

# FINAL DRAFT



## Wastewater Collection System Master Plan Trunk Main Approach South of Oso Creek

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**LICENSE NO:** 81499      **DATE:** 6/4/2010

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## June 2010

Oso Water Reclamation Plant Transfer  
To Greenwood Wastewater Treatment Plant  
Project No. 7383

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## **I. Executive Summary**

LNV Inc. developed a wastewater collection system master plan for the area south of Oso Creek which is shown in Figure 1. The area south of Oso Creek will be a sub-basin of the Greenwood Wastewater Treatment Plant (WWTP) service area.

The purpose of this wastewater sub-basin master plan is to develop a wastewater collection system while utilizing a large gravity trunk main approach. In general, the trunk mains will run adjacent to and parallel with the proposed master drainage ditches. The collection system design includes land use and projections on the service population which support the calculation of average, and peak wet weather flows.

It is not the intent of this study to assess the capacity of the Greenwood WWTP or how it will be impacted. It is however; recommended that the City evaluate the capacities of the Greenwood WWTP and determine how the development of this area will impact their required capacities.

The studied area is located in the southern region of Corpus Christi and consists of approximately 16,861 acres. The area is bound on the north and east by Oso Creek, extends south approximately 1,500 feet south of CR 18, meets up with CR 49A on the southwest corner, and continues in a northwesterly direction just shy of CR 53 on the northwest corner as shown in Figure 2.

Land use dictates the population for a given area and therefore, dictates the amount of wastewater generated over a given amount of time. For the purposes of this master plan, the areas are categorized into one of six (6) land use categories.

1. Low Density Residential (LDR)
2. Medium Density Residential (MDR)
3. Commercial (COM)
4. Parks (PRK)
5. Public/Semi-Public (PSP)
6. Estate Residential (ER)

These categories are based on the City's Adopted Future Land Use Map, dated May 24, 2005 (Ordinance 026278). Exhibit 1 identifies the adopted future land use for this area south of Oso Creek. Exhibit 2 shows the proposed wastewater collection system master plan improvements.

## **II. Introduction**

### 1. Scope of Work

Under Corpus Christi's Oso Water Reclamation Plant Transfer to Greenwood Wastewater Treatment Plant, Project Number 7383, LNV Inc. developed a wastewater collection system master plan for the area South of Oso Creek. The studied area is a sub-basin of the Greenwood Wastewater Treatment Plant (WWTP) Service Area.

This technical memorandum covers the methodology and background information which was used during the development of recommendations for collection system improvements in the undeveloped area. This study includes exhibits identifying the adopted future land use and exhibits showing the preferred collection system pipe alignment, pipe diameter, direction of flow, and any other collection system infrastructure improvements that will need to be incorporated into the study area. The following is a list of the exhibits included in this master plan:

- Exhibit 1, Adopted Future Land Use, South of Oso Creek
- Exhibit 2, Wastewater Collection System Master Plan, Trunk Main Approach, South of Oso Creek

The scope defined for this study included six tasks to perform the master planning which are outlined below:

- i. Compile and Review Existing Documentation – Collect and review existing reports and documentation provided by the City to assist in master planning efforts.
- ii. Land Use and Planning – Review land use and population data, meet with City planning staff and develop study area boundaries.
- iii. Design Flow Calculations – Calculate average and peak wet weather (peak) flows. Calculate gravity sewer and force main sizes.
- iv. Technical Memorandum – Discuss methodology and background information used in developing the master plan. Develop maps identifying land use and proposed collection system improvements for the master plan.
- v. Project Status Updates and Meetings – Facilitate kickoff meeting, and project status meetings through the duration of the project.

The final deliverable for this study includes a wastewater collection system master plan and the associated land use planning maps showing the recommended wastewater collection system improvements for the area South of Oso Creek

## 2. Master Plan Objectives and Goals

The objective of this wastewater sub-basin master plan is to develop a wastewater collection system utilizing a large gravity trunk main approach. In general, the trunk mains will run adjacent to and parallel with the proposed master drainage ditches.

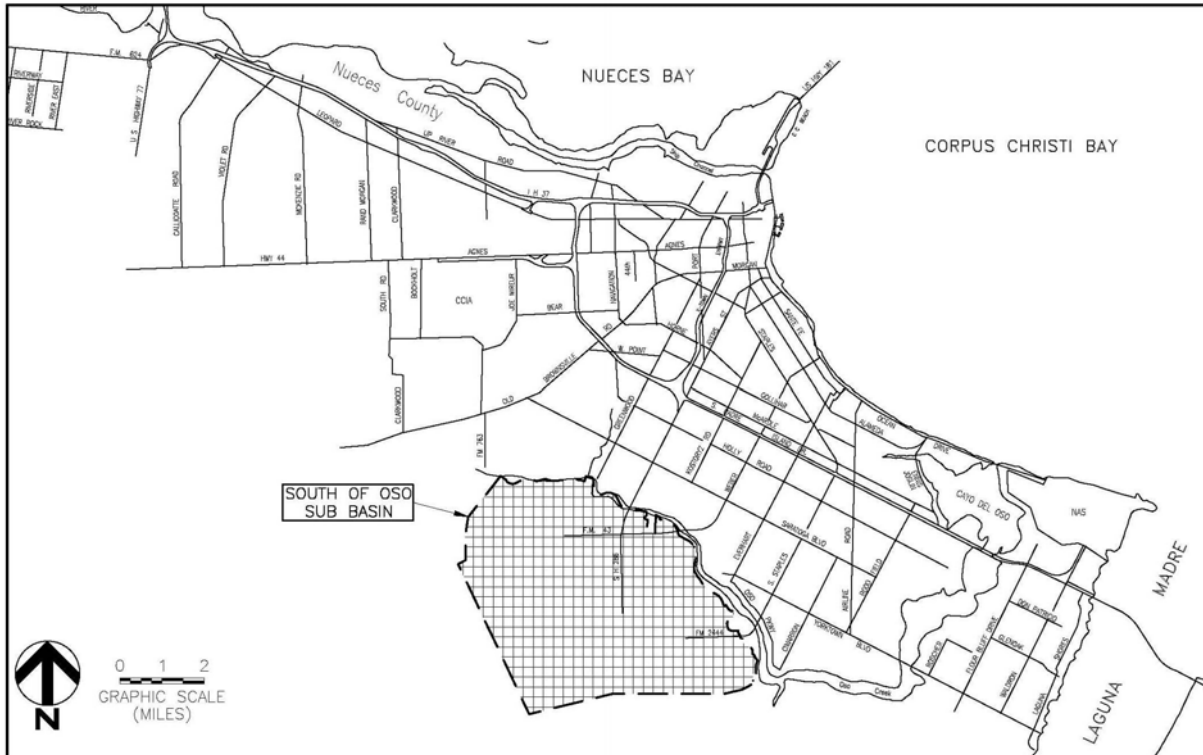
## 3. South of Oso Creek History

The City of Corpus Christi has never adopted a sanitary sewer master plan for any areas South of Oso Creek.

### III. Proposed Master Plan Area

#### 1. Study Area Boundary

Wastewater flows generated within the area South of Oso Creek will ultimately be conveyed to the Greenwood WWTP. The area is located in the south region of Corpus Christi as shown below in Figure 1, Sub-Basin Master Plan Location.



**Figure 1 – Sub Basin Master Plan Location**

The studied area consists of approximately 16,861 acres and is bound on the north and east sides by Oso Creek, extends south approximately 1,500 feet south of CR 18, meets up with CR 49A on the southwest corner, and continues in a northwesterly direction up to and just shy of CR 53 on the northwest corner. The major arterial streets which intersect this area include Weber Road (FM 43), South Staples Street (FM 2444), and Chapman Ranch Road (SH 286). An aerial photograph of this site is shown in Figure 2.

Development Services collected and provided data on the yearly platted acreage from 1995-2005 within Corpus Christi. This data was best fit with a linear line and projected to the year 2030. This projected acreage was then applied to the undeveloped areas of Corpus Christi to develop a conservative estimate of the City's growth. The area within the South of Oso Creek Sub Basin as shown in Figure 2 is an estimate of the platted acreage south of Oso Creek by the year 2030.

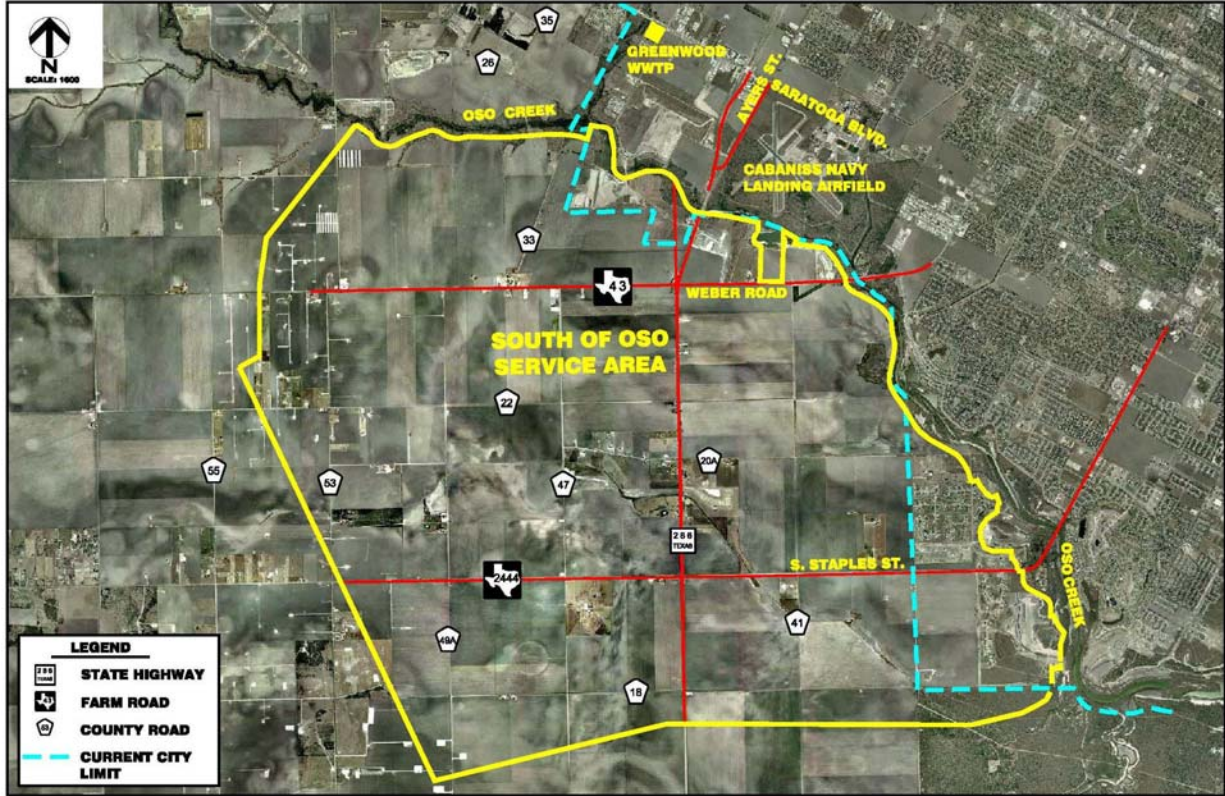


Figure 2 – South of Oso Creek Service Area

## 2. Land Use

Land use dictates the population for a given area and therefore, is directly related to the amount of wastewater generated over a given amount of time. For the purposes of this master plan, the area was categorized into one of six (6) land use categories as per the Adopted Corpus Christi Future Land Use Map, dated May 24, 2005 (Ordinance 026278). If future development begins to stray from the adopted land use plan and develops a service population with densities either considerably greater or lesser, the master plan will need to be revisited and modified accordingly.

Residential areas were divided into low and medium density; low density consisting of 4 housing units per acre, and medium density consisting of 10 housing units per acre, both of which are within the range of the Adopted Land Use Map and design parameters used in the surrounding areas. For residential areas, 3.5 persons per housing unit were used in order to determine the number of persons per acre.

The land use and population criteria is shown in Table 1 below; the colors included in the table correspond to the highlighted areas on the land use maps which are included as Exhibit 1, Adopted Future Land Use Map, South of Oso Creek.

<b>Land Use</b>	<b>Units/ Acre</b>	<b>Persons/ Acre</b>
Low Density Residential (LDR)	4	14
Medium Density Residential (MDR)	10	35
Commercial (COM)	N/A	N/A
Public/Semi-Public (PSP)	N/A	N/A
Parks	N/A	N/A
Estate Residential	1	3.5

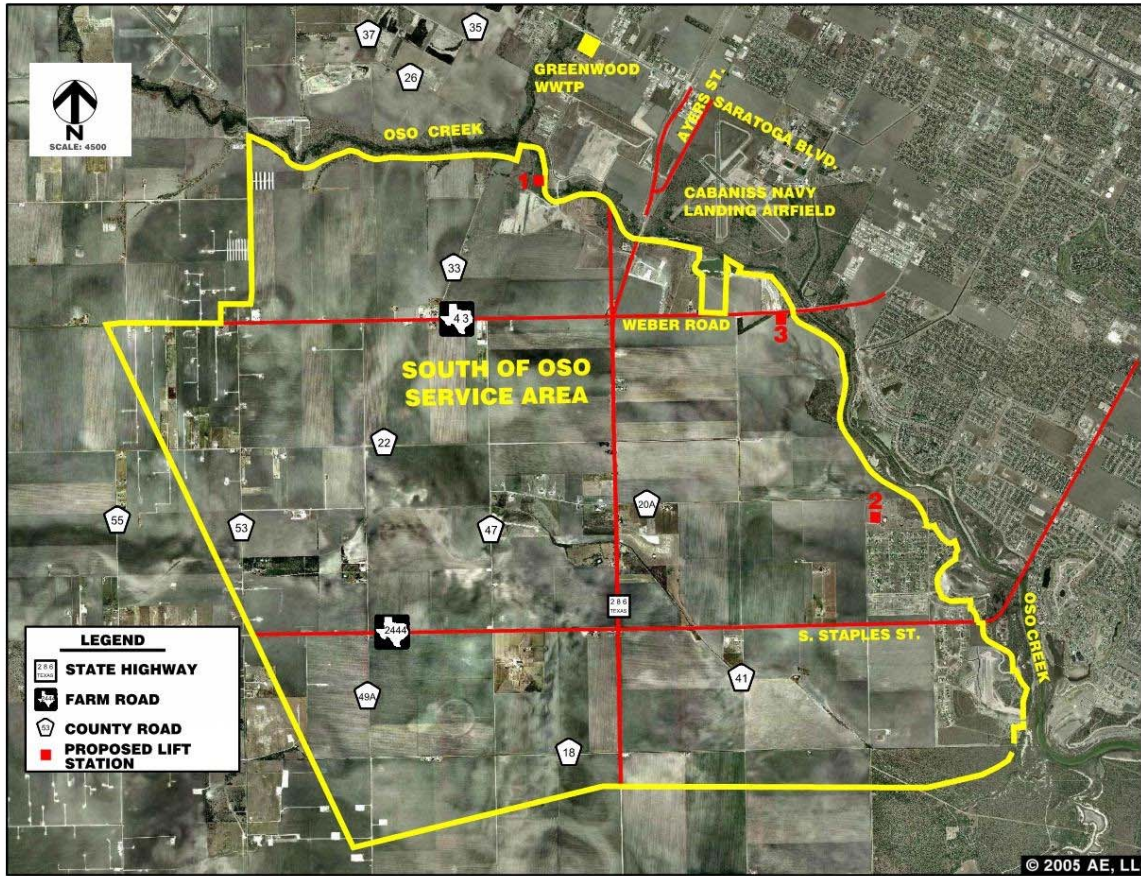
### 3. Contours and Flood Elevations

The elevation contours were derived from two sets of data. For the area east of CR 49A, contours came from the City of Corpus Christi’s LIDAR data collected in 2003 and for the area west of CR 49A, they were retrieved from the USGS 7.5 minute quadrangle maps dated 1968. The studied area naturally drains into and is bound by Oso Creek on the north and east side. The 100-year base flood elevations along the creek range from 14 to 25 feet.

### 4. Lift Stations

At ultimate build out, the area will be served by at least three (3) lift stations as shown in Figure 3 and Exhibit 2.

1. Transfer Lift Station (Proposed)
2. Oso Creek Lift Station (Proposed)
3. Weber Lift Station (Proposed)



**Figure 3- Area South of Oso Creek Lift Stations**

Currently, there are no lift stations in the study area as most of the land is undeveloped. A small portion of the study area on the southeast has been previously developed into 1 acre lots with individual on-site wastewater treatment systems. This area is identified as Sub-Area 10 on Exhibit 2. It is anticipated these subdivisions will abandon the existing on-site treatment systems and tie into the sanitary sewer facilities proposed by this master plan as they are constructed. Wastewater generated from Sub-Area 10 must be discharged into Trunk Line 17 (TL17), which is a 60 inch gravity line running north/south on County Road 41. Some of this property along the creek is very low and an additional lift station may be required to lift the wastewater to TL17.

The three(3) proposed lift stations are designed to pump to the Greenwood WWTP. In summary, the accumulated average and peak wet weather design flows for each lift station are shown in Table 2.

<b>Lift Station</b>	<b>Status</b>	<b>Service Area (acres)</b>	<b>Accumulated Average Daily Flow (mgd)</b>	<b>Accumulated Peak Design Flow * (mgd)</b>
Transfer LS	Proposed	9,539	18.2	45.175
Oso Crk LS	Proposed	7,322	8.925	32.164
Weber LS	Proposed	235	0.314	1.053

\*Peak Wet Weather

#### 5. Utility Locations and Routes

TxDOT’s Utility Accommodation rules allow public utilities to run within TxDOT right-of-way but not below the pavement section. However, if the utility ever interferes with a state highway expansion, TxDOT will require the owner to relocate the utility outside of their new pavement section at the utilities expense. For this reason, locating wastewater utilities within TxDOT right-of-way should be avoided at all locations and although some of the wastewater utilities proposed in the South of Oso Creek Master Plan appear to be shown along highways under TxDOT’s jurisdiction, the intention is to locate them within a designated City easement or City right-of-way.

#### 6. Wastewater Transfer from the Oso WRP Service Area

The existing Oso Water Reclamation Plant (WRP) has a treatment capacity of 16.2 mgd and current average flow of about 11.5 mgd ( $\pm$  71% of rated capacity). Much of the Oso WRP service area is still being developed and it is anticipated that the flows to the plant will continue to increase significantly. The TCEQ requires an engineering study on plant expansion to begin when three consecutive months of average flow reaches 75% or more of the plant’s rated capacity. In efforts to maintain the Oso WRP below 75% of its rated capacity, the City plans to transfer approximately 8 million gallons of the plant’s average daily flow to the Greenwood WWTP where a significant amount of treatment capacity is available.

A 24-inch force main from the Oso WRP service area will transfer the flows to the proposed Transfer Lift Station in 3 phases. Phase I includes an approximate 4 MGD average wastewater flow, phase II consists of an additional 2 MGD wastewater transfer from Lift Station #5, and phase III is approximately 2 MGD of additional flow from the Wooldridge Lift Station. The 8 MGD total will be transferred by the 24” force main across Oso Creek, at the Schanen Ditch, and south alongside the proposed gravity line to the Transfer Lift Station.

The transfer also includes the construction of approximately 26,000 LF of 36” force main from the proposed Transfer Lift Station to the Greenwood WWTP. In order to maintain a minimum velocity of 2 fps in the 36” force main, the Transfer Lift Station must be able to pump a minimum flow of approximately 6,400 gpm (9.2 MGD) at any given time. This is equivalent to pumping 4.0 MGD average daily flow over a 10 hour period.

#### 7. Design Consideration for Installation of Large Trunklines

This master plan proposes a wastewater collection system consisting of three (3) lift stations and miles of large gravity trunk mains ranging in depths from 20 ft to 30 ft. These trunk lines will align with the proposed master drainage channels within the study area and the downstream portions are rather large, ranging in size from 36 inch to 60 inch.

A major concern is that these large trunk lines may be installed many years before the wastewater customers produce a quantity of wastewater flow large enough to ensure adequate velocities are maintained in the lines. Ultimately, if the velocities in these trunk lines do not reach at least 2 feet per second a minimum of 1 time per day, it should be reasonably assumed the lines will demand a regular on-going maintenance schedule to avoid major issues and repairs in the future.

#### 8. Design Consideration for Undeveloped Areas

Most of the land occupying the area south of Oso Creek as discussed in this report is currently undeveloped. The land use for each area was based on the Adopted Future Land Use, through discussions with Development Services, plats approved by the City of Corpus Christi and through spot density calculations in other parts of Corpus Christi. If future development begins to stray from the adopted land use plan as shown in Exhibit 1 and develops a service population with densities either considerably greater or lesser, the master plan will need to be revisited and modified accordingly.

#### IV. Design Calculations

Calculations for wastewater flow within the area South of Oso Creek was based on the area being fully developed as per the land use shown on Exhibit 1, Adopted Future Land Use, South of Oso Creek. The design for all areas included land use and population projections which support the calculation of average wastewater flows, peak design flows, and infiltration and inflow. The design criteria used in this study is described below and backup calculations are included in Appendix A of this study.

##### 1. Average Daily Wastewater Flow

Texas Commission on Environmental Quality's (TCEQs), Texas Administrative Code (TAC), Title 30 - Environmental Quality, Chapter 217 - Design Criteria for Domestic Wastewater Systems outlines the flow design basis in the following statements:

###### *217.53 Pipe Design.*

*(a) Flow Design Basis. An owner must use the requirements of this section to design a gravity collection system.*

*(1) An owner must design a wastewater collection system to handle the transport of the peak dry weather flow from the service area, plus infiltration and inflow.*

*(2) The flow calculations must include the details of the average dry weather flow, the dry weather flow peaking factor, and the infiltration and flow.*

*(3) The flow calculations must include the flow expected in the facility immediately upon completion of construction and at the end of its 50-year life.*

In the absence of existing flow data, residential flows were assumed to be 100 gallons per person per day (100 gal/person/day), as outlined in TCEQ's Table B.1. – Design Organic Loadings and Flows for a New Facility shown in the following Table 3:

<b>*Table 3 TCEQ Acceptable Design Parameters for Wastewater Flow</b>			
		<b>Daily Wastewater Flow - Gallons</b>	<b>Wastewater Strength</b>
<b>Source</b>	<b>Remarks</b>	<b>Per Person</b>	<b>mg/L BOD<sub>5</sub></b>
Municipality	Residential	75-100	200-350
Subdivision	Residential	75-100	200-350
Mobile Home Park	3 persons per trailer	50-75	250-300
School with Cafeteria	With Showers	20	300
	Without Showers	15	300
Recreational Parks	Overnight user	30	200
	Day user	5	100
Office Building or Factory		20	300
Motel		50-75	300
Restaurant	Per Meal	7-10	1000
Hospital	Per Bed	200	300

\*The entire standard TCEQ table is shown but not all parameters shown were used in this master plan.

The service population and wastewater flow generation for the land use areas identified previously is shown in Table 4 with the column farthest to the right identifying the number of gallons of wastewater generated per land use per acre per day.

Land Use	Units/ Acre	Persons/ Acre	Wastewater Yield	
			(gal/person/day)	(gal/acre/day)
Low Density Residential (LDR)	4	14	100	1400
Medium Density Residential (MDR)	10	35	100	3500
Commercial (COM)	N/A	N/A	N/A	900
Public/Semi-Public (PSP)	N/A	N/A	N/A	900
Parks	N/A	N/A	N/A	200
Estate Residential	1	3.5	100	350

## 2. Peaking Factor

Although the average daily flow is important in the sizing of the collection system, it is also necessary to establish values for the peak rate of flow. The peak flow for all predominately residential areas was generated by calculating a peaking factor using the Harold E. Babbitt formula which is commonly used in the industry. The formula is as follows:

$$M = \frac{5}{\left(\frac{\text{Population}}{1000}\right)^{0.2}} \quad (\text{Minimum} = 2, \text{Maximum} = 4)$$

Like other peaking factor methodology in the industry, the Babbitt formula uses the population as the peaking factor variable. The higher the population the lower the peaking factor.

## 3. Infiltration and Inflow

Infiltration and Inflow (I/I) is additional flow that enters the collection system and is not introduced by the population. In general, infiltration enters defective buried infrastructure due to high ground water tables or rainfall percolating into the ground. Inflow generally denotes water which flows directly into the system and is usually attributed to storm water leakage through manhole covers or other accessible openings, through illicit drains such as roof leaders, vent shafts, similar area drains and cross connections between sanitary and storm sewers. Because infiltration and inflow is directly related to storm and ground water, it is generally estimated by the amount of land contributing to the infrastructure, such as gallons of infiltration and inflow per day per acre. Typically 300 to 400 gallons per acre per day is used for infiltration and inflow calculations. The City of Corpus Christi is challenged with high ground water table and flat topography which will reduce pipeline capacity, therefore a value of 400 gallons per day was used in this master plan.

#### 4. Peak Design Flow

For the purposes of this report, the peak flows shown in the design calculations provided in Appendix A include the peaking factor and infiltration and inflow.

#### 5. Interceptor Design Criteria

Pipe sizes and slopes in this master plan adhere to the City Wastewater Department standards on sanitary sewer minimum slopes. Due to the conservative nature of these standards, the slopes also meet TCEQ rules as established in 30 TAC 217, effective August 28, 2008. Due to the scale of the master plan and to maintain clarity, the minimum size gravity line identified in Exhibit 2 is 10". To the extent possible, all upstream laterals have a minimum depth of 4 feet.