DRAFT

Preliminary Design Report

THUNDERBIRD PASEO WASTEWATER RECLAMATION FACILITY

City of Glendale
Glendale, Arizona
Project No. S867026

March 1988
Project: 0756-03-2

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY
PROJECT NO. S867026

LAND COST ($/ACRE)	RECLAIMED WATER COST ($/1000 GAL.) 5 YEARS	10 YEARS	20 YEARS	INFINITY
$10,000.00	$0.07	$0.04	$0.03	$0.02
$20,000.00	$0.13	$0.07	$0.05	$0.04
$30,000.00	$0.20	$0.11	$0.08	$0.06
$40,000.00	$0.26	$0.15	$0.11	$0.08
$50,000.00	$0.33	$0.18	$0.13	$0.11
$60,000.00	$0.39	$0.22	$0.16	$0.13
$70,000.00	$0.46	$0.26	$0.19	$0.15
$80,000.00	$0.53	$0.30	$0.21	$0.17
$90,000.00	$0.59	$0.33	$0.24	$0.19
$100,000.00	$0.66	$0.37	$0.27	$0.21
$110,000.00	$0.72	$0.41	$0.29	$0.23
$120,000.00	$0.79	$0.44	$0.32	$0.25
$130,000.00	$0.85	$0.48	$0.35	$0.27
$140,000.00	$0.92	$0.52	$0.37	$0.29
$150,000.00	$0.99	$0.55	$0.40	$0.32
$160,000.00	$1.05	$0.59	$0.43	$0.34
$170,000.00	$1.12	$0.63	$0.45	$0.36
$180,000.00	$1.19	$0.67	$0.48	$0.38
$190,000.00	$1.25	$0.70	$0.51	$0.40
$200,000.00	$1.31	$0.74	$0.53	$0.42

NOTES:

1. Irrigation demand per FCDMC = 245.5 ac-ft/yr (80 MGAL/yr).
2. Amortized cost assumes 8% annual interest.

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MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

March 29, 1988

Mr. John Rodriguez
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
3335 West Durango
Phoenix, Arizona 85009

Re: Thunderbird Paseo
Wastewater Reclamation Facility
Glendale, Arizona

Dear Mr. Rodriguez:

Enclosed herein for your review are two (2) copies of a draft preliminary design report for the Thunderbird Paseo Wastewater Reclamation Facility.

On Tuesday, April 12, 1988, members of our staff will be meeting with representatives of the City of Glendale to discuss the draft report. This meeting will be held at 9:00 a.m., at the City of Glendale, in the 2nd Floor Conference Room. Representatives of your staff are invited to attend this meeting.

Should you have any questions, please call this office.

Very truly yours,

MALCOLM PIRNIE, INC.

Peter J. Olszewski
Project Engineer

sj

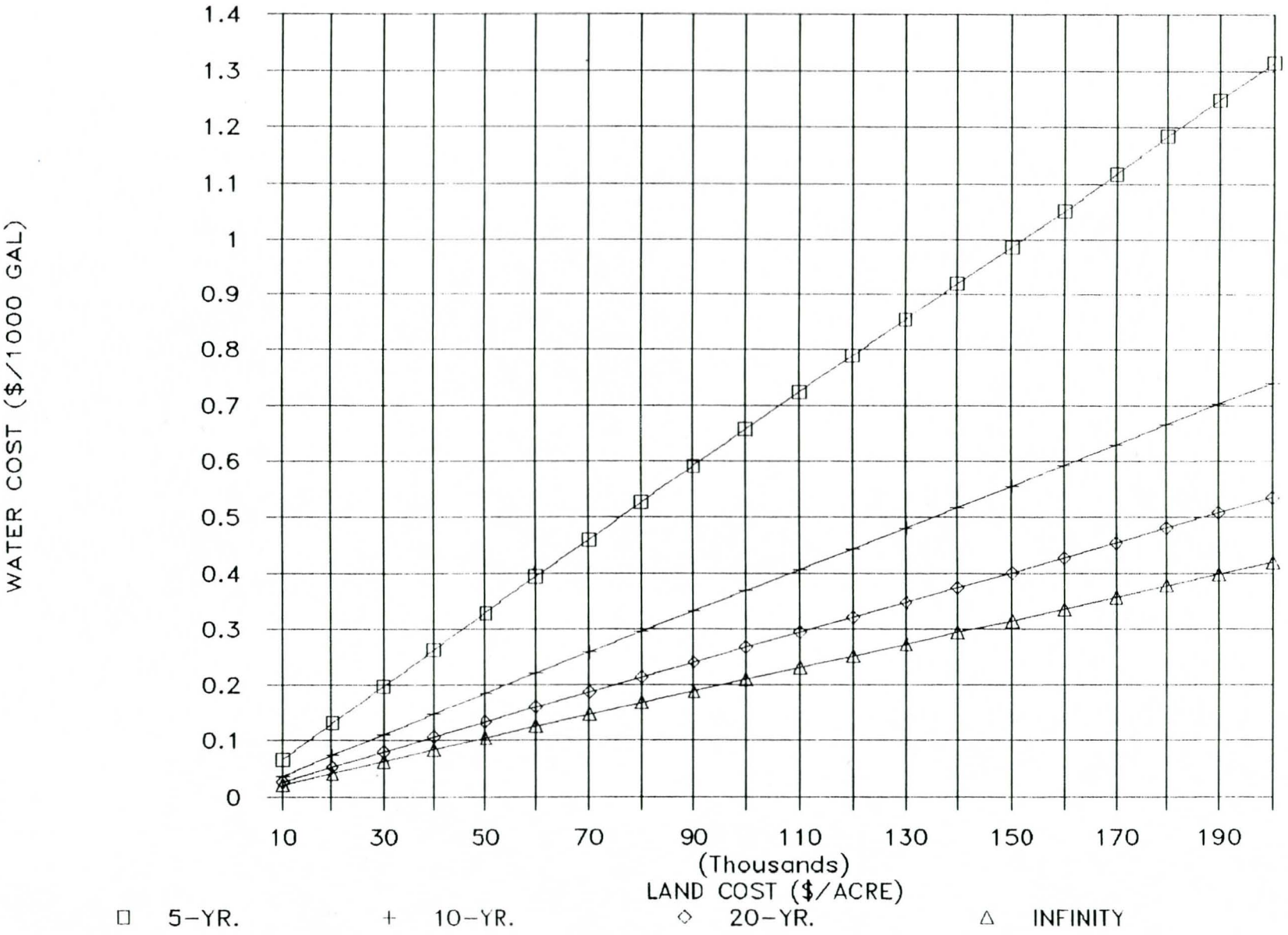
Enclosure(s)

c: G. Cline
D. Perna, City of Glendale
R. Shobe, Flood Control District ✓
of Maricopa County

0756-03-2

2650 SOUTH 46TH ST., SUITE #102 PHOENIX, AZ 85034-7416 602-241-1770 TELEX 137364

THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY
PROJECT NO. S867026



MALCOLM PIRNIE

AGENDA

PROJECT REVIEW MEETING NO. 3

PRELIMINARY DESIGN
THUNDERBIRD PASEO WASTEWATER RECLAMATION FACILITY
PROJECT NO. S867026

April 12, 1988

1. REVIEW OF DRAFT PRELIMINARY DESIGN REPORT

2. DISCUSSION OF WWRF SITE ACQUISITION

CITY OF GLENDALE, ARIZONA

THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY
PROJECT NO. S867026

PRELIMINARY DESIGN REPORT

MARCH 1988

MALCOLM PIRNIE, INC.
2650 South 46th Street
Suite No. 102
Phoenix, Arizona 85034-7416

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THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY
PROJECT NO. S867026

PRELIMINARY DESIGN REPORT

MARCH 1988

EXECUTIVE SUMMARY

INTRODUCTION

1. The City of Glendale, Arizona has retained the consulting engineering firm of Malcolm Pirnie, Inc, to design the Phase I Thunderbird Paseo Wastewater Reclamation Facility.

2. Preparation of this design includes the submission of a draft preliminary design report to the City which addresses the following items:

   - Design Criteria
   - Process Description
   - Site Requirements
   - Preliminary Cost Estimate
   - Final Design Drawing List

3. This Executive Summary presents the major findings, conclusions, and recommendations from the Engineer's draft report.

FINDINGS AND CONCLUSIONS

4. For Phases I and II a 100-foot setback is required by ADEQ. The site can accommodate both Phases I and II with the 100-foot setback. For Phases III and IV a 150-foot setback is required by ADEQ. Prior to Phase III

construction, the vacant parcel south of the existing WWRF site should be acquired to provide the required 150-foot setback.

5. A storage lake will be located within the ACDC floodway. Reclaimed water will be pumped from the lake into the irrigation system designed by the WLB Group.

6. Wastewater Treatment will be accomplished by using an extended aeration process with secondary clarification and tertiary filtration. Fine bubble aeration, circular rapid sludge withdrawal clarifiers, and automatic backwash filters will be utilized. Wastewater will be treated to meet standards set forth for use of reclaimed wastewater for irrigation of open-access landscaped areas as established by the State of Arizona.

7. The facility is surrounded by existing development. Significant odor and noise control systems will be incorporated into the design. The site will be screened by a block wall fence.

8. A preliminary cost estimate for Phase I indicates an estimated construction costs of $3,360,000.

RECOMMENDATIONS

9. The existing vacant residence located on the project site should be demolished.

10. The existing wastewater pumping station located on the project site should be utilized as the influent lift station.

11. Prior to Phase III, the vacant parcel south of the WWRF site should be acquired.

12. Acquisition of reuse, disposal, and special use permits should begin following approval of the preliminary design report.

1. INTRODUCTION

BACKGROUND

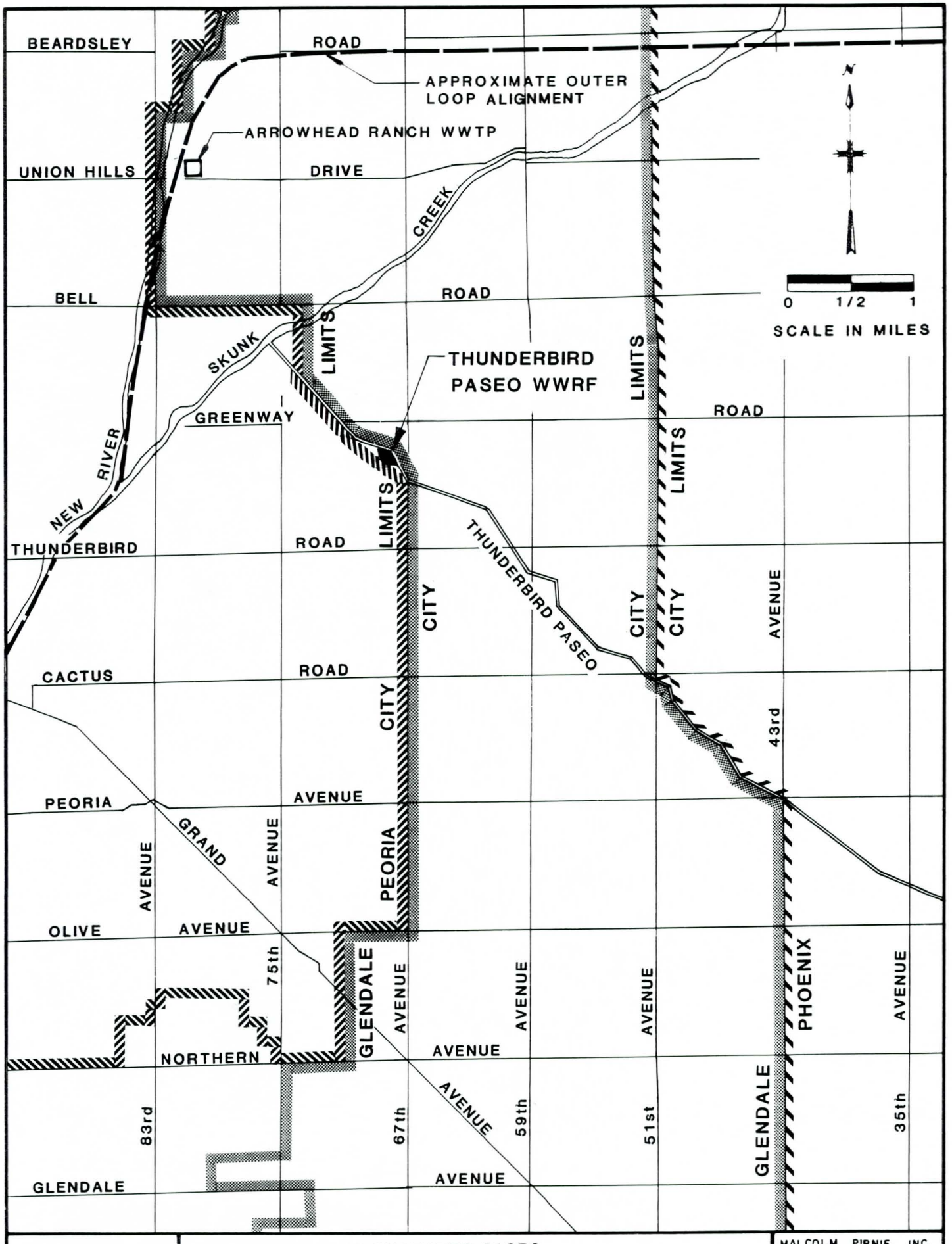
The Thunderbird Paseo (Paseo) is a section of the Arizona Canal Diversion Channel (ACDC) located within the City of Glendale (City), Arizona. Located between 51st and 75th Avenues, the Paseo is approximately 4 miles long and will comprise some 200 acres which will include recreational facilities and landscaped areas. The location of the Thunderbird Paseo is shown in Figure 1-1.

The ACDC parallels the Arizona Canal and is designed to intercept and direct 100-year flood flows within its reach in order to aid in alleviate flood-flow discharges from overflows of the Arizona Canal. These flows are conveyed to Skunk Creek, a tributary of the Gila River.

In September 1986 the City retained Malcolm Pirnie, Inc. to perform a feasibility study regarding the potential development of a wastewater reclamation system to serve the Thunderbird Paseo. The results of this study recommended construction of a wastewater reclamation facility (WWRF) to provide reclaimed wastewater for irrigation of the Paseo. Using reclaimed wastewater for irrigation would enable the City to conserve its potable water supplies while providing for the development of the recreational areas within the Paseo. The study also recommended future phased expansion of the WWRF in order to provide reclaimed water to potential users in the vicinity of the Paseo.

PURPOSE

Based upon the recommendations and findings of the Thunderbird Paseo feasibility study, the City retained Malcolm Pirnie, Inc., to design Phase I of the WWRF, which would provide reclaimed water for irrigation of the Paseo recreational areas. This report establishes the criteria which will govern the design of the Thunderbird Paseo WWRF.



MALCOLM PIRNIE

THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY
LOCATION MAP

MALCOLM PIRNIE, INC.

FIGURE 1-1

SCOPE

The issues which are addressed in the preliminary design report are as follows:

- Specific site development requirements.
- Specific Thunderbird Paseo irrigation requirements.
- Treatment process required to meet the desired effluent quality.
- Environmental controls required to reduce the impact of the wastewater reclamation facility on the surrounding development.
- Project capital and operation costs.
- Permits required for project implementation.

2. SITE DEVELOPMENT

PHYSICAL CHARACTERISTICS

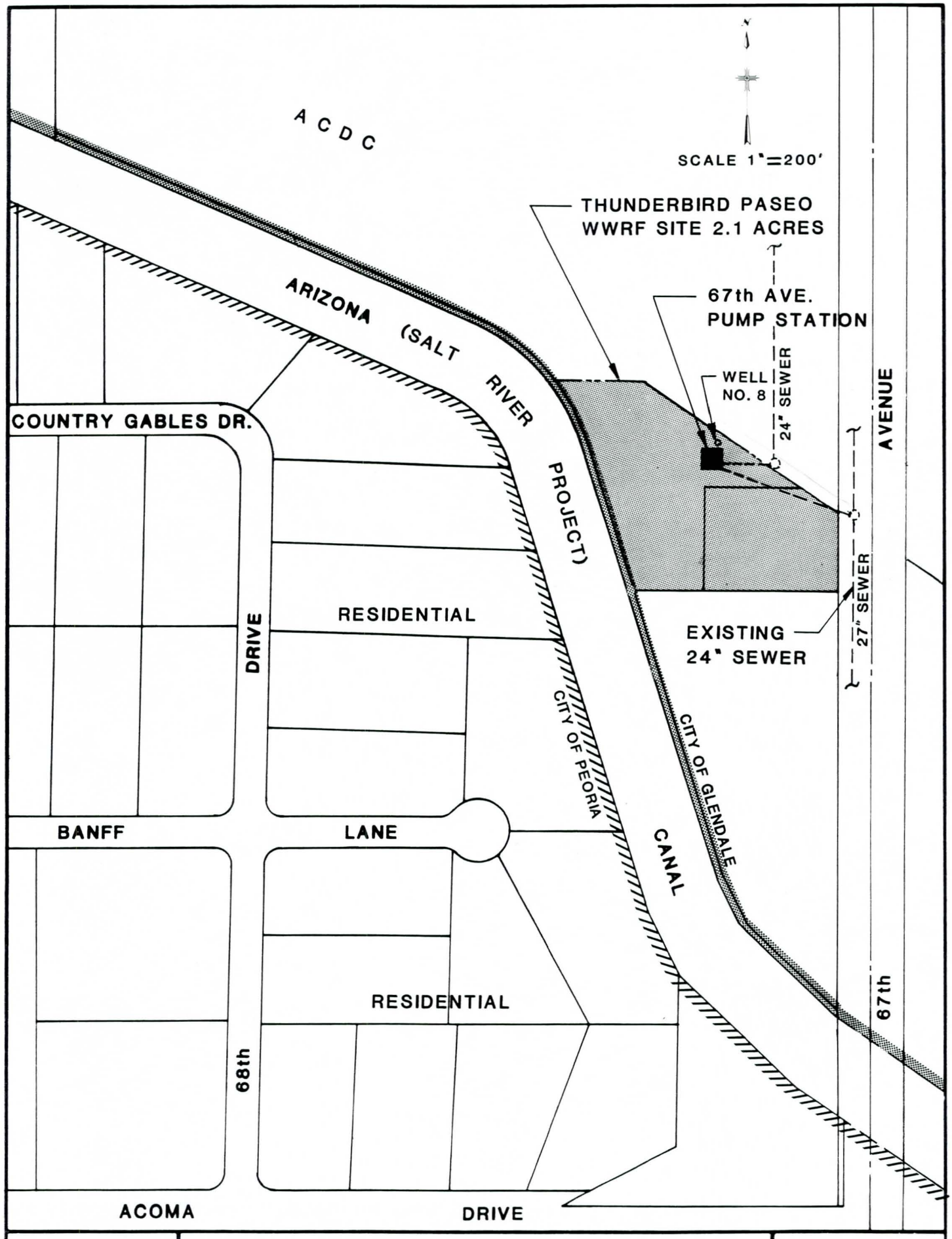
The Thunderbird Paseo WWRF site is located at the intersection of the ACDC and 67th Avenue. As shown in Figure 2-1, the site is bordered on the north by the ACDC, by the Arizona Canal on the west, 67th Avenue on the east, and a vacant parcel zoned for agricultural/residential use to the south. The site is relatively level and contains no significant topographic features other than a wastewater pumping station and an abandoned single-family residence.

The property on which the site is located is presently owned by the Maricopa County Flood Control District (MCFCD). An existing wastewater pumping station operated by the City is located on the site. The lift station transfers wastewater flow, generated by the area north of the Paseo, from a sewer passing under the ACDC channel into the sewer within 67th Avenue. The station is approximately 30 feet deep. Surface piping from Glendale Well No. 8 is adjacent to the lift station building. The well can pump water to both the Arizona Canal and a potable waterline located in 67th Avenue.

An abandoned residence also occupies a portion of the site. Discussions between the City and the U.S. Army Corps of Engineers (COE) indicate that the COE may utilize the existing structure as a field office during construction of the Paseo recreational facilities.

SURROUNDING LAND USE

The Thunderbird Paseo WWRF site is located within a semiurban residential area. The WWRF site and the Thunderbird Paseo are both zoned A-1 (agricultural residence district) by the City. This zoning designation allows for the development of publicly-owned and operated parks, and facilities necessary for operation of the parks. The A-1 zoning also allows the construction of one single-family residence per one-acre lot. The two parcels to the south of the WWRF site also are zoned A-1. An occupied, single-family residence is located on the most southerly of these two parcels.



MALCOLM PIRNIE

THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY

SITE LOCATION PLAN

MALCOLM PIRNIE, INC.

FIGURE 2-1

Land to the west of the WWRF site and across the Arizona Canal is located within the City of Peoria, Arizona. This area is residential and contains single-family structures on minimum one-acre lots.

To the east of the WWRF site is an area zoned for single-family residential use, but which is currently undeveloped. This area is located along the Paseo on the east side of 67th Avenue. Across the Paseo and to the north of the WWRF site is an area zoned for light commercial use, which is also undeveloped at the present time.

EXISTING SITE USE

The site of the Thunderbird Paseo WWRF comprises an area of approximately 2.1 acres. The lift station site occupies 0.22 acres, and the site of the abandoned residence occupies 0.78 acres.

The existing residence was evaluated for incorporation into the WWRF as an operations and control building containing a laboratory, office, storage space for spare parts and chemicals, maintenance shop, and housing of odor control facilities. Preliminary estimates indicate that a building housing these facilities would require an area of approximately 3,000 square feet.

Extensive modifications would need to be made to the existing residence to convert it for use as an operations and control building for the WWRF. Approximately 1,500 square feet of additional space is needed along with potential modifications to the existing structural frame to accommodate increased loads. Ceiling and wall enclosures would also require modification to bring the structure into conformance with local building code regulations for storage of chemicals required for WWRF operation.

The existing lift station contains 3-3,000 gallon per minute (gpm) constant-speed pumps. Discussions with the City Wastewater Operations Staff indicate that the flow presently entering the station is such that its quantity can be adequately managed by only one pump. This pump runs approximately 4 hours per day.

PLANNING RESTRICTIONS

The City of Glendale Planning and Zoning Department has established criteria governing the limits of construction within a given parcel of property. These limits, commonly known as setbacks, are dependent upon the zoning designation. For a property zoned A-1, construction of vertical structures is limited to within 15 feet of the property line along the side yard, 25 feet of the property line along the front yard, and 25 feet of the property line along the rear yard.

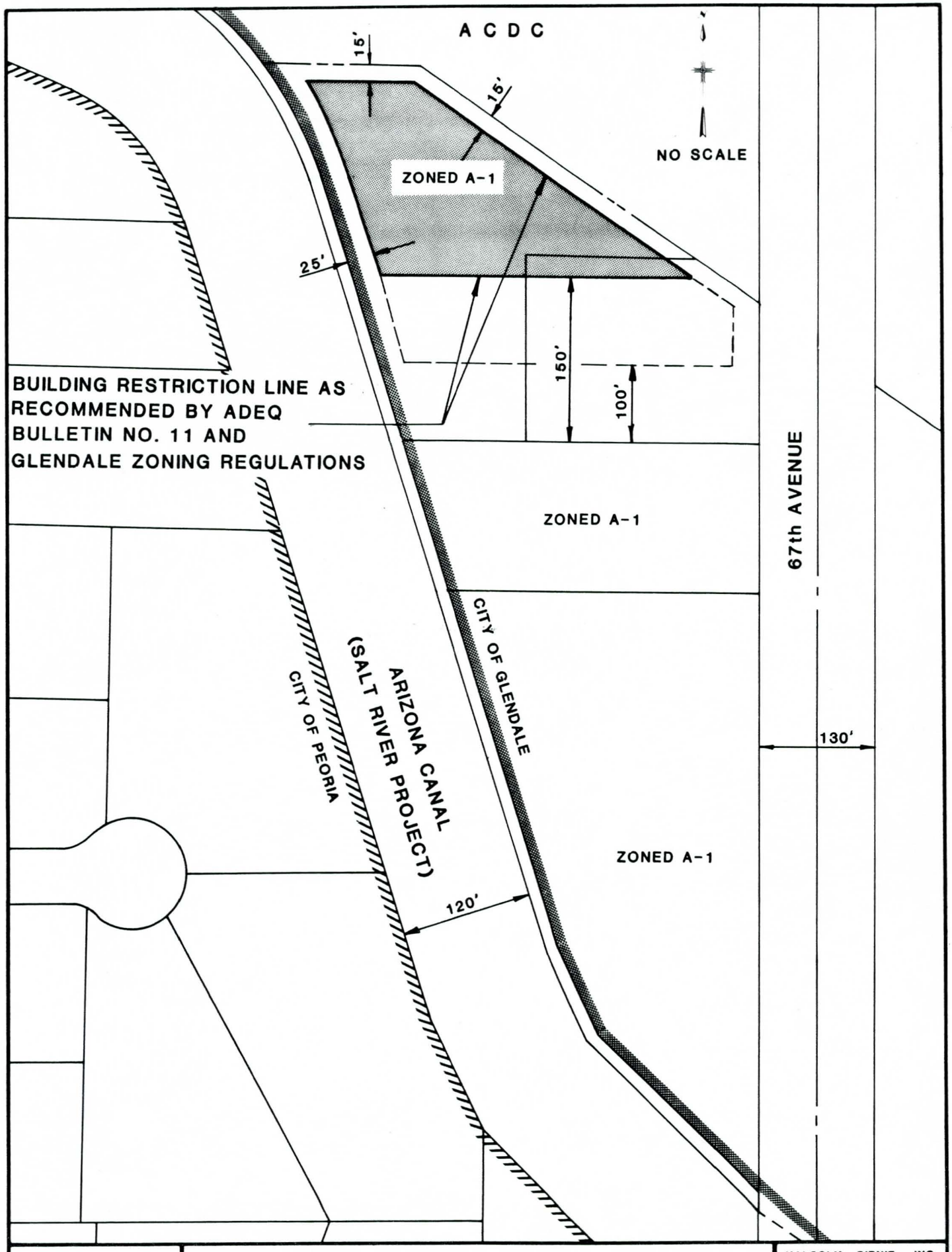
The Arizona Department of Environmental Quality (ADEQ) has established setback limits for the construction of wastewater reclamation facilities. These setback limits are dependent upon the treatment capacity of the facility and the degree of noise and odor controls to be employed at the facility. ADEQ setbacks limits are set forth in the Department's Engineering Bulletin No. 11. Table 2-1 summarizes these limits.

The ADEQ setback limits do allow structures not directly involved in the treatment process to be located outside of the setback line. Structures used for material storage, administrative offices, laboratories, and control building can be situated in this area.

Preliminary analysis indicates that the site of the Thunderbird Paseo WWRF can accommodate both Phase I and Phase II with a 100-foot setback from the property line of the vacant parcel to the south. In order to satisfy the ADEQ setback requirements, the City will need to acquire the vacant parcel to the south of the site prior to the Phase III expansion to accommodate the required 150-foot setback limit. It should be noted that the 150 foot setback is not a rigid standard and may be subject to negotiation with ADEQ. The available building area and setback limits for Phases I and II (100 feet) and Phases III and IV (150 feet) are shown in Figure 2-2.

SUMMARY OF SITE DEVELOPMENT REQUIREMENTS

The site of the Thunderbird Paseo WWRF is situated within a developed area and is confined by the surrounding development. The existing site can accommodate the Phase I and Phase II expansions with the required 100-foot



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THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY

BUILDING RESTRICTION LIMITS

MALCOLM PIRNIE, INC.

FIGURE 2-2

TABLE 2-1

ADEQ[1] MINIMUM SETBACK LIMITS

Plant Size[2]	No Controls[4]	Aesthetic, Noise, and Odor Control[6]	Enclosure with Noise and Odor Control[7]
5-25	250 feet	100 feet	25 feet
25-100	350 feet	200 feet	50 feet
100-500	500 feet	300 feet	100 feet
500-1000	750 feet	500 feet	*(5)
1 MGD[3]	1000 feet	750 feet	*(5)

Notes:

1. Setbacks from contiguous property lines per Arizona Department of Environmental Quality. (Engineering Bulletin No. 11.)
2. Ultimate Plant Capacity (x 1000 gallons per day).
3. Million Gallons per Day.
4. No noise or odor control measures used.
5. Setbacks established upon ADEQ individual project review basis for facilities with capacity greater than 1 MGD.
6. Noise and odor control measures in use.
7. Noise and odor control measures in use with treatment units enclosed.

setback. Prior to Phase III, the City will need to acquire the parcel to the south to meet the 150-foot ADEQ setback requirement. With the addition of this parcel, the site will accommodate the Phase IV expansion.

It is essential to make the most efficient use of the site to accommodate not only the Phase I facility, but all subsequent planned expansion. Therefore, it is recommended that the existing residence be demolished and replaced with a new operations building. This will allow the total 2.1 acres to be developed for the WWRF site. A preliminary Phase I site plan is included in Appendix B, Plate 1.

3. IRRIGATION

PHASE I IRRIGATION AREAS

Phase I of the Thunderbird Paseo WWRF will provide reclaimed water for irrigation of the Paseo recreational areas. The Paseo comprises approximately 200 acres, of which 185 acres will be landscaped with range grasses, and 15 acres will be landscaped with turf, trees, and shrubs. Those areas landscaped with range grasses will be maintained by the MCFCD while those areas landscaped with turf will be maintained by the City. Irrigation of the Paseo will occur during the hours between 12 a.m. and 6 a.m.

IRRIGATION DEMANDS

Original estimates of irrigation demands were developed by the WLB group, the designer of the proposed landscape and recreational facilities within the Paseo. Irrigation demands vary throughout the year, depending on weather conditions and growing seasons. The following definitions were used in assessing irrigation demands as well as production requirements for the WWRF:

- Annual Average - Average demand throughout the entire year. Original annual average demands were obtained from the designer (WLB Group) of the proposed landscaping and recreational facilities within the Paseo.

- Average Day (Maximum Month) - Average demand during the month of highest demand (usually June or July). This demand was computed as 165% of annual average demand, based on information provided by the WLB Group.

- Average Day (Minimum Month) - Average demand during the month of lowest demand (usually December or January). This demand was computed as 19% of annual average demand, based on information provided by the WLB group.

- Maximum Day (Maximum Month) - Average demand throughout the 24 hours of the highest demand day. This demand was computed as 120% of average day, maximum month, based on estimates of variations in daily irrigation demand.

STORAGE LAKE

Irrigation of the Paseo with reclaimed water will occur during those hours when the use and occupation of the Paseo by the public is at a minimum. Accordingly, reclaimed water which has been provided during the off-irrigation

hours will be stored until irrigation begins. Discussions with the COE indicate that storage may be located within the Paseo channel provided the storage facility does not adversely affect the hydraulic design of the channel. Therefore, reclaimed water storage within the Paseo will be provided with a lake whose maximum water surface elevation will be below the invert elevation of the Paseo channel. During a flood event the lake could be washed out, thus discharging reclaimed water into the floodway. For this reason certain discharge permits may be required. This is further discussed in Chapter 7.

The lake will be supplied by a gravity line from the chlorine contact chamber. The lake will have a working depth of 3 feet, and a maximum depth of 6 feet. Sides slopes of the lake will be constructed at a slope of 3:1 (horizontal to vertical). In order to prevent losses due to infiltration the bottom of the lake will be lined. The lake will be located adjacent to the WWRF as shown in Figure 3-1.

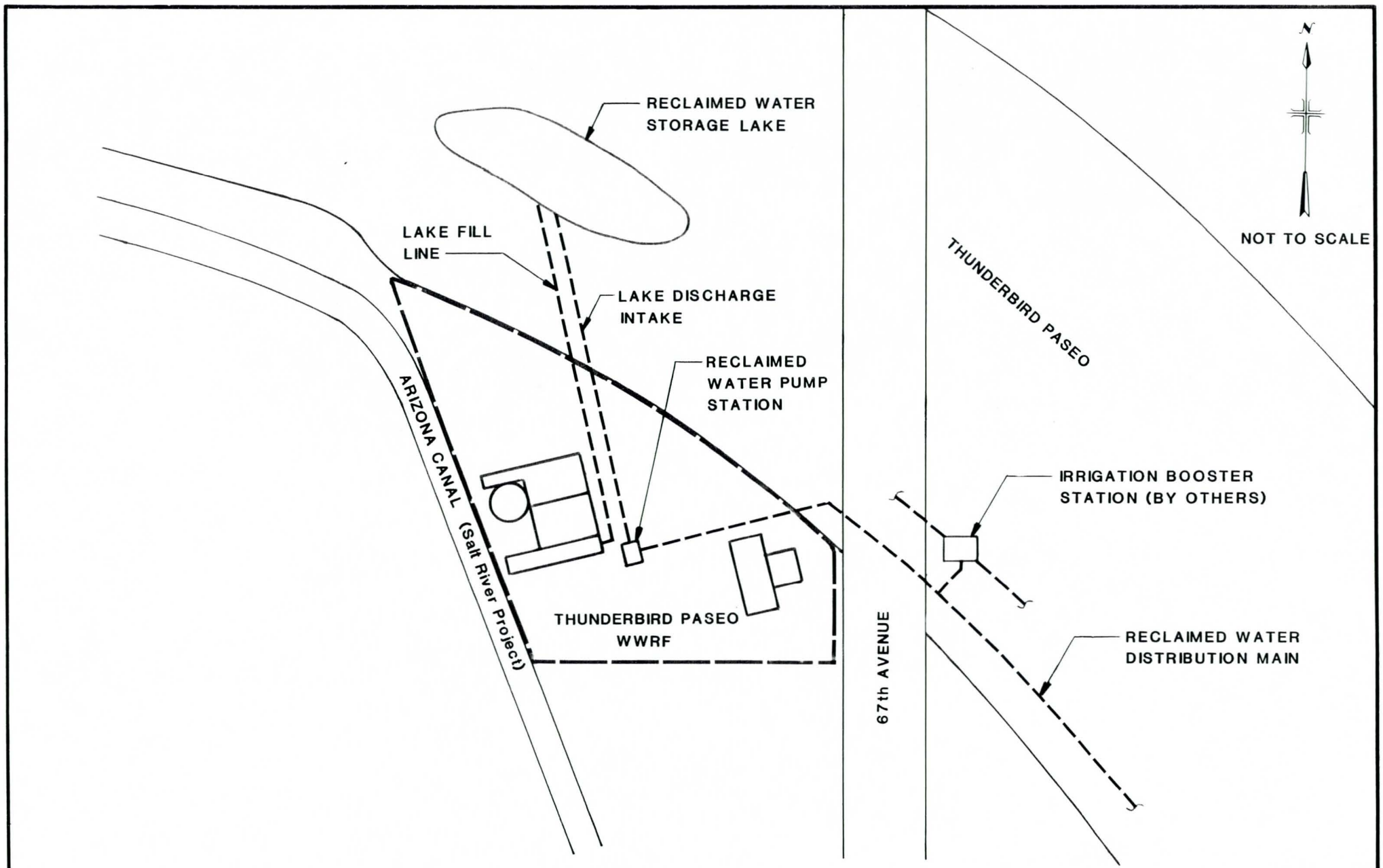
STORAGE REQUIREMENTS

Storage capacity of the lake is based upon the maximum demand. Table 3-1 summarizes the maximum demands for all phases as well as the estimated maximum storage capacity. The maximum storage capacity includes capacity for the maximum day demand and would be the actual storage capacity required. Peaks can be supplemented by using the water stored below the working storage level, or by using potable water. Estimated surface area for the lake in all phases is also shown in Table 3-1.

IRRIGATION SYSTEM OPERATION

The irrigation system for the Thunderbird Paseo as originally designed by the WLB Group is to be supplied through 4 separate connections to the City's potable water system. The portion of the Paseo within the city limits of the City of Peoria is to be supplied through a potable water well. When the WWRF is operational, the irrigation system will be supplied with reclaimed water as shown in Figure 3-2.

Reclaimed water will be delivered by gravity to the storage lake. The reclaimed water pumps will be located above the 100-year flood elevation of



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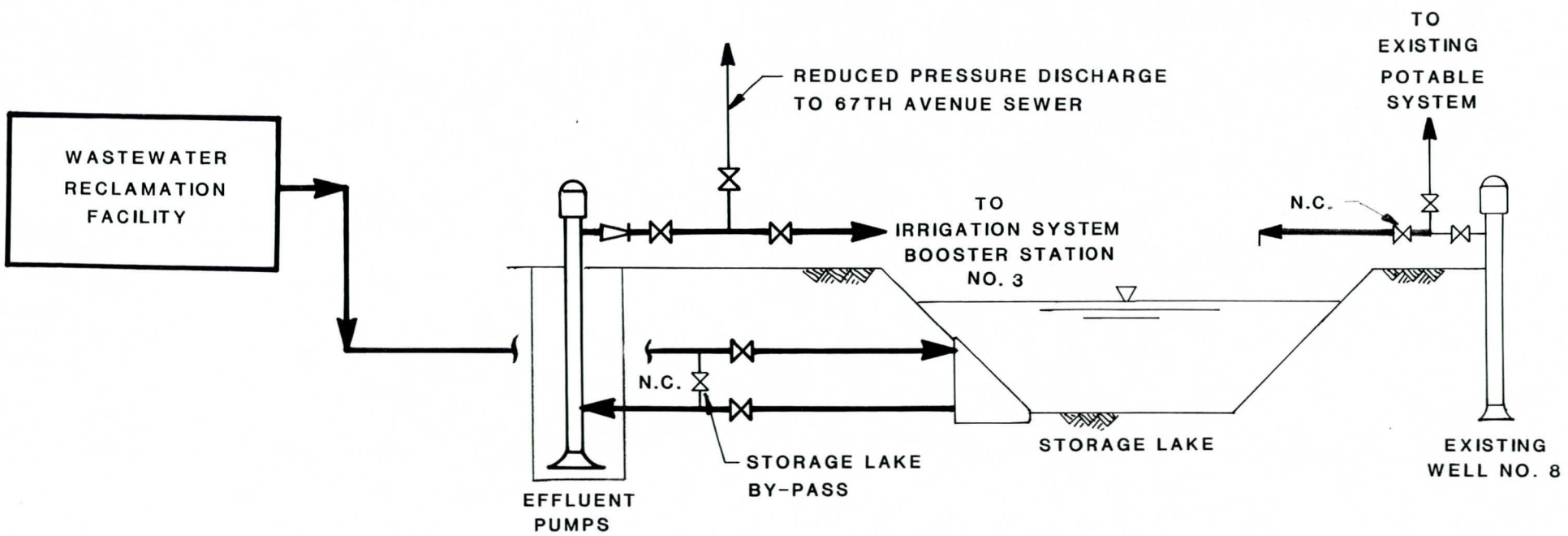
THUNDERBIRD PASEO
WASTEWATER RECLAIMATION FACILITY

IRRIGATION SYSTEM PLAN

MALCOLM PIRNIE, INC.

FIGURE 3-1



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THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY

IRRIGATION SYSTEM OPERATION SCHEMATIC

MALCOLM PIRNIE, INC.

FIGURE 3-2

TABLE 3-1

THUNDERBIRD PASEO WWRF
IRRIGATION DEMANDS AND STORAGE REQUIREMENTS

Phase	Plant Capacity	Estimated Irrigation Demand[1]	Estimated Storage Capacity[2]	Storage Lake Surface Area
I	0.5 MGD	0.41 MGD	0.40 MGD	0.5 acre
II	1.25 MGD	1.20 MGD	1.10 MGD	1.1 acre
III	2.5 MGD	2.40 MGD	2.20 MGD	2.3 acre
IV	3.25 MGD	3.20 MGD	3.00 MGD	3.1 acre

Notes:

1. Figures represent cumulative demands for Phases I, II, III, and IV.

2. Figures represent cumulative storage for Phases I, II, III, and IV.

the Paseo in order to avoid damage to the pump motors brought about by flooding. The reclaimed water pumps will pump from a wet-well which will be supplied by an intake pipe running from the lake bottom back to the wet-well. The wet-well will be approximately 30 feet deep.

The reclaimed water pumps will supply water to a 12-inch diameter pipe which will parallel the irrigation main designed by the WLB Group. Both pipes will be located in a common trench. The reclaimed water main, will deliver water at a static line pressure of approximately 60 psi to the three booster stations designed by WLB. Based on calculations supplied by the WLB group, the booster pumps will supply an additional pressure of approximately 70 psi to the irrigation system to compensate for losses through pipes and fittings.

It may be necessary to remove a treatment process unit from service temporarily for maintenance and/or repair. Depending on which unit is removed from service, the WWRF may not be able to treat wastewater to the quality required for irrigation of open-access landscaped areas. During this period, irrigation demands would be met from the City's potable water system. As shown in Figure 3-2, a discharge line from City Well No. 8 would be constructed to the storage lake. Potable water would then be discharged to the lake. This provides a temporary back-up system for the WWRF irrigation system and is only intended for occasional use.

4. WASTEWATER RECLAMATION

WATER QUALITY

As discussed in Chapter 3, the Thunderbird Paseo WWRF will produce reclaimed water to be used for irrigation. ADEQ requires that water reclaimed for irrigation of "open access" landscaped areas meet the limitations set forth in Table 4-1. Design of the reclamation facilities will be based on these criteria.

WASTEWATER CHARACTERISTICS

The WWRF will reclaim wastewater diverted from the existing 67th Avenue Pump Station. The wastewater is generated, for the most part, by domestic sources, and has the characteristics presented in Table 4-2. The wastewater has average concentrations of BOD_5 and suspended solids of 160 mg/L each and an average nitrogen concentration of 21 mg/L. A peaking factor of 1.5 was applied to these concentrations to develop design criteria. The facility will thus be designed to treat 240 mg/L BOD_5 and suspended solids, and 31 mg/L nitrogen, at design flow.

CAPACITY

Effluent from the Thunderbird Paseo WWRF will be used for irrigation. Reclaimed water requirements and plant capacity are based on maximum month, average day demand as defined and identified in Chapter 3. Initial maximum water production demand is estimated at 0.50 mgd, ultimately increasing to 3.25 mgd. These flow rates represent summer demands; demand for irrigation water during the winter months will average considerably less.

Wastewater will be diverted as needed to meet daily demands from the existing 67th Avenue Wastewater Lift Station, treated to meet the required limits, and either discharged directly to the irrigation system or to temporary storage.

DEVELOPMENT OF ALTERNATIVE TREATMENT SYSTEMS

Various treatment trains can be used to produce reclaimed water of the quality required to meet ADEQ standards for open-access irrigation. Processes

TABLE 4-1

ADEQ LIMITS FOR OPEN ACCESS LANDSCAPED AREAS

Parameter	Allowable Limit
pH	4.5 - 9
Fecal Coliform (CFU/100 ml)[1]	
geometric mean (5 sample minimum)	25
single sample not to exceed	75
Turbidity (NTU)[2]	5
Enteric Virus[3]	125/40 l
Ascaris Lumbricoides	none detectable[4]

Notes:

1. CFU = Colony Forming Units
2. NTU = Nephlometric Turbidity Units
3. Expressed as PFU, Plaque-Forming Units.
4. "None Detectable" means no pathogenic micro-organisms observed during examination.

TABLE 4-2

WASTEWATER CHARACTERISTICS[1]

Parameter	Concentration (mg/l)
Biochemical Oxygen Demand, 5-day (BOD_5)	160
Chemical Oxygen Demand (COD)	480
Suspended Solids	160
Oil and Grease	24
Total Nitrogen (as N)	30
Ammonia Nitrogen (as N)	21
Nitrate Nitrogen (as N)	0.3

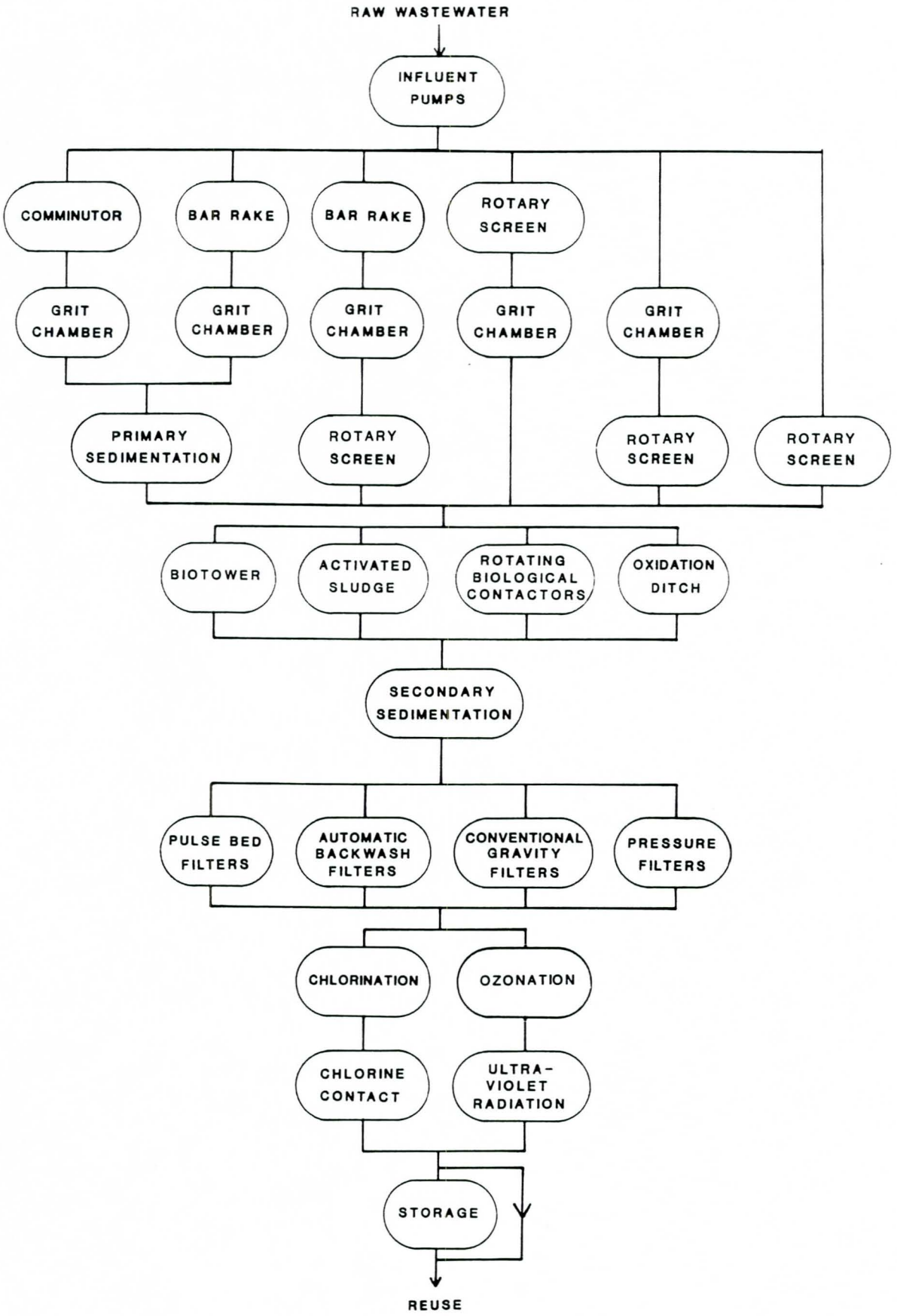
Note:

1. Data obtained from analyses conducted by City of Glendale at 67th Avenue Pump Station, August, 1986.

and operations considered in the preliminary design phase are depicted in the treatment process selection matrix, presented in Figure 4-1. All treatment alternatives developed contained the following elements:

- o Wastewater Diversion and Pumping - To divert wastewater from the existing sewer to the WWRF at a head sufficient to flow by gravity through the treatment train. Alternatives include:
  - Building new pumping facilities to divert wastewater from the existing 67th Avenue sewer
  - Replacing pumps in the existing 67th Avenue Wastewater Pump Station and constructing a diversion box to route flows by gravity to the reclamation facility.
- o Flow Measurement - To measure, record, and control wastewater flow to the plant. Experience indicates that the most effective alternatives for this type of plant are in-line magnetic flowmeters and Parshall flumes with ultrasonic flowmeters.
- o Solids Removal (Preliminary/Primary Treatment) - To remove large objects and grit from the wastewater which could damage, abrade, cause abnormal wear to, or otherwise interfere with downstream equipment and processes. Alternatives include combinations of the following units, preceded by either coarse screens or grinders:
  - Comminutors;
  - Bar rakes;
  - Primary clarifiers; and
  - Fine screens.
- o Organics Removal and Secondary Clarification (Secondary Treatment) - To remove oxygen-demanding organic material from the wastewater. Chemical treatment was excluded from consideration because of cost and operational requirements. Biological treatment alternatives include suspended growth processes, such as conventional activated sludge, extended aeration, and the oxidation ditch, and attached growth processes, such as the biotower and the rotating biological contactor.

  Secondary clarification removes settleable material from the treated wastewater and returns solids to the biological reactor, if required. Choices include:



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THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY

TREATMENT PROCESS SELECTION MATRIX

MALCOLM PIRNIE, INC.

FIGURE 4-1

- Rectangular units with chain and flight sludge scrapers
- Circular units, with or without flocculating equipment, in square basins
- Circular units, with or without flocculating equipment, in circular basins.

o Filtration - To remove suspended solids from the secondary effluent and reduce turbidity. Filtration alternatives include pressure filters; conventional gravity filters, and automatic backwash filters.

o Disinfection - To destroy pathogenic agents in the effluent prior to reuse. Disinfection alternatives included chlorination, ultraviolet (UV) irradiation, and ozonation.

EVALUATION OF ALTERNATIVES

The various treatment processes and operations evaluated in the preliminary design phase have been limited to those presented in Figure 4-1.

Wastewater Diversion and Pumping

Wastewater arrives at the proposed WWRF site via an existing 24-inch-diameter sewer, from which it enters the existing 67th Avenue Wastewater Pump Station. The wastewater spills through a basket screen into a wet pit, from which it is lifted 25.5 feet by three Allis-Chalmers dry-pit, non-clog centrifugal pumps and delivered to an existing 27-inch-diameter sewer. The wastewater then flows by gravity to the 91st Avenue Wastewater Treatment Facility. (Locations of sewers are shown on Figure 2-1.)

At current wastewater flows, the pumps at the lift station are oversized. One pump has already required overhaul maintenance because of cavitation-induced wear. This pump has been modified to hold the smallest impeller suitable for this model, and the discharge line is throttled about 50 percent to extend pumping time. The pump operates approximately 4 hours per day.

Two options for wastewater diversion are feasible:

o Construction of new pumping facilities specifically for routing flow to the WWRF.

- Modification of the existing pumping facilities, including installation of two new pumps in place of an existing pump at the 67th Avenue Pump Station and construction of a diversion box which would receive flows from the two new pumps and route the wastewater to the WWRF by gravity.

The main disadvantage of using existing facilities would be the interdependence of the wastewater lift operation and the WWRF influent pumping. If constant speed pump drives are used to power the WWRF influent pumps, the diversion structure will receive a constant rate of flow which exceeds the needs of the WWRF. Thus, a certain portion of the flow will be pumped to a higher head than otherwise required and diverted back to the 67th Avenue sewer. This will result in higher operating costs. In Phase I operation, these costs are minimal. In later phases, variable speed drives may be more cost effective.

Modification of the existing facilities is attractive for two reasons:

- Reduction of capital costs. Changes to the existing pump station are limited to:
  - Removal of one existing pump and support
  - Addition of two pumps and supports
  - Modification of existing instrumentation, including addition of new starters
  - Modification of piping to accommodate new pumps and to divert flow to the WWRF
  - Addition of odor control facilities

  The estimated cost of these modifications is approximately $130,000. Construction of new pumping facilities is estimated to cost $450,000.

- Improvement in current pumping operation. Incorporation of smaller pumps into the existing lead-lag system will decrease detention times in the pump station wet well, thus reducing odors and solids accumulation. Wear on pumps will be reduced as the existing pumps will no longer serve as lead pumps, and the small pumps will operate on a continuous basis.

The significant reduction in cpaital costs and the improvement in the efficiency of the existing pump station operation make the modification of the existing facilities more attractive than the construction of a new influent pump station. Modification of the existing pump station is therefore recommended.

Flow Measurement

The accuracy of in-line magnetic flowmeters depends upon maintenance of a range of velocities and full-pipe flow. Both these conditions are difficult to maintain in piping designed to accommodate the wide range of future flows. The use of a Parshall flume with ultrasonic flowmeter permits gravity flow through the unit over a wide range of velocities and is therefore recommended.

Preliminary/Primary Treatment

Removal of large objects from the influent to the 67th Avenue Lift Station sewer is provided primarily for pump protection. Currently wastewater flows through a basket screen at the outfall of the sewer into the pump station. The screen is an operational problem and should be replaced. Installation of any other type of screen, however, would require construction of deep-pit, upstream facilities, which would be expensive, difficult to construct, and hard to maintain.

A second, more cost effective alternative is replacement of the basket screen with grinding equipment. A support structure for this type of equipment is available which allows it to be positioned at the outfall of the sewer into the wet-pit, with provisions for coarse screening in case of equipment failure.

Removal of small objects and fines can be accomplished by a number of different units, including the following combinations:

1. Comminutors - Grit Chambers - Primary Clarifiers.
2. Bar Rakes - Grit Chambers - Primary Clarifiers.
3. Bar Rakes - Grit Chambers - Fine Screens.
4. Fine Screens - Grit Chambers.

5. Grit Chambers - Fine Screens.

6. Fine Screens.

Alternatives 1 and 2 include primary clarifiers, which, while very effective for reducing both inorganic and organic loads on secondary treatment processes, require significant space and can be a major source of odors. Alternatives 3 through 6 include various combinations of bar rakes, grit chambers, and fine screens. Experience indicates, however, that most grit-type solids can be removed on fine screens with openings of 0.04 inches or less. Installation of fine screens alone is most attractive, reducing both capital and operating costs while minimizing land area requirements for primary treatment.

Two types of fine screens are available: static and rotary. While the static screen is slightly less expensive and requires no power input, there is a tendency for solids to occasionally "hang-up" on the screen. This requires regular operator attention. The rotary screen, equipped with a small motor and spray cleaning device, provides a positive method of screen cleaning, thereby reducing the need for frequent operator attention.

Secondary Treatment

Both attached and suspended growth biological systems were considered for secondary treatment. Attached growth systems, including biotowers and rotating biological contactors, were eliminated from consideration after reviewing performance records of existing facilities in the Southwest. While capable of meeting high treatment standards for organic removal, attached growth systems produce an effluent which is difficult to filter to desired turbidity levels. To achieve low turbidity, addition of significant doses of chemicals may be required, resulting in higher operating cost. The high profile of biotowers is also inconsistent with site development goals to maintain the residential nature of the proposed facility.

Suspended growth systems considered included the oxidation ditch, conventional activated sludge, and extended aeration. The oxidation ditch, which generally requires significantly more land area than other suspended growth

systems, was eliminated from consideration because of space restrictions at the proposed site.

The extended aeration process, although requiring more land area than conventional activated sludge, is a better alternative for the proposed facility for the following reasons:

- While requiring more land area than conventional activated sludge, the extended aeration process is generally more stable than the conventional process, its longer detention times resulting in greater plant reliability and requiring less operator attention.
- Nitrification is easily achieved at design detention times
- Tankage can be designed to accommodate future process changes, including the addition of anoxic and oxic zones for denitrification. (Denitrification to reduce nitrate levels to drinking water standards would be required if the option to store reclaimed water underground for subsequent recovery were exercised.)

Three types of aeration systems were considered: coarse bubble, fine bubble, and jet aeration. Air and mixing requirements were determined for all three aeration systems. Coarse bubble aeration was eliminated from consideration as it had significantly lower oxygen transfer efficiencies at the basin depths mandated by the site. The capital and operating and maintenance costs of the two remaining alternatives were evaluated. Comparison of the two systems showed that the fine bubble system had lower capital cost, lower power requirements, and more flexibility in terms of distributing air flow, a key factor in the ability to modify basins for denitrification, if desired, in the future.

Circular clarifier mechanisms contained in square basins were eliminated from consideration due to unfavorable experience by City operations staff in the past with sludge collection in this configuration. The decision to design circular, rather than rectangular, clarifiers was based upon and the option to include flocculating equipment as part of the circular clarifier mechanism, if desired.

Filtration

Filtration of secondary effluent is required to consistently achieve the low turbidity limits for reuse. Automatic backwash (ABW) filters are more attractive than conventional gravity and pressure filters for the proposed reclamation facility for the following reasons:

- o Simplified backwash operation. Pressure and convential gravity filters require extensive, sometimes complicated backwash piping; backwash methods for these filters require major pumping and water storage facilities.
- o Extended life. ABW filters are housed in concrete concrete tanks, which are more durable than the vessels used to contain pressure filters.
- o Economic competitiveness.

Disinfection

Disinfection of the filtered effluent is required to achieve the fecal coliform and viral limits set for reuse. The three principal methods of wastewater disinfection are ozonation, ultraviolet (UV) irradiation, and chlorination.

Ozonation is not a suitable alternative at this site for several reasons. Ozone is unstable, potentially explosive, and must be manufactured on-site. Equipment that comes in contact with ozone must be stainless steel, as it is highly reactive. Ozone also carries a pungent odor, which, in the concentrations applied to disinfect wastewater, may be detectable. There is also no disinfectant residual.

UV irradiation, although attractive for small facilities because of relatively low operation and maintenance costs, has high capital costs which make it economically comparable to chlorination in present worth terms. System effectiveness depends upon consistency of effluent quality. Although there is some flexibility in dosage, disinfection capability can be greatly decreased by increases in effluent turbidity.

Chlorination is the disinfection technique most commonly employed for similar facilities. It is reliable and effective regardless of likely

variations in effluent quality. Installation of chlorination facilities has the additional advantage of providing a source of chlorine for use in the primary odor control system at the WWRF. In addition, chlorination provides a disinfection residual.

PROCESS TRAIN FOR SELECTED ALTERNATIVE

General descriptions of selected process are presented below. Processes were designed to comply with ADEQ requirements as set forth in Engineering Bulletin No. 11. The process flow schematic for the selected alternative is shown in Appendix B, Plate 4; design criteria and unit characteristics are presented in Table 4-4.

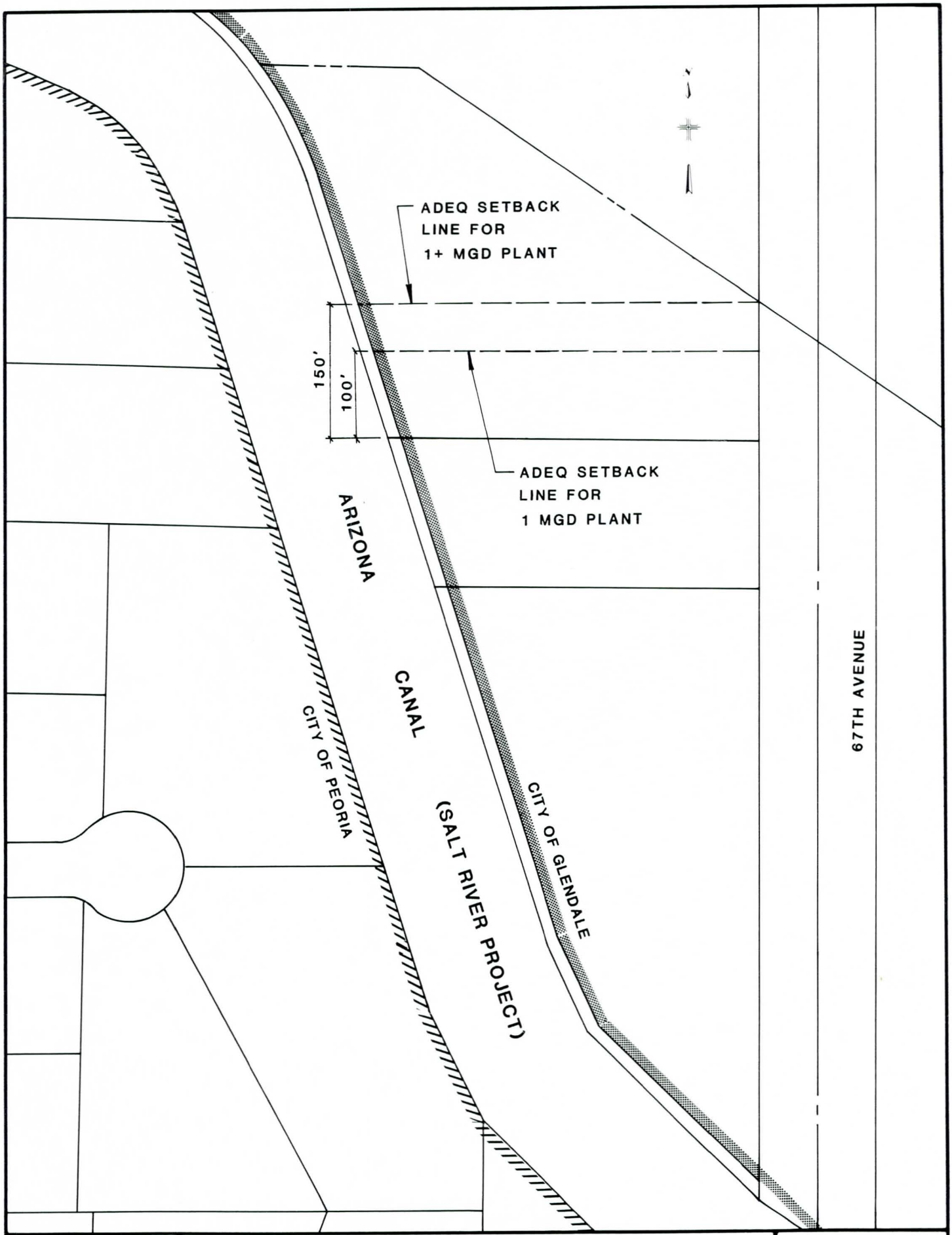
Phasing Capacity and Process Redundancy

Two factors were paramount in process selection with respect to phasing capacity and process redundancy: reclaimed water demand and site limitations.

Reclaimed Water Demand - The proposed phasing of the Thunderbird Paseo WWRF was originally structured to meet irrigation requirements of five discrete groups of users. Preliminary sizing of treatment units and equipment selection indicated that combining Phases IV and V, with capacities of 0.5 and 0.25 mgd, respectively, would minimize total number of units and standardize unit sizes. Estimated reclaimed water demands and design capacities of each of the four resulting phases are presented in Table 4-3.

(Peak 2-hour flowrate (calculated as 2 times design flow rate) was also considered in preliminary process design. The ability of the WWRF to accommodate peak flows for short periods will allow operations staff to process more wastewater during high influent flows to the pump station. This may be a convenient way to maintain the reclaimed water reserve.)

Site Limitations - Site limitations are shown in Figure 4-2. The 150-foot setback applies to facilities with ultimate capacities greater than 1 mgd. As noted earlier, the 150-foot setback is not a rigid standard and may be subject to negotiation with ADEQ. The 100-foot setback applies to facilities with ultimate capacities of 1 mgd or less. The goal of process



MALCOLM PIRNIE

THUNDERBIRD PASEO
WASTEWATER RECLAMATION FACILITY

ADEQ SETBACK LIMIT

MALCOLM PIRNIE, INC.

FIGURE 4-2

TABLE 4-3

RECLAIMED WATER DEMANDS AND DESIGN CAPACITIES[1]

	Flowrate, MGD			
	Phase 1	Phase 2	Phase 3	Phase 4
RECLAIMED WATER DEMANDS				
Annual Average	.25	0.68	1.29	1.73
Average Day (Maximum Month)	.41	1.27	2.38	3.22
Average Day (Minimum Month)	.08	.24	.45	.61
Maximum Day (Maximum Month)	.50	1.52	2.86	3.86
DESIGN CAPACITY	0.50	1.25	2.50	3.25

Note:

1. Definition and identification of demands presented in Chapter 3.

TABLE 4-4

PRELIMINARY DESIGN CRITERIA AND PROCESS DESCRIPTIONS

Criteria/Process	Parameter	Unit[1]	Phase I (0.5 mgd)	Phase II (1.25 mgd)	Phase III (2.5 mgd)	Phase IV (3.25 mgd)
EFFLUENT LIMITS	Concentration	mg/L				
	-BOD5		10	10	10	10
	-Total Suspended SOlids (TSS)		15	15	15	15
	-Total Kjeldahl Nitrogen (TKN)		10	10	10	10
	Turbidity	NTU	1 to 5	1 to 5	1 to 5	1 to 5
INFLUENT FLOWRATE	Flowrate	mgd				
	-Max Month, Maximum Day (Design)		0.50	1.25	2.50	3.25
	-Annual Average		0.25	0.63	1.25	1.67
	-Max Month, Average Day		0.41	1.04	2.08	3.00
	-Peak 2-hr		1.00	2.50	5.00	6.50
INFLUENT LOAD	BOD5					
	-Concentration	mg/L	240	240	240	240
	-Load					
	@ Design	lbs/d	1001	2502	5004	6505
	@ Avg Day	lbs/d	821	2082	4163	6005
	Total Suspended Solids (TSS)					
	-Concentration	mg/L	240	240	240	240
	-Load @ Design	lbs/d	1001	2502	5004	6505
	Total Kjeldahl Nitrogen (TKN)					
	-Concentration	mg/L	45	45	45	45
	-Load @ Design	lbs/d	188	469	938	1220
	Amonia (NH3-N)					
	-Concentration	mg/L	31	31	31	31
	-Load @ Design	lbs/d	131	328	657	854
	@ Avg Day	lbs/d	108	273	546	788
Preliminary Treatment						
GRINDING	Number					
	Existing		0	2	3	3
	New		2	1	0	0
	Total		2	3	3	3
	Total Capacity	gpm	3760	5640	5640	5640

TABLE 4-4 (Cont'd)

PRELIMINARY DESIGN CRITERIA AND PROCESS DESCRIPTIONS

Criteria/Process	Parameter	Unit[1]	Phase I (0.5 mgd)	Phase II (1.25 mgd)	Phase III (2.5 mgd)	Phase IV (3.25 mgd)
INFLUENT PUMPING	Number					
(WITH DIVERSION)	Existing		3	4	4	3
	Removed		-1	-2	2	0
Type:	New		2	2	1	0
Wastewater	Total		4	4	3	3
Centrifugal						
	Capacity	gpm				
	Pump 1		350	870	3000	3000
	Pump 2		350	870	3000	3000
	Total Dynamic Head	ft	50	50	50	50
SCREENING	Number					
	Existing		0	1	1	2
Type:	New		1	0	1	0
Rotating Screen	Total		1	1	2	2
	Screen Opening	in	0.04	0.04	0.04	0.04
	Total Capacity	gpm	2250	2250	4500	4500
BYPASS	Number					
SCREENING	Existing		0	1	1	1
	New		1	0	0	0
Type:	Total		1	1	1	1
Manual Bar						
	Bar Opening	in	1	1	1	1
	Channel Dimensions					
	-Width	ft	1	1	1	1
	-Depth	ft	1.5	1.5	1.5	1.5
	Velocity	ft/sec				
	@ Design		0.52	1.29	-	0.01
	@ 20hr Peak		1.03	2.58	1.81	3.36

TABLE 4-4 (Cont'd)

PRELIMINARY DESIGN CRITERIA AND PROCESS DESCRIPTIONS

Criteria/Process	Parameter	Unit[1]	Phase I (0.5 mgd)	Phase II (1.25 mgd)	Phase III (2.5 mgd)	Phase IV (3.25 mgd)
Secondary Treatment						
BIOLOGICAL TREATMENT FOR NITRIFICATION	Number of Basins					
	Existing		0	2	4	5
	New		2	2	1	1
	Total		2	4	5	6
Type: Extended Aeration						
	Volume	cu ft	33422	33422	66845	66837
	-per Basin		66845	133690	200535	267372
	Basin Dimensions	ft				
	-Length		55.7	55.7	55.7	55.7
	-Width		30.0	30.0	60.0	60.0
	-Sidewater Depth		20.0	20.0	20.0	20.0
	Parameters @ Design Flow					
	-Hydraulic Retention Time	hrs	24	19.2	14.4	14.8
	-BOD5 Loading	lbs/1000 cu ft	15.0	18.7	25.0	24.3
	-Mixed Liquor Suspended	mg/l	2209	2209	3680	3588
	-Mean Cell Residence Time	days	10	10	10	10
	-Food:Microorganism Ratio	lbs/d	0.109	0.136	0.109	0.109
AERATION	02 Required @ Peak 2-hr	lbs/d	2104	5004	10008	13010
	Air Required @ Peak 2-hr	scfm				
Type:	-based on Oxygen Required		584	1390	2780	3614
Fine Bubble	-based on Mixing Required		401	802	1203	1604
Disc Diffusors with Rotary Blowers		Number of Blowers				
	Existing		0	2	3	5
	New		2	1	2	0
	Total		2	3	5	5
	Unit Capacity (New)		700	700	1500	-
	Firm Capacity		700	1400	3600	3600

TABLE 4-4 (Cont'd)

PRELIMINARY DESIGN CRITERIA AND PROCESS DESCRIPTIONS

Criteria/Process	Parameter	Unit[1]	Phase I (0.5 mgd)	Phase II (1.25 mgd)	Phase III (2.5 mgd)	Phase IV (3.25 mgd)
SECONDARY CLARIFICATION	Number					
	Existing		0	1	2	3
	New		1	1	1	1
Type: Flocculator	Total		1	2	3	4
	Basin Dimensions					
	-Diameter	ft	36	36	56	56
	-Depth	ft	12	12	12	12
	Total Area	sq ft				
	-All units in service		1018	2036	4499	6962
	-Largest unit out of service		0	220	440	785
	Weir Length	lin ft				
	-All units in service		220	440	785	1131
	-Largest unit out of service		0	1018	2036	4499
	Overflow Rate	gpd/sq ft				
	-All units in service					
	@ Design Flow		491	614	556	467
	@ Avg Day Flow		403	511	462	431
	-Largest unit out of service					
	@ Design Flow		0	1228	1228	722
	@ Avg Day Flow		0	1022	1022	667
	Weir Loading	gpd/lin ft				
	-All units in service					
	@ Design		2274	2842	3183	2874
	-Largest unit out of service					
	@ Design		0	5684	5684	4138
RETURN/WASTE SLUDGE PUMPING	Number					
	Existing		0	2	3	3
	Remove		0	-1	-2	-1
Type: Two-sped, non-clog, Wastewater Centrifugal	New		2	0	2	1
	Total		2	3	3	3
	Capacity	gpm				
	Pump 1		521	521	521	1800
	Pump 2		521	521	1300	1300
	Pump 3		0	521	1300	1300
	Total Dynamic Head	ft	30	30	30	30
	Return Solids	mg/L	7500	7500	7500	7500

TABLE 4-4 (Cont'd)

PRELIMINARY DESIGN CRITERIA AND PROCESS DESCRIPTIONS

Criteria/Process	Parameter	Unit[1]	Phase I (0.5 mgd)	Phase II (1.25 mgd)	Phase III (2.5 mgd)	Phase IV (3.25 mgd)
Tertiary Treatment						
FILTRATION	Number of Filters					
	Existing		0	1	2	4
Type:	New		1	1	2	0
Automatic	Total		1	2	4	4
Backwash						
	Filter Bed Dimensions					
	-Width	ft	9	9	9	9
	-Length	ft	40	40	40	40
Media:						
Sand	Total Area					
	-All units in service	sq ft	360	720	1440	1400
	Largest unit out of service	sq ft	0	360	1080	1080
	Surface Loading Rate	gpm/sq ft				
	-All units in service					
	@ Design Flow		0.96	1.20	1.20	1.57
	@ Peak 2-hr Flow		1.93	2.41	2.41	3.13
	-Largest unit out of service					
	@ Design Flow		0.00	2.41	1.61	2.09
	@ Peak 2-hr Flow		0.00	4.82	3.21	4.18
DISINFECTION	Number of basins					
	Existing		0	1	2	3
Type:	New		1	1	1	1
Chlorine Gas	Total		1	2	3	4
	Hydraulic Detention Time	min				
	-@Design Flow		67	53	40	41
	-@Peak 2-hr Flow		33	27	20	21
	Volume	cu ft				
	-per Basin		3095	3095	3095	3095
	-Total		3095	6190	9285	12380

TABLE 4-4 (Cont'd)

PRELIMINARY DESIGN CRITERIA AND PROCESS DESCRIPTIONS

Criteria/Process	Parameter	Unit[1]	Phase I (0.5 mgd)	Phase II (1.25 mgd)	Phase III (2.5 mgd)	Phase IV (3.25 mgd)
DISINFECTION	Passes/basin		3	3	3	3
(cont'd)	Pass Dimensions	ft				
	-Length		18	18	18	18
	-Width		5.8	5.8	5.8	5.8
	-Depth		9.8	9.8	9.8	9.8
	Chlorine Dose					
	-@Annual Flow	mg/L	6.5	6.5	6.5	6.5
		lbs/d	13.6	33.9	67.8	90.4
	-@Design Flow	mg/L	15.0	15.0	15.0	15.0
		lbs/d	62.6	156.4	156.4	406.6
	Storage @ Design Flow	Days	30	30	30	30
	Volume @ Design Flow	lbs	1877	4691	9383	12197
RECLAIMED	Number					
WATER PUMPING	Existing		0	3	4	4
	Removed		0	-1	-1	-1
Type:	New		3	2	1	1
Vertical Turbine	Total		3	4	4	4
	Capacity	gpm				
	Pump 1		600	600	600	600
	Pump 2		600	600	2800	2800
	Pump 3		600	2800	2800	2800
	Pump 4		-	2800	2800	2800
	Total Dynamic Head	ft	185	185	185	185
RECLAIMED	Capacity	mg	0.37	1.08	2.16	2.88
WATER STORAGE	Operating Depth	ft	3	3	3	3
	Area	10^3 sq ft	120	360	720	960

Type: Earthern
Basin

TABLE 4-4 (Cont'd)

PRELIMINARY DESIGN CRITERIA AND PROCESS DESCRIPTIONS

(1) ABBREVIATIONS

cu ft	cubic feet
ft	feet
ft/sec	feet per second
gpd/lin ft	gallons per day per linear foot
gpd/sq ft	gallons per day per square foot
gpm	gallons per minute
in	inches
lbs/day	pounds per day
lbs/day/sq ft	pounds per day per square foot
lin ft	linear feet
mg	million gallons
mgd	million gallons per day
mg/L	milligram per liter
min	minutes
NTU	nephelometric turbidity units
sq ft	square feet

selection and unit sizing was to fit the Phase I plant within the 150-foot setback and to minimize future land acquisition by using commonwall construction and other space-saving design techniques in succeeding phases. Plate 1 in Appendix B shows the Phase I site plan. Plate 2 presents the phased development of the site.

Process Redundancy - Table 4-4 summarizes the numbers of units for each process and operation in each phase. Typical design would include redundant units for most processes. Based on discussions with the City, however, single units for grit removal, clarification, filtration, and disinfection in Phase I are recommended based on the following considerations:

- Ability to route all flow to 67th Avenue sewer in the event an essential unit is taken out of service.
- Compatibility with unit sizes in future phases.
- Provision of redundancy in future phases by addition of units.
- Reduction of Phase I construction costs.

Sufficient spare parts, including motors, should be inventoried on-site to minimize down-time due to equipment failure. Routine maintenance which requires that units be removed from service should be scheduled during low demand periods. In the event that an essential unit is taken out of service, irrigation water will be supplied temporarily from the existing potable water well.

Wastewater Pumping, Diversion, and Flow Measurement

The existing 67th Avenue Pump Station pumping facilities will be modified to meet reclamation needs. One of the three existing 3000-gpm pump will be retired and replaced in Phase I with two new constant-speed, non-clog wastewater centrifugal pumps, each rated at 350 gpm and sized to pump against about 50 feet total dynamic head (TDH). The other two 3000 gpm pumps, which are sized to pump against about 30 feet TDH, will pump flows in excess of 350 gpm

directly to the 67th Avenue sewer.

The higher head requirement will result from the addition of a new diversion structure. The new pumps will lift wastewater to the diversion structure, where the amount of flow released to the WWRF will be controlled by a motorized downward-opening flow control gate. A programmable controller will adjust the position of the gate by comparing the operator-set flowrate to the actual flowrate through the Parshall flume. Excess flow will be diverted through the gate to the 67th Avenue sewer.

In Phase II, the 350 gpm pumps will be replaced by constant speed, 870 gpm pumps, and operation will be identical to Phase I. The firm capacity of the station (one 3000 gpm pump out of service) will be approximately 4700 gpm, which will satisfy peak pumping requirements, based on estimates of peak influent flowrates reported by John Carollo Engineers, (Utilities Relocation: Arizona Canal Diversion Channel, 1982) through the year 2000.

When peak influent flowrates approach 4700 gpm (or when Phase III is implemented, should that occur first), the 870 gpm pumps will be replaced with one 3000 gpm pump sized to pump against 50 feet TDH. One of the existing 3000 gpm pumps will be modified (by increasing impeller size and motor horsepower) to pump against 50 feet TDH in order to serve as a standby. The cost effectiveness of constant-speed versus variable-speed motors for the reclamation pumps will depend upon the size of diurnal variations in pump station influent flowrate and must be evaluated prior to final design of Phase III. If the third 3000 gpm constant-speed pump, which will continue to be used to pump excess flow to the 67th Avenue sewer downstream of the WWRF, should fail, excess flow will be pumped by the WWRF influent pumps to the diversion box, from which it will flow by gravity to the 67th Avenue sewer.

Preliminary/Primary Treatment

In Phase I, the headworks will include one rotary screen with a manually cleaned bypass screen. The rotary screen will have openings of 0.04 inch. Screenings will be flushed to the sewer downstream of the facility. The bypass will permit continued operation of the facility when the screen is being serviced. A second screen will be added in Phase III.

Secondary Treatment

In Phase I, two extended aeration basins of equal size, together providing 24 hours hydraulic detention time, are proposed. The basins will be approximately 23 feet deep to minimize land area requirements. The basins will be piped such that one basin can be taken out of service as required. Each basin will be constructed such that it can be easily retrofitted with baffles to provide the required separate volume for denitrification. (As noted earlier, denitrification to reduce nitrate levels to drinking water standards would be required if the option to store reclaimed water underground for subsequent recovery were exercised.)

Phase I basins are designed for 24 hours hydraulic retention time (HRT), in conformance with the recommended guidelines presented in ADEQ's Engineering Bulletin No. 11. As can be seen from Table 4-4, future aeration basins will provide shorter HRTs. Based on experience with similar systems in the Southwest, these shorter HRTs should produce effluent which easily meets the State's criteria for irrigation of open-access landscaping (See Table 4-1). Final design of future aeration basins will be based upon performance of Phase I basins.

Ceramic disc diffusers will provide fine bubble aeration. Air will be supplied by a series of blowers sized to deliver 100 percent of the peak day process air requirements, including mixing, with one blower out of service. Larger blowers will be added or replace existing blowers in the aeration system as the plant is expanded.

One circular flocculator/clarifier with rapid suction sludge removal mechanism will be installed in Phase I. Additional clarifiers will be installed in future phases, for a total of four units.

Sludge return and wasting will be accomplished by two non-clog wastewater centrifugal pumps. Each pump will alternatively serve as duty pump and as standby. Pumps will be sized to deliver 150 percent of design flow rate. Waste sludge will be discharged as required to the 67th Avenue sewer.

Filtration

One automatic backwash filter will be installed in Phase I. Additional filters will be installed in future phases, for a total of four units.

Filters will contain 11 inches of silica sand.

Although current turbidity limits will be met without application of filtration aids, decreases in allowable turbidity levels similar to those in force in California would make their use necessary. To prepare for this possibility, space for future chemical storage and feed systems will be set aside at the Control Building, and provisions made to facilitate installation of equipment and piping to feed either inorganic coagulants or organic polymers to the flocculator/clarifiers.

Disinfection

Chlorination facilities will be provided for disinfection of secondary effluent and to deter growth in filter media. Facilities to utilize ton cylinders will be provided in Phase I, to supply both disinfection and odor control needs. Chlorination feed system capacity and contact basin volume will be increased in future phases.

CONTROLS

The proposed WWRF will be staffed with a single operator deployed part-time from Arrowhead Ranch WWRF. Important process parameters and operating status of essential units will be telemetered to Arrowhead Ranch WWRF and Cholla Water Treatment Facility for monitoring. Signals will be compatible with systems already in place (Phoenix Controls and BIF). Controls to operate the plant as described below will be provided.

Influent Pumping and Flow Measurement

Influent pumps will operate automatically, based on level in the wet well. Upon failure of any pump, the standby unit will be started automatically. As described earlier, the influent pumps will route wastewater to a diversion box, where flows in excess of the volume to be reclaimed will be diverted through a motorized flow-control gate to the 67th Avenue Sewer. Influent flowrate of wastewater routed to the WWRF will be measured and recorded by an ultrasonic meter at the Parshall flume.

Preliminary Treatment

The rotary screens will be provided with manual on-off and speed selection controls. A timer-controlled solenoid valve will activate an automatic spray wash at operator-set time intervals. When the water level in the screen feed box exceeds a certain point, indicating screen blinding, the spray wash will automatically start. If level does not subside, an alarm will be activated. Overflow will be diverted to the plant drain system.

Secondary Treatment

Aeration blowers will be multiple-speed, with manual on-off and speed selection controls. Upon failure of any blower, the standby unit will start automatically.

Return sludge pumps will be two-speed, with manual timers and speed selection controls. The standby unit will start automatically upon pump failure of duty pump to start.

Filtration

Turbidity of filtrate will be measured and recorded. A warning alarm will be activated when turbidity exceeds a manually set level. A second alarm will be activated and flow will be diverted to the 67th Avenue sewer when turbidity exceeds a second, higher manually set level.

Disinfection

Chlorine feed rate will be varied automatically in proportion to flow to meet an operator-controlled chlorine residual. If the chlorine residual analyzer fails, chlorine dosage will be maintained at a preset level by proportioning feed rate to flow.

Operations Building

An operations building will serve as the WWRF headquarters during those hours when operational maintenance personnel will be on site. The operations building will include space for the following uses:

- Maintenance shop
- Control room and Operator office
- Laboratory
- HVAC equipment
- Chlorine storage
- Spare parts storage
- Restroom (with shower)
- Janitor's closet
- Electrical equipment

The operations building will also include space for the influent diversion structure and rotary screens, as well as odor control equipment for these two items. It is anticipated that the operations building will not exceed one story in height. A preliminary floor plan of the operations building is included in Appendix B, Plate 3.

STANDBY POWER

A diesel-fueled generator will serve as a reserve power source for the Thunderbird Paseo WWRF in the event of a temporary power outage. Although flow could be diverted directly to the 67th Avenue sewer from the existing pump station during a power outage, standby power is still needed to operate the blowers in order to prevent clogging of disc diffusers and disruption of biological processes. Loss of biomass, from septic conditions in the aeration basins, could result in a lengthy interruption in water production until a new biomass is stabilized.

5. ENVIRONMENTAL CONTROLS

The Thunderbird Paseo WWRF will be located within an established community, adjacent to residential housing, commercial development and public parks. These surroundings impose certain restrictions and necessitate special design considerations concerning odor and noise control, and building and site architecture.

ODOR CONTROL

Facilities that are designed to collect and treat domestic wastewater, because of the nature of the product, can be odorous. The Thunderbird Paseo WWRF, to be a good neighbor, must implement positive measures to minimize the potential off-site odor impact of the treatment facilities.

For the WWRF, odor control measures for those facilities commonly identified with odors, and thereby, off-site impact will be implemented. Accordingly, the following areas of the proposed facility will be odor controlled:

- Existing Pump Station Wet Well.
- Proposed Influent Diversion Box and Rotary Screens Room.
- Proposed Extended Aeration Basins.

Based on Malcolm Pirnie's experience with nuisance odor assessment and odor control design in warm weather climates and the proximity of the neighboring community to the plant facilities, a high degree of odor control is required for this site. As a result, the following provisions will be incorporated into the odor control system in order to maximize the odor reduction and minimize the off-site nuisance odor impact:

- Enclose odorous processes. The pump station wet well (free volume of 11,000 cubic feet) is enclosed in an existing building; the diversion box and rotary screens will be enclosed in a 12,000 cubic foot room in the proposed control building and covers over the aeration basins will be provided (free volume of 6,400 cubic feet per basin).

- o Provide adequate surface protection for metal and concrete surfaces exposed in corrosive areas of buildings and under aeration tank covers.

- o Provide ventilation suitable for odor control at the pump station wet well and at the headworks. Forced air supply will be located at the ceiling level and exhaust registers located just above ground level. To create a negative air pressure in these areas and prevent the release of nuisance odors to the ambient atmosphere, the exhaust volume will be designed to remove a somewhat greater volume of air than the supply.

- o Ventilate the covered aeration basins. The ventilation system will be designed to establish a negative air pressure under the covers to preclude the release of any potential nuisance odors to the atmosphere.

The odor control systems will consist of wet scrubbing followed by carbon adsorption. These systems include:

- Duct work to deliver the nuisance odors to the control units.

- Wet scrubber units with chemical storage, chemical metering pumps, recirculation pumps, make-up water, fans, and air and water flow monitoring equipment.

- Carbon adsorption units.

Based on the given volumes and air change requirements, 2 scrubber units are proposed to control odors at the WWRF at ultimate capacity: a unit to control odors from the existing pump station wet well and new headworks room; and a unit to control odors from the aeration basins (ultimate free volume of 51,000-64,000 cubic feet). Phase I needs, including pump station wet well, headworks room, and two aeration basins, can be accommodated by one unit. It is recommended, therefore, that the larger of the units (the aeration unit) be installed in Phase I.

The units will be designed to control odors resulting from high concentrations of hydrogen sulfide (up to 9 ppm) in the pump station wet well.

Because of the concern for providing facilities that are in concert with the adjacent community, the odor control facilities will be designed not to exceed a vertical elevation of fifteen (15) feet.

NOISE CONTROL

Noise generated by wastewater reclamation facilities is typically the result of the operation of equipment such as centrifugal blowers, mechanical screen, and pumps. To minimize the level of noise discernible off-site, all mechanical equipment used in the Thunderbird Paseo WWRF will be located in enclosed spaces. Rotating screens for grit removal will be located inside the Operations Building. Blowers and pumps will be located in the Return Sludge Pumping Building.

SITE SCREENING

In order to minimize the visual impact which the WWRF may have on the surrounding community, the facility will be screened from exterior view. Screening can be accomplished with either fencing or construction of earth berms. Berming is not allowed by the City zoning code. Furthermore, the code only allows block wall fencing.

The City code requires a block wall fence to be a minimum of 5 feet in height for a parcel zoned A-1. This block wall will run continuously along the perimeter of the site except at the entrance gate. Architectural treatment at the fence will be consistent with those established for other structures within the WWRF site.

SITE SECURITY

Site security is necessary to ensure proper operation of the facility while providing for the safety of the public during those hours when the WWRF will be unmanned. The perimeter fence and access gate will provide the first level of security for the site.

The second level of site security will be provided by an intruder detection system to be incorporated into the entrance gate and perimeter fence. This system will serve to detect any intrusion into the plant site through the entrance gate and/or over the perimeter fence by way of a photoelectric beam system with a remote alarms at the City's Arrowhead and Cholla facilities.

Should the first and second security levels be breached, a third level of security will be used to detect intrusion on all treatment process units. Sonic curtain detectors will be located on all major process equipment such as

aeration basins, clarifiers, and filters. This system will also engage remote alarms at the Arrowhead and Cholla facilities.

ARCHITECTURAL TREATMENTS

The WWRF is intended to be a "good neighbor" facility. Although measures to control odors and noise will be incorporated into the design, the appearance of the facility should be in harmony with the surroundings. Accordingly, all structures such as the control and operations building and the existing lift station building will be designed to be architecturally consistent with style prevalent in the surrounding area. Buildings on the site will not significantly exceed one story in height.

6. PRELIMINARY COST ESTIMATES

Estimated construction cost for Phase I, and Phases II, III, and IV of the Thunderbird Paseo WWRF are presented in Tables 6-1 and 6-2, respectively. These estimates include the cost of materials, equipment, installation, and contractor overhead and profit.

BASIS OF COST ESTIMATES

Capital Costs

The following is a summary of the basis for the cost estimates presented in Tables 6-1, and 6-2.

1. Existing Lift Station Modifications:

   Estimate includes cost of new sewage grinders, new influent pumps, piping modifications, and removal of existing pumps.

2. Control Building:

   Estimate includes cost of excavation, backfill, concrete, architecture, chlorination equipment, and odor control equipment.

3. Diversion and Screening Structure:

   Estimate includes cost of concrete, rotary screen, flow control gate, flow meter, piping and valves, gratings, railings, and miscellaneous metals.

4. Aeration Basins:

   Estimate includes cost of excavation, backfill, concrete, air piping, diffusers, air manifold piping, blowers, spray water, fiberglass reinforced polyester cover, railings, return sludge piping, plug valves, influent sluice gates, and drain piping, and valves.

5. Secondary Clarifiers and Return Activated Sludge Pump Stations:

   Estimate includes cost of excavation, backfill, concrete, sludge collector with flocculator and rapid sludge withdrawal, telescopic valve, return sludge pumps, plug valves, check valves, flow meter, piping, and effluent launders.

6. Filters and Chlorine Contact Chamber

Estimate includes cost of excavation, backfill, concrete, filter equipment, weir plates, slide plates, and railings.

7. Reclaimed Water Pumping Station

Estimate includes cost of excavation, backfill, concrete, effluent pumps, piping, valves, and strainer.

8. Reclaimed Water Storage Lake

Estimate includes cost of excavation, backfill, hauling excess fill, liner, recirculation and aeration system, piping, and pumps.

9. Instrumentation

Estimate includes cost of telemetry systems, transmitters, level controls, and intrusion detection devices.

10. Electrical

Estimate includes cost of wire, conduit, trench excavation and backfill.

11. Reclaimed Water Distribution System

Estimate includes pipe, excavation, and backfill.

12. Outside Piping

Estimate includes pipe, excavation, and backfill.

13. Sitework

Estimate includes paving, blockwall, fencing, final grading, hauling excess fill, and demolition of existing non-useable structures.

14. Landscaping

Estimate represents aesthetic treatment of storage lake, and reclamation facility perimeter.

Unit Costs

The following is a summary of the unit cost used in developing the preliminary cost estimates.

Excavation	$6/cubic yard
Backfill	$8/cubic yard

Structural Concrete in place	$325/cubic yard
Hauling excess fill material	$5.50/cubic yard
Final grading	$2/square yard
Blockwall construction	$19/linear foot
Paving	$12/square yard
Landscaping	$13,000/acre

All unit costs are as of March 1, 1988.

Operating and Maintenance Costs

Annual operating and maintenance costs estimated for Phase I of the WWRF were prepared using the following unit costs:

- Labor: $15/hour
- Chemicals:
  - Chlorine $0.21/lb
  - Caustic $0.155/lb
  - Copper Sulfate $0.50/lb
- Power: $0.04/kwh
- Equipment Maintenance: 2½ percent of capital costs of mechanical equipment.

The following assumptions were used in developing estimates:

- Labor:
  - One operator deployed one half-shift per day from Arrowhead Ranch.
  - One administrative assistant employed 4 hours/week.
- Chemicals:
  - Chlorine used for continuous effluent disinfection and odor control.
  - Caustic used for continuous odor control.
  - Copper sulfate used 20 times per year as algicide at storage lake.

- Power:
  Total power requirements based on preliminary estimates of motor horsepower and projected operating schedule for all mechanical equipment.

Total annual O&M costs, based on the given assumptions and using these unit costs, are summarized below:

Annual O&M Costs

Labor	$ 25,000
Chemicals	80,000
Power	34,700
Maintenance	22,800
Total	$162,500

TABLE 6-1

THUNDERBIRD PASEO WWRF
PHASE I

ESTIMATED CONSTRUCTION COSTS

Item	Quantity	Cost[1]
Existing Lift Station Modifications	1	$ 112,000
Control Building	1	820,000
Diversion and Screening Structure	1	86,000
Aeration Basins	1	525,000
Secondary Clarifier/Return Activated Sludge Pump Station	1	315,000
Filter/Chlorine Contact Chamber	1	167,000
Reclaimed Water Pumping Station	1	87,000
Reclaimed Water Storage Lake	1	100,000
Instrumentation	1	111,000
Electrical	1	222,000
Reclaimed Water Distribution System	1	131,000
Outside Piping	1	50,000
Site work	1	66,000
Landscaping	1	8,000
	Subtotal	$2,800,000
	20% Contingencies	560,000
	Total	$3,360,000
	Cost at midpoint of Construction (2)	$3,660,000

Notes:

1. Costs in 1988 dollars.

2. Based on 5% annual inflation. Construction time estimated to be 18 months beginning March 1, 1989.

TABLE 6-2

THUNDERBIRD PASEO WWRF
PHASES II, III, IV

ESTIMATED CONSTRUCTION COSTS

Item	Phase II Costs(1)	Phase III Costs(1)	Phase IV Costs(1)
Existing Lift Station Modifications	$10,000	$ 59,000	$ 30,000
Control Building & Odor Control	---	459,000	---
Diversion and Screening Structure	---	43,000	---
Aeration Basins	508,000	546,000	486,000
Secondary Clarifier/Return Activated Sludge Pumping Station	296,000	402,000	390,000
Filter/Chlorine Contact Chamber	164,000	161,000	153,000
Reclaimed Water Pumping Station	30,000	90,000	40,000
Reclaimed Water Storage Lake	200,000	270,000	200,000
Instrumentation	60,000	102,000	65,000
Electrical	121,000	203,000	130,000
Reclaimed Water Distribution System	377,000	828,000	980,000
Outside Piping	30,000	50,000	30,000
Site work	20,000	30,000	30,000
Subtotal	$1,816,000	$3,243,000	$2,534,000
20% Contingencies	363,000	649,000	507,000
Total	$2,179,000	$3,892,000	$3,041,000

Note:

1. Costs in 1988 dollars

7. PERMITS

The Thunderbird Paseo WWRF project will be subject to review by federal, state, county, and local regulatory agencies. The regulatory review and permitting process can be separated into two distinct processes:

- Facility Review.
- Reuse Plan Review.

FACILITY REVIEW

Engineering plans and specifications will be reviewed by the Maricopa County Health Department (MCHD). MCHD has been delegated this responsibility by ADEQ. Along with engineering plans and specifications, an Application for Approval to Construct Wastewater Facilities must be submitted and approved by MCHD prior to construction.

Because the effluent storage lake will be located within the Paseo channel, plans and specifications for this lake will be submitted to the COE and the MCFCD for their review. Prior to lake construction the MCFCD will require the City to obtain a license to use right-of-way. The COE has not yet indicated whether or not any permits will be required.

REUSE PLAN REVIEW

The ADEQ will review the reuse plan for the Thunderbird Paseo WWRF project to ensure that the rules and regulations established by the State of Arizona for wastewater reuse management are met. This review process will further ensure that potential discharges of effluent to ground or surface waters will not be detrimental to the environment or public health.

ADEQ requires that all newly constructed wastewater treatment facilities submit a Notice of Disposal (NOD). The NOD serves to notify the state of the location and quality of treated wastewater discharge. An application for a permit to reuse wastewater will also be submitted. This permit is required of any facility intending to reuse treated wastewater.

The effluent storage lake will be located within the ACDC floodway. The ACDC empties into a tributary of the Gila River which is a protected waterway

of the United States. The opportunity and frequency of an indirect discharge of reclaimed water into the ACDC during a flood event is minor given the design frequency of flood events for which the ACDC is designed to contain. Nevertheless, discussions with the Environmental Protection Agency (EPA) have indicated that because of the possibility of a reclaimed water discharge to the Gila River during a flood event within the ACDC channel, a National Pollutant Discharge Elimination System (NPDES) permit will be required for the Thunderbird Paseo WWRF. The NPDES permit is not required to discharge reclaimed water to the storage lake. The NPDES permit application describes the frequency, location, and quality of the effluent discharged.

PERMIT ACQUISITION

Acquisition of the required permits should begin in the early stages of the design phase. Applications for NPDES and Reuse permits, and an NOD can be made as soon as reclaimed water quality characteristics have been established. A summary of permit requirements is given in Table 7-1.

TABLE 7-1

PERMIT REQUIREMENTS[1]

Agency	Permit Description
ADEQ	Notice of Disposal
ADEQ	Wastewater Reuse Permit
EPA	National Pollutants Discharge Elimination System Permit[2]
MCHD	Approval to Construct Wastewater Treatment Facilities
MCFCD	License to Use Right-of-Way
MCHD	Approval to Operate

Notes:

1. Permits to be acquired by the City of Glendale or its designiated agent. Building permit not included (to be acquired by Contractor).

2. NPDES permit required for occasional flood event discharge only.

APPENDIX A

APPENDIX A

CITY OF GLENDALE
THUNDERBIRD PASEO WASTEWATER RECLAMATION FACILITY

PRELIMINARY DRAWING LIST FOR FINAL DESIGN

General

1. Cover Sheet, Location Plan
2. Index and General Notes
3. Site Plan (Boring Location, Grading) (1" = 20')
4. Site Details
5. Outside Piping Plan (1" = 20')
6. Outside Piping Details
7. Landscaping Plan - Irrigation (1" = 20')
8. Landscaping Plan - Plantings (1" = 20')
9. Landscaping Details (Irrigation Details and Planting Details)

Civil/Sanitary and Structural

10. Process Flow Schematic
11. Hydraulic Profile
12. Existing Sewage Lift Station Modifications - Plans
13. Existing Sewage Lift Station Modifications - Section and Details
14. Operations Building - Plan (Diversion, Screenings, etc.) (1/4" = 1'-0")
15. Operations Building - Sections (1/4" = 1'-0")
16. Operations Building - Sections and Details
17. Aeration Basin and Clarifier - Upper Plan (1/4" = 1'-0")
18. Aeration Basin and Clarifier - Lower Plan (1/4" = 1'-0")
19. Aeration Basin and Clarifier - Sections

Preliminary Drawing List (cont'd)

20. Aeration Basin and Clarifier - Sections
21. Aeration Basin and Clarifier - Sections and Details
22. Filters and Chlorine Contact Chamber - Plan (1/4" = 1'-0")
23. Filters and Chlorine Contact Chamber - Sections (1/4" = 1'-0")
24. Filters and Chlorine Contact Chamber - Sections and Details
25. Reclaimed Water Pumping Station - Plans (Upper/Lower)
26. Reclaimed Water Pumping Station - Sections
27. Miscellaneous Details
28. Structural Details
29. Structural Details
30. Structural Details

Architectural

31. Plan
32. Elevations
33. Wall Sections and Details
34. Reflected Ceiling Plan and Roof Plan
35. Details (Door, Railing, Ladder, and Interior)
36. Miscellaneous

Heating and Ventilating; Plumbing and Sprinklers

37. Plans and Symbols
38. Sections and Details
39. Flow Schematics, Heating and Cooling - Riser Diagrams
40. Details

Preliminary Drawing List (cont'd)

Instrumentation

41. Symbols and Legend

42. P and ID - Influent Pumps, Diversion and Screenings

43. P and ID - Clarifier and Aeration

44. P and ID - Filter, Chlorine Contact Chamber and Reclaimed Water Pump Station

45. Details and Chemical Diagrams

Electrical

46. Symbols and Abbreviations

47. Site Plan

48. One-Line Diagrams

49. Power Plan - Existing Pump Station and Operations Building

50. Lighting Plan - Operations Building

51. Power and Lighting - Aeration Tank and Clarifiers

52. Power and Lighting - Filters, Chlorine Contact Chamber and Reclaimed Water Pump Station

53. Control Schematics

54. Panel Schedules

55. Details

RECLAIMED WATER DISTRIBUTION AND LAKE SYSTEM

56. Irrigation Lake Site Plan and Outside Piping

57. Irrigation Lake Details and Cross Sections

58. Piping Profiles - Supply Pipe

59. Piping Profiles - Return Pipe

Preliminary Drawing List (cont'd)

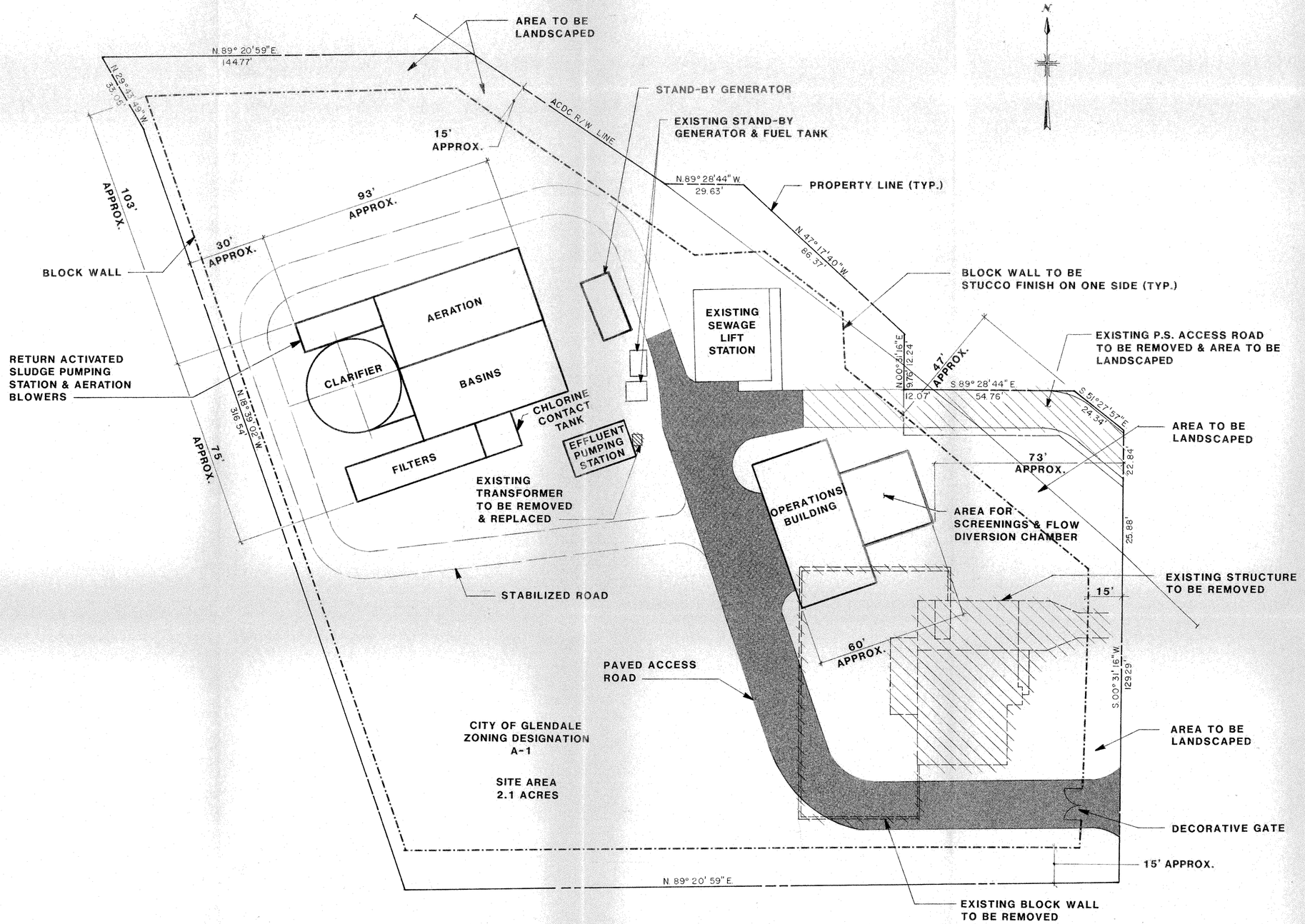
60. Recirculation and Aeration System - Plans and Sections and Diagrams
61. Electrical and Instrumentation
62. Details

IRRIGATION SYSTEM

63. Partial Plan (1" = 40')
64. Partial Plan (1" = 40')
65. Partial Plan (1" = 40')
66. Partial Plan (1" = 40')
67. Partial Plan (1" = 40')
68. Partial Plan (1" = 40')
69. Details

APPENDIX B

PLATES



NOTES

1. ALL UTILITIES ON SITE TO BE UNDERGROUND: WATER, SEWER, ELECTRICAL, ETC.

PRELIMINARY

MALCOLM PIRNIE

REVISIONS				
NO.	BY	DATE	REMARKS	
				DES
				DWN
				CKD

CITY OF GLENDALE
GLENDALE, ARIZONA

THUNDERBIRD PASEO WASTEWATER RECLAMATION FACILITY

PRELIMINARY DESIGN

PHASE I SITE PLAN

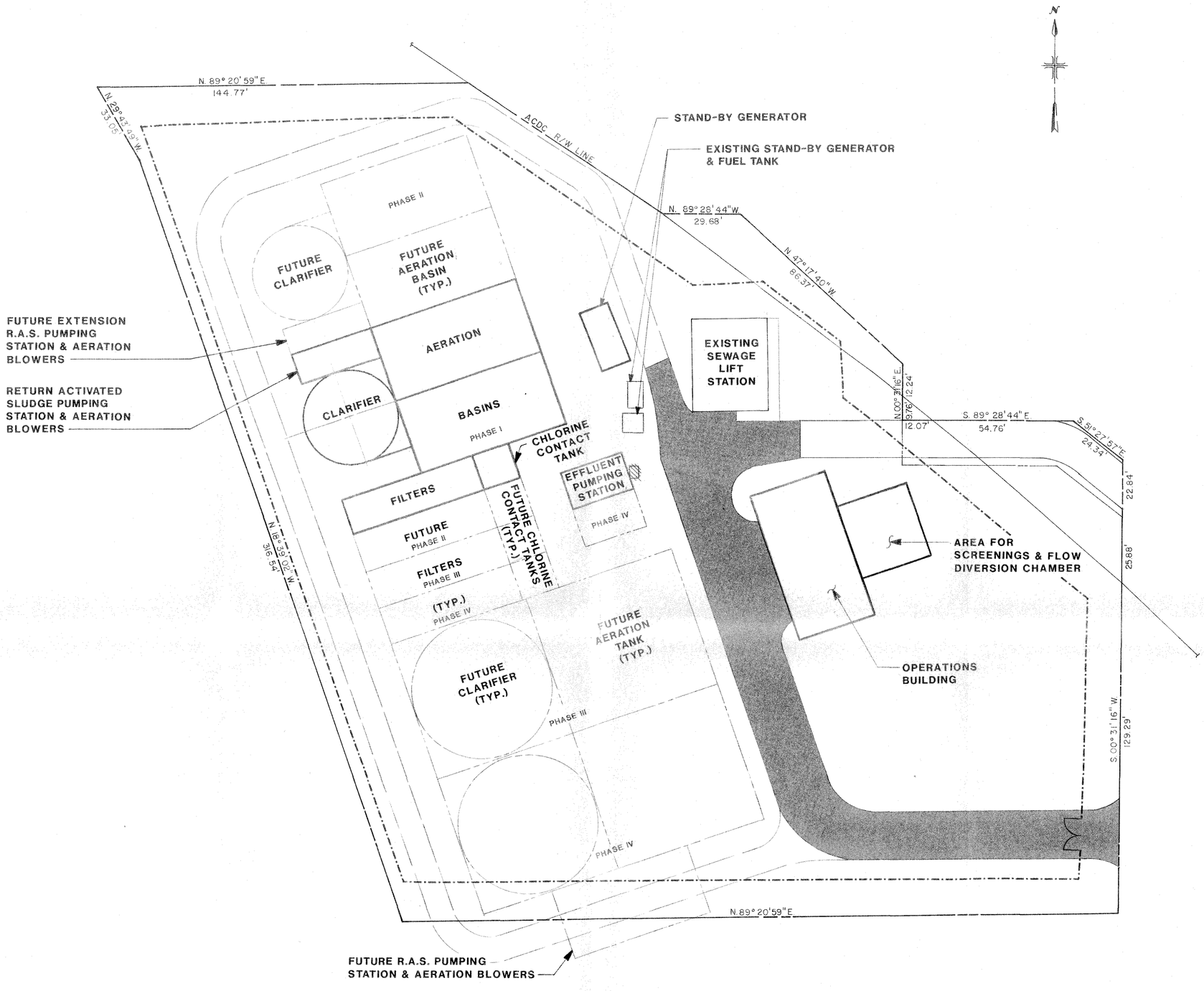
SCALE: 1"=20'-0"

MALCOLM PIRNIE, INC.

DATE MARCH 1988

PLATE 1

35840



NOTE: PHASE IV EXPANSION WILL REQUIRE ACQUISITION OF PROPERTY TO SOUTH.

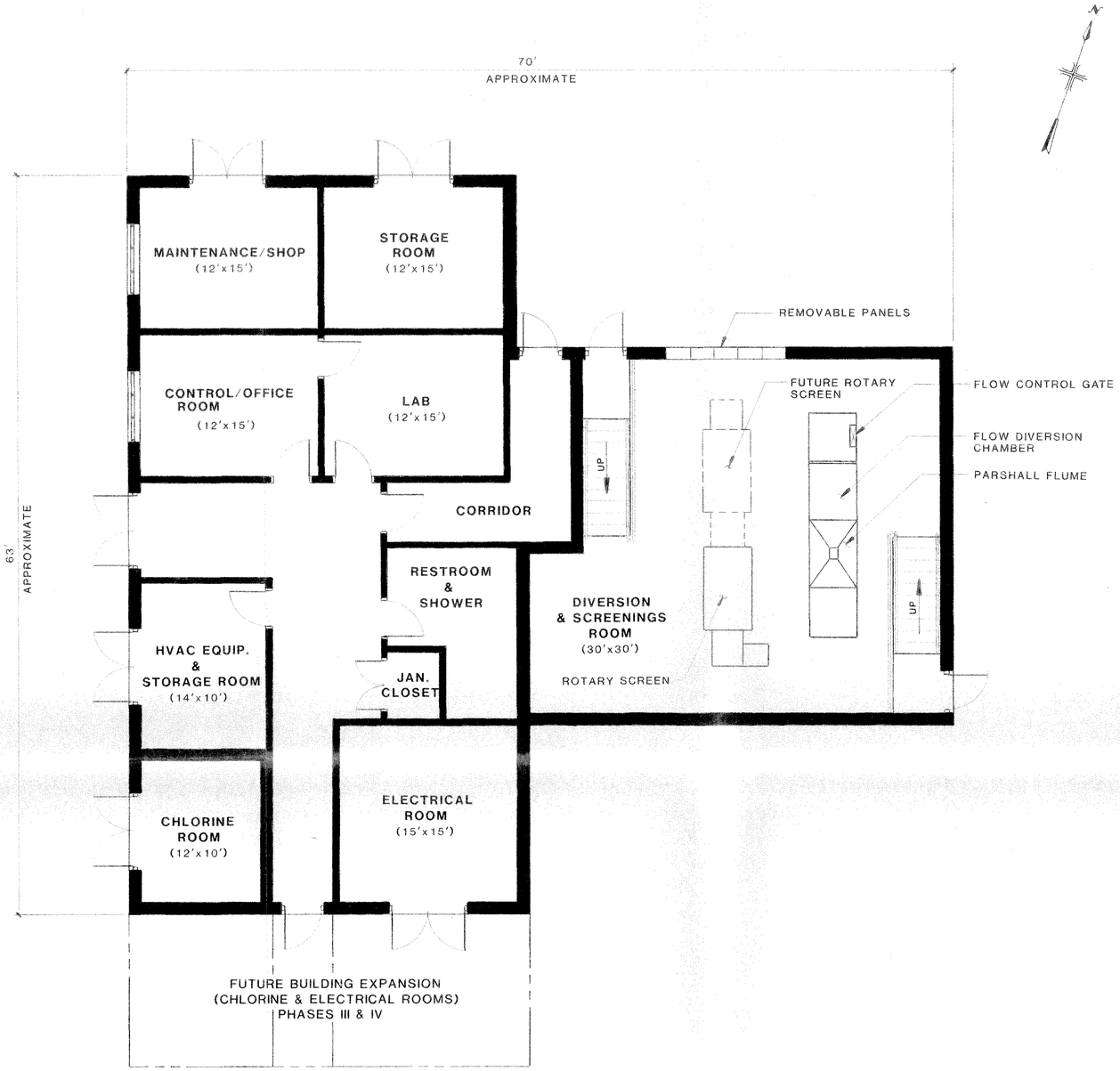
FLOOD CONTROL DISTRICT RECEIVED MAR 3 1988

PRELIMINARY

MALCOLM PIRNIE

REVISIONS				DES	CITY OF GLENDALE GLENDALE, ARIZONA	PRELIMINARY DESIGN	MALCOLM PIRNIE, INC.
NO.	BY	DATE	REMARKS	DWN	THUNDERBIRD PASEO WASTEWATER RECLAMATION FACILITY	PHASED DEVELOPMENT SITE PLAN SCALE: 1"=20'-0"	DATE MARCH 1988 PLATE 2
				CKD			

35840



PRELIMINARY

MALCOLM PIRNIE

REVISIONS			
NO.	BY	DATE	REMARKS

DES
DWN
CKD

CITY OF GLENDALE
GLENDALE, ARIZONA

THUNDERBIRD PASEO WASTEWATER RECLAMATION FACILITY

PRELIMINARY DESIGN

OPERATIONS BUILDING-CONCEPTUAL PLAN

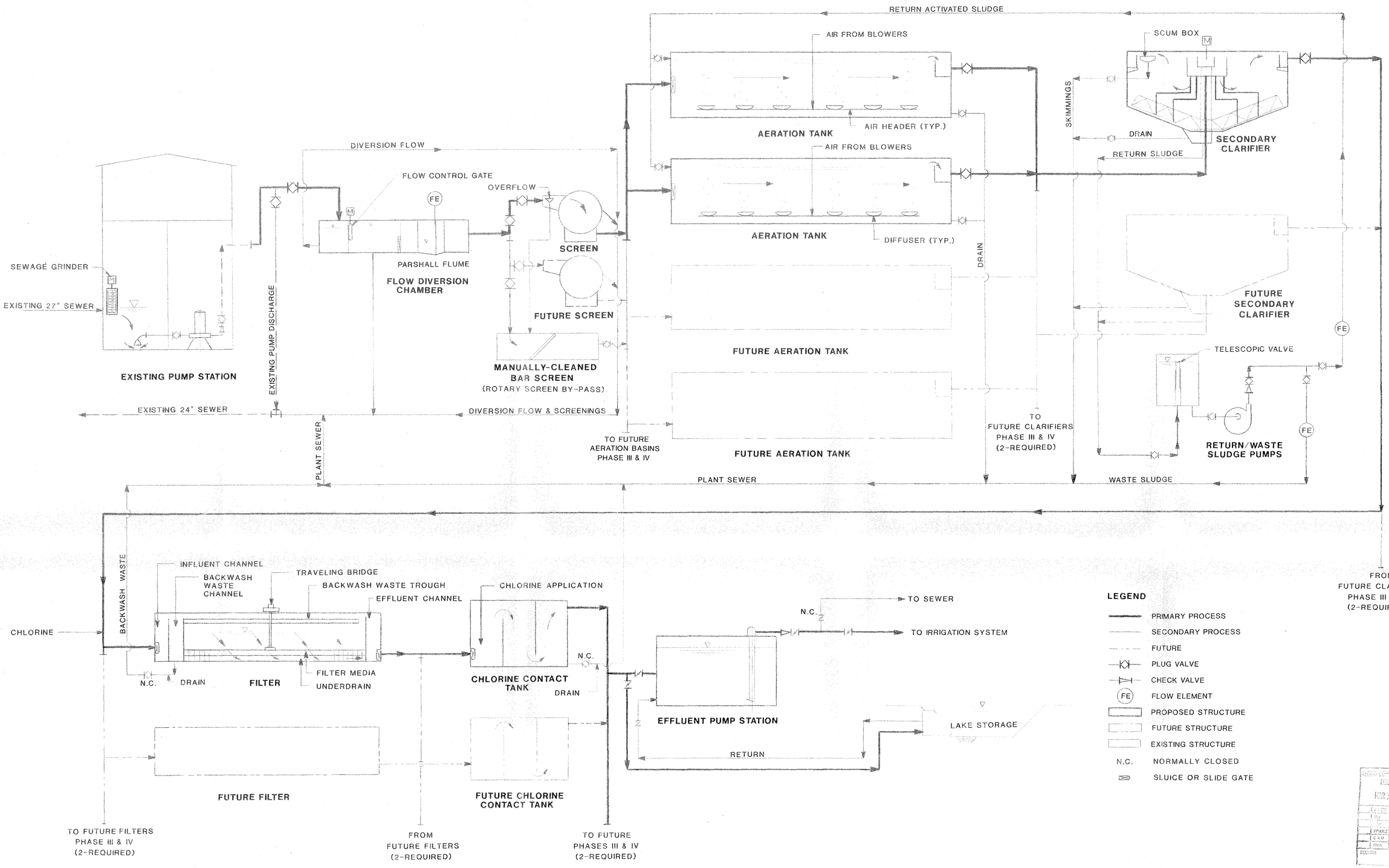
SCALE: 3/16"=1'-0"

MALCOLM PIRNIE, INC.

DATE: MARCH 1988

PLATE 3

35849



PRELIMINARY

MALCOLM PIRNIE

REVISIONS			
NO.	BY	DATE	REMARKS

DES .....
DWN .....
CKD .....

CITY OF GLENDALE
GLENDALE, ARIZONA

THUNDERBIRD PASEO WASTEWATER RECLAMATION FACILITY

PRELIMINARY DESIGN

PROCESS FLOW SCHEMATIC

MALCOLM PIRNIE, INC.

DATE MARCH 1988

PLATE 4

35840