Control Number: 45231

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PUBLIC UTILITY COMMISSION
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**SOAH DOCKET NO. 473-16-1836.WS**
**DOCKET NO. 45231**

| | | |
|---|---|---|
| **RATEPAYERS' APPEAL OF THE DECISION BY TROPHY CLUB MUNICIPAL UTILITY DISTRICT NO. 1 TO CHANGE RATES** | § § § § | **BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS** |

# TROPHY CLUB MUNICIPAL UTILITY DISTRICT NO. 1'S RESPONSE TO RATEPAYERS SECOND REQUEST FOR INFORMATION QUESTION NOS. RATEPAYER 2-1 THROUGH 2-8

COMES NOW, Trophy Club Municipal Utility District No. 1 ("TCMUD1") and files its Response to Ratepayers Second Request for Information – Question Nos. Ratepayer 2-1 through 2-8.

Respectfully submitted,

By: ______________________
John J. Carlton

John J. Carlton
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State Bar No. 03817600

ATTORNEY FOR TROPHY CLUB MUNICIPAL UTILITY DISTRICT NO. 1

## CERTIFICATE OF SERVICE

I hereby certify that I have served or will serve a true and correct copy of the foregoing document via hand delivery, facsimile, electronic mail, overnight mail, U.S. mail and/or Certified Mail Return Receipt Requested to all parties on this the 30th day of June, 2016.

John Carlton

## REQUEST FOR INFORMATION
## QUESTION NOS. RATEPAYER 2-1 THROUGH 2-8

Ratepayer - 2-1. State TCEQ permit limits for Trophy Club Municipal Utility District No. l's wastewater treatment plant.

Response: **The TCEQ permit limits for TCMUD1's wastewater treatment plant are stated in Permit No. WQ0011593001 on page 2, which TCMUD1 is producing in response to this request.**

**Prepared by: Jennifer McKnight**

**Sponsored by: Jennifer McKnight**

Ratepayer - 2-2. State limits for Trophy Club Municipal Utility District No. l's wastewater treatment plant from the Preliminary Engineering Report Wastewater Treatment Facility and Addendums prepared by the Wallace Group and provide a copy.

Response: **The limits quoted by the engineers are shown on page 14 of the Preliminary Engineering Report (PER), which TCMUD1 is producing in response to this request. There are no addendums to the PER.**

**Prepared by: Jennifer McKnight**

**Sponsored by: Jennifer McKnight**

Ratepayer - 2-3. Provide basis for selection of 18,000 gallon cap for residential sewer charges.

Response: **TCMUD1 conducted the first rate study and model development using an outside consultant in 2013 at the recommendation of the General Manager. Prior to that, staff and directors set rates. TCMUD1 capped sewer rates prior to 2014 at 12,000 gallons, as that was the average customer usage when rates were previously set (January 2012).**

**In 2013, when the first rate study was conducted with the outside consultant, the average customer usage was approximately 18,000 gallons per month. Therefore, raising the cap allowed the District to capture otherwise missed sewer revenue. The Board has maintained the 18,000 gallon cap since the original report as average customer usage has stayed basically the same.**

**See also "Water and Sewer Rate Study FINAL REPORT," dated December 4, 2103, prepared by J. Stowe & Co., and produced in response to Staff Request for Information 2-2, Bates TCMUD000869-TCMUD000953.**

**Prepared by: Jennifer McKnight**

**Sponsored by: Jennifer McKnight**

**Ratepayer - 2-4.** Provide wastewater customer class cost allocation for FY13, FY14, FY15 and test year.

**Response**: **Trophy Club MUD No. 1 employs two specific customer classes consisting of In-District Customers and Out-of-District Customers. The In-District Customer class also includes the customers of the Public Improvement District. TCMUD No. 1 does not have any Out-of-District Customers receiving sewer service, nor have any such customers existed over the time period requested. Given this, no allocation of sewer costs has been made and there are no documents available responsive to this request. All costs are attributed to the In-District Customer class.**

**Prepared by: Chris Ekrut**

**Sponsored by: Chris Ekrut**

__Ratepayer - 2-5.__ Provide correlation between customer class cost allocation for wastewater and volumetric flows at the wastewater treatment plant for FY13, FY14, FYl5 and test year.

__Response__: **Referencing response to Ratepayer RFI No. 2-4, TCMUD1 did not perform a customer class cost allocation for the requested period as all costs are attributed to the In-District Customer Class.**

**Prepared by: Chris Ekrut**

**Sponsored by: Chris Ekrut**

__Ratepayer - 2-6.__ Provide agenda, packet, power point and minutes, from June 5, 2015 Special Meeting.

__Response:__ **TCMUD1 will produce responsive and non-privileged documents.**

__Ratepayer - 2-7.__ State the date that Trophy Club MUD No. 1 Board of Directors was first presented a draft FY16 budget and provide copy of the agenda.

__Response__: **TCMUD1 objects to this request as overbroad and irrelevant under the standard of review for this proceeding. Further, TCMUD1 objects to this request as it seeks information not reasonably available to TCMUD1 at the time TCMUD1 provides this response. Texas Water Code §13.043(e) limits the Commission's review to "only the information that was available to the governing body at the time the governing body made its decision and evidence of reasonable expenses incurred by the retail public utility in the appeal proceedings." Because the rates that are the subject of this appeal were set on July 21, 2015, a presented at a meeting that occurred on August 19, 2015, was not available to TMCUD1 "at the time [it] made its decision...."**

**Without waiving and notwithstanding the foregoing objections, the Board of Directors was first presented a draft budget for FY 2016 on August 19, 2015 at a budget workshop, and TCMUD1 will produce responsive and non-privileged documents.**

**Prepared by: Jennifer McKnight**

**Sponsored by: Jennifer McKnight**

Ratepayer - 2-8. State the date that Trophy Club MUD No. 1 adopted the FY16 budget.

Response: **TCMUD1 objects to this request as overbroad and irrelevant under the standard of review for this proceeding. Further, TCMUD1 objects to this request as it seeks information not reasonably available to TCMUD1 at the time TCMUD1 provides this response. Texas Water Code §13.043(e) limits the Commission's review to "only the information that was available to the governing body at the time the governing body made its decision and evidence of reasonable expenses incurred by the retail public utility in the appeal proceedings." Because the rates that are the subject of this appeal were set on July 21, 2015, a budget that was adopted at a meeting that occurred on September 25, 2015, was not available to TMCUD1 "at the time [it] made its decision...."**

**Without waiving and notwithstanding the foregoing objections, the FY 2016 budget was adopted by the Board of Directors on September 25, 2015.**

**Prepared by: Jennifer McKnight**

**Sponsored by: Jennifer McKnight**

## VERIFICATION

THE STATE OF TEXAS §

§

COUNTY OF Denton §

BEFORE ME, the undersigned authority, on this day personally appeared Jennifer McKnight, who being by me duly sworn, on oath stated that she is an authorized representative of Trophy Club Municipal Utility District No. 1; that she has read the above and foregoing Response to Ratepayers Second Request for Information and that the answers are true and correct.

Jennifer McKnight

SUBSCRIBED AND SWORN TO BEFORE ME on the 30th day of June, 2016 to certify which, witness my hand and official seal.

Notary Public, State of Texas

KRISTIN MCINTIRE
Notary Public, State of Texas
My Commission Expires
January 29, 2018

**RESPONSIVE TO RATEPAYERS 2-1**

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Outfall Number 001

1. During the period beginning upon the date of issuance and lasting through the date of expiration, the permittee is authorized to discharge subject to the following effluent limitations:

   The annual average flow of effluent shall not exceed 1.75 million gallons per day (MGD); nor shall the average discharge during any two-hour period (2-hour peak) exceed 2,431 gallons per minute (gpm).

| Effluent Characteristic | Discharge Limitations | | | | Min. Self-Monitoring Requirements | |
|---|---|---|---|---|---|---|
| | Daily Avg. | 7-day Avg. | Daily Max. | Single Grab | Report Daily Avg. & Daily Max. | |
| | mg/l (lbs/day) | mg/l | mg/l | mg/l | Measurement Frequency | Sample Type |
| Flow, MGD | Report | N/A | Report | N/A | Continuous | Totalizing Meter |
| Carbonaceous Biochemical Oxygen Demand (5-day) | 5 (73) | 10 | 20 | 30 | Two/week | Composite |
| Total Suspended Solids | 12 (175) | 20 | 40 | 60 | Two/week | Composite |
| Ammonia Nitrogen | | | | | | |
| April – September | 1 (15) | 5 | 10 | 15 | Two/week | Composite |
| October – March | 3 (44) | 5 | 10 | 15 | Two/week | Composite |
| Nitrate-Nitrogen* | 24 (350) | N/A | 51 | 72 | One/week | Composite |
| Total Copper** | Report (Report) | N/A | Report | N/A | One/week | Composite |
| *E. coli*, CFU or MPN/100 ml | 126 | N/A | 394 | N/A | Daily | Grab |

* See Other Requirements, Item 11, page 34.
** See Other Requirements, Item 12, page 35.

2. The permittee shall utilize an Ultraviolet Light (UV) system for disinfection purposes. An equivalent method of disinfection may be substituted only with prior approval of the Executive Director.
3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per week by grab sample.
4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.
5. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit.
6. The effluent shall contain a minimum dissolved oxygen of 6.0 mg/l and shall be monitored twice per week by grab sample.
7. The annual average flow and maximum 2-hour peak flow shall be reported monthly.

## RESPONSIVE TO RATEPAYERS 2-2

# TROPHY CLUB
# MUNICIPAL UTILITY DISTRICT NO. 1

# PRELIMINARY ENGINEERING REPORT
# WASTEWATER TREATMENT FACILITY

**WORK ORDER 22650**

**APRIL 2013**

TROPHY CLUB
MUNICIPAL UTILITY DISTRICT
No. 1


## THE WALLACE GROUP, INC.

4-5-2013

STATE OF TEXAS
SCOTT C. WETZEL
98107
LICENSED PROFESSIONAL ENGINEER

1825 Market Center Boulevard, Suite 440
Dallas, Texas 75207
(214) 747-3733
www.wallace-group.com
TBPE F-54


TCMUD001703

TROPHY CLUB
MUNICIPAL UTILITY DISTRICT NO. 1

# PRELIMINARY ENGINEERING REPORT
# WASTEWATER TREATMENT FACILITY

## TABLE OF CONTENTS

### PRELIMINARY ENGINEERING REPORT



### EXHIBITS



### APPENDIX



TCMUD001704

# 1.0 INTRODUCTION

## 1.1 Purpose

The Wallace Group, Inc. (TWG) contracted with Trophy Club Municipal Utility District No. 1 (TCMUD) to provide an engineering investigation and assessment of their existing wastewater treatment facility (WWTF). The objective of this study is to identify options to increase the capacity and capabilities of the existing WWTF in order to address the ever-expanding population served by TCMUD and the wastewater demands placed on the plant, as well as to better meet the requirements and discharge limits stipulated by the plant's Texas Pollutant Discharge Elimination System (TPDES) permit, and as regulated and enforced by the Texas Commission on Environmental Quality (TCEQ). Specifically, the study focuses on two options for biological and/or physical-chemical treatment at the plant. In addition, an in-depth assessment was conducted on the necessary improvements to the auxiliary processes at the plant, including grit and debris removal, return activated sludge (RAS) and waste activated sludge (WAS) pumping, tertiary filtration, disinfection, solids (sludge) treatment and dewatering, and pumping capacity of the various plant lift stations.

## 1.2 Background

The exact year of construction and the size of the original WWTF are unknown. It is believed to have been constructed in the mid to late 1970s. The plant incorporated biofilm reactor technology in the form of rotating biological contactors (RBC) to achieve its biological treatment goals, one small secondary clarifier, and an effluent lift station for irrigation/disposal of the treated effluent. Biofilm reactors were very common prior to 1980 and worked reasonably well for the permitted effluent limits in those days. To better meet the growing population served by TCMUD and the changing requirements for wastewater effluent standards, the plant was expanded in the mid-1980s with a larger capacity of 1.40 MGD and converted to a dual technology treatment plant with the addition of a new suspended growth activated sludge aeration basin. The plant was designed to operate either or both treatment trains simultaneously, i.e., the RBCs and/or aeration basin. The plant expansion also included a new submersible lift station, coarse bar screen, two additional center pivot clarifier units, new RAS/WAS lift station, aerobic sludge digestion, sludge drying beds, tertiary sand filtration and chlorine disinfection. In 2002, the plant was again expanded to 1.75 MGD in an effort to keep pace with the ever-growing community served by TCMUD's WWTF. This expansion included the replacement of the RBCs with a second activated sludge aeration basin, equal in capacity to the existing basin. The RBCs had proved ineffective in treating the wastewater to adequately meet the modern effluent permit requirements. Also, RBCs were problematic to operate and maintain. Other improvements included the addition of fine screening for debris and grit removal, bioselector basin, one additional clarifier, replacement of one sand filter with a high capacity cloth media disk filter, ultraviolet (UV) light disinfection to replace the chlorine system, and a belt filter press (BFP) to mechanically dewater the treated sludge at a much higher capacity than drying beds.

### 1.3 Present Challenges

The benefits of the 2002 plant expansion were largely negated by events that occurred shortly after its implementation. Primarily, the TPDES permit limits for biochemical oxygen demand (BOD), total suspended solids (TSS) and ammonia nitrogen (N) were reduced significantly. These are the primary constituents that are monitored and submitted to TCEQ for compliance purposes. They reflect the quality of the plant's treatment operations. Intermittently or consistently exceeding these parameters can result in regulatory action by TCEQ requiring TCMUD to take action to correct the deficiencies. As a result of these permit changes, the effective treatment capacity of the plant's processes and infrastructure were reduced accordingly by the lowering of these permit requirements. Specifically, the 2002 plant expansion design was targeted for permit limits of 10 mg/L for carbonaceous oxygen demand (CBOD), 15 mg/L total suspended solids (TSS) and 3 mg/L for ammonia nitrogen (NH3-N), which can be summarized as 10/15/3 (CBOD/TSS/NH3-N). The permit that is now in place reduced those limits to 5/12/3 (October through March) and 5/12/1 (April through September), thus significantly reducing the effective treatment capacity of the plant upgrades.

## 2.0 POPULATION

### 2.1 Background

There are two components to wastewater treatment that must be taken into consideration in determining the size requirements for any WWTF. One is the amount of flow (hydraulic loading) requiring treatment and the second is the organic strength of the wastewater to be treated. While the concentration of the organics contained in any wastewater (strength) is function of the characteristics unique to each population served by the WWTF (number and type of residential vs. commercial vs. industrial contributors served by the system), the total amount of flow and total amount of organics to be treated each day by the plant is a direct function of the population equivalent (PE) size to be served by the plant. The PE size converts the total number of residential, commercial and industrial users into an "equivalent" number of persons (one individual person). Consequently, in order to reasonably project the 20-year capacity requirements for TCMUD's WWTF, we must identify a population equivalent to be served by the plant in order to project the flow and organic loading on the future plant expansion.

Historically in the United States (US), the per capita contribution by residential users to a typical wastewater collection system is 100 gallons per capita per day (gpcd). Although that number can vary slightly from community to community, the 100 gpcd has withstood the test of time as being fairly accurate. In fact, TCEQ uses this number as a requirement for planning and designing any new treatment facility, lacking other credible testing/monitoring data that indicates the per capita residential contribution is more than 100 gpcd. Under no circumstances should we design for less than 100 gpcd for residential users. For commercial, industrial and other users, the per capita contribution can vary significantly. TCMUD does not have any industrial users and based on zoning regulations, does not anticipate ever having any such customers. However, TCMUD does have commercial (office) users, which typically have a much lower contribution per day due to such factors as shorter hours per day spent at work, no or limited bathing facilities, and no kitchen/dining facilities. For purposes of this study, we will follow the North Central Texas Council of Governments (NCTCOG) guidelines for commercial/office contributions of 35 gpcd.

## 2.2 Population Equivalent Forecasts

Considerable time and coordination with TCMUD administration and staff went into developing the PE to be used for planning the required plant expansion for TCMUD's WWTF.

Generally, historic trends in population are used to project and forecast future trends in population, thereby arriving at some future design population. The inherent assumption in this type of model is that past performance in population growth will reasonably represent future trends in population growth. We then usually apply some type of model equation (e.g., linear regression, etc.) to the growth trends, measure its "fit" to the past data trends, and then select the equation for which the model fits the historic trends reasonably well. Therefore, it should be a reasonably good predictor for estimating a future, target design population. Inherent in this line of thinking and in all models is this: All population forecasts will be wrong because it is impossible to predict the future.

However, we did not use the above model technique to project the 20-year population forecast to arrive at the capacity requirements for TCMUD's WWTF expansion. Because TCMUD is nearing its ultimate build-out capacity, the remaining undeveloped land areas are known and were identified. Working with TCMUD, Town of Trophy Club and Planning & Zoning (P&Z) maps, we calculated total wastewater flowrates generated from each remaining undeveloped tract of land based on the type and density of development to be constructed on that tract. Those tracts of land, in conjunction with the build-out population for TCMUD, allowed us to arrive at a future total population equivalent to be served by TCMUD. Exhibit 2-1: Population Land Tracts, depicts the location and size of the three tracts of land for development, as well as the boundary containing the service area for TCMUD. Table 2-1 below identifies the characteristics of each of the three property tracts, as well as the total build-out population for TCMUD.

**TABLE 2-1: POPULATION DATA**

| Tract No. | Type | Size (Acre) | Units/Acre Units/Prkg. | Density (Person/Unit) | Total P.E. |
|---|---|---|---|---|---|
| Tract 1 | Single Family Residential | 89 | 1.0 | 3.2 | 285 |
| Tract 2 | Multi Family / Mixed Use | 86 | 20.0 | 3.0 | 5,160 |
| Tract 3 | Commercial / Office | 155 | 53.6 | 1.0 | 8,308 |
| TCMUD | Build-Out | N/A | N/A | N/A | 14,000 |
| **TOTAL** | | | | | 27,753 |

The current population equivalent served by TCMUD is 9,800 and the build-out population is projected to be 14,000 by 2017. The total population equivalent projected for TCMUD for the 20-year planning period for the WWTF expansion is 27,753. The total hydraulic and organic loading on the plant projected to be generated by this PE is identified in the following section.

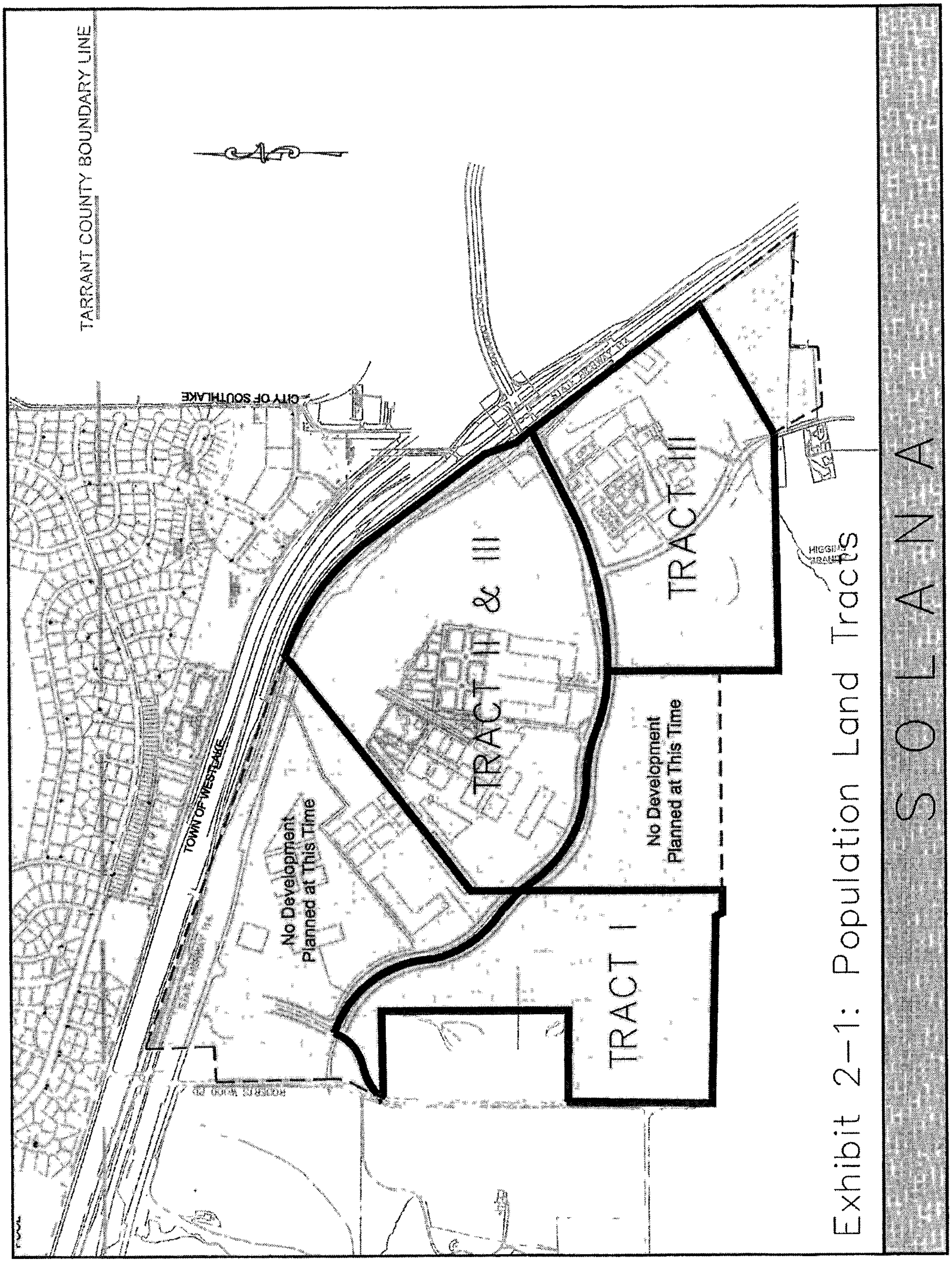



Exhibit 2–1: Population Land Tracts

TCMUD001709

## 3.0 HYDRAULIC LOADING

### 3.1 Historic Data

Ideally, the more historic data that is available for evaluating trends, capacities and limits, the more confidence we have in our projections. Unfortunately, due to issues with record keeping and with the completeness of the existing records prior to mid-2012, we are somewhat limited in the quantity of data available for assessment. For purposes of this report we have tabulated data from November 2011 through November 2012. However, more credibility is lent to the data obtained after May 2012 than to the data recorded prior to that date due to incomplete or missing records and questionable recorded values contained in those earlier records. The suspect accuracy of these early data could be due to a number of reasons. Primarily, we are not certain that the flow meter and recorder were accurately calibrated prior to June 2012.

The WWTF must be capable of adequately treating the average daily flow to the plant, as well as the peak flow through the plant. TCEQ requires that the plant be hydraulically capable of handling the 2-hour peak flow, 3.5 MGD, as well. TCEQ further stipulates that if the plant flows exceed 75% of the permitted daily average or annual average flow for three consecutive months, that the permittee must initiate engineering planning for expansion of the plant. In this case for TCMUD, exceeding the average daily and peak 2-hour flows have not been a problem. The compliance issue for TCMUD is primarily a function of the quantity and strength of organic loadings on the plant. The assessment for organic loading on the WWTF will be evaluated in detail in the following section. However, hydraulic loading and sizing of the WWTF remains a critical factor for the design of the future plant expansion, so it will be assessed in detail.

The following table provides a breakdown of the historic (13 months) average daily and 2-hour peak flowrates to TCMUD WWTF. Where applicable, the flows are separated between those prior to June 2012 and those after that date. As mentioned previously and demonstrated in the table below, the flowrates increased considerably beginning in June 2012. The average daily flow prior to June 2012 was approximately 0.526 MGD, while the period beginning in June 2012 averaged over 0.729 MGD. That is in excess of 200,000 gallons per day (GPD), a 38.6% increase. Appendix-A: WWTF Record Data, contains the detailed daily flow and testing records for this 13-month period.

TABLE 3-1: HISTORIC FLOWRATES

| Flow Condition | Flowrate (GPD) | Flowrate (gpcd) | Description |
|---|---|---|---|
| Average Daily Flow: Pre-June 2012 | 526,310 | 53.7 | Mean of Average Daily Flows |
| Average Daily Flow: Post May 2012 | 729,440 | 74.4 | Mean of Average Daily Flows |
| Average Daily Flow: All | 620,290 | 63.3 | Mean of Average Daily Flows |
| Maximum Daily Flow | 1,154,000 | 117.8 | Occurred April 12, 2012 |

The data in Table 3-1 is largely recorded during a period of drought. As a result, these flows should be indicative of actual sewer flows, with minimal extraneous flow entering the wastewater collection system. In other words, very little precipitation or groundwater would have been entering the collection system during this time period. Although minimizing these extraneous flows is desirable from a treatment standpoint, we must take them into account when planning and designing for any treatment plant expansion, because they will enter the system during non-drought conditions and will detract from the capacity of the WWTF to treat the actual wastewater flows. The following section will discuss these flows in more detail and their impact on the wastewater plant

Based on the above data and as mentioned previously, we believe the post May 2012 data is the most representative. The average per capita flow for that period is 74.4 gallons per day (gpd), which is primarily dry weather flow. In order to plan conservatively for future flows, we have used 100 gpcd to account for extraneous flows as well.

## 3.2 Infiltration and Inflow (I/I) and Peak Flowrates

Extraneous flows that enter a wastewater collection system are classified as infiltration and inflow (I/I). It is during these events that flows recorded at the WWTF are their largest. Large peak flows occur for numerous reasons, primarily due to non-sanitary sewage water sources entering the sewer collection system and being transported to the wastewater plant. This can be by means of leaks in the sewer collection system that allows precipitation and subsurface water to enter into the sanitary sewer system. Although this water does not contain appreciable concentrations of organic waste, it mixes with the normal sewage to create a dilute wastewater that must still be treated by the plant. Furthermore, the plant must be hydraulically capable of handling peak hydraulic loads without surcharging the system.

Infiltration consists of groundwater entering the sewer collection system through deficiencies such as leaking manholes and deteriorated pipes. As the collection system ages, a certain degree of infiltration should be expected. Inflow is comprised of non-wastewater type flows that enter the collection system. Typical sources of inflow into sanitary sewer systems include storm water entering through leaking or missing manhole lids and roof drains emptying into the collection system.

Currently there is little information to fully evaluate the impact of I/I on TCMUD's collection system. Operations staff has reported a minimal noticeable increase in plant flowrates following a rain event compared to dry weather flows. However, the past seven months have seen little precipitation so a minimal impact would be expected and is not necessarily indicative that I/I does not have much of an impact on the WWTF.

Precipitation data for the Alliance Airport in Fort Worth (closest available national weather data located approximately 8-miles ENE from TCMUD WWTF) for November 2011 through November 2012 were obtained to compare to the daily flowrates recorded at the WWTF during the same time period. There is some error involved with this comparison due to the separation distance between TCMUD plant and Alliance Airport. The amount and occurrence of rainfall recorded at Alliance Airport does not necessarily mean that the rain occurrence or that a similar quantity of precipitation occurred at TCMUD plant. However, it is worth comparing to gauge any noticeable trends. Table 3-2 below shows the significant measured precipitation at Alliance Airport and the flows recorded at the wastewater treatment plant for the same time period.

**TABLE 3-2: PRECIPITATION & WWTF FLOWS**

| Time Period | Precipitation (inch) | WWTF Peak Flows (MGD) | Peaking Factor |
|---|---|---|---|
| January 24-26, 2012 | 4.13 | 0.590 | None |
| February 18, 2012 | 1.26 | 0.4960.4790.468 | None |
| March 8-11, 2012 | 1.52 | 0.479 | None |
| March 19-20, 2012 | 3.59 | 0.805 | None |
| April 8, 2012 | 0.50 | 0.753 | None |
| April 15, 2012 | 0.44 | 0.896 | 1.30 |
| May 11, 2012 | 0.40 | 0.559 | 1.21 |
| May 28-31, 2012 | 0.79 | 1.190 | 1.45 |
| June 6-7, 2012 | 0.75 | 1.050 | None |
| June 15, 2012 | 0.52 | 0.814 | 1.92 |
| August 14-15, 2012 | 2.37 | 0.9210.773 | 1.69 |
| August 18, 2012 | 2.79 | 1.150 | 1.31 |
| August 21, 2012 | 0.38 | 0.613 | 1.49 |
| September 14, 2012 | 0.28 | | 1.25 |
| September 28-30, 2012 | 1.77 | | 1.85 |
| October 13, 2012 | 1.15 | | None |

As can be seen from the table, most of the data collected prior to June 2012 is inconclusive due to suspect records. However, for the latter dates in which recorded data exists for precipitation and flows, and since that data is more trustworthy, there does appear to be a correlation between the two events. Therefore, since it is reasonable that I/I does have an impact on the WWTF we used the above information to determine a typical daily peaking factor for the plant's future needs. The maximum recorded peak daily flow for the assessment period is 1.190 MGD while the average daily flow during that period was 0.620 MGD. This equates to a peaking factor of 1.92. Therefore, for planning purposes we have used a daily peaking factor of 2.0 for the 20-year planning period and this report. TCEQ also requires the WWTF to be capable of adequately handling the 2-hour peak flow as well. More information will be provided on the 2-hour peak used for planning purposes in the subsequent sections of this report. Available precipitation data for the Alliance Airport in Fort Worth for November 2011 through November 2012 is contained in Appendix-B: Alliance Airport NOAA Records.

## 3.3 Recycle Flows

The suspended growth activated sludge process requires a certain amount of return flow to the aeration basins. These solids are accumulated in the subsequent settling process from the clarifier basins. The purpose of this return of activated sludge is to maintain a sufficient concentration of the activated sludge in the aeration basins to ensure the required degree of treatment can be achieved in the desired time period. These flows can range from 0.5-1.5 times the design average daily flow. Therefore, tanks/basins and equipment sizing must be sufficient to accommodate this additional flow. TCMUD plant typically operates between 0.5-1.0 times the design daily average flow. Therefore, for purposes of this report and the 20-year planning period, we will use a recycle ratio of 1.0. Table 3-3 shows the breakdown of the flows and plant design sizing to be used for this report and the 20-year planning period.

**TABLE 3-3: PLANT DESIGN FLOWS**

| Tract No. | Type | Total P.E. | Flow/Capita (gal/capita/day) | Inflow/Infiltration (gal/acre/day) | Total Flow (gpd) |
|---|---|---|---|---|---|
| Tract 1 | Single Family Residential | 285 | 100 | 400 | 64,080 |
| Tract 2 | Multi Family /Mixed Use | 5,160 | 100 | 400 | 550,400 |
| Tract 3 | Commercial /Office | 8,308 | 35 | 240 | 327,993 |
| TCMUD | Build-Out | 14,000 | 100 | Included | 1,400,000 |
| **TOTAL** | | 27,753 | | | 2,342,473 |

## 3.4 Flowrate Forecast

Based on the numbers contained in Table 3-3, the following flowrates are used throughout this report and for the 20-year planning period:

- Average Daily Flow: 2.342 MGD (1.00x)
- Peak Daily Flow: 4.684 MGD (2.00x)
- Peak 2-Hour Flow: 6.106 MGD (2.61x)

The 2-hour peak flow was determined using the historic 2-hour peak flows at the WWTF for the testing period from December 2011 through December 2012, and applying the resulting per capita flow for that historic period to the future projected population for TCMUD's contributing area to the WWTF. Table 3-4 identifies the data used to derive the peak 2-hour multiplier.

**TABLE 3-4: 2-HOUR PEAK DATA**

| Date | 2-Hour Flow (gpm) | Gallons/Capita/Day (gpcd) |
|---|---|---|
| December 2011 | 843 | 124 |
| January 2012 | 909 | 134 |
| February 2012 | 991 | 146 |
| March 2012 | 1270 | 187 |
| April 2012 | 870 | 128 |
| May 2012 | 1279 | 188 |
| June 2012 | 1281 | 188 |
| July 2012 | 1500 | 220 |
| August 2012 | 1450 | 213 |
| September 2012 | 1250 | 184 |
| October 2012 | 1305 | 192 |
| November 2012 | 1300 | 191 |
| December 2012 | 1299 | 191 |

Based on the data contained in Table 3-4, the maximum 2-hour peak flow identified was 1500 gpm, which equates to 220 gpcd. Applying this to the future build-out population of 27,753 equals a future projected 2-hour peak flow of 6.106 MGD.

# 4.0 WASTEWATER CONSTITUENT LOADING

## 4.1 Historic Data

Similar to the previous section, the test data and records for the various components contained in the influent and effluent wastewater, including the organic and inorganic constituents, are somewhat incomplete. Again, we have tabulated the data from November 2011 through November 2012 for the monitored constituents. Likewise, the credibility of the data obtained after May 2012 is superior to the data recorded prior to that date, for the same reasons as was stated earlier for the hydraulic data. Therefore, more credibility will be lent to these data values than those prior to that date. The earlier data is used for reference but is generally not used for calculating treatment requirements, sizing processes and equipment, etc.

Table 4-1 provides a summary of the tested constituents for the WWTF during this time period. The table provides both influent (raw) untreated test results, as well the effluent treated test results for the major TPDE permitted constituents.

**TABLE 4-1: TESTED WASTEWATER CONCENTRATIONS**

| Parameter | Influent (mg/L) | Effluent (mg/L) | TPDES Limit (mg/L) |
|---|---|---|---|
| Biochemical Oxygen Demand (BOD) | 207 | 4.6 | 5.0 |
| Total Suspended Solids (TSS) | 244 | 2.6 | 12.0 |
| Ammonia Nitrogen: | | | |
| Summer | 36.8 | 0.41 | 1.0 |
| Winter | 41.0 | 0.63 | 3.0 |
| Nitrate Nitrogen | N/A | 14.0 | 24.0 |
| E. Coli | N/A | 13.5 | 126* |
| pH | N/A | 7.1-7.7 | 6.0-9.0** |
| Total Copper | 0.14 | N/A | Report |

* Colony Forming Units/100 mL
** Standard Units

## 4.2 Discharge Permit & Compliance

As can be seen from Table 4-1, on an average basis, the existing WWTF is generally in compliance with the permitted limits per the TPDES permit. However, the data and figures shown in Table 4-1 and used in the analysis of this study are for the previous 13 months. That period of time also corresponds to one of the worst droughts for Texas in recorded history. Therefore, very little I/I is contributing to the recorded flows at the WWTF. This is significant because I/I will reduce the effective capacity of the plant and is a significant contributor to any plant exceeding its permit limits due to shorter residence time for treatment within the plant. Consequently, this data represents a best-case scenario.

The testing data contained in Appendix-A: WWTF Record Data was further evaluated for its compliance with the TPDES permit limits on a daily basis to help determine a clearer picture of the performance of the plant's treatment capabilities and limitations. Table 4-2 below shows testing and treatment limits for each constituent regulated by the TPDES permit, as well as the number of tests recorded that exceed its permitted limit for the period extending from November 2011 through November 2012.

**TABLE 4-2: TESTING OCCURANCES**

| Parameter | Number of Days Exceeding Permit Limit | |
|---|---|---|
| | Nov. 2011 – May 2012 | June 2012 – Nov. 2012 |
| Biochemical Oxygen Demand (BOD) | 39 | 16 |
| Total Suspended Solids (TSS) | 38 | 0 |
| Ammonia Nitrogen | 0 | 0 |
| Nitrate Nitrogen | 5 | 1 |
| E. Coli | 3 | 1 |

Most noteworthy of the figures depicted in Table 4-2 is that the number of tests recorded that exceed their permitted limit during the current period of drought and limited I/I. Although the plant is being operated well and at a high level by staff, the plant is very near its treatment capacity. Therefore, the frequency of tests that will exceed their permitted limit will increase as the population served by the treatment plant increases and normal weather and precipitation return to our area. The calculations completed by the author of this study indicate that the treatment loading and demands on the existing WWTF will exceed the existing WWTF's capacity and capabilities by May 2014 (See Appendix-C: TCMUD Plant Capacity Calculations), at current growth rates within the plant's service area. At that point, reported violations to TCEQ will become more commonplace. Generally, this will prompt mandatory compliance action and enforcement by TCEQ.

## 4.3 Constituent Loading Forecast

As discussed above, the treatment plant as it presently exists will become undersized by May 2014, based on current growth rates within its service area. Although the hydraulic permitted capacity of the plant will likely not be exceeded by this date, the organic/inorganic loadings on the plant will exceed the plant's capacity by this time. Table 4-3 depicts what the total loadings on TCMUD's WWTF are at current conditions and what they will approximately be at the full build-out population of the service area.

**TABLE 4-3: PLANT LOADINGS**

| Parameter | Present Loading (2012) | Build-Out Loading (2020) | %-Change |
|---|---|---|---|
| Avg. Day Flow | 0.729 MGD | 2.342 MGD | 221% |
| BOD | 1,261 Lbs/Day | 4,692 Lbs/Day | 272% |
| TSS | 1,485 Lbs/Day | 4,887 Lbs/Day | 229% |

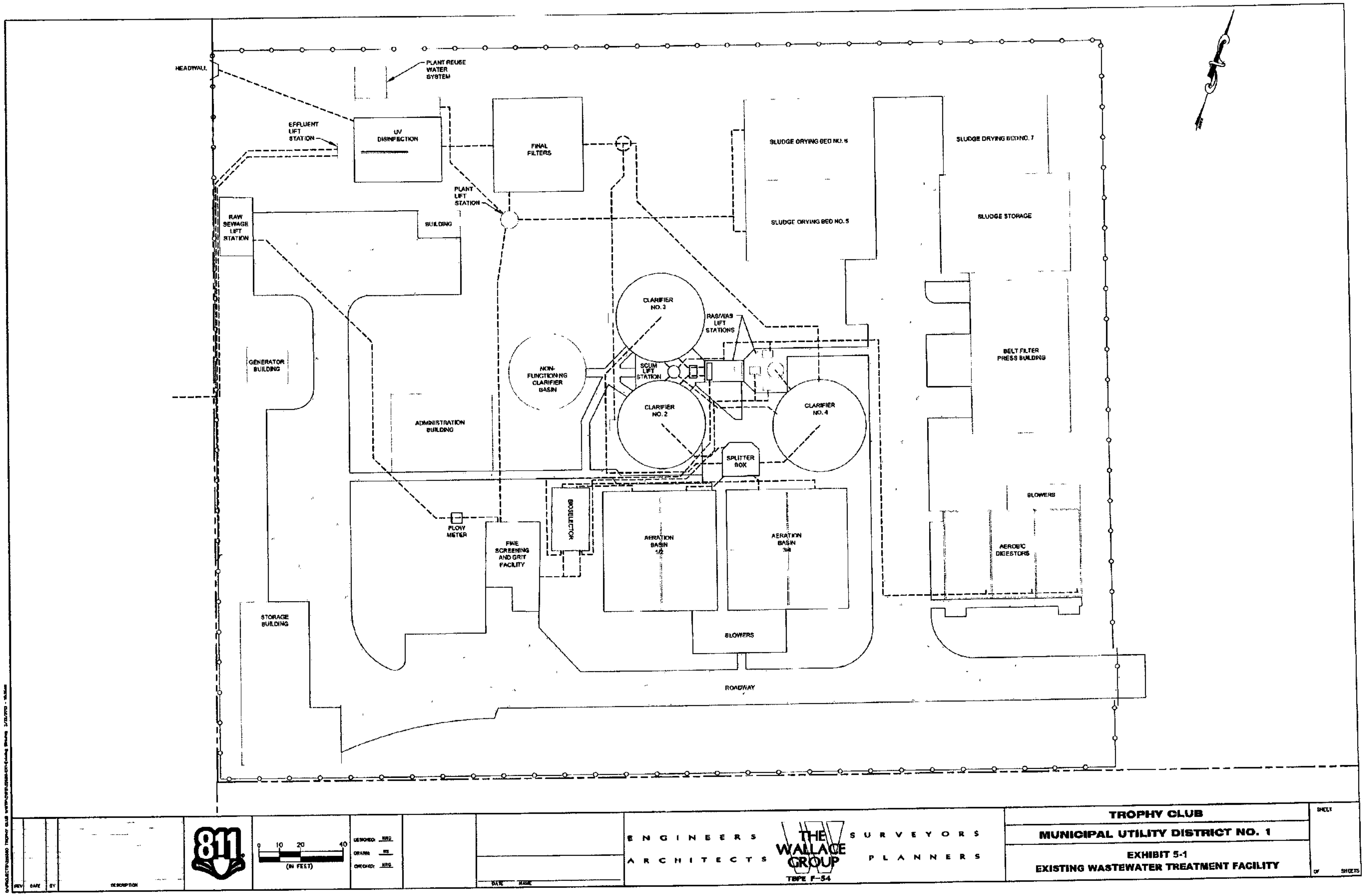
As can be seen from Table 4-3, the demands on the WWTF will continue to increase, thus exceeding its present capacity and requiring expansion.

# 5.0 EXISTING CONDITIONS & ALTERNATIVES

The following sections provide an in-depth discussion of the various unit processes and equipment utilized at the existing WWTF. The discussion includes the present capabilities of each, as well as options for improving and/or expanding the equipment/processes to meet future needs at the plant, where applicable. Exhibit 5-1: Existing Wastewater Treatment Facility, provides a layout of the existing WWTF with the various equipment and unit processes identified.

## 5.1 Phased Planning & Construction

The following assessment of the unit processes and equipment will be investigated and sized with options presented for phased implementation and construction (where applicable), as well as for full build-out capacity. This means of presenting the various process and equipment options to TCMUD Board with the ability for a phased approached will provide the Board with better flexibility in planning for wastewater treatment future growth needs, and better capability to make a feasible alternative work within TCMUD's needs and budget. Phase I – Immediate Needs, will consist of those improvements proposed to upgrade and/or expand the plant that are necessary to meet the increased hydraulic and/or constituent loadings on the plant, or are needed to accommodate changes in the processes and equipment proposed at the plant to help better meet permit requirements. Phase II – Future Needs, will consist of those improvement proposed to the WWTF that are not immediately required to meet current flows, but that are required to meet the flows and loadings associated with full build-out populations.


HEADWALL
PLANT REUSE WATER SYSTEM
EFFLUENT LIFT STATION
UV DISINFECTION
FINAL FILTERS
PLANT LIFT STATION
RAW SEWAGE LIFT STATION
BUILDING
SLUDGE DRYING BED NO. 6
SLUDGE DRYING BED NO. 5
SLUDGE DRYING BED NO. 7
SLUDGE STORAGE
BELT FILTER PRESS BUILDING
CLARIFIER NO. 3
RAS/WAS LIFT STATIONS
SCUM LIFT STATION
CLARIFIER NO. 2
CLARIFIER NO. 4
NON-FUNCTIONING CLARIFIER BASIN
GENERATOR BUILDING
ADMINISTRATION BUILDING
SPLITTER BOX
BIOSELECTOR
AERATION BASIN 1/2
AERATION BASIN 3/4
BLOWERS
AEROBIC DIGESTORS
FLOW METER
FINE SCREENING AND GRIT FACILITY
STORAGE BUILDING
ROADWAY
811
0 10 20 40
(IN FEET)
ENGINEERS SURVEYORS
ARCHITECTS PLANNERS
THE WALLACE GROUP
TBPE F-54
TROPHY CLUB
MUNICIPAL UTILITY DISTRICT NO. 1
EXHIBIT 5-1
EXISTING WASTEWATER TREATMENT FACILITY

## 5.2 Headworks & Primary Influent Lift Station

The existing headworks and influent lift station consist of a traveling mechanical bar screen with pressure wash system and four submersible wastewater pumps.

### 5.2.1 Mechanical Bar Screen

The existing mechanical bar screen was installed in 2011. The unit is designed for coarse screening to remove debris of approximately ½-inch and larger. The peak capacity of the unit is 3.0 MGD. The influent basin is equipped with an overflow channel and a stationary manual bar screen to accommodate flows larger than the 3.0 MGD loading by overflowing a weir gate and allowing the excess wastewater to pass through the manual bar screen channel. The down-side of this system is that the manual bar screen has larger openings (approximately 1") and allows larger debris to enter subsequent treatment operations.

### 5.2.2 Influent Lift Station

The lift station presently contains four submersible non-clog wastewater pumps. Two pumps are fixed-speed and are rated for 1250 gpm at 52 feet of total dynamic head (TDH). The lift station is designed to operate with one fixed-speed "lead" pump operating. The second fixed-speed "lag" pump is designed to initiate operation once flows exceed the capacity of the lead pump. The second two pumps are variable speed pumps and are each rated at 625 gpm with TDH of 52 feet. These pumps are designed to initiate operation upon flows exceeding the capacity of the lead and lag pumps operating simultaneously. The existing total rated capacity of the lift station with all four pumps operating simultaneously is approximately 3.45 MGD (2400 gpm).

### 5.2.3 Conclusions and Recommendations

The WWTF must be capable of adequately conveying the 2-hour peak flow through the plant without surcharging (overflowing) the treatment plant. The historic 2-hour peak flows for the plant were previously presented in Table 3-4 (Section 3). The largest peak flow for that period is 1500 gpm (2.16 MGD). Therefore, the existing influent lift station has additional capacity remaining before it becomes undersized and requires replacement. Appendix-D: Influent Lift Station Pump Curves contains two pump curve charts. The first chart depicts the system curve for the existing lift station and pumps (Flygt Model C-3201). The second chart shows the system curve associated with replacing all four pumps with new, larger submersible pumps ( Flygt Model C-3202) that would be capable of delivering a total flow of 3200 gpm (4.6 MGD). Since the existing lift station is capable of adequately handling the immediate and near-term flows, TCMUD should delay replacing the pumps and upsizing the corresponding header piping and electrical until which time the flows warrant replacing the pumps. This construction would be delayed to Phase II construction and would help reduce construction costs in Phase I construction for the plant upgrades.

## 5.3 Screening, Grit Removal & Bioselector

### 5.3.1 Fine Screening

The existing plant is currently equipped with an Andritz fine screening unit. The wastewater passes through a concrete channel that houses the fine screen (stainless steel plate with 6-mm perforations). Rotating brushes mounted on a shaftless screw convey clean the screen area and transport the solids through stainless steel tube. The solids are washed inside the tube using an external pressure water source. This process is used to separate the organics and inorganics, where the inorganic solids are finished by being transported to a compactor, which dewaters the solids and discharges them into a dumpster for disposal. The organics are washed into the channel for subsequent biological treatment. The screen, auger and compactor are designed to pivot out of the channel for maintenance. The exact O&M manual for the Andritz screen could not be located for this study. However, comparable units by other manufacturers indicate that the net capacity of this unit when factoring in the pressure (head) loss due to debris accumulation on the screen is approximately 4.0 MGD (2775 gpm). Consequently, the existing screening system does not have sufficient capacity to meet future projected peak flows associated with the ultimate build-out of TCMUD service area. Also, 6-mm (1/4-inch) openings are suitable for suspended growth activated sludge treatment. However, should other treatment processes be selected to replace the existing system, such as a membrane treatment system, then screens capable of removing debris in the 1-mm to 2-mm range would be required to reduce the interference of debris and trash from fouling the membranes.

### 5.3.2 Grit Removal

The present grit removal system is a Type AS Lakeside aerated straight line grit chamber with grit washing and dewatering screw conveyor, which discharges the washed grit into a dumpster for disposal. Similar to the existing fine screen, the existing grit unit is capable of treating flows up to 4.0 MGD. Flows in excess of this value can be hydraulically handled by the existing system, however, the grit removal efficiency decreases correspondingly with excess flows.

#### 5.3.3 Bioselector

The bioselector that currently is used at the WWTF is designed to facilitate the growth of the desired type of microorganism in the aerated treatment basins. Prior to the upgrades made to the plant in 2002, the WWTF suffered from bulking of the sludge in the treatment basins and clarifiers due to the growth and proliferation of filamentous bacteria. Bulking occurs when the accumulation of bacteria with filaments accumulate into a bulky floc. The end result is a floc that is buoyant and does not easily settle, hence being carried into the plant effluent, causing TSS and BOD effluent levels to be elevated in excess of the TPDES limits. The bioselector was installed to help limit the growth of the undesirable filamentous bacteria and promote the growth of the desired "good" non-filamentous bacteria. The bioselector is intended to help facilitate the growth of the desired bacteria by creating an anoxic (low oxygen) environment in which the "good" bacteria grow and the filamentous bacteria generally do not. The existing bioselector has a hydraulic residence time of less than 10 minutes under typical flow conditions. Generally, since the 2002 plant upgrade, the WWTF has not encountered as much difficulty with bulking problems. No conclusive findings can attribute this to the operations for the bioselector, other modifications made to the plant at that time, or a combination of both.

#### 5.3.4 Conclusions and Recommendations

There are many scenarios for the expansion and/or replacement of the screening, grit and bioselection processes at the plant. The following is the most feasible options with consideration to these processes. The fine screening and grit removal construction would need to take place in the first phase of construction if the biological treatment process were changed to a membrane process. If a membrane process or other similar process is adopted by the Board to replace the existing CAS system, then the bioselctor is no longer required and could be removed from service.

If the CAS process is retained and we simply expand the capacity of the biological treatment basins, the fine screening and grit removal upgrade could be delayed to Phase II, when flowrates to the plant reach the 4.0 MGD level. Likewise, the bioselector basin and process would require expansion as well with a larger basin.

## 5.4 Biological Treatment

Numerous options exist by which to expand the capacity of the WWTF to meet the future demands of the system. However, due to cost limitations and available land at the existing WWTF, the most viable options for expanding the plant is to add additional capacity with like-kind processes or to retrofit the existing process basins with equipment/processes that are capable of treating more flow capacity within roughly the same footprint. In the case for TCMUD, we evaluated three treatment alternatives for the existing wastewater treatment facility. Option 1 is to construct additional CAS basins that use the same diffused air fine-bubble technology as the existing system and work in parallel with the two present basins. Option 2 is to install membrane biological reactors (MBRs) in the existing aeration basins that are capable of treating more flow capacity within the same basin area and volume. This option would require at least one additional concrete basin in order to maintain treatment capacity during construction and meet future peak hourly flows. A third option is to add a treatment media system to the existing basins that will enhance treatment capacity. In this case we assessed the BioMag system which utilizes magnetite flocculate particles to enhance coagulation and settling capacities to achieve larger treatment capacities. All three options will be discussed in more detail in the following sections. In addition, a fourth treatment option will be discussed in Section 6.0 in which the Trinity River Authority will be presented as an option for contracting out the treatment of TCMUD's wastewater.

### 5.4.1 Conventional Activated Sludge (CAS)

The CAS system presently used at the WWTF is a suspended growth technology utilizing fine bubble air diffusion through simulated plug flow reactor (PFR) basins. The plant was originally designed as a completely mixed reactor (CMR) system but with the last upgrade to the plant conducted in 2002, basin partitions were installed to make the treatment process more like a PFR system, which has some advantages over a CMR system. In all, the two basins effectively operate as four PFRs. Each of the PFRs has nominal dimensions of 55-feet by 28-feet and a side water depth (SWD) of approximately 15.8-feet (total wall height/basin depth of 17.0'), for a total volume contained in all four PFRs of 97,300 cubic feet (cf). The four PFRs are constructed such that they are housed in two rectangular concrete basins (i.e., 56′ x 55′). The following information contained in Table 5-1 provides the tabulated design parameters used and the resulting capacities for the aeration treatment basins.

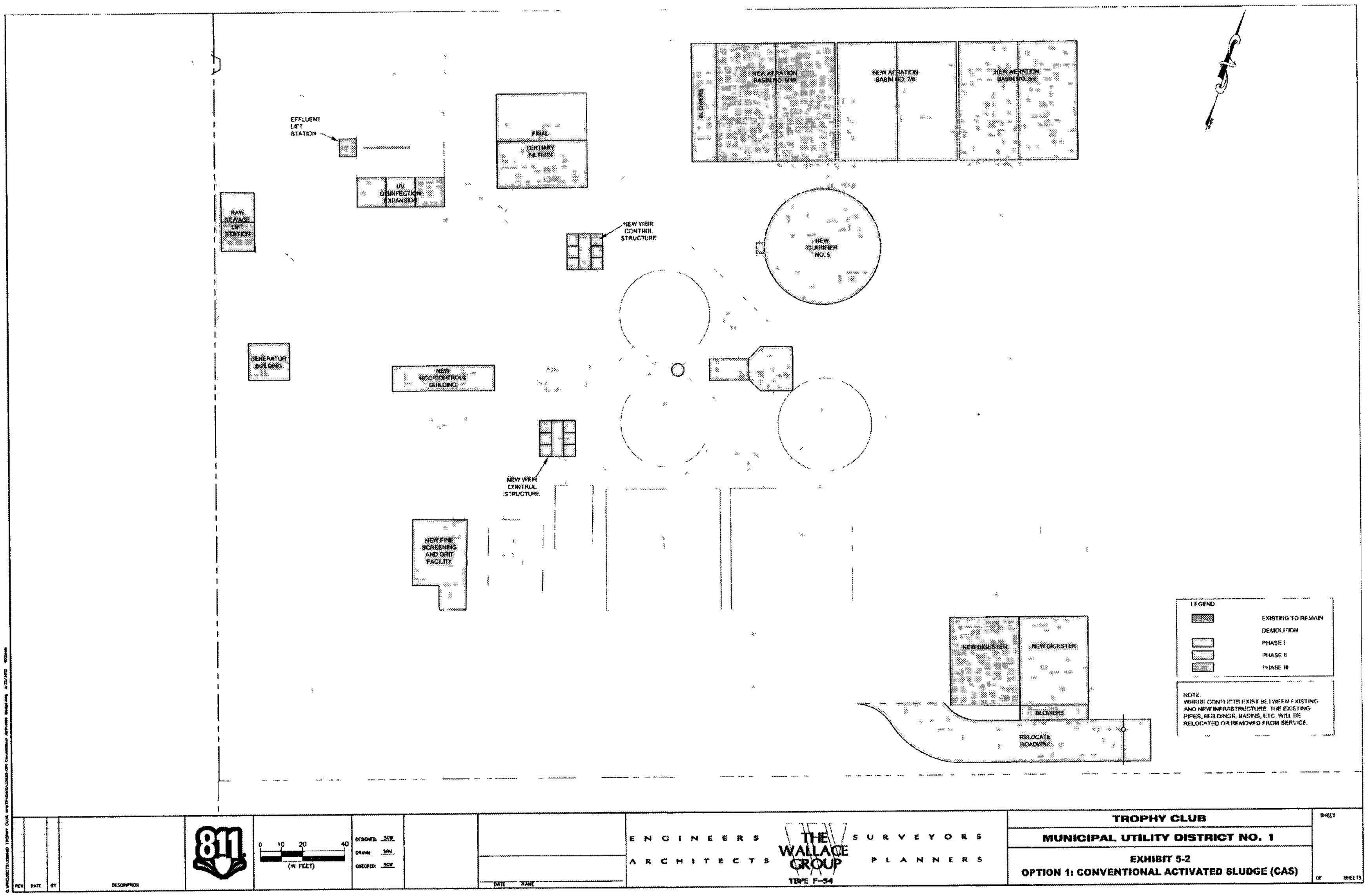
**TABLE 5-1: PARAMETERS FOR AERATION BASIN DESIGN**

| Criteria | Existing Basins | Build-Out |
|---|---|---|
| Average Day Flow | 0.800 MGD | 2.343 MGD |
| Peak Day Flow | 1.600 MGD | 4.686 MGD |
| Peak 2-Hour Flow | - | 6.100 MGD |
| MLVSS | 3,000 mg/L | 2,880 mg/L |
| Net Yield (Y) | 0.88 lb VSS/lb $BOD_5$ | 0.80 lb VSS/lb $BOD_5$ |
| Rate Constant, $k_d$ | Unknown | 0.06/day |
| Efficiency | Unknown | 85% |
| Basin Volume | 97,300 $ft^3$ | 307,000 $ft^3$ |
| Basin Dimensions | 4 @ 55′ x 28′ | 4 @ 55′ x 28′ + 6 @ 56′ x 28′ |
| Oxygen – Average | 3,535 lb/day | 8,600 lb/day |
| Oxygen – Peak Day | 7,070 lb/day | 17,200 lb/day |

Exhibit 5-2: Option 1 – Conventional Activated Sludge (CAS) provides a location and layout for the additional aeration basin configuration and their proximity to the existing plant infrastructure. Please note, there are a myriad of types of CAS systems that could be used to expand the existing plant. Obviously, they all use activated sludge as their principal means of achieving treatment. However, their basin configurations, internal flow mechanisms, aeration, etc. vary from system to system and offer some certain advantages and disadvantages for the prescribed application. For TCMUD's treatment system it makes the most sense to stay with the system that is already in place if TCMUD decides to expand capacity with a CAS system.

#### 5.4.2 Membrane Biological Reactor (MBR)

An MBR is a combination of the suspended growth activated sludge treatment process with membrane filtration equipment performing the separation function of biological solids from the mixed liquor. In a CAS plant this separation function is accomplished using clarifiers. Therefore, one advantage to converting the plant to MBR treatment is that no extraneous clarifiers would be required. A second advantage of the MBR system is that it can provide more treatment capacity in the same basin volume as compared to the current CAS system. As mentioned previously, there are currently four CAS basins with nominal dimensions of 55'x28'x17'. Based on currently effluent limits, those four basins are able to treat approximately 0.90 MGD, or 0.23 MGD per basin. Comparably, a typical MBR system installed in the same four basins could conceivably treat 1.9 MGD, without increasing the footprint. The addition of a fifth MBR basin would bring the total treatment capacity of the plant to approximately 2.4 MGD, which would be of sufficient capacity to meet the projected build-out flow (i.e., 2.343 MGD) for TCMUD. A sixth MBR and basin could be constructed to allow for redundancy in treatment should one of the units need to be taken down for maintenance. However, this comes with considerable costs. Maintenance could be conducted during lower flow periods when flowrates are below 2.4 MGD.

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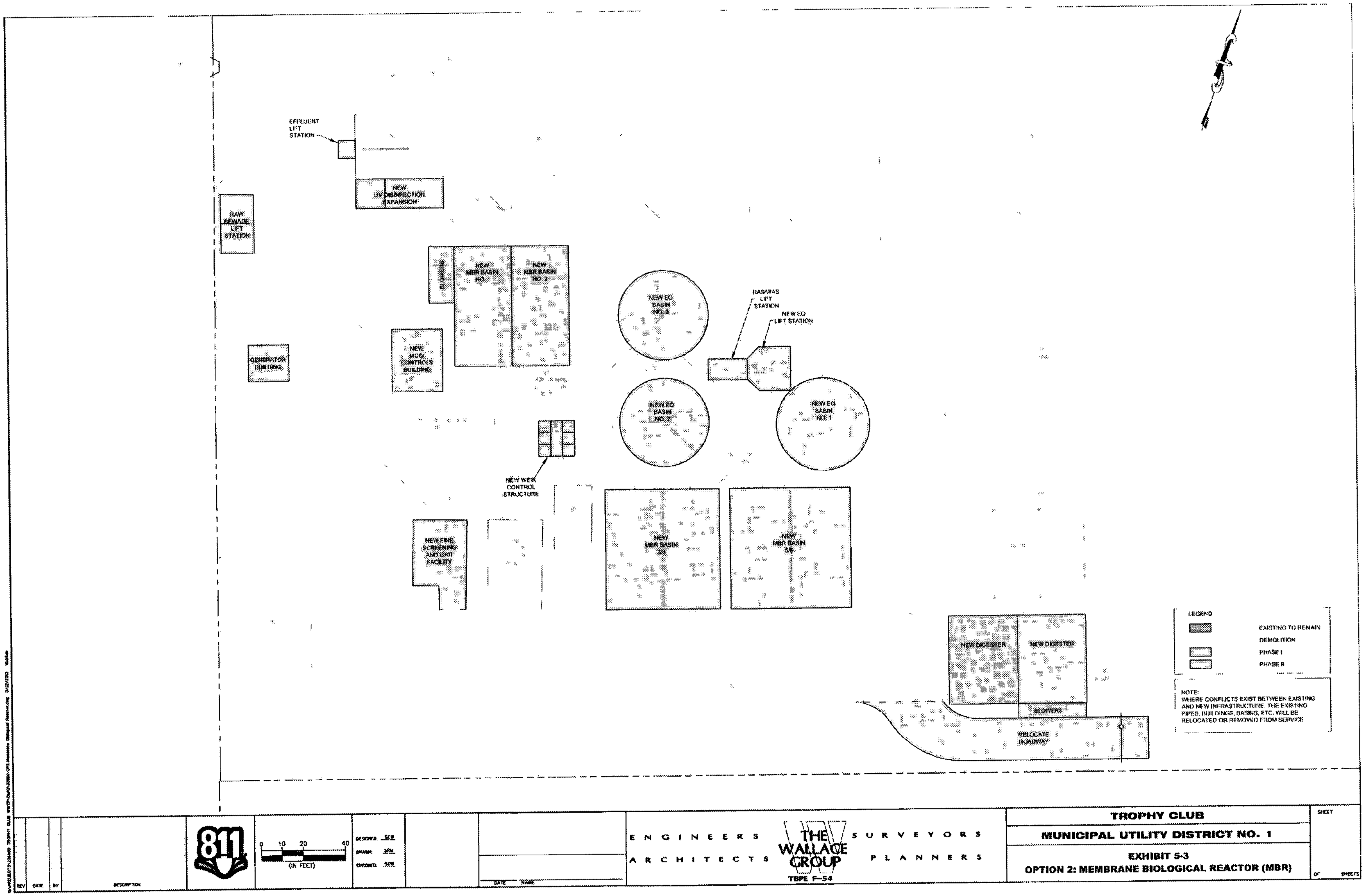
#### 5.4 2.1 Phased Construction & Implementation

In order to maintain full existing treatment capabilities and not decrease the present capacity of the plant, a new (fifth) concrete basin would be required constructing to house the first MBR. The construction of this new treatment basin would increase the plant capacity to approximately 1.38 MGD. The remaining aeration basins could be retrofitted at later dates to accommodate TCMUD's budget, as well as the increased flows to the plant. For example, Table 5-2 depicts a scenario for expanding the plant's treatment capacity in three phases of construction to ultimately bring the total plant capacity to 2.4 MGD. Exhibit 5-3: Option 2 – Membrane Biological Reactor (MBR) provided a detailed layout of the phased construction for the MBR system and auxiliary equipment and processes required to expand the capacity of the wastewater treatment facility

**TABLE 5-2: PHASED MBR CONSTRUCTION**

| Construction | CAS Basins (Qty.) | MBR Basins (Qty.) | Capacity (MGD) |
|---|---|---|---|
| Phase 0 | 4 | 0 | 0.90 |
| Phase I | 4 | 1 | 1.38 |
| Phase II | 2 | 3 | 1.86 |
| Phase III | 0 | 5 | 2.40 |

One operational detractor of this approach is that the plant would operate using two different types of treatment technologies until which time all treatment basins were converted to MBR treatment, so in effect it would almost be the equivalent of operating two plants. The differing characteristics of the sludge produced from the two different treatment processes would cause them to dewater differently as well. This could present some inconveniences and challenges for the operations staff, particularly in operating the digesters and belt filter press.

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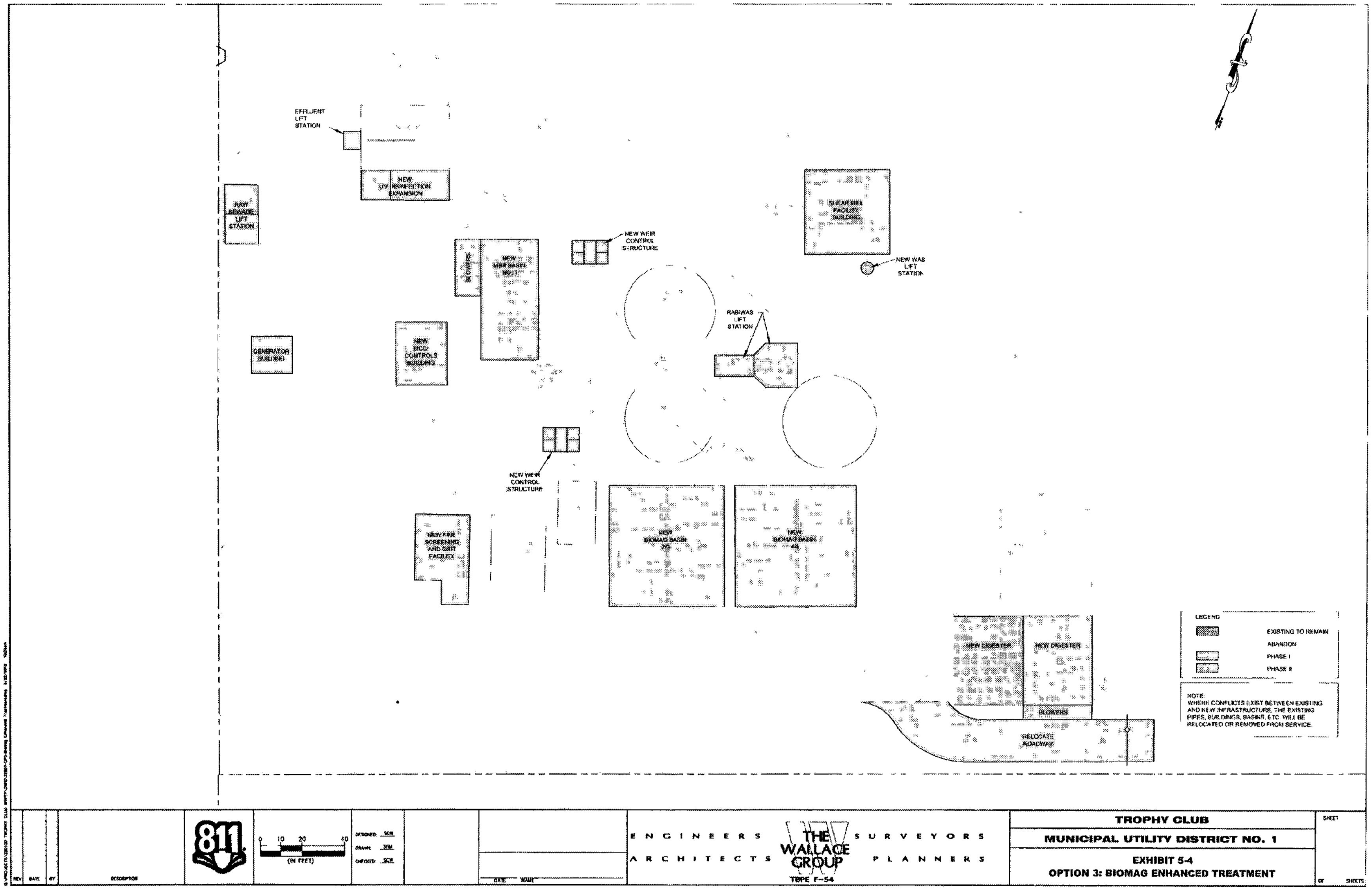
### 5.4.3 BioMag Enhanced Treatment

The BioMag system is a proprietary system that is retrofitted to the activated sludge process to enhance biological treatment and plant capacity. BioMag uses finely graded uniform particles of magnetite that are placed in the existing biological aeration treatment tanks by using a ballast feed tank and slurry. The aeration tanks must be modified and retrofitted to accommodate the BioMag equipment and process. In addition, other equipment and processes must be added to the plant in order to operate the BioMag system. The magnetite provides a biological flocculate particle with much higher specific gravity than typical CAS floc particles. The result is the treatment system can operate at much higher concentrations of treatment biology in the aeration basins (mixed liquor) and achieve much higher settling velocities in the clarifiers, thus doubling or tripling the capacity of the existing wastewater treatment facility. The magnetite is recovered from the settled sludge using a proprietary sheer mill. The recovered magnetite is reused in the treatment process and the separated sludge is sent to the digesters for further treatment. Return activated sludge is processed the same as in the CAS system and the existing RAS lift stations can be used. The treatment capacity of the existing four PFRs can be increased to 2.4 MGD using the existing basin at the present TCMUD wastewater plant and retrofitting them with the necessary equipment, in addition to adding the BioMag feed tanks, sheer mill and other necessary plant improvements to bring the capacity of all unit processes to 2.4 MGD. Exhibit 5-4: Option 3 – BioMag Enhanced Treatment provides a layout for the phases of construction associated with the BioMag system. It should be noted that the initial phase of construction with this option requires the entire BioMag system to be installed in Phase I. Therefore, its initial construction cost is larger than the other options.

There are other similar treatment systems that utilize other media (e.g., specialized sand) to achieve similar operations and results. Presently, the BioMag system is not a preapproved treatment process by TCEQ. Therefore, it would either require a pilot study to prove to TCEQ it is a viable treatment system, or TCEQ could possibly accept a performance bond from the manufacturer guaranteeing the system to work as they have advertised it. A pilot study is a lengthy process and is not conducive to the relatively short timeline which currently faces TCMUD for making plant improvements.

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### 5.4.4 Integrated Fixed Film Activated Sludge (IFAS) Systems

IFAS systems combine fixed film treatment with activated sludge treatment within the same basin. The result is that the treatment basin can operate at higher mixed liquor concentrations, treat higher organic loadings, and better treat for most nutrients than can a CAS system. This is achieved by adding a floating media (usually plastic structures with relatively high surface area to promote biological growth) into the activated sludge aeration tanks. There are a number of manufacturers who make this equipment and while the process varies slightly between the various systems, the principal of combing fixed film and activated sludge is the same. For instance, the manufactured media that provides the surface for the fixed biological film to grow on may vary in configuration and materials of construction, etc.

Again, IFAS systems are presently not preapproved by TCEQ for wastewater treatment. Therefore, the same requirements exist for the IFAS system as for the BioMag system in gaining TCEQ approval. While The Wallace Group feels that the IFAS system could be a cost effective option for TCMUD to expand their treatment plant, we did not provide a full assessment of this system due to the TCEQ approval limitation. At the time of the writing this report, TWG had not been able to receive a response from TCEQ on their requirements for the design and construction of an IFAS (or BioMag) treatment system.

### 5.4.5 TCEQ Pre-Approval

TCEQ requires any and all treatment processes to be pre-approved by their agency before those treatment processes can be used in any publicly owned treatment works facility. The approval process can vary but generally includes either implementing a reduced-scale or full-scale pilot study to monitor how well the proposed treatment process operates, or for the treatment equipment manufacturer to provide performance bond that would "guarantee" that their process and equipment would perform as intended and designed, as required to meet the TPDES permitted effluent limits. The Wallace Group will continue to communicate with TCEQ and will work to schedule a meeting with them in order to determine TCEQ's preliminary position on the BioMag and/or other systems. Should this information become available following the completion of this report, The Wallace Group will communicate with TCMUD on the feedback and decision of TCEQ on this matter. Again as previously stated, at the writing of this report neither the BioMag nor the IFAS treatment systems have received preapproval by TCEQ for wastewater treatment. Therefore, no design standards are in place that can be used by TWG for planning purposes.

### 5.4.6 Conclusions and Recommendations

The MBR and BioMag (including the IFAS system) processes provide the most flexibility to TCMUD for expanding the existing WWTF. They possess several advantages over the CAS process. First, they can fit in the existing footprint of the CAS basins while providing increased treatment capacity at a higher effluent treatment level. One or more concrete basins can be added for ease of construction and/or redundancy. Second, for the MBR system the secondary treatment units, like stand-alone clarifiers and tertiary filters, are no longer required due to the higher effluent treatment limits achieved using the MBR. The BioMag system would still require the existing clarifier units but not the tertiary filter to achieve effluent limits. The IFAS system would still require both the existing clarifiers and the tertiary disk filters. Third, for the MBR process the existing clarifiers can be converted to equalization (EQ) basins once the plant is completely converted over to MBR treatment from the present CAS process since these basins would no longer be needed. This could reduce the number of treatment basins required since the EQ basins could provide temporary storage and serve as a buffer during peak hourly flows. The main disadvantage of the MBR system is its cost and the inconvenience of operating two dissimilar treatment systems during the years of phasing out the CAS system and implementing both phases of the MBR process. The primary disadvantage of the CAS system is its large expanded footprint and considerable additional equipment needed to bring the treatment plant's capacity to 2.4 MGD, which adds considerably to the amount of equipment that must be maintained by the operations staff. The primary disadvantage of the BioMag system is that it is not currently preapproved by TCEQ.

## 5.5 Clarifiers & Weir Control Structure

The existing plant is equipped with three circular clarifiers. Clarifiers are basically sedimentation tanks used to separate the biological solids from the mixed liquor contained in the wastewater. Mixed liquor is the combination of biological solids and wastewater. The biological solids are settled out in the clarifier basin and hydraulically transferred to the RAS/WAS lift station. A portion of the settled biological solids (sludge) is returned to the aeration basins as seed to maintain the desired concentration in the treatment basins, while the excess portion of sludge is wasted to the digester. Clarifier No. 1 was constructed with the original plant construction. This clarifier equipment was removed with the 1986 expansion project, but the empty concrete basin remains. Clarifiers No. 2 and No. 3 were constructed with the 1986 plant upgrade and are 36.5-foot nominal diameter basins. Clarifier No. 4 was constructed with the 2002 plant upgrade and is a 41-foot diameter basin. The flow from the aeration basins is proportioned between the existing three clarifiers by means of a weir control structure (splitter box). Field measurements and hydraulic calculations have indicated that the splitter box is constructed at an elevation above what is desired for the aeration basins to operate at their proper internal water level. Consequently, the aeration basins typically operate at a surcharged level inside their basins, which results in short-circuiting between weir gates, reduced residence time in the basin, and diminished treatment capacity.

Table 5-3 shows the breakdown of the capacities of the three existing clarifiers. TCEQ regulates the design criteria for secondary clarifiers as follows:

- Maximum Surface Loading @ Peak Flow = 1200 $gpd/ft^2$
- Minimum Effective Detention Time @ Peak Flow = 1.8 hrs

The table also shows the required dimensions for a new clarifier that would be required with the expansion of the WWTF using the CAS process and construction of new aeration basins. Should TCMUD opt to expand the plant using MBR technology in lieu of CAS, then the additional Clarifier No. 5 would not be required.

TABLE 5-3: SECONDARY CLARIFICATION

| Category | Clarifier Unit Number | | | |
|---|---|---|---|---|
| | No. 2 | No. 3 | No. 4 | No. 5 |
| Diameter | 36.5′ | 36.5′ | 41′ | 56′ |
| Side Water Depth | 11′ | 11′ | 14′ | 14′ |
| Surface Area | 1045 $ft^2$ | 1045 $ft^2$ | 1320 $ft^2$ | 2463 $ft^2$ |
| Volume | 11,500 $ft^3$ | 11,500 $ft^3$ | 14,500 $ft^3$ | 34,480 $ft^3$ |
| Design Flow | 0.489 MGD | 0.489 MGD | 0.772 MGD | 1.468 MGD |
| Surface Loading | 468 gpd/$ft^2$ | 468 gpd/$ft^2$ | 585 gpd/$ft^2$ | 596 gpd/$ft^2$ |
| Weir Loading | 4270 gpd/ft | 4270 gpd/ft | 5990 gpd/ft | 8344 gpd/ft |
| Detention Time | 4.22 hrs | 4.22 hrs | 3.99 hrs | 4.00 hrs |
| Peak Flow | 0.978 MGD | 0.978 MGD | 1.54 MGD | 2.936 MGD |
| Surface Loading | 935 gpd/$ft^2$ | 935 gpd/$ft^2$ | 1169 gpd/$ft^2$ | 1192 gpd/$ft^2$ |
| Weir Loading | 8530 gpd/ft | 8530 gpd/ft | 11,980 gpd/ft | 16,689 gpd/ft |
| Detention Time | 2.11 hrs | 2.11 hrs | 2.00 hrs | 2.00 hrs |

The existing three clarifiers currently share RAS/WAS pumping and scum removal pumping. As mentioned previously, the flow to the clarifiers is proportioned using a weir control structure. That structure will need to be modified or completely replaced to accommodate the new Clarifier No. 5, as well as correct the elevation issue that causes the aeration basins to surcharge. Again, if TCMUD opts to expand the plant using the MBR technology, then the secondary clarifiers are no longer required and the splitter box will not need to be corrected or replaced.

#### 5.5.1 Conclusions and Recommendations

If TCMUD decides to expand the CAS aeration basins then a new 56′ diameter circular clarifier must be installed. However, if the Board opts to expand the plant using the MBR process then no additional clarifiers must be constructed.

## 5.6 RAS/WAS Lift Station

The plant currently maintains two RAS/WAS lift stations. The first lift station was constructed with the 1986 plant improvements and consists of three submersible non-clog wastewater pumps. This lift station contains 1-5 HP and 1-10 Hp RAS pumps and one 10-Hp WAS pump. The two RAS pumps deliver the settled sludge from clarifier No. 2 and No. 3 to the aeration basins to maintain the desired mixed liquor concentration in those basins. The WAS pump is used to waste the settled sludge from Clarifier No. 2 and No. 3 to the digester in order to maintain the proper solids concentration in the treatment basins. The second lift station was installed with the 2002 plant improvements and consists of three self-priming dry-pit centrifugal wastewater pumps. This lift station contains three 10-Hp pumps, two for RAS and one for WAS. Two of the pumps deliver the settled sludge from Clarifier No. 4 to the aeration basins, while one of the pumps deliver the sludge to the digester.

A third RAS/WAS lift station will be required with any subsequent plant expansion. This will be required regardless of whether the plant is expanded using CAS or MBR technology. The quantity and concentration of the sludge may vary between the two processes. However, the mechanics used in the addition of a third RAS/WAS lift station will remain consistent with those that exist with the first two lift stations. The new lift station will need to be capable of returning approximately 0.5-1.5 times the design flow for RAS. Table 5-4 shows the existing pump parameters for the two existing RAS/WAS lift stations, as well as the approximate conditions for the future third lift station. Appendix-E: RAS/WAS Lift Station Pump Curves contains the pump and system curves for the existing RAS/WAS pumps.

TABLE 5-4: RAS/WAS LIFT STATIONS

| Lift Station/Pumps | No. of Units | Power (Hp) | Flowrate (gpm) | Pressure/Head (ft) |
|---|---|---|---|---|
| Station No. 1 | | | | |
| RAS Pump | 1 | 5 | 500 | 29 |
| RAS Pump | 1 | 10 | 550 | 31 |
| WAS Pump | 1 | 10 | 420 | 41 |
| Station No. 2 | | | | |
| RAS Pump | 2 | 10 | 710 | 27 |
| WAS Pump | 1 | 10 | 565 | 39 |
| Station No. 3 | | | | |
| RAS Pump | 2 | 25 | 1050 | 55 |
| WAS Pump | 1 | 20 | 700 | 58 |

### 5.6.1 Conclusions and Recommendations

One other option for addressing the future RAS/WAS lift station demands would be to consolidate all RAS/WAS pumping operations into one lift station. From an operations viewpoint this would be advantageous since only one lift station would require maintenance. However, from a constructability and cost perspective this option is not desirable. Considerable logistics would be required to maintain current RAS/WAS pumping operations through construction and startup of the new left station and forcemains. In addition, due to the confined space remaining at the WWTF, routing gravity lines and forcemains to and from the new RAS/WAS lift station to/from the existing clarifiers, aeration basins and digesters would be extremely difficult, time consuming and expensive. The better option is to maintain the existing RAS/WAS lift station and piping, while adding a third lift station for the new clarifier.

## 5.7 Tertiary Filtration

The tertiary filters are used to reduce the BOD and TSS beyond that which can be achieved using only clarifiers. Clarifiers such as those used at TCMUD WWTF (in conjunction with the CAS and other existing processes at the plant) are capable of achieving effluent limit of roughly 10 mg/L BOD and 15 mg/L TSS. TCMUD's existing TPDES permit requires effluent limits of 5 mg/L BOD and 12 mg/L TSS. In order to achieve these lower effluent limits, tertiary filters are used. Presently, the plant utilizes one sand filter basin and one cloth media disk filter basin. The operations staff has had difficulty with these filters being a bottleneck for flow through the plant. Further investigation is warranted to determine the cause of this problem. Hydraulic analysis of the piping entering and exiting the filters indicates that the filter piping should be adequate to meet the peak hydraulic flows encountered at the plant. The sand filter manufacturer, Auqua Aerobics, indicate that the existing unit at TCMUD WWTF is capable of meeting 792,000 gpd, sustained, and meeting a peak flow of 1.98 MGD. The disk filter manufacturer, Five Star Filtration, has indicated that their equipment that is installed at TCMUD is capable of treating sustained flows of 1.3 MGD, and peak flows of 2.6 MGD. Table 5-5 shows a summary for the two filters for average day and peak flow conditions

**TABLE 5-5: TERTIARY FILTRATION CAPACITY**

| Flow Rate | Sand Filter | Disk Filter | Total Capacity |
|---|---|---|---|
| Average Day | 0.792 MGD | 1.300 MGD | 2.09 MGD |
| Peak 2-Hour | 1.980 MGD | 2.600 MGD | 4.58 MGD |

### 5.7.1 Conclusions and Recommendations

The existing tertiary filters should have enough capacity to meet current design average daily flows (0.80 MGD), as well as the current peak 2-hour design flows (3.50 MGD). Additional investigation will need to occur to determine the present issue with flow constriction at the filter. However, for future design flows to meet the ultimate build-out demands, additional filtration capacity will be required for any expansion using the CAS process. If the plant expansion is completed using MBRs then the tertiary filters can be taken out of service since the MBRs are capable of producing an effluent quality below the current TPDES permit levels. However, should the plant expansion be phased construction, then the filters will not be taken out of service until all CAS basins have been converted to MBRs.

## 5.8 Ultraviolet (UV) Light Disinfection

The UV light disinfection system was installed with the 2002 plant upgrades. The UV system replaced the chlorination disinfection system and the UV basin was modified to accommodate the UV equipment in one channel. The structure is also equipped with a by-pass channel for flows that exceed the peak design flowrate for the UV system. The UV system has a number of advantages over chlorine disinfection, making it the better disinfection system for TCMUD WWTF. Primarily, the UV system does not add any chemicals to the water to achieve disinfection of the effluent wastewater. Consequently, no additional chemicals must be added to the effluent water to remove the excess chlorine before the water is discharged into the receiving stream. The existing UV system is manufactured by Trojan Technologies, Model UV3000, with a capacity of 1.75 MGD based on TSS below 15 mg/L, minimum light transmittance through the water of 65%, achieving less the 800 Fecal CFU per 100 mL, where CFU is colony forming units. The UV system contains two banks of UV lights and is flow-paced to accommodate the varying flows. When flows occur between 0 to 0.875 MGD only one bank of lights operates to disinfect the water. Both banks of lights operate when the flow exceeds 0.875 MGD. The two banks are designed to alternate and cycle so as to maintain equal wear on both banks of UV lamps, and are timed to prevent frequent on/off cycles.

### 5.8.1 Conclusions and Recommendations

The existing UV system will require expansion to meet the future build-out loadings on the plant. Currently, the existing system can treat sustained flows up to 1.75 MGD. Flows above this amount still receive treatment but at a reduced contact time. Currently, if flows exceed the 1.75 MGD threshold, it is generally due to an I/I situation caused by a storm event. The additional water passing through the plant is stormwater and does not contain any appreciable organic loading. Consequently, the water is relatively clear and clean, thus, not placing a significant demand on the UV system. So, even if these flows exceed the capacity of the UV system, the UV system is generally still capable of meeting the disinfection requirements. However, in the future when the sustained flow of wastewater does exceed the design capacity of the UV system, the system will not be capable of adequately disinfecting the wastewater and will need to be expanded. A second channel should be added to the existing basin to accommodate two additional banks of UV lamps to bring the peak daily flow capacity of the UV system to 4.686 MGD. In addition, the UV channels hydraulic capacities should be capable of meeting the peak 2-Hour peak flow of 6.1 MGD.

#### 5.8.1.1 Effluent Weir Control

TCEQ requires that the UV channel be equipped with a level control device that allows the depth of water in the UV channel to be maintained under all flow conditions. The existing channel is equipped with a stationary concrete weir control structure. The weir is constructed at a height that causes the water in the UV channel to surcharge during heavy flow conditions through the plant. The existing concrete weir opening should be saw-cut and an adjustable stainless steel weir gate should be installed to allow the water depth in the UV channel to be adjusted according to the flow conditions experienced at the plant.

## 5.9 Effluent Pump Station

The original plant design provided the capability of discharging treated effluent water from the chlorine contact basin to either the receiving stream located adjacent to the WWTF via a 12-inch discharge line, or to the golf course for temporary storage prior to being used for irrigating the golf course. The original plant design provided a duplex submersible lift station, valve vault, and 6-inch PVC forcemain to deliver the water to the golf course lake. The 1986 plant expansion provided two additional submersible irrigation pumps for pumping treated water to a new golf course lake, using most of the existing 6-inch forcemain and installing several isolation valves in the line to accomplish this. The original duplex submersible lift station, containing submersible pumps installed with the 1986 expansion, is capable of delivering approximately 300 gpm. Combined, the four pumps are capable of delivering 710 gpm. The combined flow of operating all four pumps simultaneously does result in additional pressure headlosses. As a result, each pump is not capable of pumping as much flow individually when operated in combination with the other pumps. However, collectively when all pumps operate they are capable of delivering more water to the lakes than with only one pump operating.

### 5.9.1 Conclusions and Recommendations

The effluent lift station must be capable of meeting the ultimate build-out 2-Hour peak flow, 6.1 MGD. Currently, the lift station is not capable of delivering that much flow to the golf course. As a result, the existing pumps and forcemain should be upgraded. Preliminary hydraulic calculations indicate that replacing the four effluent pumps with four new submersible wastewater pumps, each capable of delivering 2,100 gpm will provide sufficient flow to meet the peak 2-hour demand of 6.1 MGD, while also providing redundancy to the system. In addition, due to the age and condition of the valve vault and meters associated with the effluent lift station, these appurtenances should also be replaced to