C1.03 – San Marcos Wastewater Force Main

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Freese and Nichols

Project Overview

The increasing population in San Marcos Texas requires improvements in the conveyance of wastewater for surrounding developments to the city's wastewater treatment plant. We are tasked to design a wastewater force main to operate with an existing 6 MGD lift station.

Design considerations include:

- Horizontal and vertical alignment
- State, county, and city regulations
  - TxDOT and County ROW
  - Private easement acquisition
  - Pipeline size and material

Constraints and Standards

Texas Administrative Code Title 30 Part 1 Chapter 217 – Subchapter A, B, & C

Texas Administrative Code Title 43 Part 1 Chapter 21 – Subchapter C

Hays County Development Regulations Chapter 715 – Subchapter 4

City of San Marcos Standard Details – Series 500

City of San Marcos Infrastructure Utilities Criteria Manuals – Wastewater Design Guide

Sustainability Analysis

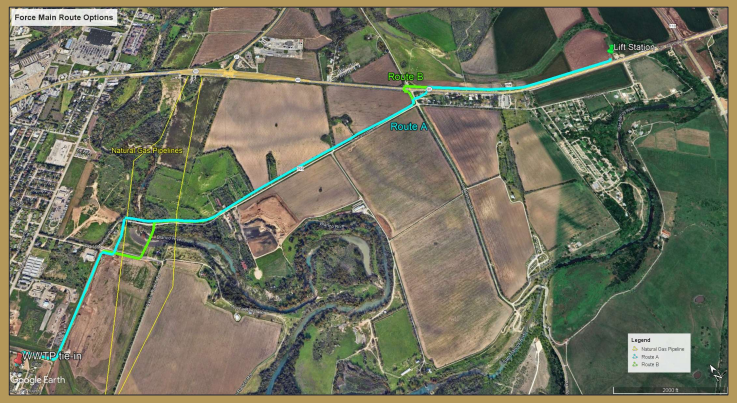
ISI Envision Framework was used for sustainability analysis of Alternative #1 and #2. Below is the result table for the selected Alternative #2, in which a verified score of 24% was achieved.

	Submitted Score Information		
Credit Category	Applicable	Submitted	Percentage
Quality of Life	184	52	28%
Leadership	*Not Applicable*		
Resource Allocation	196	33	17%
Natural World	232	57	25%
Climate and Resilience	42	14	33%
Total Points / %	654	156	**24%**

Route Selection

Route A:

2.87 Miles
15,143 LF



Route B:

2.95 Miles
15,571 LF

Alternative Design Descriptions

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Ductile Iron w/ non-corrosive lining	HDPE	PVC (min pressure rating of 150 psi)	HDPE
Route A	Route A	Route B	Route B
Horizontal directional drilling for crossing under roads	Horizontal directional drilling for crossing under roads and Blanco River	Horizontal directional drilling for crossing under roads and Blanco River	Microtunneling for crossing under roads and Blanco River
Open-cut for crossing Blanco River			

Alternative Design Selected

Private Easement Acquisition Index (PEA)

$$Private\ parcel\ length\ (ft)\ x\ 20ft\ wide\ easement\ x\ \frac{1\ acre}{43{,}560\ ft^2}$$

$$Total\ acreage\ estimate = \Sigma\ private\ parcel\ acreage$$

$$PEA = \left(\frac{1}{total\ acres}\right)^2 x\ 100$$

Material and Length Feasibility Index (MLF)

$$MLF = Material\ rating\ x\ \frac{1}{Total\ pipeline\ length\ (miles)}$$

Environmental and Historical Impact Index (EHI)

$$EHI = Avg(roadway\ method, river\ method) - \#\ of\ THC\ sites\ impacted$$

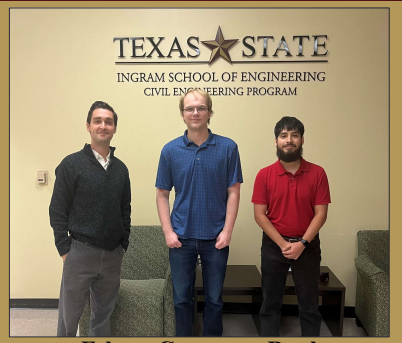
Evaluation Comparison				
Metric	Alternative 1	Alternative 2	Alternative 3	Alternative 4
PEA	5.016	5.016	4.515	4.515
MLF	1.134	1.742	1.017	1.695
EHI	2.875	3.25	2.25	2.25
Total Score	9.025	10.008	7.782	8.460

In the first phase of the project, Alternative Designs #1 and #2 were selected for further evaluation based on a criteria evaluation analysis.

Alternative Design #2 was ultimately selected based on the sustainability and cost analysis, as well as its consistency with industry norms and practicality.

This design will be further explored in Senior Design II, which will feature a system analysis of the entire design and an in-depth design of specific design elements.

Meet the Team



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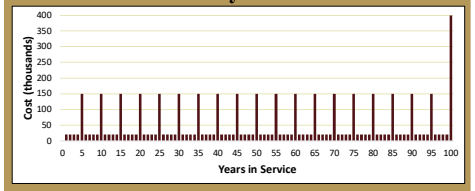
Special thanks to our sponsor, Freese and Nichols – Caden Smith, Collin Brewer, Ryan Ramsey

Cost Analysis

Capitol Cost

Opinion of Probable Construction Costs				
Item	Measurement	Unit	Unit Cost	Total Cost
Land Acquisition				
ROW private easement	7	Acre	$30,000	$210,000
Temporary construction easement	3.5	Acre	$600	$2,100
Construction Materials				
HDPE, 18-inch diameter (50 ft sections)	15,143	LF	$38	$575,434
3–4-inch crushed limestone	4,400	CY	$40	$176,000
Concrete Encasement	250	LF	$96	$24,000
Air release valve, 3-inch orifice	12	EA	$2,537	$30,444
Isolation valve	12	EA	$10,000	$120,000
Elbows, 45 degree	25	EA	$2,400	$60,000
Thrust block	25	EA	$2,000	$50,000
Coupling (restrained joint)	280	EA	$3,000	$840,000
Water for dust suppression & HDD drill	10,000	Gal	$0.002	$20.00
Machinery				
CAT Excavator 313	3	Monthly	$15,500	$46,500
CAT Pipelayer	3	Monthly	$14,600	$43,800
Backhoe loader (68-70 HP)	3	Monthly	$2,700	$8,100
HDD Vermeer D60X90	3	Monthly	$68,000	$204,000
Water truck (2000-gallon capacity)	3	Monthly	$8,000	$24,000
Safety/Personnel				
Labor	2,500	Hrs	$150	$375,000
PPE	25	EA	$250	$6,250
Silt Fence	30,000	LF	$5	$150,000
			Total Cost	~$2,950,000
			Total Cost w/ 15% cont.	~$3,400,000

Life Cycle Cost



Annual O&M: $20,000
ROV inspection every 5 years: $85,000
Ice pigging every 5 years: $45,000
Grout fill at end of service life: $400,000
Total life cycle cost: $4.85 Million