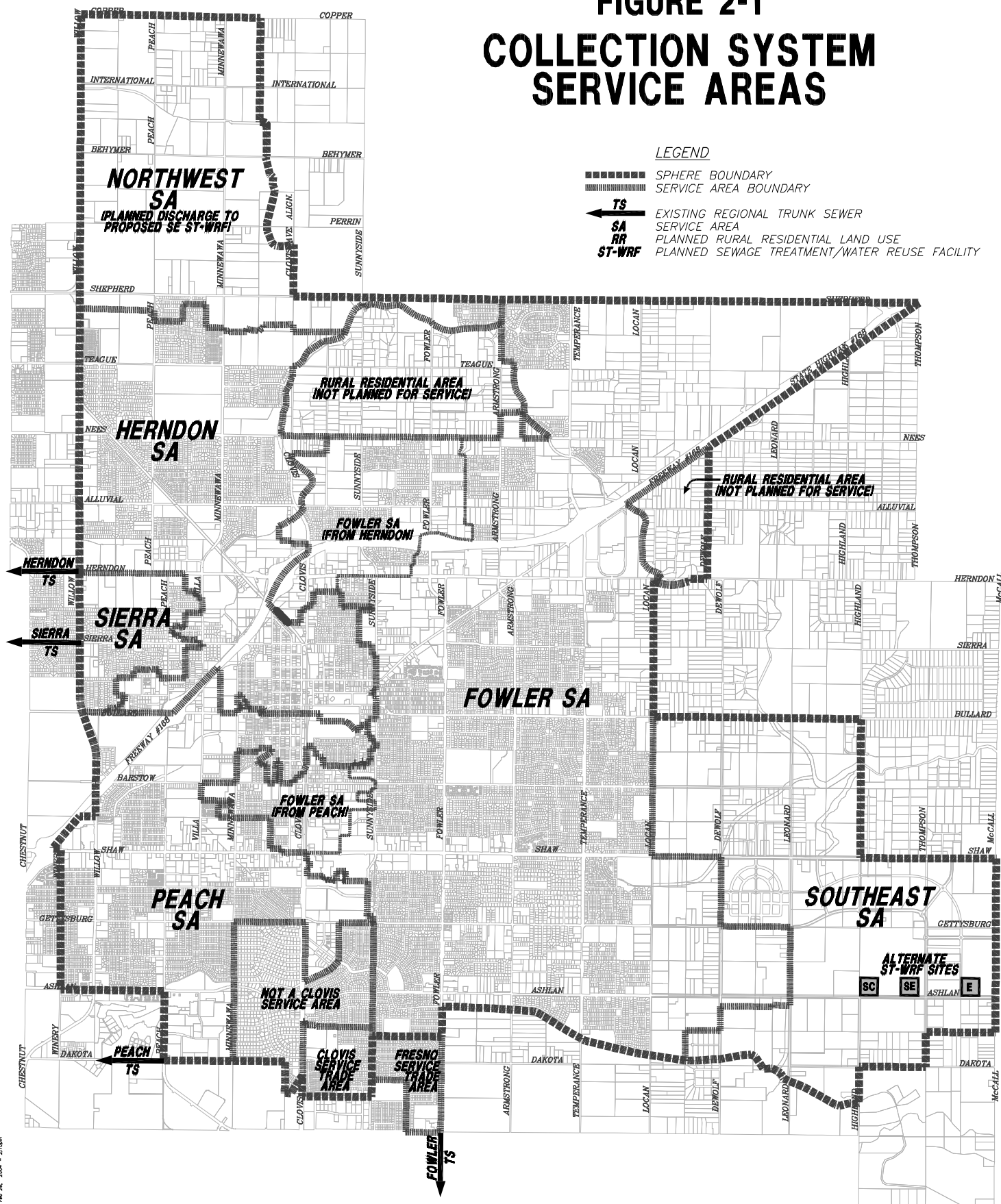
Malcolm Pirnie, Inc. assisted in the study by preparing conceptual plans and providing opinions of probable cost of pump stations and associated facilities. Malcolm Pirnie, Inc. also provided estimates of the annual cost of operations, maintenance and replacement of pump stations associated with the three alternatives studied.

CITY OF CLOVIS WASTEWATER COLLECTION SYSTEM MASTER PLAN

FIGURE 2-1 COLLECTION SYSTEM SERVICE AREAS

LEGEND

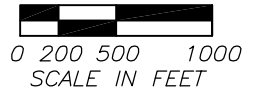
-  SPHERE BOUNDARY
-  SERVICE AREA BOUNDARY
-  EXISTING REGIONAL TRUNK SEWER
-  SERVICE AREA
-  PLANNED RURAL RESIDENTIAL LAND USE
-  PLANNED SEWAGE TREATMENT/WATER REUSE FACILITY



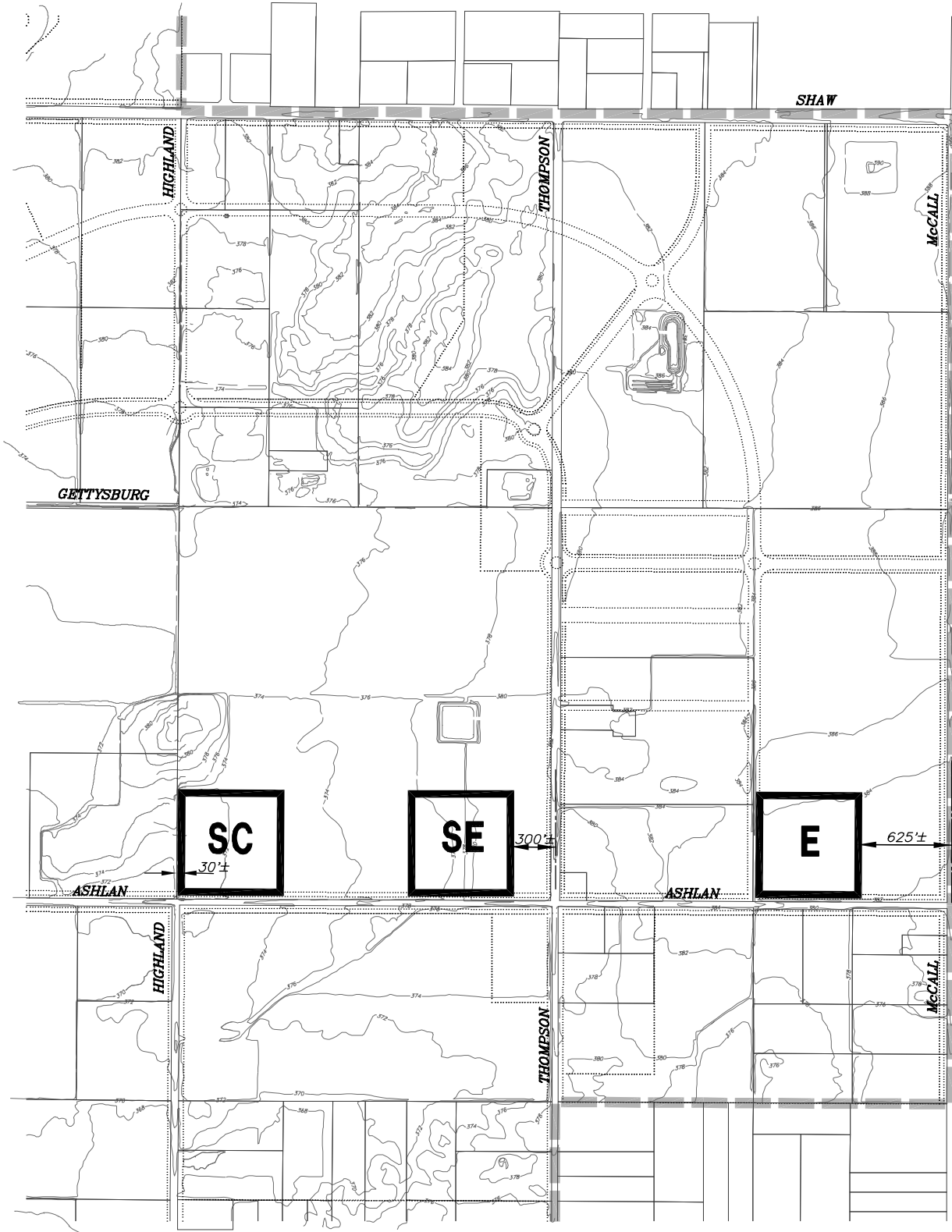
Drawn by J. J. Dwyer, City Engineer, on 07/12/01. Approved Report 002-012-09-2-1-049
 Date: 07/12/01. City of Clovis, 2001. All Rights Reserved.

FIGURE 2-2 ALTERNATE ST-WRF SITES

INDICATES
ALTERNATE
ST-WRF
SITE
LOCATION



NOTE: ALL SITES ARE 10 ACRES, 660' x 660'



3. DEVELOPMENT OF COLLECTION SYSTEM MASTER PLANS FOR ALTERNATE ST-WRF SITES

The Clovis Wastewater Collection System Master Plan, currently in draft form, was modified to integrate the specific location of each of the alternative ST-WRF sites. A separate plan was developed for each alternative. Criteria set forth for development of the alternatives dictated that where the location of an alternate ST-WRF site would require trunk sewers or collector sewers to be constructed at depths significantly exceeding 25 feet over significant distances, pumping facilities would be included in the plan to minimize construction at excessive depths.

3.1 GRAPHIC MODELS

Plates 1, 2, 3, 4 and 5 in Appendix B depict the alternate master plan configurations, as follows:

Plate 1	Same for all alternative plans
Plate 2	Same for all alternative plans
Plate 3	Alternate Plan SC
Plate 4	Alternate Plan SE
Plate 5	Alternate Plan E

In addition to the wastewater collection facilities which form a part of the Master Plan, interim and/or temporary pumping and force main facilities were also shown on the plates. These elements are included for the following purposes:

- To provide potential interim service for the SE Service Area prior to completion of construction of a ST-WRF. This requires a pump station within the Southeast Service Area with a force main connection to the Fowler Trunk Sewer.
- To provide assured initial inflow to the completed ST-WRF. This requires a pump station near the Fowler Trunk Sewer and a force main connection to the ST-WRF (the same force main can be used for much of the route as used for the interim service element).

3.2 FLOW GENERATION MODELS

The flow generation model for the Clovis Wastewater Collection System Master Plan was modified to incorporate the particular collection system configuration for each of the alternative ST-WRF sites. A separate model was developed for each alternative.

The flow generation model for each of the alternatives contains a calculated flow generation projection of 2.0639 million gallons per day (mgd), average daily flow, from the Northwest Service Area, together with a flow generation allowance (as determined by the City of Clovis Wastewater Master Plan Update, Phase 1-B, November 20, 1996) of 3.8160 mgd, average daily flow, from the future Northeast Growth Area. This allowance may need to be reduced in concert with future specific planning of the

Northeast Growth Area to result in a total projected inflow to the ST-WRF not exceeding its planned buildout design capacity of 8.40 mgd. Flow projections for the planned trunk sewer system have not been reduced in advance of specific planning for the Northwest Service Area and Northeast Growth Area.

Flow generation calculations are included in Appendix C, as follows:

ALL ALTERNATIVES	
Table FG-1	Wastewater Flow Generation Projection Criteria
ALTERNATIVE SC	
Table SC-FG-1	Flow Generation Model
Table SC-FG-2	Flow Generation Model
Table SC-FG-3	Flow Generation Model
ALTERNATIVE SE	
Table SE-FG-1	Flow Generation Model
Table SE-FG-2	Flow Generation Model
Table SE-FG-3	Flow Generation Model
ALTERNATIVE E	
Table E-FG-1	Flow Generation Model
Table E-FG-2	Flow Generation Model
Table E-FG-3	Flow Generation Model

3.3 HYDRAULIC MODELS

The hydraulic model for the Clovis Wastewater Collection System Master Plan was modified to incorporate the particular collection system configuration for each of the alternative ST-WRF sites. A separate model was developed for each alternative.

Design criteria for the Clovis Wastewater Collection System Master Plan are summarized below.

Manning’s Equation

All gravity flow pipeline hydraulic design is to be based upon Manning’s equation, with a roughness coefficient of 0.013.

Maximum Depth of Pipeline Flow

For analysis and design purposes, the maximum ratio of depth of peak design flow to diameter of pipeline, (d/D) , shall not exceed 0.82.

Peaking Factor

For design purposes, the ratio of peak flow capacity to average daily flow capacity shall be no less than that indicated in Table 3.3-1 below. The designated peaking factors result in maximum design ratios of depth of average design flow to diameter of pipeline (d/D) as indicated.

DIAMETER OF SEWER	MINIMUM PEAKING FACTOR	MAXIMUM d/D AT AVERAGE FLOW
6	2.50	0.44
8	2.00	0.50
10	2.00	0.50
12	2.00	0.50
15	1.71	0.55
18	1.71	0.55
21	1.71	0.55
24	1.71	0.55
27	1.71	0.55
30	1.71	0.55
33	1.71	0.55
36	1.71	0.55
39	1.71	0.55
42	1.71	0.55

Pipeline Slope

For design purposes, gravity flow pipeline slope shall be as indicated in Table 3.3-2 below.

DIAMETER OF SEWER	STANDARD SLOPE	MINIMUM SLOPE
6	0.0050	0.0040
8	0.0034	0.0024
10	0.0024	0.0020
12	0.0020	0.0014
15	0.0015	0.0012
18	0.0011	0.0010
21	0.0010	0.0010
24	0.0010	0.0010
27	0.0010	0.0010
30	0.0010	0.0010
33	0.0010	0.0010
36	0.0010	0.0010
39	0.0010	0.0010
42	0.0010	0.0010

Steeper pipeline slopes shall be used wherever feasible, subject to pipeline depth and other considerations. Flatter pipeline slopes on the larger diameter sewers may be considered on a case by case basis.

Pipeline Depth

The target minimum depth from the existing ground surface to the invert elevation of gravity sewers at the shallowest locations shall be no less than 6 feet. This may not be possible in some locations where the depth of existing sewers, or the local topography, do not allow this minimum depth.

The target maximum depth from the existing ground surface to the invert elevation of gravity sewers shall be no greater than 20 feet, except where unavoidable because of service area topography. Depths significantly greater than 25 feet for significant distances shall be avoided. In no case shall sewers be designed for depths greater than 30 feet.

Pipeline Design

Pipeline sizing shall be based upon an application of the hydraulic design criteria together with conservative engineering judgment. The minimum pipeline diameter for sewer mains shall be 8-inches.

Hydraulic calculations are included in Appendix D, as follows:

ALTERNATIVE SC	
Table SC-HY-1	Hydraulic Model
Table SC-HY-2	Hydraulic Model
Table SC-HY-3	Hydraulic Model
ALTERNATIVE SE	
Table SE-HY-1	Hydraulic Model
Table SE-HY-2	Hydraulic Model
Table SE-HY-3	Hydraulic Model
ALTERNATIVE E	
Table E-HY-1	Hydraulic Model
Table E-HY-2	Hydraulic Model
Table E-HY-3	Hydraulic Model

4. ESTIMATES OF CONSTRUCTION COSTS

An estimate of the cost of construction of infrastructure associated with development of the Master Plan for Alternative ST-WRF Site SC (the base alternative) was prepared. This included estimates of construction cost of the following:

- Trunk mains (sewers 24-inches in diameter and larger) and associated facilities
- Pump stations, force mains and associated facilities (including interim and/or temporary elements)
- Sewage Treatment – Water Reclamation Facilities

Construction cost estimates were also prepared for infrastructure associated with development of the Master Plan for Alternative ST-WRF Sites SE and E. This was accomplished in some instances by preparing comparative cost estimates for

differences between the base alternative (SC) and the SE alternative, and between the base alternative and the E alternative.

4.1 TRUNK SEWERS AND ASSOCIATED FACILITIES

Included in these estimates of cost were sewer mains 24-inches in diameter and larger, together with facilities associated with the trunk sewers, such as manholes, surface restoration, and other associated facilities and operations. A minor lift station (0.20 mgd, average daily flow) associated with the collection system master plan for alternative SC and SE was included in this category of work.

For the comparative estimates of cost for alternatives SE and E, some collector sewers less than 24-inches in diameter were also included, where they would affect the comparative cost analysis.

Estimates of Quantities of Sewers and Manholes at Installation Depths

Quantities of proposed sewers at the various installation depths dictated by the alternate designs were extracted from the graphic model in not greater than 300 foot long increments along all trunk sewers (and collection sewers where they affected the cost comparison analysis). Quantities of manholes at the various construction depths were also extracted, assuming manhole spacing at 600 foot intervals and at every junction or change in direction. Ground elevation data was extracted from Fresno Metropolitan Flood Control District topographic plats.

The quantity takeoffs are included in Appendix E, as follows:

ALTERNATIVE SC	
Table SC-EST QUANT-1	Tabular Quantities for SC
ALTERNATIVE SE	
Table SE-EST QUANT-1	Tabular Quantities for Differences from SC
ALTERNATIVE E	
Table E-EST QUANT-1A	Tabular Quantities for Differences from SC
Table E-EST QUANT-1B	Tabular Quantities for Differences from SC

For convenience, estimates of quantities for trench resurfacing were also recorded on these tables.

Pipe Structural Analysis

Conceptual design level structural analysis was performed for the pipe (and pipe bedding envelope) to provide information for costing parameters for the pipe material and installation. For purposes of this analysis, it was assumed that all pipe 36-inches and greater in diameter would be reinforced concrete pipe (ASTM C76) with 360° PVC interlocked lining, and all pipe 30-inches or less in diameter would be PVC sewer pipe (ASTM D3034 and F679).

Exploratory soil borings along the proposed route of the trunk sewers, and adjacent to each alternative ST-WRF site, were performed by Krazan & Associates, Inc., and a report issued on January 29, 2004. The report indicated that the soils encountered were typical of those found in the geologic region of the investigation. Ground water was encountered at depths of as shallow as 28 feet below ground surface (at intersection of DeWolf and Shaw Avenues) to 44 feet (at intersection of DeWolf and Gettysburg Avenues), and was not encountered to the 50 foot depth of boring in three locations North of Shaw Avenue. Because the depths of proposed facilities are generally somewhat above the ground water levels, ground water was not considered a significant design or cost element in this study, although additional testing and closer scrutiny will be warranted upon more detailed design. Table 4.1-1 below indicates the depth of ground water at the location of the ST-WRF sites and at Pump Station E. The Krazan report with boring logs is included in Appendix O, for reference.

BORING NO.	LOCATION	DEPTH TO GROUND WATER (FEET)
1	Adjacent to ST-WRF Site E	38
2	Adjacent to ST-WRF Site SE	41
3	Adjacent to ST-WRF Site SC	36
5	Adjacent to site of Pump station E	37
11	At shallowest ground water location at intersection of DeWolf & Shaw Avenues	28

Tabular conceptual structural design data and associated design criteria are included in Appendix F, as follows:

REINFORCED CONCRETE PIPE	
Table RCP-1-A	Design Criteria
Table RCP-1-B	Conceptual Structural Design Data
PVC SEWER PIPE	
Table PVC-1-A	Design Criteria
Table PVC-1-B	Conceptual Structural Design Data

Cost Parameters for Trunk Sewers and Collection Sewers

Cost parameters were developed for trunk sewers, collection sewers, and associated facilities.

Sewers

It was assumed that all pipe 36-inches and greater in diameter would be reinforced concrete pipe (ASTM C76) with 360° PVC interlocked lining, and all pipe 30-inches or less in diameter would be PVC sewer pipe (ASTM D3034 and F679). Costs directly associated with these items include the cost of pipe material, excavation, pipe bedding envelope, backfill and compaction.

Estimated excavation and backfill requirements for the various depths of installation involved were calculated, and unit estimates of cost developed. The backhoe excavation rate typically determines the production rate of the pipe laying operation. Excavations to depths over 25 feet were assumed to be initially scraper cut to provide a bench for a backhoe excavation of maximum 25 foot depth. Because of the relatively limited width of working room available at excavation depths over 25 feet, some of the excavated material was anticipated to be transported some distance for temporary storage before being returned to the trench for backfill. A cross-section of a typical excavation for trunk sewers is included in Appendix G, as follows:

Figure G-1	Typical Cross-section of Excavation for Trunk sewer
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Estimates of special bedding costs were included where dictated by the conceptual pipe structural analysis.

Pipe material costs were estimated jobsite delivered, including sales tax.

Unit costs were developed for sewers at the various depths dictated by the alternatives, incorporating the costs of pipe material and installation. Estimates of these unit costs are included in Appendix G, as follows:

REINFORCED CONCRETE PIPE	
Table RCP-Costs-1-A	Design Criteria for Estimating Costs
Table RCP-Costs-1-B	Estimate of Installed Cost
PVC SEWER PIPE	
Table PVC-Costs-1-A	Design Criteria for Estimating Costs
Table PVC-Costs-1-B	Estimate of Installed Cost

Manholes

Manholes costs were estimated based upon 60-inch diameter PVC lined manholes for trunk sewers, and 48-inch diameter manholes for collector sewers. Unit costs were developed for such manholes at various depths dictated by the alternatives. Estimates of manhole costs are included in Appendix G, as follows:

Table MH-1	Estimated Cost of Manholes
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Various Other Pipeline Project Construction Items

Estimating costs were developed for other pipeline project construction items, such as mobilization, clearing and grubbing, traffic control, dust control, worker protection from the hazard of caving ground in excavations, boring and jacking steel casing (assumed a requirement at trunk sewer crossing of Shaw Avenue at DeWolf Avenue), and trench resurfacing. Estimates of these costs are included in Appendix G, as follows:

Table Var-Costs-1	Estimated Cost of Various Pipeline Project Construction Items
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Minor Lift Station for Alternatives SC & SE

An estimate of cost for a minor lift station (0.20 mgd, average daily flow) associated with the collection system master plan for alternative SC and SE was developed. Since the basic design of the lift station is anticipated to be comparable to two such stations constructed in Clovis in 1998, the contract amounts for the constructed pump stations were used as a basis for the cost estimate. The contract amounts were then adjusted for anticipated upgrades required for the new lift station, and other factors. The estimate of cost is included in Appendix G, as follows:

Table Lift-Sta-1	Estimate of Cost of Lift Station, 0.20 mgd, ADF
------------------	---

Miscellaneous Facilities and Operations

Local projects typically include a bid item for miscellaneous facilities and operations, intended to account for items of work not specifically included in other bid items. For purposes of this analysis, the item for miscellaneous facilities and operations was estimated at 5% of the sum of all other construction costs. This number was adjusted to result in a subtotal of estimated construction cost rounded to the nearest \$1,000.

Design, Staking and Inspection

An allowance for the costs of engineering related functions such as design, construction staking and inspection was included in the estimates. For purposes of this analysis, this allowance was set at 10% of the subtotal of estimated construction cost, and rounded to the nearest \$1,000. This allowance would normally also cover items such as geotechnical services, City administrative and review costs, and other associated items. This allowance was also included in estimates of cost of pump stations and force mains in Section 4.2.

Contingencies

An allowance for contingencies was included in the estimates. For purposes of this analysis, this allowance was set at 15% of the subtotal of estimated construction cost, and rounded to the nearest \$1,000. This allowance was also included in estimates of cost of pump stations and force mains in Section 4.2.

Right of Way Requirements for Trunk Sewer Construction

Widths of existing street right of way along the proposed trunk sewer routes are in most cases inadequate to allow room for construction at the depths required. Utilizing criteria similar to that used on other local trunk sewer projects, the following was established for this analysis:

- Where the existing street right of way width is 60 feet or greater, no additional right of way width would be acquired by the City for the trunk sewer construction.
- Where the existing street right of way width is less than 60 feet, additional right of way width would be acquired by the City to bring the total to 65 feet of width for the trunk sewer construction.

Estimates of the area of additional right of way required were developed for each alternative. The estimates are included in Appendix G, as follows:

ALTERNATE SC	
Table RW-SC	Right of Way Requirements for SC
ALTERNATE SE	
Table RW-SE	Differences in Right of Way Requirements for SE
ALTERNATE E	
Table RW-E	Differences in Right of Way Requirements for E

It is the intention of the City that where additional right of way width is required, permanent easements for street widening will be acquired, rather than temporary construction easements. For purposes of this analysis, additional street right of way acquisition is estimated at \$2.50 per square foot, with the extended total rounded to the nearest \$1,000. No allowance is provided in the estimates for severance costs, due to the variability of value and application.

Summary Estimates of Cost of Trunk Sewers

Summary estimates of cost of trunk sewers for Alternative SC (the base alternative), and for the difference in trunk sewer costs between Alternative SE and the base alternative, and between Alternative E and the base alternative, are included in Appendix H, as follows:

Table Trunk Cost-SC	Summary Estimate of Cost of Trunk Sewer System Alternative SC (Base Alternative)
Table Trunk Cost Diff-SE	Summary Estimate of Difference in Cost of Trunk Sewer System Alternative SE from Alternative SC (Base Alternative)
Table Trunk Cost Diff-E	Summary Estimate of Difference in Cost of Trunk Sewer System Alternative E from Alternative SC (Base Alternative)

The total estimated cost of the alternative trunk sewer systems are summarized in Table 4.1-2 below.

ALTERNATIVE	DIFFERENCE FROM ALTERNATIVE SC (Base Alternative)	ESTIMATED COST
SC (Base Alternative)	\$0	\$8,255,000
SE	+ \$669,000	\$8,924,000
E	- \$777,000	\$7,478,000

4.2 PUMP STATIONS AND FORCE MAINS

Pump stations and force mains form part of the overall implementation plan for the three alternatives.

For Alternatives SC and SE, a temporary pump station is required at each ST-WRF site if potential interim development is to occur in the SE Service Area prior to completion of construction of the first phase of the ST-WRF. For Alternative E, a permanent pump station is required at the NE corner of the intersection of Ashlan and Leonard Avenue, the first phase of construction of which will provide for potential interim development. A force main would be constructed from this permanent pump station to ST-WRF Site E. A force main would also be constructed from each of these pump stations along Ashlan Avenue to the Fowler Trunk Sewer at Fowler Avenue.

For all of the alternatives, a pump station would be constructed at the Fowler Trunk Sewer just South of Ashlan Avenue. This pump station would deliver initial flow to the ST-WRF at startup. The force main constructed for potential interim development would also be utilized for this function.

Included in the estimates of cost are the facilities described in Table 4.2-1 below:

FACILITY	LOCATION	DESCRIPTION	PUMP STATION CAPACITY FOR APPLICABLE ALTERNATIVE (Avg. Daily Flow)		
			SC	SE	E
Temporary Pump Station A	At ST-WRF	Temporarily discharges flow from interim development in SE Area through 18" force main to Fowler Trunk Sewer	1.1 mgd	1.1 mgd	
Pump Station E Phase 1A	NE Cor. Ashlan & Leonard Aves.	Temporarily discharges flow from interim development in SE Area through 18" force main to Fowler Trunk Sewer			1.1 mgd
Pump Station E Phase 1B	NE Cor. Ashlan & Leonard Aves.	Discharges East through 30" force main to ST-WRF E			2.8 mgd
Pump Station E Phase 2	NE Cor. Ashlan & Leonard Aves.	Discharges East through 30" force main to ST-WRF E			5.6 mgd
Pump Station E Phase 3	NE Cor. Ashlan & Leonard Aves.	Discharges East through 30" force main to ST-WRF E			8.4 mgd
Pump Station B	Fowler Ave. S/O Ashlan Ave.	Discharges ST-WRF start-up flow from Fowler Trunk Sewer East through 18" force main to ST-WRF (relayed through Pump Station E for Alternative E)	1.4 mgd	1.4 mgd	1.4 mgd
Influent Pump Station	ST-WRF Site E Phase 1	Reduction in cost due to Pump Station E			2.8 mgd
Influent Pump Station	ST-WRF Site E Phase 2	Reduction in cost due to Pump Station E			5.6 mgd
Influent Pump Station	ST-WRF Site E Phase 3	Reduction in cost due to Pump Station E			8.4 mgd

Pump Stations

Conceptual designs were developed by Malcolm Pirnie, Inc. for Pump Station A, B and E, based on design capacities furnished by Blair, Church & Flynn Consulting Engineers. Conceptual design sketches of the functional facilities associated with these pump stations are included in Appendix I, as follows:

PUMP STATIONS A & B	
SHEET 1 OF 3	CONCEPT PLAN, UPPER LEVEL
SHEET 2 OF 3	CONCEPT PLAN, LOWER LEVEL
SHEET 3 OF 3	CONCEPT PLAN, ELEVATIONS
PUMP STATION E	
SHEET 1 OF 4	CONCEPT PLAN, UPPER LEVEL
SHEET 2 OF 4	CONCEPT PLAN, LOWER LEVEL
SHEET 3 OF 4	CONCEPT PLAN, ELEVATION
SHEET 4 OF 4	CONCEPT PLAN, MISCELLANEOUS DETAILS

City of Clovis staff, utilizing the above referenced conceptual plans for the functional facilities, developed conceptual site renderings to provide a sense of how the pumping stations might be architecturally configured. These renderings follow the conceptual drawings in Appendix I.

Table 4.2-2 summarizes the design capacities of the pump stations for the three alternatives:

TABLE 4.2-2 DESIGN CAPACITIES OF PUMP STATIONS			
PHASE	AVERAGE DAILY FLOW CAPACITY (MGD)	PEAKING FACTOR	PEAK FLOW CAPACITY (MGD)
PUMP STATION A (ALTERNATIVES SC & SE)			
SINGLE PHASE	1.10	3.00	3.30
PUMP STATION B (ALTERNATIVES SC, SE & E)			
SINGLE PHASE	1.40	1.65	2.31
PUMP STATION E (ALTERNATIVE E)			
PHASE 1A	1.10	3.00	3.30
PHASE 1B	2.80	2.75	7.70
PHASE 2	5.60	2.41	13.50
PHASE 3	8.40	2.00	16.80

Pump Station Conceptual Design

For Alternatives SC and SE, temporary Pump Station A (1.1 mgd, average daily flow) is required at each ST-WRF site to discharge flow from interim development in the SE Service Area through an 18-inch force main to the Fowler Trunk Sewer, prior to completion of construction of the first phase of the ST-WRF. Similarly for all alternatives, Pump Station B (1.4 mgd, average daily flow) is required at Fowler Avenue, South of Ashlan Avenue, to discharge the ST-WRF start-up flow from the Fowler Trunk Sewer, East to the ST-WRF through an 18-inch force main (relayed through Pump Station E for Alternative E). Conceptual designs of Pump Station A and B are described below.

Both pump stations will consist of a buried, circular wet well approximately 40 feet in depth, constructed of pre-cast concrete manhole sections. An access hatch will be provided in the top slab at grade level. The wet well will contain three wet-pit submersible pumps. The pumps will be non-clog, centrifugal type, solids handling pumps, and will be mounted on a rail system to allow removal of the pumps without the need to enter the wet well. All pumps will have constant speed motors, and will be operated based on wet well level. The pumps will be sized to handle the peak flow for their respective stations, which are listed in Table 4.2-2 above. It should be noted, that the hydraulic design of the pumping equipment for each pump station may vary under each alternative, which may impact final equipment sizing and operating costs. Final sizing of the pumping equipment for each pump station will be determined during detailed design based upon the selected alternative.

Adjacent to the wet well structure will be a buried valve vault, approx. nine feet in depth, with an access hatch provided in the top slab at grade level. This vault will house the swing check valves and plug valves located on the discharge piping of each pump. These valves offer protection to the pumping equipment and allow for equipment isolation in the event that maintenance is required in the wet well or for removal of a pump for maintenance without any interruption in operation of the pump station.

Downstream of the valve vault will be a flow meter vault, approximately nine feet in depth, with an access hatch provided in the top slab at grade level. This vault will house a magnetic flow meter used to measure the flow rate through the pump station. A bypass line around the flow meter and isolation valves will be provided to allow removal of the flow meter for maintenance or replacement without an interruption to pump station operation.

A pig launching station will also be located on the pumping station site, approximately nine feet in depth, with an access hatch provided in the top slab at grade level. The station will be located downstream of the meter vault, to allow for insertion of a pig (cleaning device) into the 18-inch force main to remove any solids that may settle out in the force main during low flow periods.

Above ground structures at the site will include a building to house electrical and control gear, standby generator, odor control equipment and sulfide control equipment. The superstructure will be architecturally treated to provide an aesthetically pleasing appearance compatible to the surrounding community, and will be designed to minimize noise, odors, and visibly objectionable elements, while maintaining safety and security.

For Alternative E, Pump Station E (8.4 mgd, average daily flow) is sited at the Northeast corner of the intersection of Ashlan and Leonard Avenues. The operation and capacity of Pump Station E will be phased, as described in Table 4.2-1. During the first phase of construction, which will provide for potential interim development, all buried and above grade structures will be constructed, and building support services, such as HVAC, plumbing, and electrical equipment, will be installed. At each phase, as average daily flow capacity increases, the pumping equipment and associated piping and electrical appurtenances will be added, or removed and replaced as needed with larger capacity equipment, as described in Table 4.2-3.

Pump Station E will consist of a buried wet well and dry well structure, approximately 35-40 feet in depth. The wet well area will be completely separated from the dry well area so that only equipment located in the wet well area will be required to be rated for operation in a hazardous location. This separation will also reduce odors and reduce the overall size of the odor control system. A separate stair will be provided to allow access from grade to each of the wet well and dry well areas. Located above a portion of the buried structure will be an above grade electrical room to house electrical and control gear. A separate above grade structure will be provided to house a standby generator, odor control equipment and sulfide control equipment.

The wet well area will consist of three influent channels to divert flow from the influent sewer to one of two channel grinders installed in two of the channels. Each grinder will operate continuously, and be sized to handle half of the peak station flow. The third channel will serve as a bypass channel, and will have a manual bar rack installed in it. Each of the channels will have manual slide gates at either end to allow for isolation of the grinders and to divert flow to the bypass channel in the event that a grinder needs to be taken out of service for maintenance. The channels will be covered to reduce odors in the wet well area and to reduce the size of the odor control equipment. Hatches will be provided to allow access to the influent channels for cleaning and maintenance and for removal of large objects that cannot pass through the grinders.

The three influent channels will combine into two channels and will enter the pump station wet well, where the pump suction intakes will be located. Manual slide gates will be provided at the two wet well influent locations in order to isolate the wet well as needed. The wet well will be covered to reduce odors and reduce the size of the odor control equipment. Hatches will be provided to allow access to the wet well for cleaning and maintenance. In addition, an equipment hatch will be provided in the ceiling to allow equipment removal from the buried wet well area to the grade level above.

The dry well area, completely separated from the wet well area, will contain the pumping equipment and appurtenances. All swing check valves and isolation plug valves will be located in the dry well area to allow removal of any pump for maintenance or replacement as needed without any interruption to the operation of the pump station. An overhead monorail hoist will be provided for pump removal. In addition, an equipment hatch will be provided in the ceiling to allow equipment removal from the buried dry well area to the grade level above.

The phasing of the operation and capacity of Pump Station E will require that pumping equipment and associated piping and electrical appurtenances be added or removed and replaced as needed with larger capacity equipment as station flows increase. To accommodate this phasing, two different capacity pumps may initially need to be installed and operated to accommodate the range of flows anticipated during the life cycle of the pumping station. As the flow increases, all installed pumps will eventually be identical in capacity and design.

Table 4.2-3 below describes the required pumping equipment proposed to be installed and removed during each phase of operation of Pump Station E.

TABLE 4.2-3
GENERAL DESCRIPTION OF PUMPING EQUIPMENT TO BE INSTALLED AND REMOVED AT EACH PHASE

PHASE	DESCRIPTION OF PUMPING EQUIPMENT INSTALLED OR REMOVED AT EACH PHASE	DESCRIPTION OF INSTALLED PUMPING EQUIPMENT AT EACH PHASE	AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR	PEAK FLOW (MGD)
Phase 1A	Install (2) Small Constant Speed Pumps and (1) Large Pump w/ VFD	(2) Small Constant Speed Pumps (1) Large Pump w/ VFD	1.1	3.00	3.30
Phase 1B	Install (2) Large Pumps w/ VFD and remove (1) Small Constant Speed Pump	(1) Small Constant Speed Pump (3) Large Pumps w/ VFD	2.8	2.75	7.70
Phase 2	Install (1) Large Pump w/ VFD and remove (1) Small Constant Speed Pump	(4) Large Pumps w/ VFD	5.6	2.41	13.50
Phase 3	Install (1) Large Pump w/ VFD	(5) Large Pumps w/ VFD	8.4	2.00	16.80

The sizing of the pumps required during each phase of operation of Pump Station E as outlined in Table 4.2-3 will be based on the peak station flow for each respective phase. Final sizing and number of pumps to be installed under each phase will be determined during detailed design.

All pumps will be dry-pit submersible pumps. The pumps will be non-clog, centrifugal type, solids handling pumps. The small pumps installed under Phase 1A will have constant speed motors, and will be operated based on wet well level. All large pumps installed under Phase 1B and all successive phases will have variable speed motors, and will be operated based on wet well level.

Pump Station E will require a flow meter vault and a pig launching station similar in design to those proposed for Pump Station A and B. The depth of both will be approximately 10 feet at the Pump Station E site. Due to the phased operation of Pump Station E as described in Table 4.2-1, two flow meter vaults and two pig launching stations will be required. One flow meter vault and pig launching station will be required for the 18-inch force main that temporarily discharges flow from interim development in the SE Area to the Fowler Trunk Sewer. The second flow meter vault and pig launching station will be required for the 30-inch force main which discharges East to the ST-WRF.

All above ground structures will be architecturally treated to provide an aesthetically pleasing appearance compatible to the surrounding community, and will be designed to minimize noise, odors, and visibly objectionable elements, while maintaining safety and security.

Engineer's Opinion of Probable Cost of Pump Stations

Conceptual level construction cost opinions for Pump Stations A, B, and E were prepared by Malcolm Pirnie, Inc. The cost estimates were based upon conceptual

design information for each pump station, historical cost curves for pumping stations and experience on projects of similar size and complexity. The estimates prepared by Malcolm Pirnie, Inc. include associated site work, but do not include the cost of land, engineering or contingencies.

Summary estimates of cost of pump stations, including savings in influent pump station costs for Alternative ST-WRF Site E, are included in Appendix J, as follows:

Table PS-1	Estimates of Cost of Pump Stations
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These summary estimates include the cost of land, engineering and contingencies.

Force Mains and Associated Facilities

Force mains are required to transport raw wastewater from pump stations to points of discharge. Under all three alternatives, a force main is required between the terminus of the gravity sewer system for the SE Area and the Fowler Trunk Sewer, to provide for interim service for the SE Service Area and to later provide startup flow to the ST-WRF. Under Alternative E, a force main is also required between terminus of the gravity sewer system for the SE Area at Pump Station E to ST-WRF Site E.

Force Main Design

Pipe material preliminarily selected for force mains consists of ductile iron pipe with internal polyethylene lining for corrosion resistance. Hydraulic analysis was based upon the Hazen-Williams formula, with roughness coefficient C of 130. Force mains were sized, wherever practicable, to provide for velocities of flow between 2 and 8 feet per second, while allowing maximum flexibility for future operations.

Insertion stations for pigging (cleaning device) facilities were included in pump station facilities (since they will be located there). Pigging retrieval stations were included at the discharge of each force main.

The preliminary concept design provides for eccentric plug valves in each force main to allow the control of flow.

Concept level hydraulic design parameters are included in Appendix J, as follows:

Table FM-1	Concept Level Hydraulic Design for Proposed Force Mains
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Estimates of Cost of Force Mains

Estimating costs were developed for the various force main construction items. Estimates of these costs are included in Appendix J, as follows:

Table FM-2	Estimate of Cost of Various Force Main Project Construction Items
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Summary estimates of cost of force mains are included in Appendix J, as follows:

Table FM-SC-1	Alternate SC – For temporary Pump Station at ST-WRF Site SC and for Pump Station at Fowler Trunk Sewer
Table FM-SE-1	Alternate SE – For temporary Pump Station at ST-WRF Site SE and for Pump Station at Fowler Trunk Sewer
Table FM-E-1	Alternate E – For Phase 1A Pump Station at Ashlan and Leonard Avenue and for Pump Station at Fowler Trunk Sewer
Table FM-E-2	Alternate E – For Phase 1B Pump Station at Ashlan and Leonard Avenue to ST-WRF Site E

Combined Estimates of Cost of Pump Stations and Force Mains

Summary estimates of cost of pump stations including associated force mains, segregated by contemplated construction phase, are included in Appendix J, as follows:

Table PS-2	Summary Estimate of Cost of Pump Station and Force Mains
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The total estimated cost of the pump station and force main systems associated with the three alternatives, including facilities provided for potential interim development, are summarized in Table 4.2-4 below.

ALTERNATIVE	DIFFERENCE FROM ALTERNATIVE SC (Base Alternative)	ESTIMATED COST
SC (Base Alternative)	\$0	\$5,135,000
SE	+ \$240,000	\$5,375,000
E	+ \$6,937,000	\$12,072,000

4.3 SEWAGE TREATMENT-WATER REUSE FACILITIES (ST-WRF)

Estimates of cost for sewage treatment - water reuse facilities (ST-WRFs) were extracted from the City of Clovis Wastewater Master Plan Update, Phase 1-B, November 20, 1996. The raw estimate of total cost of the ST-WRF from Alternate 5 in the report was then adjusted for inflation. For purposes of this cost comparison analysis, it was assumed that the base cost of the ST-WRF would be identical for each of the alternative sites.

It was also assumed for purposes of this cost comparison analysis that the cost of the three phases of contemplated construction of the ST-WRF would be proportioned as

shown in Table 4.3-1 below. This assumption has no significant effect on the comparative cost of the alternatives.

PHASE OF ST-WRF CONSTRUCTION	TOTAL CAPACITY OF ST-WRF	CAPACITY ADDED BY PHASE	% OF TOTAL ST-WRF COST
PHASE 1	2.8 MGD	2.8 MGD	50%
PHASE 2	5.6 MGD	2.8 MGD	25%
PHASE 3	8.4 MGD	2.8 MGD	25%

An adjustment was then made to the estimated cost of Alternative E, for savings in influent pump station costs at the ST-WRF site.

Estimates of cost of the ST-WRFs, segregated by contemplated construction phase, may be found in Appendix K, as follows:

Table ST-WRF SC	Estimated Cost ST-WRF Alternative SC
Table ST-WRF SE	Estimated Cost ST-WRF Alternative SE
Table ST-WRF E	Estimated Cost ST-WRF Alternative E

The total estimated cost of the ST-WRF's for the three alternatives, including the savings in influent pump station cost at ST-WRF Site E, are summarized in Table 4.3-2 below.

ALTERNATIVE	DIFFERENCE FROM ALTERNATIVE SC (Base Alternative)	ESTIMATED COST
SC (Base Alternative)	\$0	\$46,000,000
SE	\$0	\$46,000,000
E	-\$6,260,000	\$39,740,000

5. ESTIMATES OF ANNUAL COST OF OPERATIONS, MAINTENANCE AND REPLACEMENT

Estimates of the annual cost of operations, maintenance and replacement of trunk sewers, minor lift stations, pump stations and force mains, and ST-WRF's associated with the three alternatives were developed.

5.1 TRUNK SEWERS

The Clovis Public Utilities Department indicates that the cost of operations and maintenance of sewers within the City of Clovis averages \$0.23 per lineal foot per

year for trunk sewers (24-inches and larger in diameter), and \$0.18 per lineal foot per year for smaller sewer mains.

Reinforced concrete trunk sewers with 360° interior interlocking PVC liners are considered to have a design life of at least 100 years. For purposes of this analysis, replacement costs were based upon a design life of 100 years.

Summary calculations for the estimated annual cost of operations, maintenance and replacement for trunk sewers and other affected non-trunk sewers for the three alternatives are included in Appendix L, as follows.

Table OMR-TS	Estimated Annual Cost of O,M&R for Trunk Sewers and Affected Non-Trunk Sewers
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5.2 MINOR LIFT STATIONS

A minor lift station with average daily flow capacity of 0.20 mgd is required under the plans for Alternate SC and Alternate SE. The Clovis Public Utilities Department indicates that the cost of operations and maintenance of a similar station located along Freeway 168 at Peach Avenue within the City of Clovis averages \$14,600 per year, not including energy charges. The average cost to Clovis for energy at such facilities is \$0.13 to \$0.14 per kilowatt hour.

Summary calculations for the estimated annual cost of operations, maintenance and replacement for the minor lift station for Alternatives SC and SE are included in Appendix L, as follows:

Table OMR-LS	Estimated Annual Cost of O,M&R for Minor Lift Station
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5.3 PUMP STATIONS AND FORCE MAINS

Estimates of the annual cost of operations, maintenance and replacement of pump stations and force mains associated with the three alternatives were developed.

Pump Stations

Estimates of the annual cost of operations, maintenance and replacement of equipment associated with the three alternatives were developed by Malcolm Pirnie, Inc.

For Alternatives SC and SE, temporary Pump Station A (1.1 mgd, average daily flow) is required at each ST-WRF site. For all alternatives, Pump Station B (1.4 mgd, average daily flow) is required at Fowler Avenue, South of Ashlan Avenue. For Alternative E, Pump Station E (8.4 mgd, average daily flow) is sited at the Northeast corner of the intersection of Ashlan and Leonard Avenue.

For each pump station, maintenance tasks for each type of equipment were identified. The required tasks and frequency of maintenance were based on operations information and experience from projects of similar size and complexity. For each task, the actual “wrench time” required to perform the maintenance procedure was determined and then adjusted using a full time equivalent to more accurately represent the time and labor required to completely perform a procedure. Also included in the cost estimates were benefits for operating staff.

Operating costs for each pump station were calculated for all major pieces of equipment installed at each facility. For estimating purposes, a cost of \$0.14 per kilowatt hour was used. Annual energy costs were calculated for each of the major pieces of equipment based on preliminary motor data provided by equipment manufacturers. Annual operating costs for sulfide control equipment were based on information provided by US Filter for the Bioxide® chemical feed system. For estimating purposes, a cost of \$1.80 per gallon was used, which includes system maintenance provided by US Filter. Daily Bioxide dosage rates were calculated based on preliminary station flow and force main information provided by Blair, Church, & Flynn Consulting Engineers.

Annual costs for routine parts replacement and major parts replacement costs were determined for each of the major pieces of equipment based on operations information and experience from projects of similar size and complexity, as well as information provided by equipment manufacturers. Major parts replacement costs were included in the cost estimates as a lump sum price assessed in the actual year of replacement.

An estimate of the annual cost of operations, maintenance and replacement of equipment associated with locating the influent pump station at the ST-WRF site (Alternatives SC & SE) in lieu of remotely locating this site (Alternative E) was also prepared. Operations, maintenance, and replacement costs associated with pigging, sulfide control, and general site maintenance were eliminated for this estimate.

Summary calculations for the estimated annual cost of operations, maintenance and replacement for the pump stations for Alternatives SC, SE and E are included in Appendix L, as follows:

Table OMR-PS	Estimated Annual Cost of O,M&R for Pump Stations, and for Savings at ST-WRF Site E
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Other supporting calculations for the estimated annual cost of operations, maintenance and replacement for the pump stations for Alternatives SC, SE and E, as prepared by Malcolm Pirnie, Inc., are included in Appendix M.

Force Mains

The Clovis Public Utilities Department indicates that the cost of operations and maintenance of sewers within the City of Clovis averages \$0.23 per lineal foot per year for trunk sewers (24-inches and larger in diameter), and \$0.18 per lineal foot per

year for smaller sewer mains. For purposes of this analysis, the cost of operations and maintenance of force mains was taken to be the same as for sewers.

Force mains consisting of ductile iron pipe with internal polyethylene lining are considered to have a design life of at least 50 years. For purposes of this analysis, replacement costs were based upon a design life of 50 years.

Summary calculations for the estimated annual cost of operations, maintenance and replacement for force mains for the three alternatives are included in Appendix L, as follows:

Table OMR-FM	Estimated Annual Cost of O,M&R for Force Mains
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5.4 SEWAGE TREATMENT–WATER REUSE FACILITIES (ST-WRF’s)

Estimates of the annual cost of operations, maintenance and replacement for sewage treatment-water reuse facilities (ST-WRFs) were extracted from the City of Clovis Wastewater Master Plan Update, Phase 1-B, November 20, 1996. The raw estimates of O,M&R cost per mgd average daily flow capacity for the three contemplated phases of construction of ST-WRF’s from the report were then adjusted for inflation. For purposes of this cost comparison analysis, it was assumed that the O,M&R cost of the ST-WRF would be identical for each of the alternative sites, except for the elimination of the influent pump station under Alternative E.

Summary calculations for the estimated annual cost of operations, maintenance and replacement for the ST-WRF’s for the three alternatives are included in Appendix L, as follows:

Table OMR-ST/WRF	Estimated Annual Cost of O,M&R for ST-WRF’s
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6. SUMMARY COST ESTIMATES AND PRESENT VALUE ANALYSIS

The estimates of cost produced in other sections of the report were combined and an analysis was performed to determine a present value cost comparison of the three alternatives. The time period for the analysis was through year 2030, consistent with the planning window of the 1993 Clovis General Plan.

Time based flow projections, assuming a constant City-wide development rate of 1,500 equivalent single family residential units per year, had previously been prepared and projections segregated for the areas tributary to the proposed Southeast Clovis ST-WRF. To these projections were added an allowance for potential interim development in the SE Service Area (prior to completion of construction of the ST-WRF), and a 1.20 mgd flow diversion from the Fowler Trunk Sewer to provide startup flow for the ST-WRF. The allowance for interim development was set at 0.20 mgd average daily flow, or about 750 equivalent units per year. Flow projections were then made on a year-by-year basis through 2030 for the ST-WRF and for each pump station unit.

For the cost analysis, these flow projections dictated the timing of facility construction to meet projected demand, and provided average flow rates used in the estimates of annual cost of operations, maintenance and replacement (O,M&R) of facilities.

The present value analysis assumed a constant inflation rate of 3%, and a constant interest earned rate of 5% over the period of the analysis. The present value analysis, together with the associated time based flow projections and cost matrix, is included in Appendix N as Table PV-1.

Table PV-1	Present Value Cost Comparison Analysis for Alternate ST-WRF Sites
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The present value cost comparison for the three alternatives is summarized in Table 6-1 below.

TABLE 6-1 PRESENT VALUE COST COMPARISON OF ALTERNATIVES THROUGH 2030					
ALTERNATIVE	PRESENT VALUE OF CONSTRUCTION COSTS	PRESENT VALUE OF ANNUAL COST OF O,M&R	TOTAL PRESENT VALUE	DIFFERENCE FROM ALTERNATIVE SC	
				DOLLARS	%
SC (Base Alternative)	\$50,855,000	\$38,630,000	\$89,485,000	\$0	0.0
SE	\$51,746,000	\$38,831,000	\$90,577,000	+\$1,092,000	+ 1.2
E	\$50,238,000	\$40,889,000	\$91,127,000	+\$1,642,000	+ 1.8

7. SYSTEM IMPLEMENTATION AND OPERATIONAL DIFFERENCES

Following are some implementation and operational differences of the three alternatives, which may or may not be reflected in the economic comparisons:

- a. Where the influent pump station is located at the ST-WRF site (Alternatives SC & SE), there are some operational efficiencies over an influent pump station located remote from the ST-WRF (Alternative E). In addition to the operational efficiencies, there are also operational, maintenance, and replacement cost differences as compared to an influent pump station located remote from the ST-WRF (Alternative E). A pig launching (cleaning) station is not required at the ST-WRF site, and sulfide control is not required. The operator of the ST-WRF will likely also operate the remote influent pump station and interconnecting force main under Alternative E as well as performing any general site maintenance that would have been performed remotely under Alternative E.
- b. Where the influent pump station is located remote from the ST-WRF site (Alternative E), some facilities which could be shared if the influent pump station was integrated with the ST-WRF (such as back up power generation facilities), must be duplicated.

- c. Alternative E allows the elimination of the construction of, and the perpetual operation, maintenance and operation of, a minor lift station required under Alternatives SC and SE.
- d. Alternative E places the influent pump station for the ST-WRF at the lowest topographical site of the three alternatives, which provides for the preferable gravity sewer arrangement leading to the pump station.
- e. Alternative E, through phasing of construction of the remote influent pumping station, allows for the pumping of flow from potential interim development of the SE Service area (prior to completion of the ST-WRF), to the Fowler Trunk sewer without the need to construct a temporary pump station at the ST-WRF (as required by Alternatives SC and SE). However, this phasing will require dual force main connections at the pumping station to allow the flow to be conveyed to both discharge points.
- f. Depending upon the amount of development activity that may occur in the area tributary to the existing gravity sewer in Ashlan Avenue between Leonard Avenue and the Fowler Trunk Sewer, this gravity line may contain capacity for some quantity of pumped flow from interim development of the SE Service Area prior to completion of the ST-WRF. The first phase of the remote pump station under Alternative E is situated adjacent to the upstream end of the gravity sewer, whereas the temporary pump stations required at the ST-WRF under Alternatives SC and SE are one-half mile or more from the gravity sewer, requiring a connecting force main.
- g. Because of the potential need for interim service for the SE Service Area, under Alternative E the influent pump station, to ultimately be operated by the ST-WRF DBO entity, will likely not be designed and the first phase likely not constructed by the DBO entity. The influent pump station for the ST-WRF would be designed and constructed by the DBO entity under Alternatives SC and SE. There are advantages to the DBO entity designing and constructing the facilities that will be operated by the entity.
- h. Although all three alternatives require that a pump station be constructed at the Fowler Trunk Sewer to provide assured initial flow for the ST-WRF at start-up, the interconnecting 18-inch diameter force main is shortest under Alternative E (since it relays flow through Pump Station E).