

# Group C2.03 – Rust Busters

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## Background

### Bobcat City Water Authority

- New groundwater treatment plant, 40MGD
- High iron and manganese concentrations
- Meet TCEQ secondary aesthetic standards
- Match existing BCWA water characteristics

### First Semester's Work

- Alternatives analysis for treatment processes
- Selection of three-phase treatment system
  - Rapid Mixing
  - Flocculation
  - Sedimentation
- Capital, Life-Cycle Costs Evaluations
- Envision Sustainability Analyses

### Second Semester Engineering Design Elements:

- 1) Basin Sizing & Layout
- 2) Hydraulic Profile
- 3) Stormwater Mitigation & Earthworks

## Design Elements

### Element 1 – Basin Sizing & Layout

- Driven by Surface Overflow Rate for sedimentation & flocculation detention time to allow for growth of oxidized particulate.

Flow rate per train: 7,000gpm

- 1) 3 Stage Rapid Mixing (each stage): 28ft wide x 3ft long (1min detention)
- 2) Flocculation & Coagulation: 28ft wide x 84ft long (30min detention)
- 3) Sedimentation: 28ft wide x 125ft long (SOR of 2gpm/ft<sup>2</sup>)

$$T_d(\text{minutes}) = \frac{\text{Basin Volume}(\text{ft}^3)}{Q(\frac{\text{ft}^3}{\text{minute}})} = \frac{w(\text{ft}) \cdot d(\text{ft}) \cdot l(\text{ft})}{Q(\frac{\text{gal}}{\text{minute}}) \cdot \frac{1\text{ft}^3}{7.48\text{gal}}}$$

$$SOR(\frac{\text{gpm}}{\text{ft}^2}) = \frac{Q(\text{gpm})}{\text{Surface Area}(\text{ft}^2)}$$

### Element 2 – Hydraulic Profile

- Determine appropriate vertical alignment of systems to maintain gravity-fed flow through the system
- Establish a minimum water level in raw water storage tank to overcome system head losses

Bernoulli's Principle:  $\frac{P_1}{\gamma} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{v_2^2}{2g} + z_2 + h_{\text{loss}}$

$$h_{\text{loss}} = h_{\text{friction}} + h_{\text{minor}} + h_{\text{others}}$$

### Element 3 – Stormwater Mitigation & Earthworks

- Site located within FEMA 100yr-24hr precipitation event
- Expected 2ft of surface sheet flow
- Design a site perimeter berm to prevent sheet flow onto site
- Design a stormwater detention system to slow down excess runoff created by site development

## Engineering Solutions

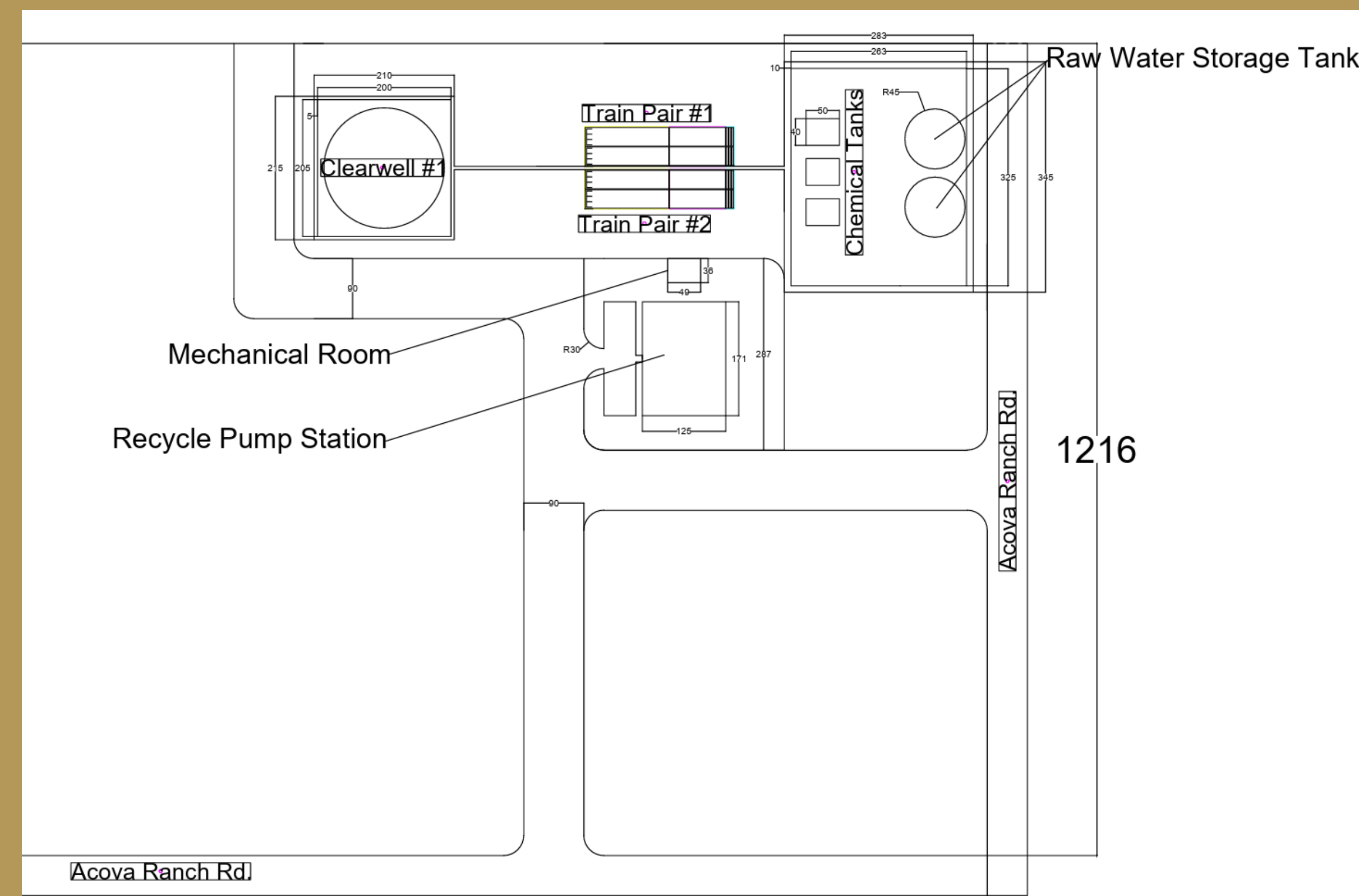


Figure 1: Initial draft of treatment plant layout prior to Design Elements 2 & 3

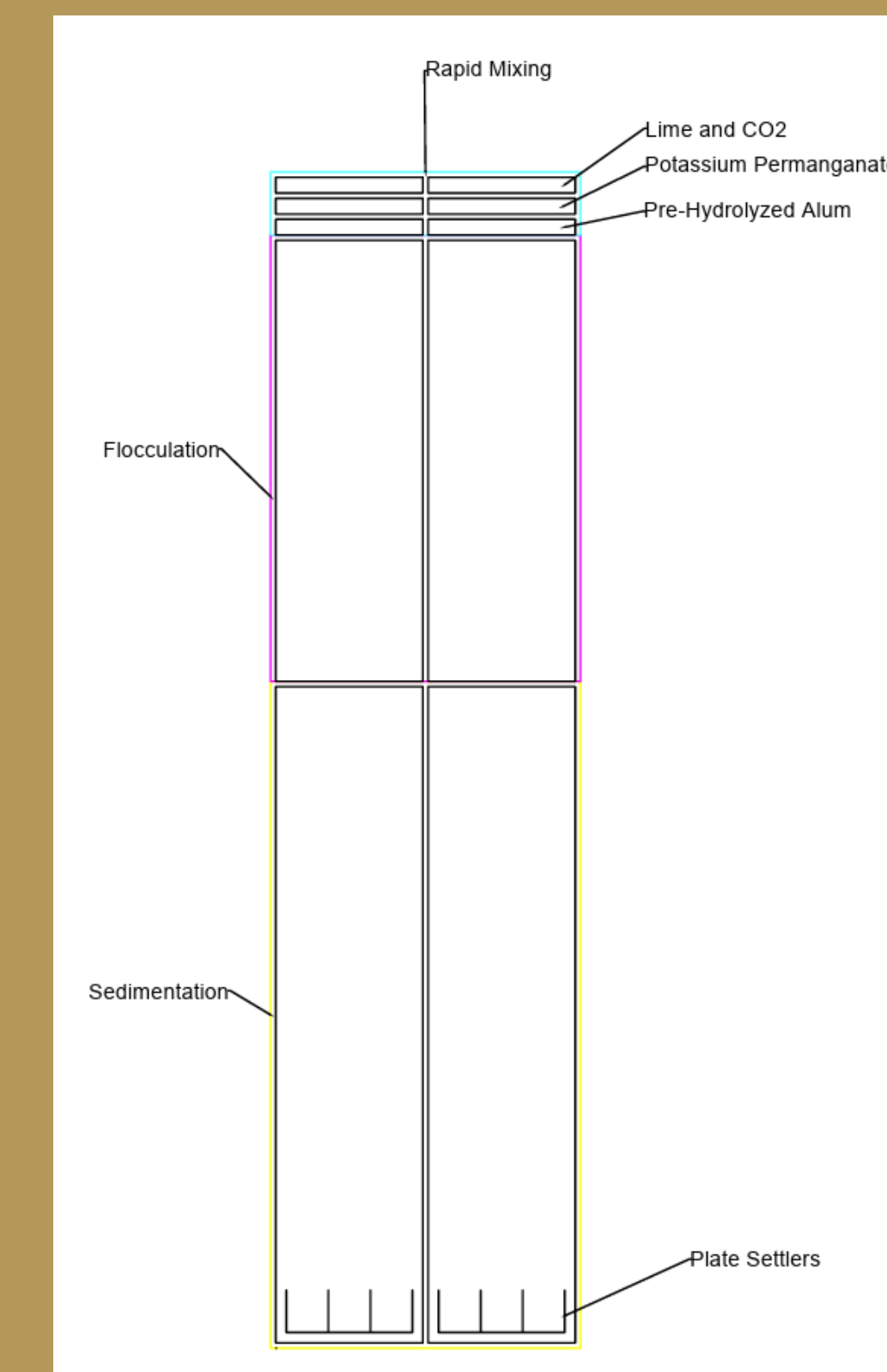


Figure 2: Treatment sub-basin train pair, 20MGD.

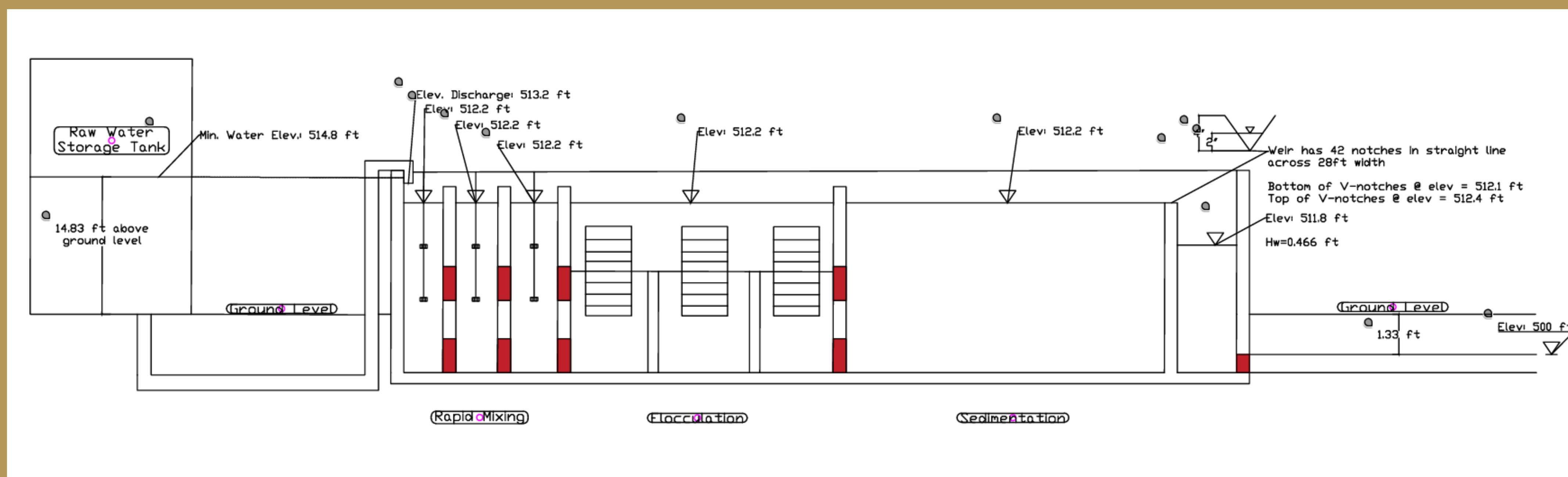


Figure 3: Hydraulic profile from RWS Tank minimum height to filter stage entrance.

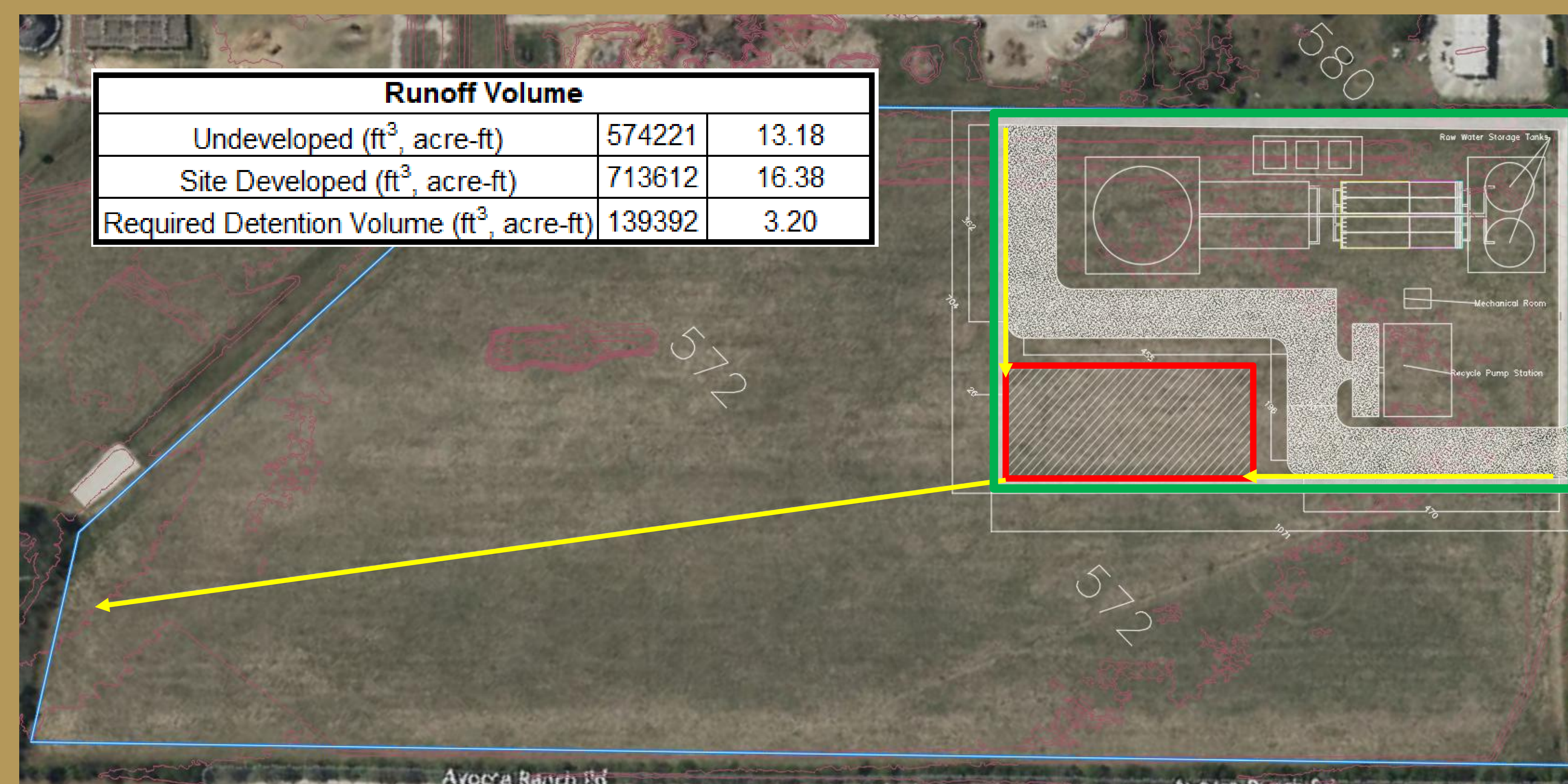


Figure 4: Developed site layout including treatment, berm, and stormwater detention pond, and elevation contours (ESRI).

## Costs & Constraints

Table 1: Capital & Life-cycle Cost Estimates Summary

Phase / Alternative	Total Capital Cost Estimate	Total 30-yr Life-Cycle Cost (NPV) Estimate
<b>Item 1</b> Flash-Mix Basins w/ Mechanical Agitators (4 basins)	\$0.45M – \$1.25M	\$0.75M – \$1.85M
<b>Item 2</b> Pre-hydrolyzed Alum + Polymer Feed Systems	≈ \$1.40M	≈ \$2.75M
<b>Item 3</b> Flocculation & Sedimentation (4 basins)	\$1.25M – \$2.0M	≈ \$5.65M
<b>TOTAL (Items 1-3)</b>	<b>\$3.0M – \$4.75M</b>	<b>≈ \$9.0M – \$10.25M</b>

### Constraints & Standards

- Bobcat City (client) Criteria
- ASCE/AWWA – Basin Sizing Standards
- FEMA 100yr Floodplain Designation
- FEMA P-936 - Floodproofing
- Texas Administrative Code 290 – Aesthetics
- Texas Administrative Code 217 – SOR/HRT
- USACE – Hydraulic Design & OCF

## Location & References



Figure 4: Bobcat City's Future Water Treatment Location  
Bobcat City's new water treatment is planned to be built near the existing wastewater treatment plant near the Bobcat City River. Sustainability and construction considerations will take these proximities into account.

### References

- American Water Works Association, & American Society of Civil Engineers. (2022). *Water treatment plant design* (6th ed.). McGraw-Hill Education.
- Google. (2025). *Google Maps* [Mapping application]. <https://maps.google.com>
- Esri. (n.d.). *World Imagery* [Basemap]. Retrieved March 15, 2026, from <https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9>