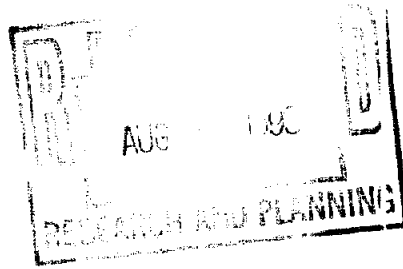


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CITY OF ODESSA



**RESIDENTIAL
REUSE
REPORT**

**FINAL REPORT
PREPARED BY**

Landgraf, Crutcher and Associates, Inc.
TRANSPORTATION • ENVIRONMENTAL • CIVIL ENGINEERS ODESSA, TEXAS

Alan Plummer and Associates, Inc.
CIVIL/ENVIRONMENTAL ENGINEERS • ARLINGTON-FT. WORTH-AUSTIN, TEXAS

AUGUST 25 1993

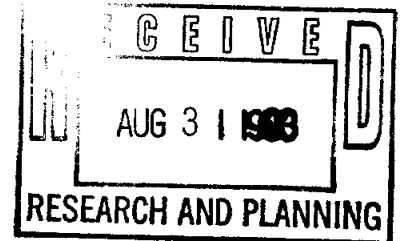


CITY OF ODESSA

BYRON F. GAINES

Director of Utilities

August 26, 1993



Mr. Gordon Thorn
Texas Water Development Board
1700 N. Congress Avenue
P. O. Box 13231
Austin, Texas 78711-3231

Dear Mr. Thorn:

On behalf of the City of Odessa I submit to you the Final Report associated with the City's Residential Reuse research effort. You should find twelve copies as required by contract. I have also included copies of the materials that were accumulated during the research.

In addition, I will deliver (Wednesday) a copy of a 30 minute video tape that was produced during a visit to Florida. As David Boutin indicated in your telephone conversation, this video exhibits the practical application of residential reuse in Florida, as well as, Florida's progressive attitude towards the general use of reclaimed water. I would like to play the tape and discuss it at our Wednesday meeting.

The comments you submitted following your review of the Draft Residential Reuse Report are appreciated and are addressed in the following manner:

The "Fire Protection" section on pages 4-11 and 4-12 were expanded to clarify the City's intention not to provide reclaimed water for fire protection. If the City's supply of reclaimed water was not limited, reclaimed water for fire protection would be considered.

The City of Odessa is continuing negotiations with local developers with regard to their participation in any residential reuse project. It is anticipated that residential reuse distribution systems, will be installed coincident with the installation of potable water lines for new subdivisions. Of course, the Odessa City Council will determine the ultimate cost effectiveness of any proposed residential reuse project and will make the final determination as to the City of Odessa participation. It is not anticipated that there will be any

unwillingness to use reclaimed water for irrigation in any proposed subdivision due to the requirement that the individual irrigation systems must be buried.

A discussion of salinity was added to Section 3.1 beginning at the top of page 3-4.

The lake described in the third paragraph on page 5-1 would be the terminal storage facility for the park and supply its irrigation needs. The terminal storage facility for Residential Reuse is proposed to be a covered tank. A statement clarifying this issue was added to the end of the paragraph.

The City was advised by representatives from communities in Florida to establish effective inspection policies and procedures. The City intends to follow this advice, as evidenced by the "Cross-Connection Control" and "Inspections" sections on pages 4-7 and 4-8 of the Management Plan chapter. The City believes these sections address its intent to prevent potential commingling of potable and reclaimed water at the point of service, and additionally, within the customer's property as may be associated with the installation of the customer's irrigation system. Cross-connection control equipment will be required by the City, and an inspection will be made to ensure that the irrigation system and all connections meet the City's required specifications prior to connection to the reclaimed water system. The City intends to make the additional inspections that are necessary to prevent commingling of potable and reclaimed water supplies.

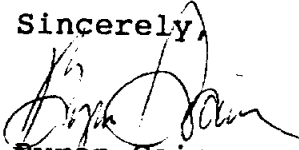
The City of Odessa is committed to provide reclaimed water of quality at least equal to the minimum standards required under state and federal regulations. The paragraph in Section 4.6 at the bottom of page 4-5 was intended to address the possibility of an inadequate supply of reclaimed water, not the possibility of substandard quality. The paragraph was revised by removing the phrase "of good quality".

Sections 3.2, 3.3, and 3.4 of the report speak to the current rules and recommended practices for residential reuse as promulgated at the state and federal levels. Recommendations are made in Section 3.6 with regard to competing requirements from the Texas Water Commission (TWC) and the United States Environmental Protection Agency (EPA).

A statement describing the effect of the proposed residential reuse system on water conservation was added to the second paragraph on page 5-1.

On behalf of the City of Odessa I hope that your comments have been adequately addressed. The modifications found in the Final Report have certainly added to its value. Please accept the Residential Reuse Report along with the City of Odessa's appreciation of the opportunity to participate in this project with the Texas Water Development Board.

Sincerely,

A handwritten signature in black ink, appearing to read "Byron Gaines", written over the word "Sincerely,".

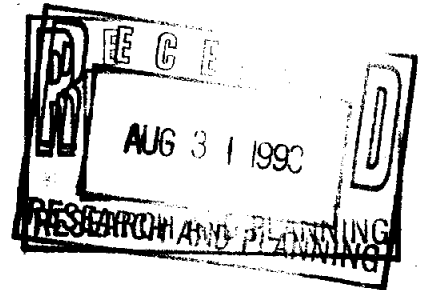
Byron Gaines
Director of Utilities

cc: Jerry McGuire, City Manager, Odessa, Texas
Drew Crutcher, Landgraf, Crutcher & Associates, Inc.
David Boutin, Administrative Analyst

Landgraf, Crutcher and Associates, Inc.
TRANSPORTATION • ENVIRONMENTAL • CIVIL ENGINEERS

521 NORTH TEXAS • ODESSA, TEXAS 79761
(915) 332-5058 or 580-8812 • FAX (915) 332-8812

May 25, 1993



Mr. Byron Gaines
City of Odessa
Director of Utilities
P.O. Box 4398
Odessa, Texas 79760

Dear Mr. Gaines:

This report presents the results of our investigation of the elements associated with the residential reuse of reclaimed water for irrigation. It reviews the background of residential reuse in the United States, addresses quality issues, and presents a proposed residential reuse management plan. Additionally, it presents the preliminary design concepts necessary to implement the use of reclaimed water in an example subdivision in Odessa.

We have appreciated the opportunity to serve you in this regard and we are thankful for the guidance and assistance supplied by you and your staff.

Sincerely,

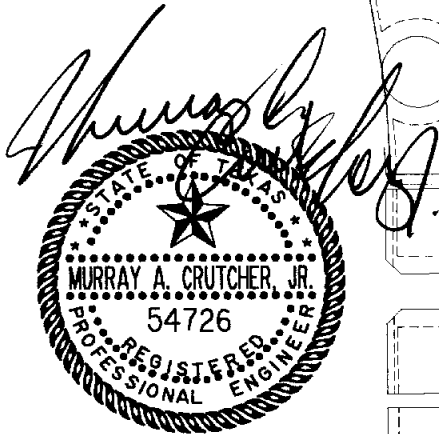
LANDGRAF, CRUTCHER & ASSOCIATES, INC.

Murray A. Crutcher, Jr., P.E.



CITY OF ODESSA

RESIDENTIAL REUSE REPORT



THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY MURRAY A. CRUTCHER JR. TEXAS P.E. NO. 54726 (NOT VALID UNLESS SIGNED) ON 8/21/93

**FINAL REPORT
PREPARED BY**

Landgraf, Crutcher and Associates, Inc.

TRANSPORTATION • ENVIRONMENTAL • CIVIL ENGINEERS ODESSA, TEXAS

Alan Plummer and Associates, Inc.

CIVIL/ENVIRONMENTAL ENGINEERS • ARLINGTON-FT. WORTH-AUSTIN, TEXAS

AUGUST 25 1993

CITY OF ODESSA
RESIDENTIAL REUSE REPORT

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SECTION 1
INTRODUCTION

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SECTION 1

INTRODUCTION

1.1 PURPOSE

On January 12, 1993, the Texas Water Development Board approved the City of Odessa's application for funding in conjunction with efforts by the City to develop a Residential Effluent Reuse Management Plan. This report contains the results of the City's efforts by providing a description of the City's current reuse efforts, a preliminary analysis and design of a proposed Residential Reuse Project in Odessa, background information covering successful Residential Reuse Projects in the United States, and a discussion of quality and treatment issues.

This report also contains a proposed Residential Reuse Management Plan. The City intends to submit this plan to the Texas Water Commission for approval in conjunction with the City's proposed Residential Reuse Project. An approved management plan is seen as not only a precedent for other similar projects in which the City may become involved, but also a model against which other Residential Reuse Projects throughout the State of Texas might be measured. Thus, the City's efforts should pave the way for Residential Reuse to become a reality; and therefore, foster the growth in Texas of a most effective water conservation technique.

1.2 CURRENT REUSE EFFORTS IN ODESSA

The disposal of treated wastewater effluent is not a new concept to the City of Odessa. In fact, the City of Odessa has been one of the most progressive cities in the State of Texas with regard to the use of reclaimed water. The City has been successfully providing reclaimed water to a local industry for process use since 1956. This arrangement represents one of the earliest steps taken by the City towards the strong water conservation policy it most recently adopted.

In 1985 the City commissioned Camp Dresser & McKee Inc. to conduct a water reuse study. This six month study's purpose was to "develop and evaluate alternatives for utilizing reclaimed water as augmentation and supplement to the City of Odessa's water supply through the year 2010." Several alternatives were presented and evaluated by this study.

In 1987 the City engaged Landgraf, Crutcher and Associates, Inc. (LCA) to more fully develop that alternative calling for the use of reclaimed water for landscape irrigation. A preliminary design of the most cost effective system was accomplished. Subsequently, the City commissioned LCA to develop plans and specifications for this system.

The City is currently in the process of receiving approval from the Texas Water Development Board and the Texas Water Commission to expand its effluent reuse system and effectively double the quantity of reclaimed water provided by the system. The City plans to produce an extremely high quality effluent that will be delivered to three golf courses, the local university, and the Texas Department of Transportation for landscape irrigation.

The expanded reuse system will contain approximately sixteen miles of transmission lines in its effort to deliver a peak demand of three million gallons per day. Expansion and upgrade of the City's Bob Derrington Water Reclamation Plant will not only provide the pumping capacity required, but also provide the quality necessary to supply these public facilities.

1.3 REQUESTS FOR RESIDENTIAL SERVICE

In the course of bringing the Reuse Project to fruition the City Council and City staff received numerous inquiries from citizens regarding the possibility of obtaining reclaimed water for irrigation of residences. As the approved Reuse Project got closer to reality the City began to see the possibility of providing this additional service.

The City staff determined that retrofitting existing residences with this service would be less cost effective than installing distribution systems in new subdivisions as they were developed. At that point the staff began to isolate planned subdivisions for consideration. In turn, the list of eligible subdivisions was further limited to those in close proximity to the proposed transmission route.

Discussions with subdividers and members of the project engineering team revealed numerous questions with regard to Residential Reuse that had not been addressed by the Texas Water Commission because no project of this nature had yet been developed. The City determined that it would be in the best interest of its citizens and the citizens of Texas to pursue the Residential Reuse concept in an effort to take water conservation efforts to an even higher level.

Subsequent investigations by the City's staff suggested that the City could qualify for financial help from the Texas Water Development Board through its Water Research Grant Program. As mentioned earlier, the City's grant application was approved, providing the impetus for this report.

One of the subdivisions that the City determined would meet preliminary qualifications for eligibility as a potential site to be provided with reclaimed water for residential irrigation was highlighted in the City's grant application. The subdivision is called Emerald Forest and is scheduled to be developed in three phases.

Because Phase I is already being developed and would, therefore, have to be retrofit with any future Residential Reuse Service, Phase II and Phase III (25 acre Addition) are the only phases being considered by the City for involvement in this project. These phases could ultimately consist of approximately one hundred twenty residences. A proposed project design analysis is located in Appendix A, Section A of this report.

The subdivider of Emerald Forest has shown interest in the City's project, to date, and will be contacted as soon as this report is accepted by the Texas Water Development Board and the Texas Water Commission. If the City finds that it has the ability and the desire to fund the project, negotiations with the subdivider are anticipated to follow.

SECTION 2
BACKGROUND

LCA

SECTION 2

BACKGROUND-RESIDENTIAL REUSE IN THE UNITED STATES

Although residential reuse projects are currently nonexistent in Texas, other parts of the United States have embraced this concept wholeheartedly. California and Florida are the most noteworthy for residential reuse and for the use of reclaimed water in general. Therefore, preliminary investigations by the City centered around these two areas.

California has made great strides in enhancing its water conservation efforts through various uses of reclaimed water. Because a significant portion of the state suffers from marginal supplies of water due to a predominantly arid climate, California's attitude towards reclaimed water use has been somewhat protectionist with regard to the reclaimed water supply. As a result, the management concept that has been promulgated through state reuse regulations appears to be rather cumbersome in practice.

Residential irrigation systems in California are primarily limited to multifamily dwellings with common landscape areas and are totally controlled by the reclaimed water provider (municipal authority). The City of Odessa did not view this strategy as meeting the level of service that would be desired by the citizens of Odessa and, therefore, decided to seek more appropriate and practical examples that might be followed in formulating its own management plan.

The State of Florida in its endeavor to responsibly maximize the use of reclaimed water offered much better examples for the City of Odessa to follow. Because Florida experiences higher quantities of annual rainfall throughout the state, reclaimed water use management plans in Florida are not as restrictive as those in California. Extensive research in reclaimed water use in Florida has resulted in numerous practical applications across the state. Those involved in promoting the use of reclaimed water appear to have taken the attitude of "how can it be used" not "how can't it be used". The reuse management plans developed by most Florida communities allow residential customers almost total control of reclaimed water hours and consumption.

The Florida communities of St. Petersburg, Apopka, and Altamonte Springs were quickly identified by the City as leaders in Residential Reuse implementation. In particular, the St. Petersburg Residential Reuse program, started approximately 17 years ago, appeared to be especially progressive. These three communities became the logical choices for the City to investigate and subsequently use as references in the preparation of this report. The proposed Management Plan contained in this report is based on a composite of the plans used by these communities.

SECTION 3
QUALITY

ICA

SECTION 3

QUALITY AND REGULATORY ISSUES

The reuse of reclaimed water in residential areas has obvious benefits that have been identified in this and other reports. However, the introduction of treated wastewater effluent into an area where individuals could easily come in contact with the reclaimed water is a new practice in Texas. Adequate information concerning the aesthetic quality of the reclaimed water and health issues must be developed and provided to area residents and regulatory agencies to assure both groups that the use of reclaimed water is appropriate for residences in Odessa, Texas.

This chapter of the report identifies issues concerning the quality of the reclaimed water to be used. These issues should be addressed prior to the implementation of a residential reuse project. Since this project would be the first residential reuse project in Texas, it is possible that additional issues may emerge during the regulatory approval process or the implementation of the project.

3.1 WATER QUALITY CONSIDERATIONS

This section identifies the water quality considerations associated with the use of reclaimed water in a residential setting. In general, the considerations fall into three broad categories, public health concerns, aesthetics, and operational concerns with the ease of operation and the reliability of a residential reuse system. These considerations are important to both the residents living in the area and the regulatory agencies that are charged with the responsibility of ensuring the public safety and well being. The regulatory requirements instituted by various agencies in response to these considerations and their responsibility to the public will be addressed in a separate section.

Public Health Considerations

Untreated wastewater generally contains significant levels of microorganisms and chemical constituents that present health concerns. The principal microorganisms of concern are bacteria, parasites (including protozoa), and viruses. The following sections present the specific concerns associated with each of the types of harmful agents.

Bacteria

Typical wastewaters contain numerous types of pathogenic bacteria. These waterborne pathogens have been identified as the cause of diseases such as enteric

fevers (typhoid fever), cholera, dysentery, and acute gastroenteritis. The typical method of treatment for bacteria is disinfection through the use of chlorine, ozone, or ultraviolet radiation. The indicator used to determine the effectiveness of the disinfection process is the level of fecal coliform in the reclaimed water. Coliform levels are used as an indicator because they occur in higher concentrations than other pathogens, they are easily detectable, they exhibit a positive correlation to other fecal contamination, and they generally respond to treatment processes in the same manner as many other bacterial pathogens.

Parasites

The primary pathogenic parasites occurring in wastewater are protozoa, metazoa, and helminth. Parasites belonging to these families have been identified as the cause of diseases worldwide. The diseases include amoebic dysentery, amoebic hepatitis, gastroenteritis, and intestinal worms such as tapeworms, whipworms, and hookworms. These parasites are of particular concern since they are frequently found in the form of cysts or eggs which may be resistant to typical disinfection procedures. However, it is believed that other forms of wastewater treatment such as sedimentation, filtration, and stabilization ponds are effective in removing these pathogens.

Viruses

Humans excrete over 100 different types of enteric viruses that are capable of causing infections or disease. The diseases caused by these viruses include polio, hepatitis A, and gastroenteritis. Epidemiological studies of the incidence of viral infections or diseases from waterborne viruses have not been conducted for several reasons: current virus detection methods are not sufficiently sensitive; enteric virus infections are often not apparent and may go unreported; illnesses due to enteroviral infections may not become obvious for several months; and finally, enteric viruses are easily transmitted by person-to-person contact, thereby obscuring the role of water in its transmission. As such, limited information is available concerning the effectiveness of wastewater treatment processes in the elimination of viruses.

Chemical Constituents

The major consideration involving the chemical constituents present in municipal wastewater involve the toxic or carcinogenic nature of the chemicals. These concerns are most important where direct ingestion of reclaimed water is anticipated. The health risks associated with the ingestion of numerous chemical constituents have been well documented through the drinking water standards established by EPA. These standards identify the maximum contaminant levels (MCL) allowed for several inorganic and organic constituents. These standards have been established based on the assumption that human ingestion occurs routinely over a long period of time which is definitely not the case with the use of reclaimed water. Even so, the wastewater treatment processes practiced today generally provide the ability to reduce the concentrations of these constituents to below the MCLs. As a result, the potential for adverse health effects from residential irrigation with reclaimed water is not believed to be significant.

Aesthetics

The aesthetic qualities of the reclaimed water are very important when the reclaimed water is to be used in a residential setting. The typical public perception of treated wastewater is that the effluent can cause offensive odors and be discolored. Both of these qualities would limit the residential user's desire to use reclaimed water for irrigation. Practical experience with advanced wastewater treatment facilities would indicate that aesthetic issues are primarily associated with public perception and are not usually a problem if the plant is operated correctly. However, these issues must be addressed in order for a residential reuse project to be accepted within a community.

Functional Concerns

The final area of concern involving the quality of the reclaimed water is the ease and reliability with which a residential customer can use the reclaimed water to fulfill his irrigation needs. If the use of reclaimed water is laborious due to excessive maintenance or operational requirements, the system will not be accepted. Likewise, if the reuse system fails to provide a consistent amount of reclaimed water meeting all of the quality criteria, customers will likely look to other sources to meet their demands.

Within the State of Texas, regulation of the collection, treatment, and disposal of domestic wastewater is the responsibility of the Texas Water Commission (TWC). As part of their regulation of the disposal of treated wastewater, the TWC, in association with the Texas Water Development Board (TWDB), has been encouraging the development of reuse projects throughout the state as a means to conserve precious water resources in Texas. To date, reuse projects in the state have been associated with large irrigation users such as golf courses and agricultural concerns. Therefore, the TWC rules governing the reuse of reclaimed water (31 TAC Chapter 310) primarily address these uses. The rules do not establish unique requirements for residential reuse projects. The only reference to residential reuse in the rules is a provision that exempts residential reuse projects from the requirement that the user notify the TWC in addition to the provider as is the case for other types of reuse projects.

The following is a list of regulatory requirements that must be met under the existing rules. Since the TWC has not previously approved a residential reuse project, it is not known if additional requirements may be included by the TWC during their review process.

- WATER RIGHTS - The city must establish that the reuse project does not effect existing water rights.
- NOTIFICATION - The city must notify the TWC of their intent to provide reclaimed water to residential users. This notification must include a description of the intended use of the reclaimed water, including quantity, quality, origin, and location of the intended uses. The notification should also include an operation and maintenance plan that will clearly indicate the means for insuring regulatory compliance with 31 TAC Chapter 310 and, at a minimum, contain a copy of a signed contract between the user and provider, a labelling and separation plan for the prevention of cross connections, measures that will be implemented to prevent unauthorized access or operation of the reuse facilities, procedures for monitoring the reclaimed water, a description of the plan to minimize the risk of inadvertent human exposure, schedules for routine maintenance, a plan for training, and a contingency plan for system failure or upset.

- PERMITS - The reuse notification must be approved by the executive director of the TWC. A permit from the TWC will not be required so long as the reclaimed water is not treated for a more restrictive use by the user, transferred by a user to a third party, or discharged. The current rules do not address the permissibility of routine line flushing through hydrants or other appurtenances.
- QUALITY - Reclaimed water used in unrestricted access landscaped areas such as residential lawns must have a 30-day average value meeting the following criteria: 5-day biochemical oxygen demand (BOD₅) of 5 milligrams per liter (mg/l), turbidity of 3 nephelometric turbidity units (NTU), and fecal coliform not to exceed 75 colony-forming units (CFU)/100 milliliters (ml). The only other regulatory requirement related to the quality of the reclaimed water is that disinfection must be provided to insure compliance with the fecal coliform limits if the water is stored for more than 24 hours prior to its use.
- SAMPLING AND ANALYSIS - The reuse rules require that the reclaimed water be sampled and analyzed once per week when the intended reuse is the irrigation of unrestricted landscaped areas. This sampling shall occur prior to distribution.
- GENERAL REQUIREMENTS - The reuse rules include numerous specific requirements concerning the method and appropriate procedures for the use of reclaimed water. These requirements, which primarily affect the operations and maintenance of the system include items such as limiting the potential for human contact by limiting the use of reclaimed water to times when the area to be irrigated is not in use.

3.3 WATER QUALITY REQUIREMENTS ESTABLISHED BY OTHER JURISDICTIONS

It is believed that the individual homeowner's ability to operate his system at any time is very desirable. While this type of on-demand irrigation system is currently provided in other areas of the country, the TWC has not previously approved a residential reuse project that would provide reclaimed water for unrestricted irrigation by the homeowner. As a result, it is not known if additional requirements might be established by the TWC for unrestricted irrigation projects of this nature. Therefore, the regulations established by other jurisdictions addressing this type of use were investigated. The U.S. Environmental Protection Agency (EPA) recently published a technical manual concerning the reuse of reclaimed water. The manual, "Guidelines for Water Reuse, September 1992" was prepared as a joint project by the EPA and

the U.S. Agency for International Development (AID) to assist local utilities that are considering the use of reclaimed water. The manual provides an overview of planning, design, health, and legal issues surrounding the use of reclaimed water. In addition, the manual summarizes the regulations or guidelines currently existing in each state.

The EPA manual identifies ten states which have regulations addressing the quality of reclaimed water that can be used for unrestricted urban reuse. In addition, twelve states have guidelines in place addressing water quality issues for unrestricted urban reuse. The manual identifies specific water quality parameters that are addressed by each state. However, the manual does not include information concerning management controls that might be included by the states. In addition, the existence of state regulations does not necessarily mean that residential reuse is occurring in the state.

The following is a summary of the water quality regulations or guidelines that have been adopted by other entities.

- Nine states identify the treatment processes that must be used to produce the reclaimed water. These states do not have specific water quality limits on parameters other than fecal coliform levels. An additional nine states identify the treatment processes that must be used and include specific water quality limits.
- Eight states have limits on BOD₅ levels. These limits range from 5 mg/l to 30 mg/l.
- Six states have limits on TSS levels. These limits range from 5 mg/l to 30 mg/l.
- Six states have limits on turbidity. These limits range from 2 NTU to 5 NTU.
- Nineteen states have limits on fecal coliform. These limits range from non-detectable to 200 CFU/100 ml.
- Two states have limits on enteric viruses. These limits vary from no detectible viruses to <1 plaque-forming unit (PFU)/100 ml.

3.4 EPA GUIDELINES FOR WATER REUSE

The manual prepared by EPA/AID includes recommendations regarding the type of facility and the quality of reclaimed water that are appropriate for specific uses. The guidelines are based upon the combined experiences of numerous water reclamation and reuse projects throughout the U.S. and in other countries. The experiences of other residential reuse systems indicate that inadvertent human contact with the reclaimed water is quite likely to occur on a limited basis. Therefore, EPA identifies the following specific recommendations:

- Adequate levels of treatment should be provided. Treatment processes should include secondary treatment, filtration, and disinfection.
- The addition of chemical coagulants and/or polymers prior to filtration may be necessary to meet water quality criteria recommendations.
- EPA Class 1 reliability is recommended for all water reclamation plants. This class of reliability includes duplicate power sources, multiple treatment units and equipment so that the plant remains functional despite a loss of power or equipment malfunction, emergency storage, piping and pumping flexibility, automatic chlorine feed controls, and automatic alarms to report equipment or unit failures.
- The pH of the reclaimed water should be between 6 and 9. The pH should be monitored on a weekly basis.
- The BOD₅ of the reclaimed water should not exceed 10 mg/l. BOD₅ levels should be monitored weekly.
- The 24-hour average turbidity of the reclaimed water should not exceed 2 NTU. Turbidity should not exceed 5 NTU at any time. These turbidity criteria should be met prior to the disinfection process. Turbidity should be monitored continuously. Appropriate alarms and controls should be included so that effluent exceeding these turbidity criteria can be identified and diverted away from the reuse system.

- Fecal coliform levels should have a median value during a 7-day period that is below the detectable limits. The maximum allowable level for any one sample should be 14 CFU/ 100 ml. Fecal coliform levels should be monitored daily.
- The chlorine residual of the reclaimed water following a minimum contact time of 30 minutes should be 1 mg/l. The chlorine residual should be monitored continuously. Appropriate alarms and controls should be included so that effluent failing the residual chlorine criteria can be identified and diverted away from the reuse system.
- The reclaimed water should not contain measurable levels of pathogens. A higher chlorine residual and/or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed.
- The reclaimed water should be clear, odorless, and contain no substances that are toxic upon ingestion.
- A chlorine residual of 0.5 mg/l or greater in the distribution system is recommended to control odors, slime, and bacterial regrowth.
- Covered storage is preferred to preclude biological growth. If open pond storage is used, retreatment such as filtration and disinfection may be needed to meet the reclaimed water quality criteria for the intended use.

3.5 OPERATIONAL EXPERIENCES

The EPA guidance manual identified several case histories of communities that are successfully operating unrestricted urban reuse systems. The experiences of these cities indicates that these types of systems can be operated effectively. In fact the cities that have adopted reuse projects have generally achieved significant benefits from their reuse programs. The list of benefits includes water conservation, cessation of water degradation in receiving streams, and replenishment of aquifer levels. In many instances, these benefits have actually provided the cities with a monetary advantage since new resources did not have to be developed.

Public Health

It would appear as though the environmental and monetary benefits experienced by cities such as St. Petersburg, FL; Altamonte Springs, FL; Apopka, FL; Hilton Head, SC; and Irvine Ranch Water District, CA, have been achieved while minimizing possible detrimental health effects from the use of reclaimed water. In fact, the Water Reuse Manual of Practice, 1989, by the Water Pollution Control Federation indicates that the use of reclaimed water in the U.S. has not been implicated as the cause of any infectious disease outbreaks.

The basic management approach that officials in cities using reclaimed water in urban areas and the agencies regulating these cities have adopted is one of continually monitoring turbidity and chlorine residuals as an indicator of pathogen levels. The limitation of solids in the reclaimed water in combination with adequate disinfection appears to provide an effective control for the quality of reclaimed water used in urban environments.

Aesthetics

The level of treatment routinely employed at municipal wastewater treatment plants is capable of producing reclaimed water with appropriate aesthetic qualities. It is not anticipated that offensive odors or discoloration will be a problem with the proposed Residential Reuse Project in Odessa. In general, public opinions concerning the use of reclaimed water to irrigate residential lawns is more favorable than might be expected. In fact, the EPA manual identifies six separate surveys conducted between 1972 and 1985 in which a maximum of six percent of the respondents were opposed to the use of reclaimed water for residential irrigation. Despite the seemingly low level of concern, it will still be very important to include a strong public education program as part of the proposed management plan for the residential reuse system.

Functional Concerns

The proposed residential reuse system is expected to provide a consistent quality of reclaimed water such that users will be able to operate their irrigation systems in an efficient and effective manner. The use of reclaimed water should have negligible effects on the individual user compared to the use of potable water for irrigation. As an additional measure of reliability, the reuse system will have the capability of substituting other sources of water for the reclaimed water should unforeseen circumstances arise.

3.6 ALTERNATIVES

Four separate scenarios have been identified for the implementation of a residential reuse project in Odessa, Texas. The alternatives present four different approaches to balancing the needs of residents to have unrestricted access to water to meet their irrigation demands and the water quality criteria established by the TWC and other regulatory agencies.

Alternative 1 - Existing TWC Water Quality Regulations with Restrictions on Uses

The reclaimed water produced at the City of Odessa's wastewater treatment plant is expected to meet the quality criteria established in the existing TWC regulations, which are 30-day averages for BOD₅ and turbidity not to exceed 5 mg/l and 3 NTU, respectively and fecal coliform counts not to exceed 75 CFU/100 ml at any time. However, TWC regulations also require that the City limit the use of this reclaimed water to times when the areas to be irrigated are not commonly in use. As a result, TWC could require the City to only provide reclaimed water to the residents for irrigation of their lawns at night.

Under this alternative, the cost of the reuse system would be limited to the cost associated with the delivery of the reclaimed water to the residents which would include the construction of the distribution piping and an in-line booster pump station to pressurize the distribution system so that pop-up spray heads could be operated. Terminal storage for the residential reuse project would not be required since residential irrigation would be restricted to times when the reuse transmission main and pump station would be in operation.

Alternative 2 - Provide for Unrestricted Use Based Upon Criteria Adopted in Florida

The State of Florida currently regulates several urban reuse projects where the supply of reclaimed water to the individual users is not restricted. The oldest of these projects is located in St. Petersburg, Florida, which began operations in 1978 and currently serves more than 7,000 residences and businesses with approximately 21 mgd of reclaimed water. The water quality criteria established by the State of Florida include the following:

- Secondary treatment with filtration for TSS control.
- An annual average for CBOD of 20 mg/l.

- A maximum TSS level of 5 mg/l.
- Minimum chlorine residual of 1 mg/l after 15 minutes contact time at the peak hourly flow.
- Fecal coliform samples should have 75 percent that are less than detectable with a maximum of 25 CFU/100 ml for any one sample.

In addition to these specific quality criteria, Florida has the following criteria:

- The TSS limit must be achieved before disinfection.
- Continuous turbidity monitors must be installed. The turbidity is monitored as an indicator of the TSS levels based on the historical relationship between turbidity and TSS. When the turbidity level increases to the point where the TSS level is presumed to be close to the 5 mg/l level, remedial action is taken to lower the TSS and turbidity. If the turbidity is not decreased, individual TSS samples are collected and analyzed to determine if the TSS criteria is being met.
- Chemical feed equipment must be installed.

The treatment facilities in Odessa are capable of meeting all of these criteria with one exception; the application of chlorine at the plant occurs prior to filtration. As a result the TSS level at the time of the initial application is probably not always under 5 mg/l. However, if a residual chlorine content of 0.5 mg/l is required throughout the reuse transmission main, additional disinfection will be accomplished. The travel time between the plant and the residential reuse site is estimated to be in excess of 2 hours. Based upon a comparison of the product of the chlorine dosage and the contact time, the chlorine contact time product for a residual of 0.5 mg/l is 4 times larger than the product required under the Florida regulations. As a result of the increased contact time following filtration, it is expected that this type of disinfection would be at least as effective as the disinfection procedure identified in the Florida regulations.

Alternative 3 - Provide for Unrestricted Use with Stricter Water Quality Criteria

If residents are to be provided with reclaimed water for irrigation and no restrictions are placed on its use, it is possible that the TWC might establish criteria more restrictive than the Florida criteria. The EPA guidelines for the use of reclaimed water in urban areas sets forth the most

restrictive criteria which have been identified, so the impact of these criteria have been assumed to be a "worst case" scenario. If TWC were to adopt the EPA guidelines, significant modifications to the treatment process and management system should be anticipated. These revisions could include one or more of the following:

- Addition of chemical feed equipment.
- Replacement of the existing single-media filters with dual-media filters.
- Provision of additional chlorination capabilities.
- Development of procedures to address what is to be done with effluent that does not meet the stricter quality criteria. These procedures are particularly important since reclaimed water that does not meet the criteria for residential reuse might still meet the requirements of the other reuse customers. As a result, the procedures developed would need to address the continued supply of irrigation water to the other customers and the resumption of service to the residential users.
- Provision of a terminal storage facility near the residential reusers.

All of these revisions represent a significant expense. These costs would be in addition to the distribution piping and booster pump station previously identified. It is possible that the combination of these costs would render the project financially infeasible.

Alternative 4 - Conduct Analysis of Existing Treatment to Determine Appropriate Quality Criteria

Alternatives 1 and 3 represent two ends of the spectrum concerning the water quality criteria and treatment requirements that might be applied to this project with Alternative 2 representing a middle ground that appears to be effective for communities in Florida. The ends of this spectrum are not that far apart in terms of water quality criteria. The primary difference is the turbidity requirement. While the EPA is recommending a 24-hour average turbidity of 2 NTU with a maximum of 5 NTU, Texas requires a 30-day average turbidity of 3 NTU. This small difference in the turbidity criterion can have a large impact on the cost of a residential reuse system since significant upgrades to the treatment process may be required to meet the 2 NTU criterion on a consistent basis.

The benefits derived from this additional expense are difficult to quantify in terms of public safety and health. The EPA recommendations are premised on the belief that turbidity in an effluent inhibits the effectiveness of the disinfection process and may allow viruses and parasites that might be resistant to chlorination to remain in the reclaimed water. The guidance document prepared for EPA is unclear as to what level of protection a 2 NTU criterion represents versus what level of protection a 3 NTU criterion would represent. It would appear as though the Florida approach of using turbidity levels as an indicator of TSS has provided an adequate level of protection for the users without imposing a strict turbidity level.

In light of the various levels of regulation being adopted across the country, the TWC may adopt any one of the four alternatives presented: TWC may conclude that the existing Texas regulations provide adequate protection for this type of reuse; TWC may adopt regulations similar to Florida's; or TWC may adopt regulations similar to the guidelines suggested by EPA. Before the TWC were to select the third alternative, it would be prudent to establish the necessity of this more restrictive standard before it is adopted. This is particularly true in light of the significant costs associated with achieving the 2 NTU turbidity criterion. This could be accomplished by completing a detailed microbiological study of the wastewater effluent at the Odessa treatment plant to establish a relationship between turbidity and the capability of disinfection to deactivate or kill viruses and protozoa in wastewater. A study of this nature could be valuable in establishing a scientific basis for the identification of cost-effective requirements for residential reuse projects throughout the state.

The ultimate cost of a residential reuse system for the City of Odessa would be greatly dependent upon the results of this type of study. Assuming that this study resulted in a "best-case scenario" by determining that the existing treatment process provided adequate destruction or deactivation of pathogenic microorganisms, the cost of a residential reuse system would include the cost of the distribution piping, a booster pumping station, and a terminal storage facility. The booster pumping station and terminal storage facility would be required to provide an "on-demand" irrigation system.

3.7 CONCLUSIONS

The use of reclaimed water to meet urban irrigation demands in residential areas is currently not practiced in Texas and is used in limited areas within the U.S. As such, the development of a residential reuse system for the City of Odessa will be setting a precedent within Texas. The existing systems in the country, particularly those in Florida appear to be operating at a level that provides many benefits to the cities and the users of the reclaimed water. If residential reuse projects are to become a reality in the State of Texas, it will be important for everyone involved in the regulation and operation of the systems to learn from the successes experienced in other parts of the country. Regulations and operating procedures must be developed that adequately protect the health and safety of the public without unduly burdening the providers of reclaimed water with over-restrictive quality criteria that make the development of a residential reuse system cost-prohibitive.

**SECTION 4
RESIDENTIAL REUSE
MANAGEMENT PLAN**

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SECTION 4

PROPOSED CITY OF ODESSA RESIDENTIAL REUSE MANAGEMENT PLAN

4.1 INTRODUCTION

The City of Odessa is in the process of expanding its treated wastewater reuse system. The system currently provides reclaimed water to local industry for process use. The expanded system will additionally supply reclaimed water that meets Texas Water Commission standards for public access use for irrigation of large landscape areas, such as parks and golf courses.

The reclaimed water system is an integral part of the City's utility system and provides benefits to both the potable water and wastewater utilities. The potable system benefits by reducing the use of high quality potable water for nonpotable uses. This results in a lower annual average and lower peak potable water demand. Further, the use of high quality potable water where a lower quality water is appropriate and available is contrary to the City's water conservation policy.

The wastewater utility benefits because the reuse system will provide for the disposal of a majority of the total wastewater flow in a manner encouraged and supported by regulating agencies and the general public. By maintaining an effective reuse program the City significantly reduces the volume of treated wastewater which must be discharged by means that do not promote or encourage conservation of water resources in the City.

It is the intent of the City to continue reclaiming wastewater in a manner that is environmentally sound and economically feasible. The City is committed to supporting and expanding the reuse system via the development of a distribution system for residential irrigation using reclaimed water. The policies and procedures associated with the City's management of the proposed Residential Reuse System are detailed in this document and will be incorporated into the Odessa City Code in conjunction with development of the system.

4.2 DEFINITIONS

AIR GAP - shall mean a physical separation sufficient to prevent backflow or back-siphonage between the free flowing discharge of the reclaimed water system and any other system, physically defined as a distance equal to twice the diameter of the supply side pipe diameter, but not less than one inch.

APPLICATION - shall mean an application for reclaimed water service and all associated documents required by the City of Odessa in order to process a request for service.

AUXILIARY WATER SUPPLY - shall mean any water supply other than reclaimed water produced at the City of Odessa's wastewater treatment facilities.

BILLING - shall mean the charges made for reclaimed water service delivered to a residence.

CITY - shall mean the City of Odessa, Texas.

CITY COUNCIL - shall mean the City Council of the City of Odessa, Texas or its designee.

CITY MANAGER - shall mean the City Manager of the City of Odessa, Texas, or his designee.

CROSS-CONNECTION - shall mean any physical arrangement where a public water supply is connected directly or indirectly with any other water supply, such as sewer, water well, swimming pool, plumbing fixture, or other devices which may contain contaminants or pollutants or polluted water or liquid of unknown or unsafe quality which may be capable of importing contamination of pollutants to a water supply system such as reclaimed water.

CUSTOMER - shall mean the applicant or user of the reclaimed water service for residential irrigation.

DEPARTMENT - shall mean the Utilities Department of the City of Odessa, Texas.

DIRECTOR or DIRECTOR OF UTILITIES - shall mean the individual responsible for the Utilities administration for the City of Odessa, or his designee.

DISCONTINUATION OF SERVICE - shall mean cessation of reclaimed water service or an appropriate method to ensure that no service can be received.

DISTRIBUTION MAINS - shall mean those conduits used to supply reclaimed water to service lines from transmission lines.

DOUBLE CHECK VALVE - shall mean an assembly of two independently operating spring loaded check valves with tightly closing shut off valves on each side of the check valve assembly plus properly located test cocks for the testing of each check valve.

DUAL CHECK VALVE ASSEMBLIES - shall mean an assembly of two operating spring loaded check valves.

MASTER CONTROL VALVE - shall mean the manually operated valve which controls total reclaimed water flow to the customer's property located at the point where the reclaimed service line crosses the property line.

PVC - shall mean polyvinyl chloride pipe.

RATES - shall mean those charges that will be made on a monthly basis for providing reclaimed water service (except where specifically noted as for providing potable water or sewer service) and are subject to change as approved by the City Council.

RECLAIMED WATER - shall mean nonpotable water provided through a separate distribution system meeting the Texas Water Commission's requirements for public use given in Chapter 310, of the Texas Water Commission's permanent rules.

RECLAIMED WATER FACILITIES - shall mean all facilities owned, operated, and maintained by the City of Odessa for the purposes of treating and distributing reclaimed water to residential customers.

REDUCED PRESSURE PRINCIPLE BACKFLOW ASSEMBLY - shall mean any assembly consisting of two independently operating approved check valves with an automatically operating differential relief valve located between the check valves, tightly closed shut off valves on each side of the reduced pressure device, plus properly located test cocks for testing the test assembly and relief valve.

SERVICE LINE - shall mean that conduit for reclaimed water from the distribution main to the property line.

SUBDIVIDER - shall mean the owner or developer of a residential subdivision or his designee.

TRANSMISSION MAINS - shall mean those conduits used to supply reclaimed water from the pumping station or treatment plant to the distribution mains.

TWC - shall mean the Texas Water Commission.

4.3 AUTHORITY

The City Council shall have the authority, by resolution or ordinance, to establish reasonable policies and regulations concerning the use and control of reclaimed water. The City Council shall have the authority by ordinance, duly adopted after public hearing, to establish rates, fees, and charges for the reclaimed water system and to provide terms and conditions for payment and collection of same. Upon the determination that a Residential Reuse Project will be implemented, the City intends to adopt the ordinance(s) necessary to establish use and control policies and procedures, inspection policies and procedures and associated fees, consumption rates, and other fees and charges associated with residential reclaimed water service.

4.4 RESIDENTIAL RECLAIMED WATER SERVICE

City Service

Reclaimed water service shall be provided for residential properties located within the City of Odessa which comply with the provisions for such service as set forth in this document subject to availability. The supply of reclaimed water is a finite amount. It is the intent of the City to provide the maximum amount of reclaimed water available without compromising the City's overall wastewater treatment goals, permit requirements, or the City's intent with regard to reclaimed water quality and dependability of supply.

Reclaimed water service will not be provided to residences outside the City of Odessa.

Availability of Service

The existence of a reclaimed water main adjacent to or near the premises of an applicant for the service does not necessarily mean that service is available to that location. The Director shall make a determination of reclaimed water availability based on total system demand, specific transmission/distribution capabilities within the applicant's project area, and the estimated cost of providing reclaimed water service to that area. No service taps will be made to reclaimed water transmission mains.

4.5 EXTENDING RESIDENTIAL RECLAIMED WATER SERVICE

Request for Distribution Main Extension

A subdivider interested in residential reclaimed water distribution main extension shall submit a written request for such extension following the same procedures established by the City of Odessa as required for "potable water" distribution main extension. Such request shall include a layout of the property to be served.

Eligibility

The Director shall determine the eligibility for the extension of distribution mains to developing residential subdivisions in accordance with, but not limited to, the following criteria:

- a. Availability of an adequate supply of reclaimed water to satisfy the peak demand of the fully developed subdivision over and above the peak demand of the entire reuse system
- b. Proximity of the subdivision to the reuse system's transmission route
- c. Economic feasibility with regard to the City's financial obligation resulting from extension of reclaimed water service and the City's desire to commit to such obligation

4.6 APPLICATION FOR RECLAIMED WATER SERVICE

Application for Connection to Reclaimed Water Distribution Service

Reclaimed water service shall be applied for by the property owner or occupant in the Billing and Collection Office by completing and signing the Application. The Application shall be composed of identification information with respect to the property owner or occupant, requested service size and location, and a plan detailing the property owner's irrigation system.

The City will attempt to the best of its ability to deliver an adequate supply of reclaimed water at all times. However, no guarantees can be provided due to circumstances beyond the City's control. Therefore, the customer will be required to complete a Hold Harmless Agreement as part of the Application prior to the connection. The Director shall have the authority to establish schedules which restrict the use of reclaimed water at certain times, including but not limited

to, periods of shortages in reclaimed water availability in order to reduce peak demands on the system.

Customers shall agree to abide by the City's reclaimed water policies and regulations as a condition of reclaimed water service. A statement to this effect will be included in the Application. By signing the Application a customer shall affirm his agreement to abide by the City's reclaimed water policies and regulations.

In the event of a change of ownership or occupancy of property that is currently served with reclaimed water, the new owner or occupant shall complete and submit the Application for service. Reclaimed water service will not be provided to the new owner or occupant until the Application is approved by the City.

CUSTOMER RESPONSIBILITY

Upon satisfaction of all requirements of the Application and of all other requirements of the Odessa City Code, the City shall approve the customer's application pending installation of a suitable irrigation system. The irrigation system to be provided by the customer will consist of a standard underground system with permanently placed sprinkler devices. The irrigation system should be designed and constructed in such a manner as to minimize runoff and overspray. Final application approval by the City will be subject to a post-installation inspection and approval of the customer's irrigation system.

Information

Applicants accepted to receive reclaimed water service shall receive a brochure summarizing the appropriate use of reclaimed water as well as those uses that are prohibited. This information shall also address such topics as hours of delivery, system pressures, cross-connection control, reclaimed water quality, recommended application, and other related topics.

4.7 WATER USE REQUIREMENT

Appropriate Use of Reclaimed Water

Residential reclaimed water customers shall be authorized to use reclaimed water for irrigation of ornamental grasses, trees, shrubs, flowering plants, and garden variety fruit and vegetable plants. Fruit and vegetable plants that will not be cooked or peeled prior to consumption must be irrigated in a manner other than spray irrigation. Customers must regulate irrigation systems so that runoff and overspray are minimized.

Hose bibbs are not an approved device for irrigation with reclaimed water. Hose bibb connections to a customer's reclaimed water irrigation system will result in the denial of the customer's application for reclaimed water service or result in the discontinuance of an existing service.

Maintenance by Customer

The property owner and/or customer shall be responsible for the maintenance of all facilities associated with the use of reclaimed water located on the owner's and/or customer's private property.

The customer shall install a master control valve to isolate the customer's reclaimed water irrigation system. The Director may require additional valves to assist in cross-connection control inspections of complex systems. The City reserves the right to disconnect the service to any property that does not maintain their system.

Cross-Connection Control

All customers shall be required to protect the public potable water supply by installing an approved backflow prevention device or an air gap of not less than two times the diameter of the supply pipe or no less than one inch. The purpose of these devices is to prevent contamination of the City's potable water system. All devices and materials installed for cross-connection control must be approved by the Director.

A cross-connection, by any means, between the reclaimed water service and any other water source is prohibited. In all instances where a cross-connection is found, it shall be disconnected immediately. Before reconnection of that service, the public potable water system shall be protected against the possibility of future cross-connections, and additional devices may be required, as specified by the Director and installed at the customer's expense. For properties where access is restricted, or for properties with a history of cross-connection control problems, the Director may require the installation of an approved reduced pressure principle backflow device at the customer's expense.

Inspections

To determine the presence of any potential hazards to the public potable water system, the City and/or the Texas Water Commission shall have the right to enter upon the premises of any customer. All reclaimed water customers, by application, shall give prior written consent to such entry upon the customer's property.

Prior to delivery of reclaimed water to any customer the City shall conduct an on site inspection of the customer's property as provided for in the Application. This inspection shall serve to approve the installation of the customer's irrigation system and to minimize the potential for illegal connection or unauthorized use of reclaimed water.

The City, additionally, reserves the right of intermittent inspection of customer sites without prior notification. Such inspections shall be made to ensure that no tampering or unauthorized modification or use of the reclaimed water system or the customer's reclaimed water irrigation system has occurred.

Upon completion of the inspection, the inspector shall prepare an inspection report detailing the findings. A copy of this report shall be left at the premises for the customer's review. If an unauthorized condition has been discovered, the reclaimed water service shall be immediately discontinued until such time as the unauthorized condition has been corrected.

Upon notification by the customer that an unauthorized condition has been corrected, the City shall schedule a reinspection of the customer's property. If the appropriate corrective action is found to have been taken by the customer, the reclaimed water service will be reactivated.

Discontinuance of service shall not preclude the City from taking any civil or criminal remedies or prosecution that may be appropriate due to the violation of the policies and regulations of the reclaimed water system.

Transfer of Reclaimed Water

It shall be unlawful for any customer to sell, barter, trade, or otherwise transfer reclaimed water to any other person or entity without written authorization from the Director.

Billing

Rates, fees, and other charges associated with residential reclaimed water service will be established in the City of Odessa Water and Sewer Rate Ordinance.

4.8 DISCONTINUING AND REINSTATING SERVICE

Discontinuing Service - by City

The City may discontinue reclaimed water service to any customer due to a violation of these policies and regulations, or for any condition discovered on the customer's property that is detrimental to the reclaimed water system. The City may also discontinue reclaimed water service for delinquent charges associated with a customer's reclaimed water service.

Discontinuing Service - by Customer

The City may discontinue reclaimed water service at the request of the customer. Billing procedures for discontinuing service by the customer will be established in the City of Odessa Water and Sewer Rate Ordinance.

Existing Service Reinstated

Existing reclaimed water service may be reinstated as a result of the submission of an application for reinstatement by a customer. Reinstatement of service will not occur until after a satisfactory reinspection is performed by the City and until all outstanding and reinstatement charges are paid.

Service Interruption

The City reserves the right to temporarily interrupt reclaimed water service to any portion of, or the entire, reclaimed water system for the purposes of maintenance, testing, or other reasons necessary to provide reclaimed water service in the manner set forth in this document.

Appeal Process

Any customer may appeal the discontinuance of service by written request to the City Manager for appearance before the City Council.

4.9 RECLAIMED WATER FACILITIES

Public Easement Requirement

All reclaimed water facilities that are dedicated for City ownership, installed in accordance with the requirements of this document, and accepted by the City for maintenance will be located in a dedicated public right-of-way or dedicated public easement. No obstruction of any kind shall be planted, built, or otherwise created within the limits of the easement or right-of-way without prior written permission of the City Manager.

Ownership

All reclaimed water facilities when constructed and accepted by the City shall become and remain the property of the City. Where reclaimed water distribution mains are dedicated to the City, the subdivider shall submit such documents as are typically required for the dedication of public facilities. No person shall by payment of any charges, or by causing any construction of facilities accepted by the City, acquire any interest or right in any of these facilities, or any portion of these facilities, other than the privilege of having their property connected for reclaimed water services.

Identification

All pipes, valve boxes, and above ground cross-connection control devices installed as a part of or in conjunction with the City's reclaimed water system or installed in order to receive authorized reclaimed water service shall be adequately identified by the appropriate reclaimed water system color and shall be clearly marked with the words "NON-POTABLE WATER". The appropriate reclaimed water system color shall be that color that is mandated by federal or state regulations; or in the absence of federal or state regulations, the system color shall be lavender (purple).

The coloring may be characteristic of the pipe or device material, added after manufacture of the pipe or device by a coloring agent, or permanently attached to the pipe or device. Alternatively, there shall be a minimum of three colored stripes per joint of pipe (located at 10 o'clock, 12 o'clock, and 2 o'clock when the pipe is in its installed position), each stripe being a minimum of two inches wide.

Every residential lot that has been connected to a reclaimed water distribution main shall have a 2" galvanized H-Section line fence post installed in the vicinity of the service tap. The fence post shall be at least four feet in height; and the top 2 feet shall be painted brown if service is not currently provided and lavender if service is currently provided.

System Sizes and Specifications

A. Minimum Sized Reclaimed Water Mains

The minimum size of mains installed in the City shall be four inches in diameter, with the following exceptions:

(1) Two Inch Mains

Mains two inches in diameter will only be allowed by approval of the Director, and in no case will be allowed for any extension servicing more than ten

domestic customers on a cul-de-sac or twenty domestic customers on a line that is looped. Two-inch mains shall be connected at each end to a main four inches in diameter. A two inch main shall be looped to a main four inches or larger in diameter in a cul-de-sac.

(2) Service Lines

Service line pipe size shall be as required by the type or size of the property served, but shall in no case be less than three-fourths (3/4) inch in diameter.

B. System Specifications

The reclaimed water system shall comply with all City standards and specifications for potable water systems with the exception of the indentification outlined in this section.

System Pressure and Delivery Hours

The City shall not guarantee the quantity of reclaimed water available but shall ensure that the delivery of reclaimed water is consistent with the pressure rates available for potable water. Should the customer require reclaimed water at different pressures, or different quality, or in any way different from that normally supplied by the City, the customer shall be responsible for the necessary devices to make these adjustments and for obtaining approval by the Director for such devices.

Right To Refuse Service

The City shall have the right to refuse to extend reclaimed water distributions mains or to extend service on the basis of an inadequate supply of reclaimed water, the lack of payment of required fees, the inability of the City to adequately fund the extension, or a proposed use of reclaimed water that would be detrimental to the reclaimed water system.

Fire Protection

The City of Odessa is currently under contract with several large water users for the sale of reclaimed water for the purpose of landscape irrigation. The total contracted amount of reclaimed water to be delivered is projected to equal more than 90% of the reclaimed water supply that will be available for unrestricted use. Therefore, the supply of reclaimed water available for residential use will be very limited.

Because the supply of reclaimed water for the purpose of fire protection would be undependable, the City does not intend to provide any reclaimed water for fire protection.

Extent of City Maintenance

All facilities that have been accepted by the City shall become the property of the City and will be operated and maintained by the City. No person shall do any work nor be reimbursed for any work, or in connection with any work, on the system unless written authorization from the City is received prior to the work being accomplished.

The City shall make a reasonable effort to inspect and keep its facilities in good repair, but assumes no liability for any damage caused by the system that is beyond the control of normal maintenance or due to situations not previously reported to the Utilities Department. This shall include damage resulting from the breaking of transmission or distribution pipes or poor quality of water caused by unauthorized or illegal entry of foreign material into the system.

Separation

The reclaimed transmission lines will be constructed with a minimum separation from potable water lines of nine (9) feet whenever possible. When it is not possible to maintain this separation, the reuse line will be constructed in accordance with 31 TAC, Section 317.12(a)(1)0(4) concerning separation of potable and nonpotable water piping.

Sources of Nonpotable Water

The primary source of nonpotable water will be derived from the City's water reclamation facilities. However, the City reserves the right to supplement the reclaimed water system with other sources of water meeting current TWC requirements as a means of eliminating or mitigating shortfalls in the reclaimed water supply.

SECTION 5
APPENDIX A

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APPENDIX A

PROPOSED PROJECT DESIGN

The Emerald Forest Subdivision phases for which this preliminary analysis is conducted are projected to ultimately include approximately one hundred and twenty residences. After discussions between the subdivider and the City, it was decided that the system to deliver the reclaimed water for landscape irrigation would, as closely as possible, duplicate the delivery of potable water.

Therefore, it was concluded that a static pressure of between 50 and 60 psi would be available to each residence. The hours of operation would be dictated by the homeowner, but it was concluded that a typical watering schedule would result in an application of one inch per week. This volume of irrigation would most likely be applied over three days in equal proportions. Additionally, this volume represents current irrigation usage patterns and should directly reflect the amount of potable water that will be conserved. No more than six hours of watering at a residence is anticipated to occur on any one day. Distribution and trunk mains were designed to accommodate the resulting flows.

The reclaimed water source is an 18" pipeline in the proposed right-of-way of East Ridge Road. This pipeline is not pressured during peak electrical hours. For this reason and due to the volume of water required for this project, a storage facility is required. There is a future park site adjacent to the future alignment of East Ridge Road. This park is to be developed around an existing caliche pit. The City of Odessa has proposed that the caliche pit be reshaped and lined to create a small lake in the park. The lake is proposed to receive stormwater run-off and a constant level for the lake is to be maintained by the supply of reclaimed water from the 18" pipeline. Additionally, a raw Colorado River Municipal Water System line traverses the proposed park site, and this raw water has been identified as an additional source of water to maintain the lake. This lake will ultimately be the source of irrigation water for the proposed park. The terminal storage facility for the residential reuse system will be a covered ground storage tank.

A pump station will be needed for the park irrigation. We have therefore concluded that this would be an ideal location for the pumps required to maintain adequate pressure on the lines delivering reclaimed water to the Emerald Forest subdivision. Our calculations indicate that Phase II of Emerald Forest will require a 15 horsepower pump. An additional 15 horsepower pump should be utilized for adequate back-up. Irrigating the entire 120 lots will necessitate the

replacement of one of the 15 horsepower pumps with a 25 horsepower pump. Subsequent pages present an analysis of the amount of reclaimed water necessary to irrigate Emerald Forest and a preliminary cost estimate of the necessary equipment to deliver the water. We have not included any costs associated with reshaping or lining the caliche pit.

RESIDENTIAL REUSE SYSTEM

ENGINEER'S REPORT

DEMAND

(1) Number of Lots

Emerald Forest Phase II 52 Lots
25 ac Addition 2.7 Lots/ac x 25 68 Lots
Number of Lots for Reusage - 120 Lots

(2) Water Demand Per Lot

Net Area to Water Per Lot 6,000 SF
Volume Water - 1"/Week to Apply
Volume Usage = 6,000 SF x 1/12" ft = 500 CF
= 500 CF x 7.48 gal/CF = 3,740 g/wk
To Be Applied Three Days Per Week
Gallons Per Day = 3,740/3 = 1247 gal/day
Rate to be Applied over 6 hours/day
Usage Rate = 1247/360 = 3.46 gpm
Daily Usage 120 lots x 3.46 gpm = 415 gpm
= 0.15 MGD

DISTRIBUTION SYSTEM

Design Data:

Elevation at Pump House (1) 2,872
Elevation at Subdivision (2) 2,890
Length Supply Line 3,000
Average Demand 415 gpm @60 psi
Estimated Peak Demand 620 gpm @50 psi

For Pipe:

Use C-900 6" or 8" c=150

From Chart F-1

6" Pipe Q=415 gpm Total Head = 83.2 psi = 200 ft
Q=620 gpm Total Head = 89.2 psi = 214 ft

* 8" Pipe Q=415 gpm Total Head = 72.3 psi = 174 ft
Total Head = 66.2 psi = 160 ft

For Pumps At Full Usage

6" Pipe Q=620 gpm TH=214
BHP = (620 x 214)/(3960 x 0.70) = 48 HP

* 8" Pipe Q=415 gpm TH=174
BHP = (415 x 174)/(3960 x 0.70) = 26 HP

For Pumps At Phase II Only

* 8" Pipe Q=200 gpm TH=170
BHP = $(200 \times 170) / (3960 \times 0.70) = 12.3$ HP

*Summary

From the above design data the Engineers recommend that the supply line from the pumphouse to the subdivisions should be 8" C-900 pipe.

The cost is an additional \$9,300 for installing 8" instead of 6" but the cost of power and the pump sizes are decreased by half.

The pumps should be phased in according to demands. The Engineers recommend using a 15 HP vertical turbine pump until the additional 25 acres is developed and the normal pressure drops below 50 psi due to the increased demand. Then one 15 HP pump should be replaced with a 25 HP pump. The pump controls will include:

- (a) Chlorinator system
- (b) Pressure tank
- (c) Air release and surge protection valves as recommended by the pump manufacturers and Engineer.

CHART F-1

Q = 415 gpm

COMPUTED

<u>Elev.</u> @ 1 ft	<u>Pressure</u> @ 1 psi	<u>Elev.</u> @ 2 ft	<u>Pressure</u> @ 2 psi	<u>VARIABLE</u> <u>Discharge</u> gpm	<u>Diam.</u> in.	<u>Length</u> ft.	<u>Hazen-WC</u>
2872.00	83.19	2892.00	60.00	415.00	6.00	3000.00	150.00
2872.00	72.25	2892.00	60.00	415.00	8.00	3000.00	150.00

Q = 620 gpm

<u>Ele.</u> @ 1 ft.	<u>Pressure</u> @ 1 psi	<u>Elev.</u> @ 2 ft.	<u>Pressure</u> @ 2 psi	<u>Discharge</u> gpm	<u>Diam.</u> in.	<u>Length</u> ft.	<u>Hazen-WC</u>
2872.00	89.21	2892.00	50.00	620.00	6.00	3000.00	150.00
2872.00	66.19	2892.00	50.00	620.00	8.00	3000.00	150.00

CONSTRUCTION COST ESTIMATE
Alternative 2 - Unrestricted Use

Phase II

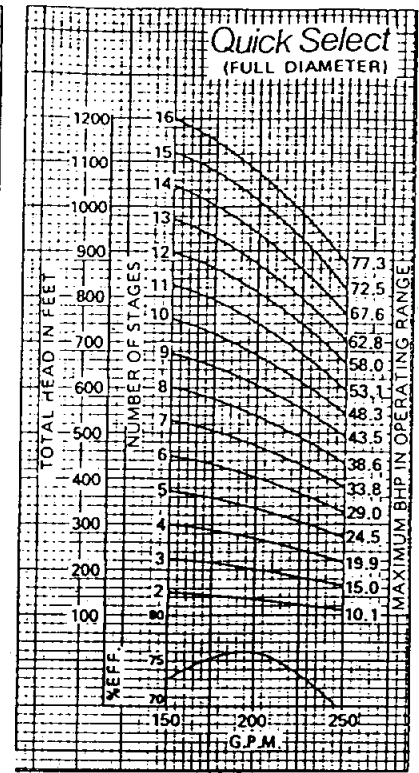
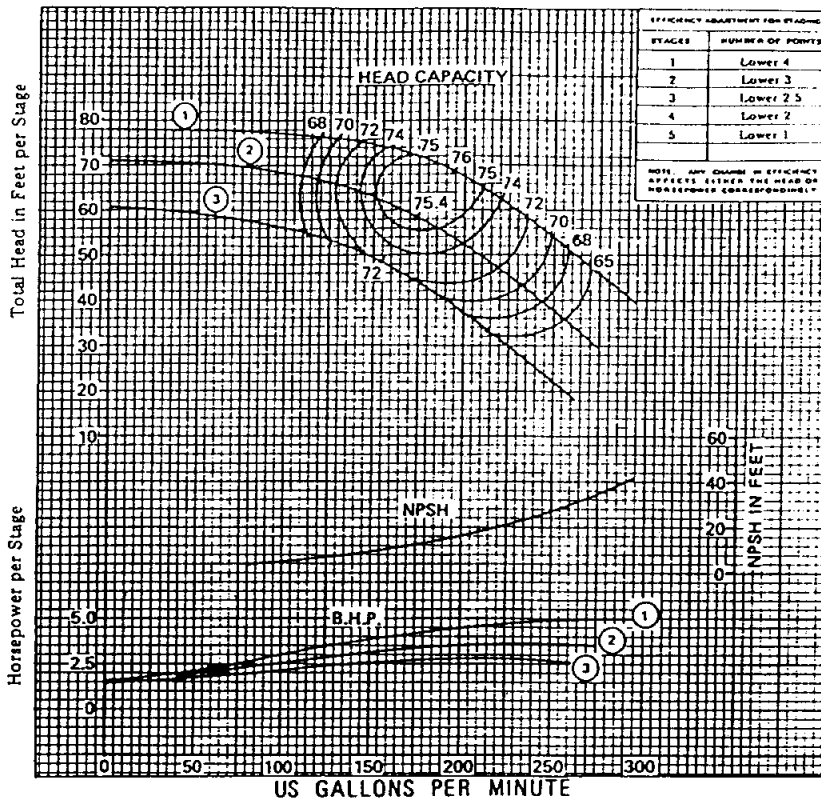
<u>Description</u>	<u>Quantities</u>	<u>Unit Cost</u>	<u>Amount</u>
8" C-900 Pipe Installed (4')	3,100 Ft.	20	\$ 62,000
6" C-900 Pipe	3,160 Ft.	17	53,720
4" C-900 Pipe	3,000 Ft.	12	36,000
8" Gate Valve w/Box	2	525	1,050
6" Gate Valve w/Box	8	375	3,000
4" Gate Valve w/Box	5	275	1,375
Air Release Valves	3	300	900
8x8x8 Tee	1	200	200
6x6x6 Tees	6	175	1,050
4x4x4 Tees	1	150	150
V.T. Pumpx 15 HP w/Controls*	2	10,000	20,000
Pump House w/Wet Well	1	45,000	45,000

*See Report

25 ac Addition

<u>Description</u>	<u>Quantities</u>	<u>Unit Cost</u>	<u>Amount</u>
6" C-900 Pipe Installed	4,120 Ft.	17	\$ 70,040
4" C-900 Pipe	3,900	12	46,800
6" Gate Valves w/Box	10	375	3,750
4" Gate Valves w/Box	7	275	1,925
8x8x8 Tee	1	200	200
6x6x6 Tees	8	175	1,400
4x4x4 Tees	2	150	300
Terminal Storage Tank (300,000 gal.)	1*	L.S.	<u>300,000</u>
	Sub-Total		\$649,160
	10% Contingency		<u>64,916</u>
	Estimated Costs		\$714,076
	Cost Per Lot		\$ 5,950

* Assuming no further quality measures are required.

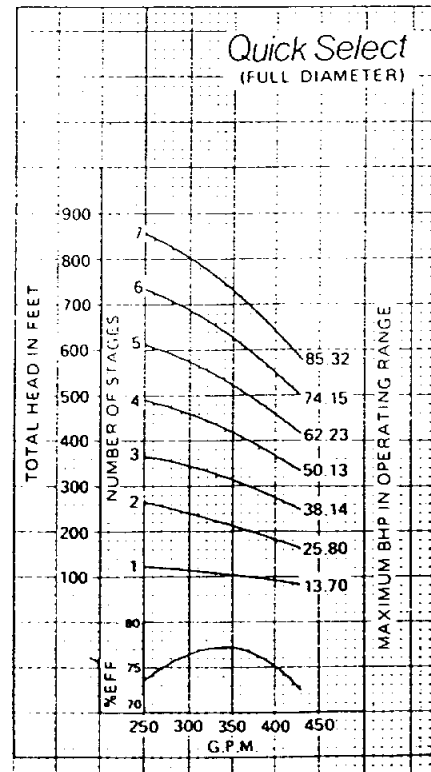
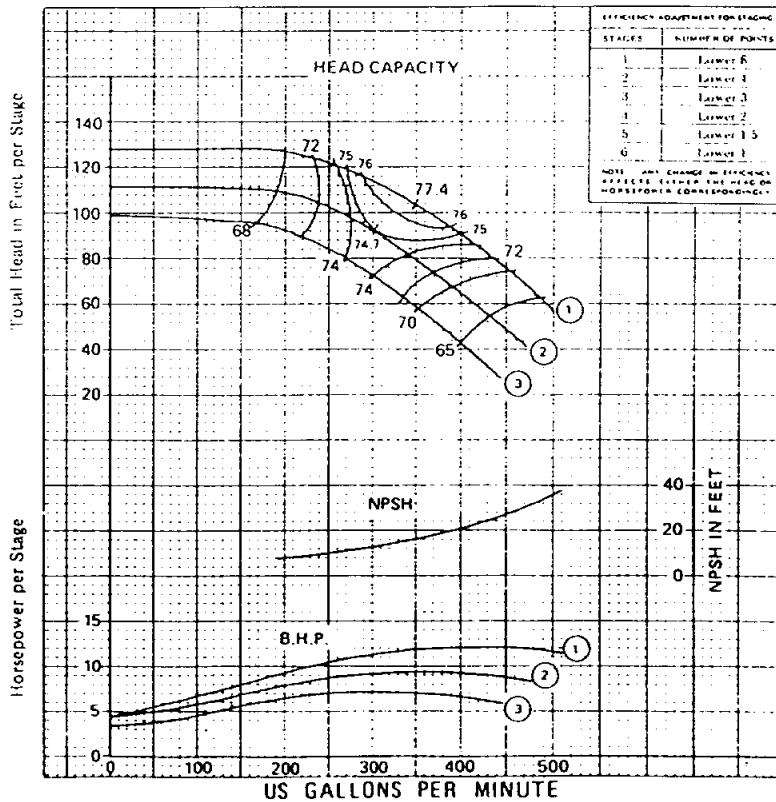


6LB

Curve No. 4806261

Impeller No. 2616318

3460 RPM

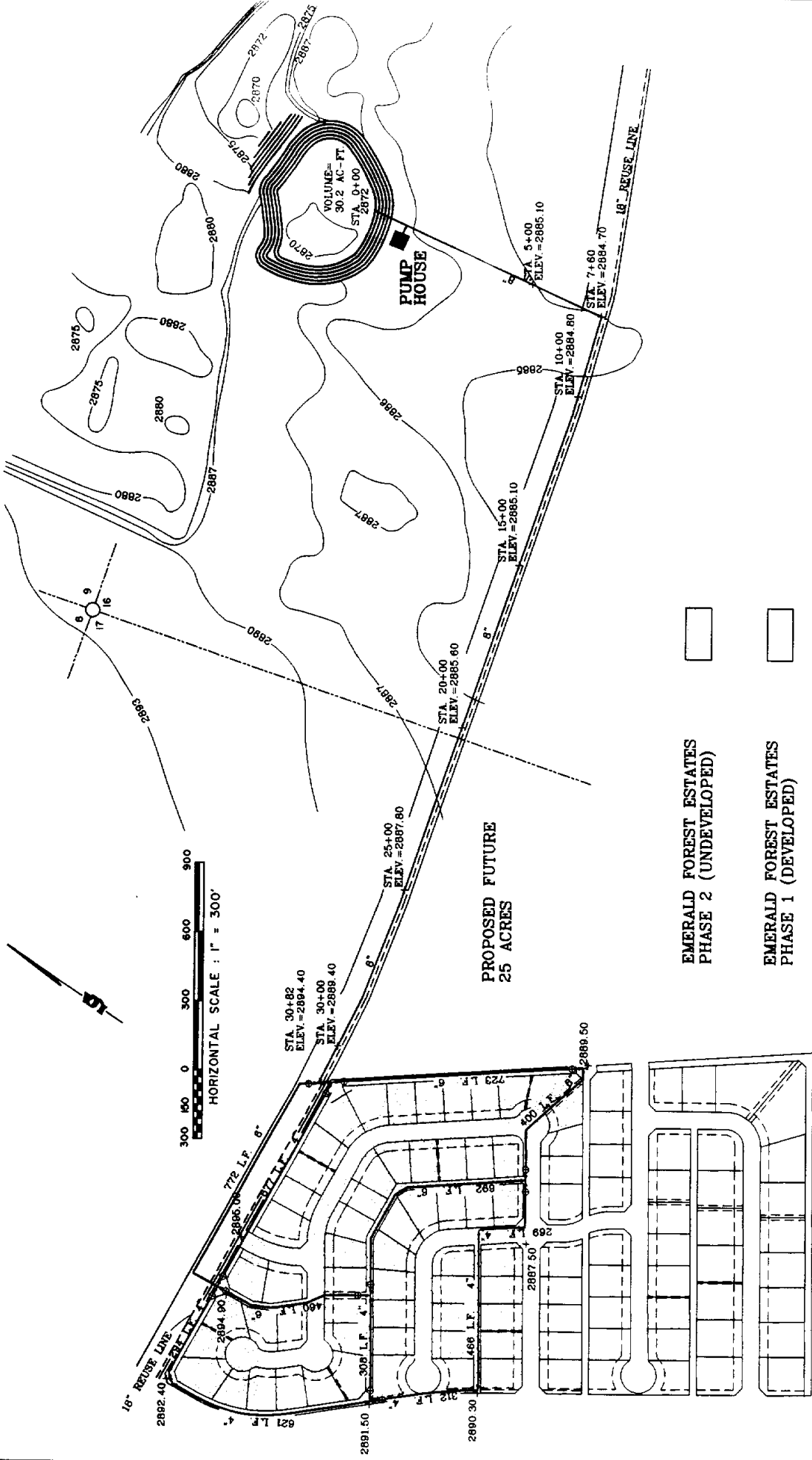


8LB

Curve No. 4806268

Impeller No. 2616464

3460 RPM



PUMP HOUSE

VOLUME =
30.2 AC-FT
STA. 0+00
ELEV. 2872

**PROPOSED FUTURE
25 ACRES**

EMERALD FOREST ESTATES
PHASE 2 (UNDEVELOPED)

EMERALD FOREST ESTATES
PHASE 1 (DEVELOPED)

RESIDENTIAL REUSE WATER SYSTEM

Landgraf, Crutcher and Associates, Inc.

SECTION 6
APPENDIX B

ICA

REFERENCES

1. City of St. Petersburg Policies and Regulations Reclaimed Water System City Project No. 93401-134, March 1993, David K. Ammerman, P.E. Florida Reg. P.E. No. 41803, Robert B. Driver, P.E. Florida Reg. P.E. No. 4722, Camp Dresser & McKee, Inc., Clearwater, Florida
2. Joseph V. Towry, Reclaimed Water Coordinator, Public Utilities Department, City of St. Petersburg, Florida
3. J. David Shulmister, Wastewater Operations Manager, Public Utilities Department, City of St. Petersburg, Florida
4. Project Apricot, Policies and Regulations Governing the Installation and Use of the Reclaimed Water System, City of Altamonte Springs, Florida, February 1989
5. Allison Marcous, Information Liaison, City of Altamonte Springs, Florida
6. City of Apopka Agreement For The Delivery And Use of Reclaimed Irrigation Water (current)
7. Bob Elmquist, Water Resources Superintendent, City of Apopka, Florida