

Group C1.02 – Sedimentation Basin Design

Patrick Figueroa, Drew Simmonds,
Orlando Torres, and Diego Aguilar
Sponsored By: STV, Felipe Gutierrez, and
Keisuke Ikehata

Project Overview

- Construction of a groundwater sedimentation basin system for a 40 MGD water treatment system.
- Sedimentation basin system is to be focused on the removal of current contaminants as well as increase calcium hardness and alkalinity to match current San Marcos water sources.

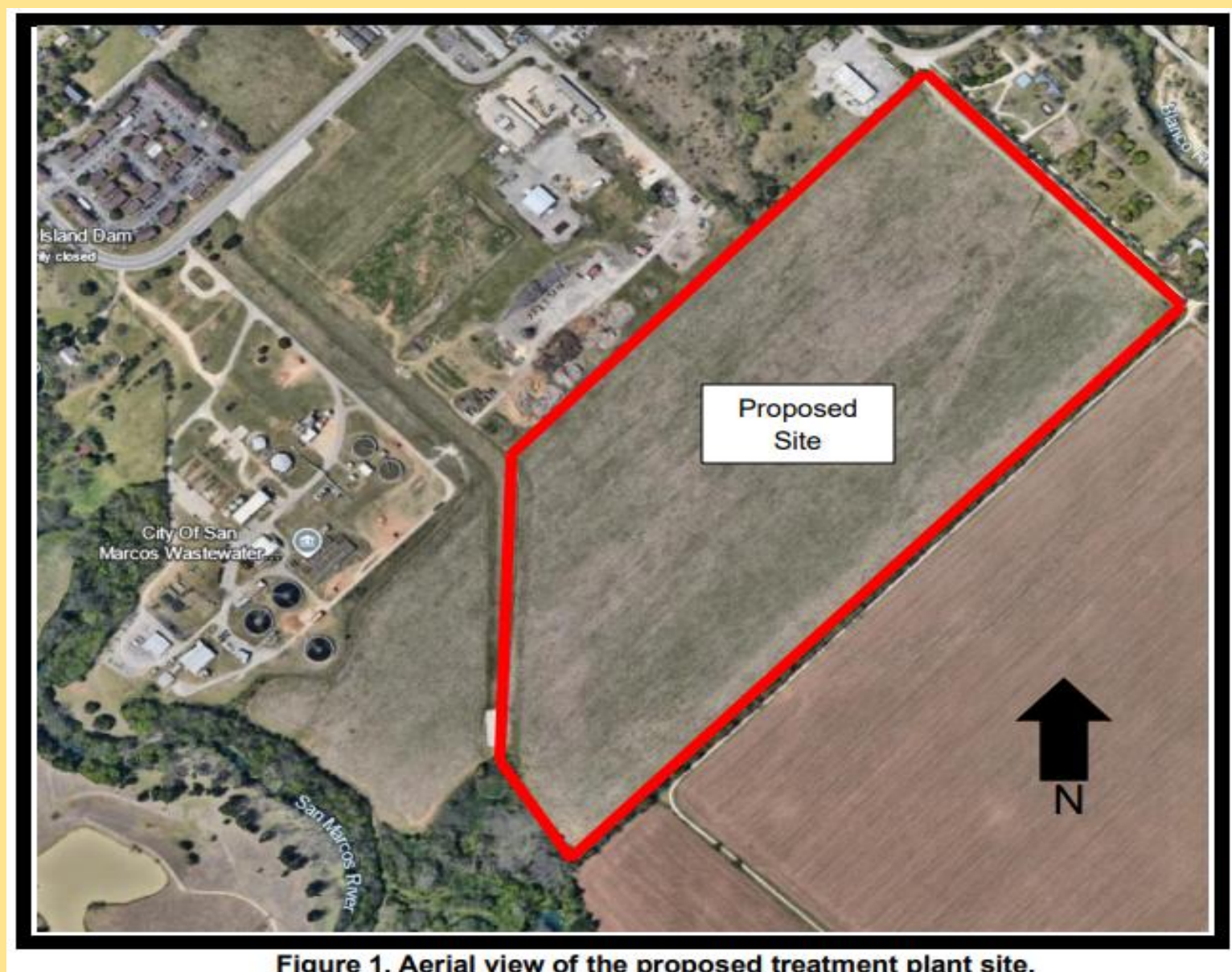


Figure 1. Aerial view of the proposed treatment plant site.

Overarching Issues:

- Major surplus of Iron & Manganese found in the water.
- Current groundwater calcium and alkalinity values are too low.

Constraints & Standards

Table 1. Raw Groundwater vs. San Marcos Water

Parameter	Groundwater	San Marcos
Iron (mg/L)	6 average 10 maximum	<0.1
Manganese (mg/L)	0.1 average 0.3 maximum	<0.005
pH	6	7.8
TDS (mg/L)	190	350
Alkalinity (mg/L as CaCO ₃)	20	220
Calcium (mg/L as CaCO ₃)	30	200

This table was given to us as a water quality guideline to be focused on for the water treatment of the given raw groundwater.

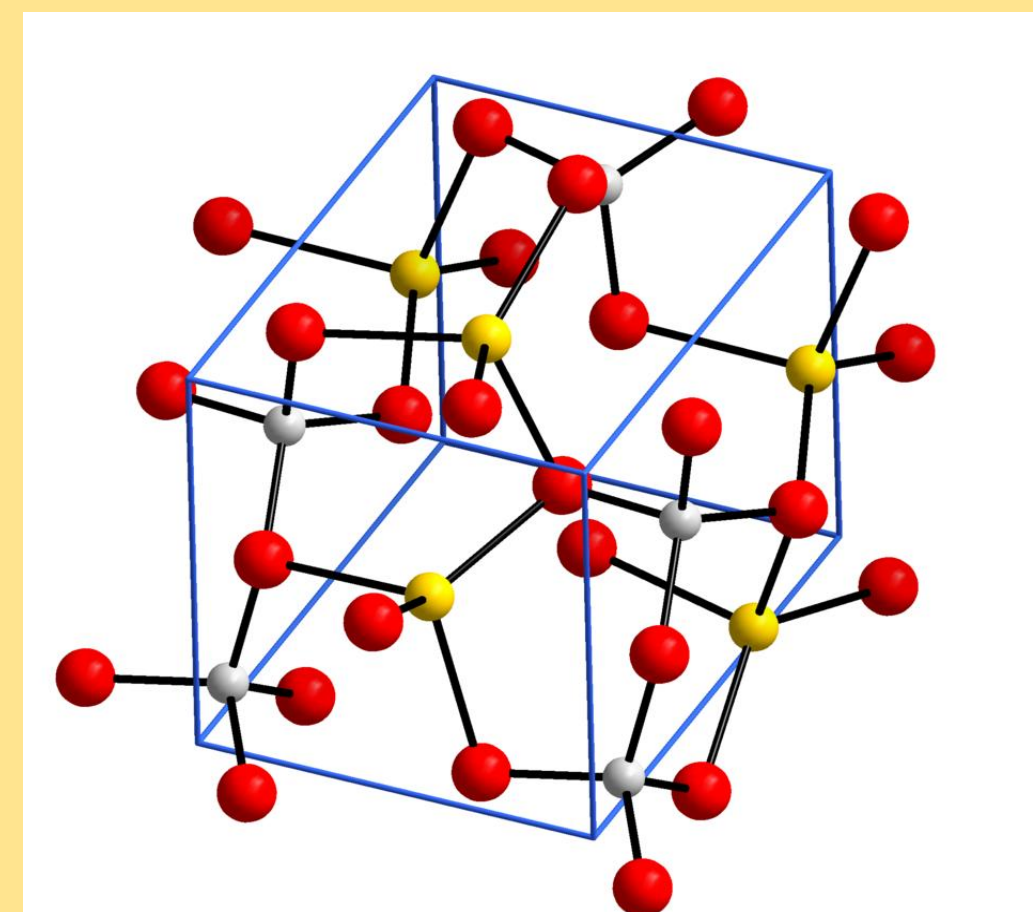
- Alternatives adhere closely to Texas Administrative Code 290.
- TCEQ regulations were closely followed during the design process for sedimentation basins.
- Primary and secondary MCLs followed from EPA for design considerations.

Alternatives Considered

Two alternative sedimentation basin systems were chosen for analysis in this project. These alternatives are each broken up into four smaller 10 MGD systems for each component. Descriptions of each step in both alternatives can be seen below in descending order from top to bottom.

Alternative 1:

- Multiple-tray aeration
- Propellor-type rapid mixing
- Sodium aluminate coagulant added into mixing basins
- Inclined plate settler system
- Sand filtration



Atomic Structure of Sodium Aluminate
(Image from "Andif1" on Wikimedia Commons)

Alternative 2:

- Propellor-type rapid mixing
- Lime coagulant added into mixing basins
- Clarifier tanks for sediment removal and oxidation
- Inclined plate settler system
- Sand filtration



Clarifier Tank (Image from "90.5 WESA" on Flickr)

Capital Costs

Table 2. Alternative 1 Capital Costs

COST CATEGORY	Initial Cost (2025 \$)
Civil / Structural (basins, buildings)	\$ 10,000,000
Multiple-tray aerators (4)	\$ 3,200,000
Propeller rapid-mixers + VFDs (4)	\$ 276,000
Sodium aluminate dosing system	\$ 1,100,000
Lamella settler packs (4)	\$ 3,200,000
Dual-media filters (4) + underdrains	\$ 24,000,000
Backwash & air-scour blowers	\$ 1,600,000
Instrumentation & SCADA	\$ 3,800,000
Electrical / MCC / transformers	\$ 6,200,000
Painting & coatings	\$ 1,200,000
SUBTOTAL ESTIMATED CAPITAL	\$ 54,576,000

Table 3. Alternative 2 Capital Costs

COST CATEGORY	Initial Cost (2025 \$)
Civil / Structural (basins, buildings)	\$ 10,000,000
Rapid Mixers + VFD's (4 x 10 MGD)	\$ 276,000
Lime storage silo + slakers/feeders	\$ 2,600,000
Conventional clarifiers/ oxidation (4)	\$ 24,000,000
Lamella plate settler packs (4)	\$ 3,200,000
Dual-media filters (4) + underdrains	\$ 24,000,000
Backwash and air-scour blowers	\$ 1,600,000
Instrumentation & SCADA	\$ 3,800,000
Electrical / MCC / Transformers	\$ 6,800,000
Painting & Coatings	\$ 1,400,000
SUBTOTAL ESTIMATED CAPITAL	\$ 77,676,000

Life Cycle Costs

Table 4. Alternative 1 Net Present Value

COST CATEGORY	(2025 \$)
Capital Costs	\$ 54,576,000
Life-Cycle Costs	\$ 80,070,000
Discount Rate (%)	4
TOTAL 30-YEAR LIFE-CYCLE NPV	\$ 134,646,000

Table 5. Alternative 2 Net Present Value

COST CATEGORY	(2025 \$)
Capital Costs	\$ 77,676,000
Life-Cycle Costs	\$ 80,010,000
Discount Rate (%)	4
TOTAL 30-YEAR LIFE-CYCLE NPV	\$ 157,686,000

Sustainability Evaluation

Credit Category	Applicable	Submitted	Percentage
Quality of Life	170	23	14%
Leadership	182	48	26%
Resource Allocation	188	82	44%
Natural World	154	39	25%
Climate and Resilience	190	58	31%
Total Points/%	884	250	28%

Using the Envision Sustainability Framework, the project earned a total percentage of 28% of the possible points. This earned a verified level in the framework.

Group Photo

