Innovative Disposal System Performs Well Under Performance-Based Groundwater Discharge Permit

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- Project Background
- Hydrogeologic Evaluations
- Effluent Disposal Design
- WWTF Design
- WWTF Performance
- Rapid Infiltration Basin Performance
- Summary/Conclusions
- Acknowledgements

Project Background

Developer

- Affordable Residential Housing (Ch. 40B)
- 300 Bedrooms
- 40 More Bedrooms added Later

Effluent Disposal

- Challenging Site for Disposal
- Tight Glacial Soils, Stumps
- Near and Upgradient of Town Drinking Water Supply
- Property Abuts Landfill, Wetlands, and MassDOT Salt Storage

Monitoring Requirements

- MassDEP Groundwater Discharge Permit Requirements, Standard
- Town Water Commission Requirements, More Stringent

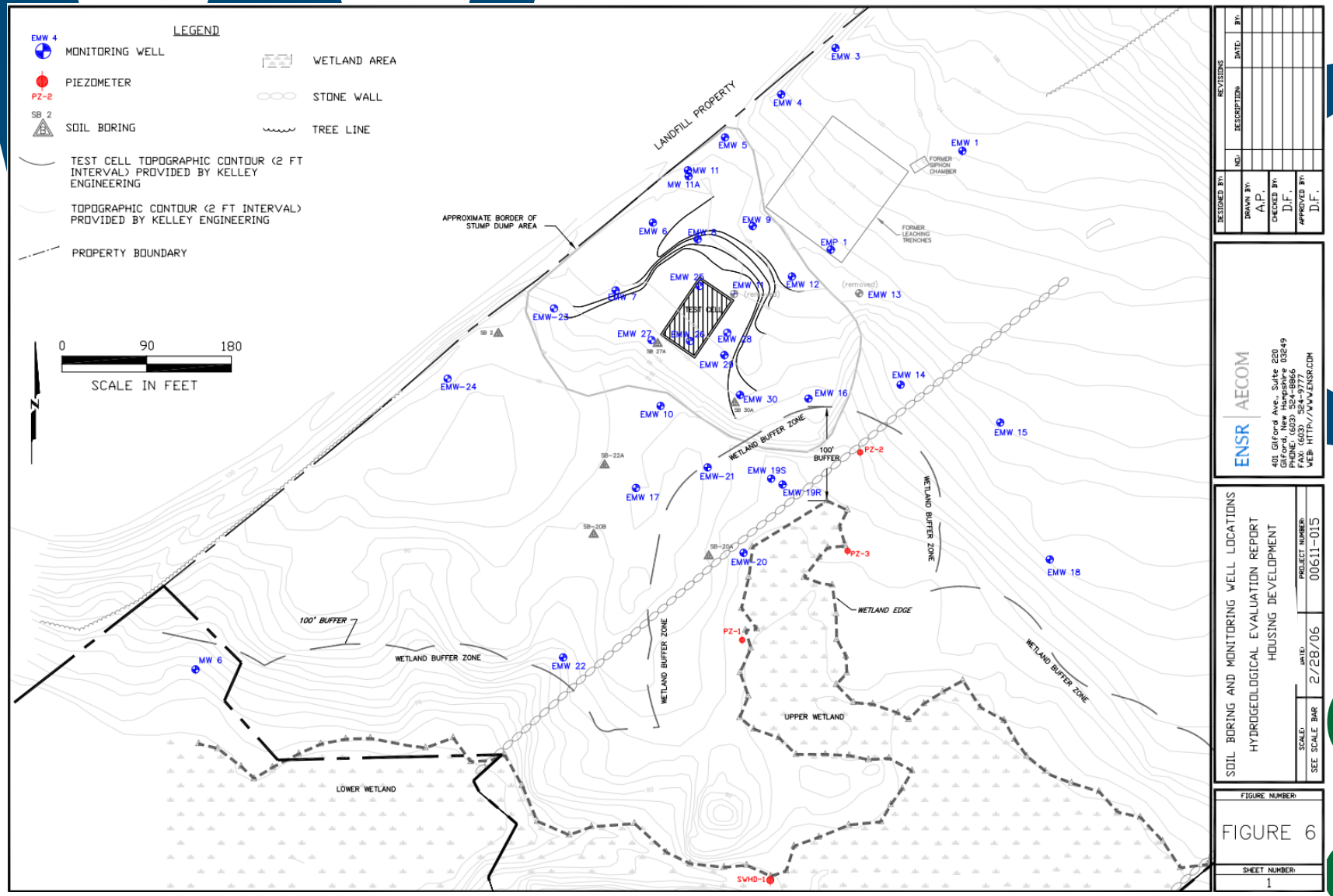
e Overview


TOWN WATER TANK
MASSDOT SALT FACILITY
WASTEWATER TREATMENT FACILITY
LANDFILL
RAPID INFILTRATION BASINS
WETLANDS
DRIP DISPERSAL SYSTEM
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
ZONE 6
KING STREET
WATER PUMP STATION
N
TRUSTEES OF RESERVATIONS
STORMWATER MANAGEMENT POND

Hydrogeologic Study

- ENSR
- 2-Year Effort
- 69 Test Pits, 52 first year
- 72 Soil Borings
- 21 Ledge Probes

Hydrogeologic Study – Continued



- 30 Monitoring Wells
- 3 Piezometer Locations
- 11 Infiltration Tests
- Loading Test Cell

Hydrogeologic Study – Continued

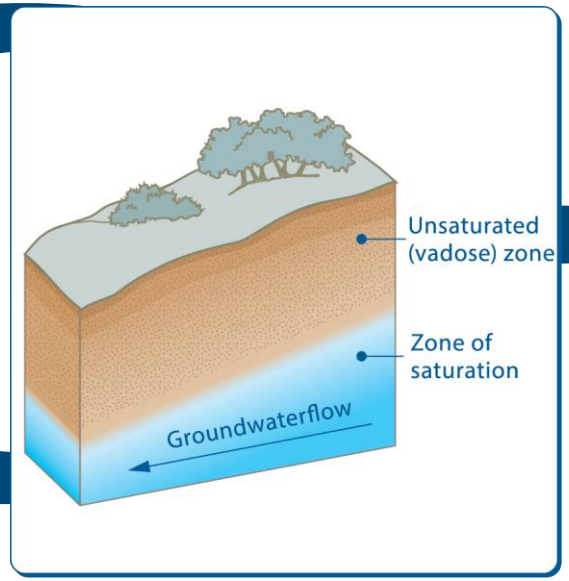
Constructed Test Cell

Hydraulic Load Test

- Why needed?
  - Favorable sands and gravels found 30' down during site work
  - Suitable Location if proven
- Test Specifics
  - Test Cell 2,800 sq. ft.
  - 5 weeks – one of the wettest Autumns on record
  - Proved at least 3 gpd/sq. ft. possible

Groundwater Discharge Goals

1. Avoid Ponding at RIB Surface
2. Maintain 4-foot Vadose Zone at Seasonal High-water Conditions
3. Prevent Early Emergence of Effluent-impacted Groundwater
4. Account for Fate of Nutrients at Downgradient Receptor



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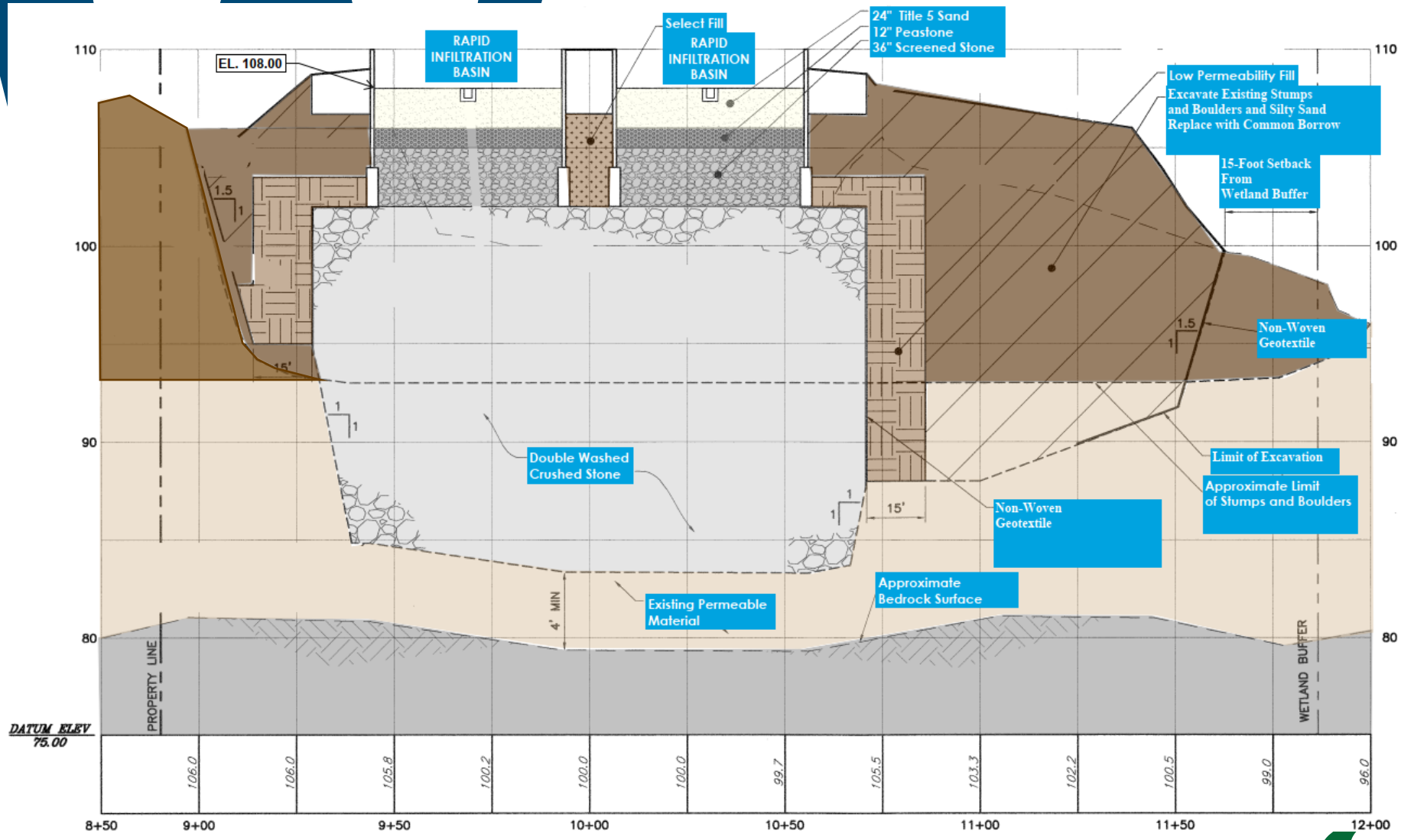

- Sitework
- Over-excavation to expose favorable soils
- 20 feet of crushed stone
- High Groundwater ~95'

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- 4 RIBs, 40 x 40 feet each
- Design loading rate, 3.5 gpd/sq. ft. on top area, 1.9 gpd/sq. ft. on exposure to favorable soil area (approx. 20 feet below grade)
- 33,500 gpd capacity

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MassDEP Conclusions

- Thorough Hydrogeologic Investigation
- Appropriate Effluent Disposal Design
- Standard Groundwater Discharge Permit Issued
- Typical Monitoring Well Requirements

Town Water Commissioners Requirements

- Build It, But Performance Needs to Be Proven
- Prove Mound No Closer Than 4 feet Below RIB Surface
- Prove Mound No Closer Than 6 Inches Below Ground Surface 150 Feet Away
- If Mound Is Too High, Reduce Effluent Flow
- Prove No Significant Groundwater P Concentration 100 Feet Away
- If P Migration Occurs, Add P Removal In WWTF
- Design WWTF to Total Nitrogen of 5 mg/L

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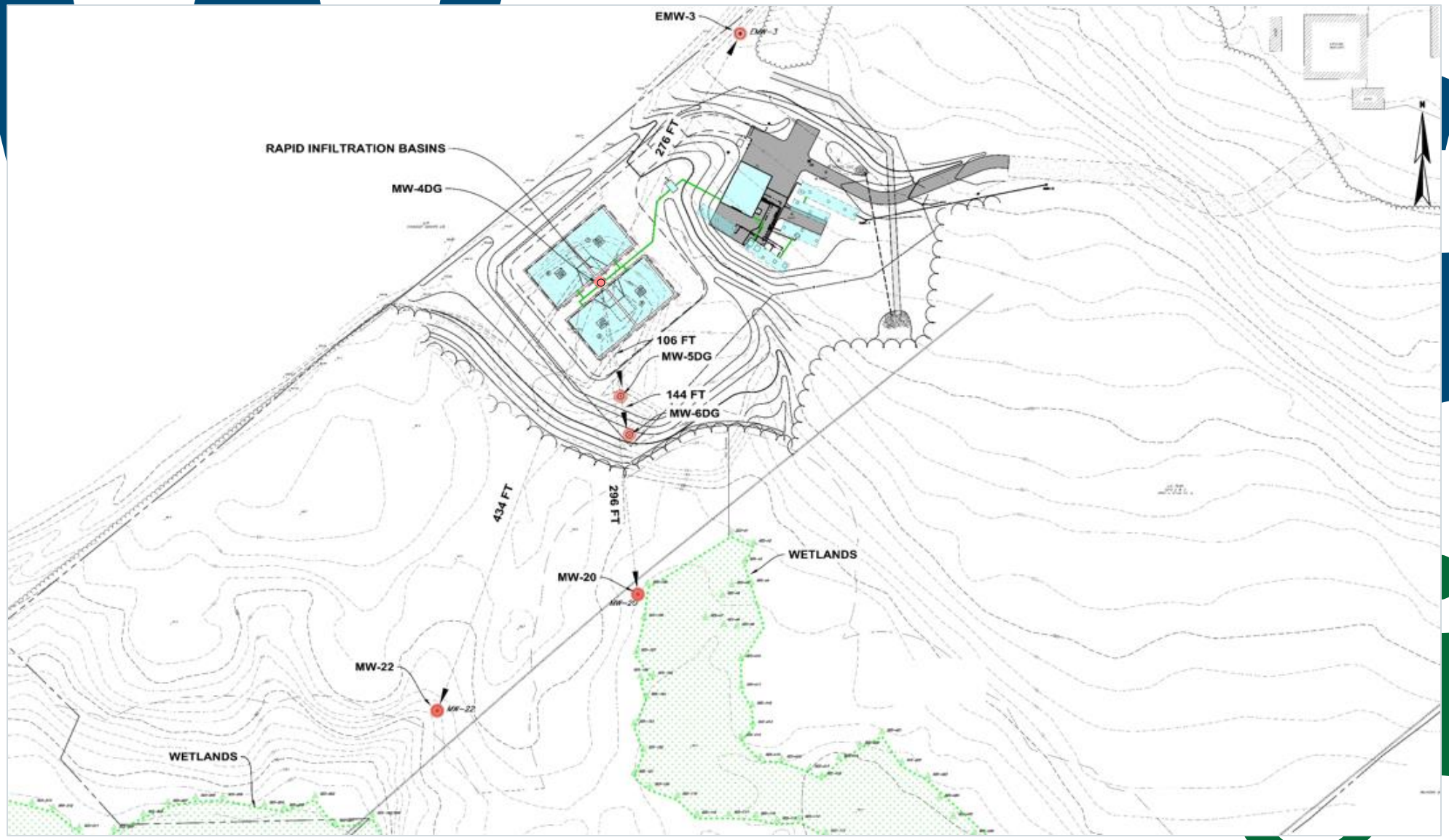
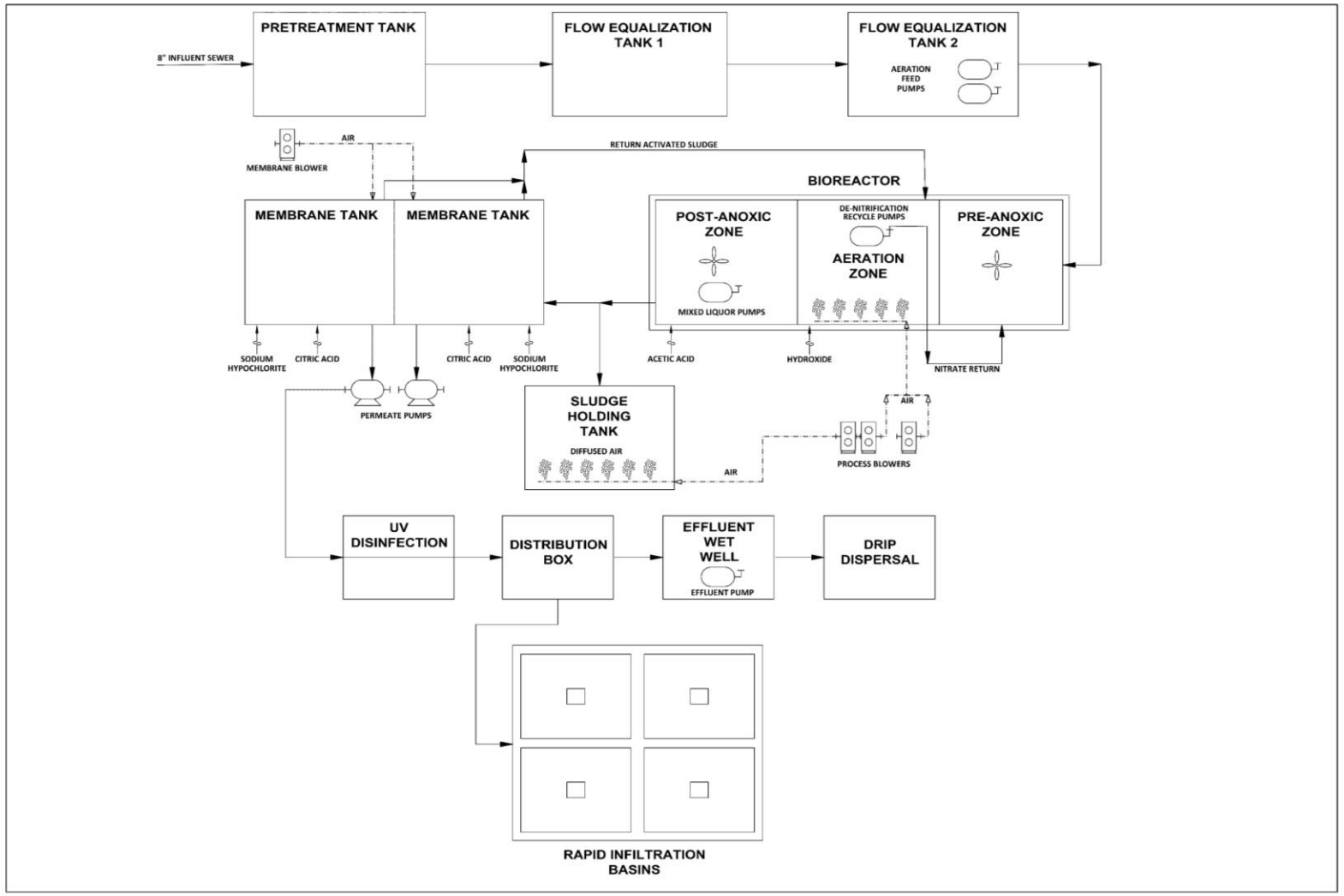


WTF D n

Process Flow Schematic



- Residential WW
- Package MBR System
- 37,900 gpd
- Pre-Treatment Tank
- Flow Equalization
- Bioreactor – Anoxic, Aeration, Post-Anoxic
- Membrane System
- UV Disinfection
- Effluent Pumping
- Solids Holding

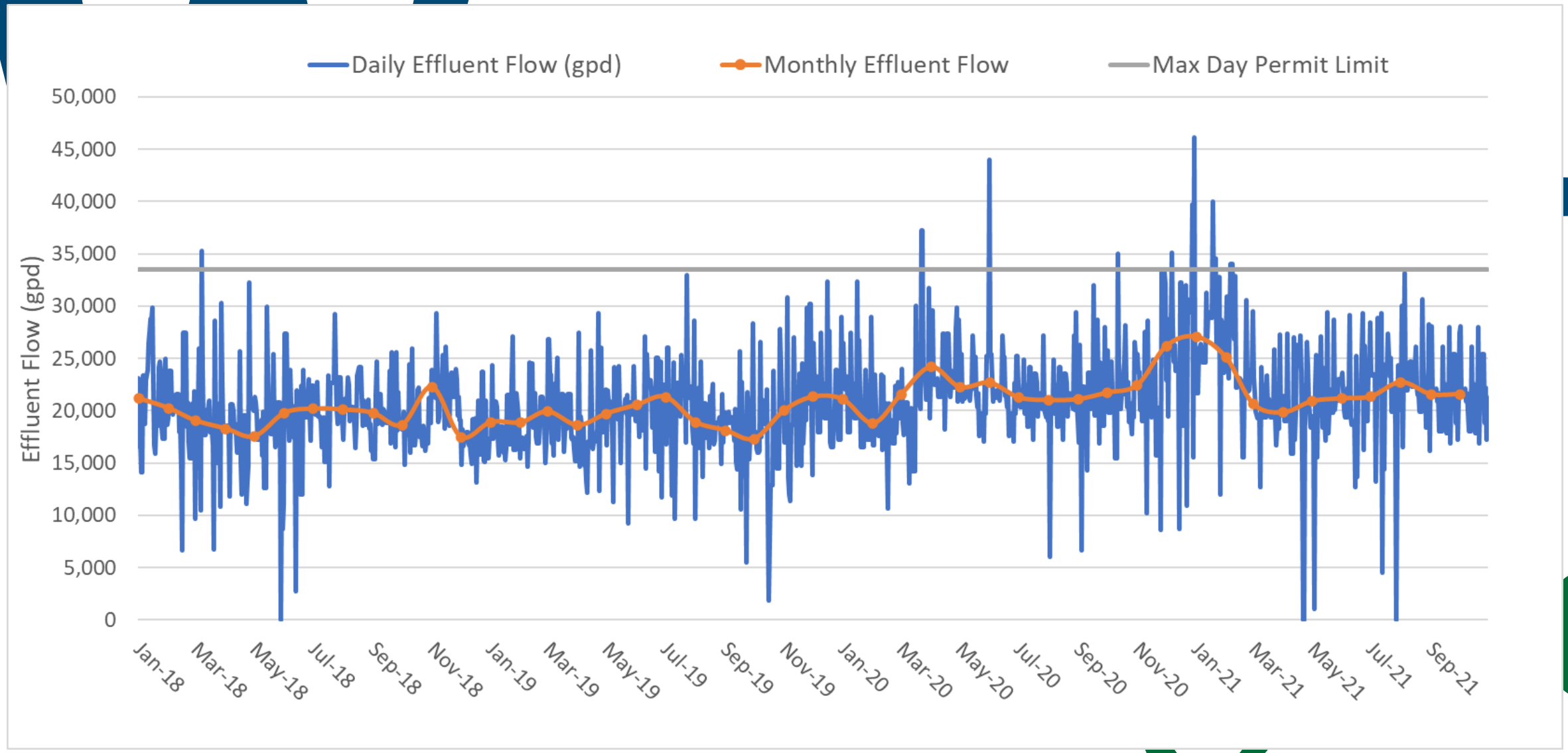
WTF P[illegible]rmanc[illegible] (2018-2021)

Parameter	Effluent
Flow (gpd)	
Maximum Day	46,130
Maximum Month	27,082
2018-2021 Average	20,750
BOD (mg/L)	
2018- 2021 Average	2.4
TSS (mg/L)	
2018- 2021 Average	9.0
Total Nitrogen (mg/L)	
2018- 2021 Average	2.4
Total Phosphorus (mg/L)	
2018- 2021 Average	0.6
Ortho-Phosphorus (mg/L)	
2018- 2021 Average	0.4

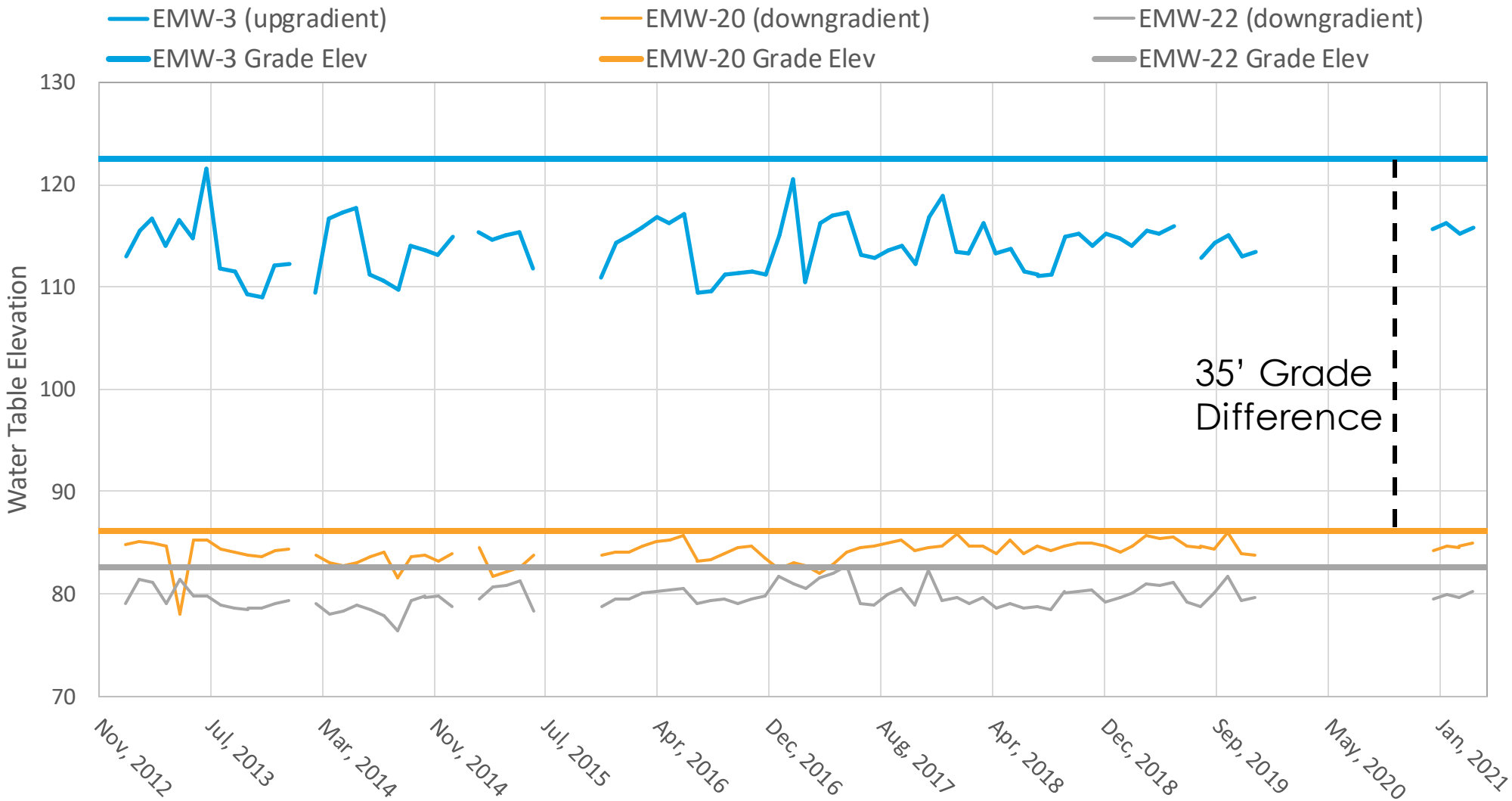
IGH

Engine

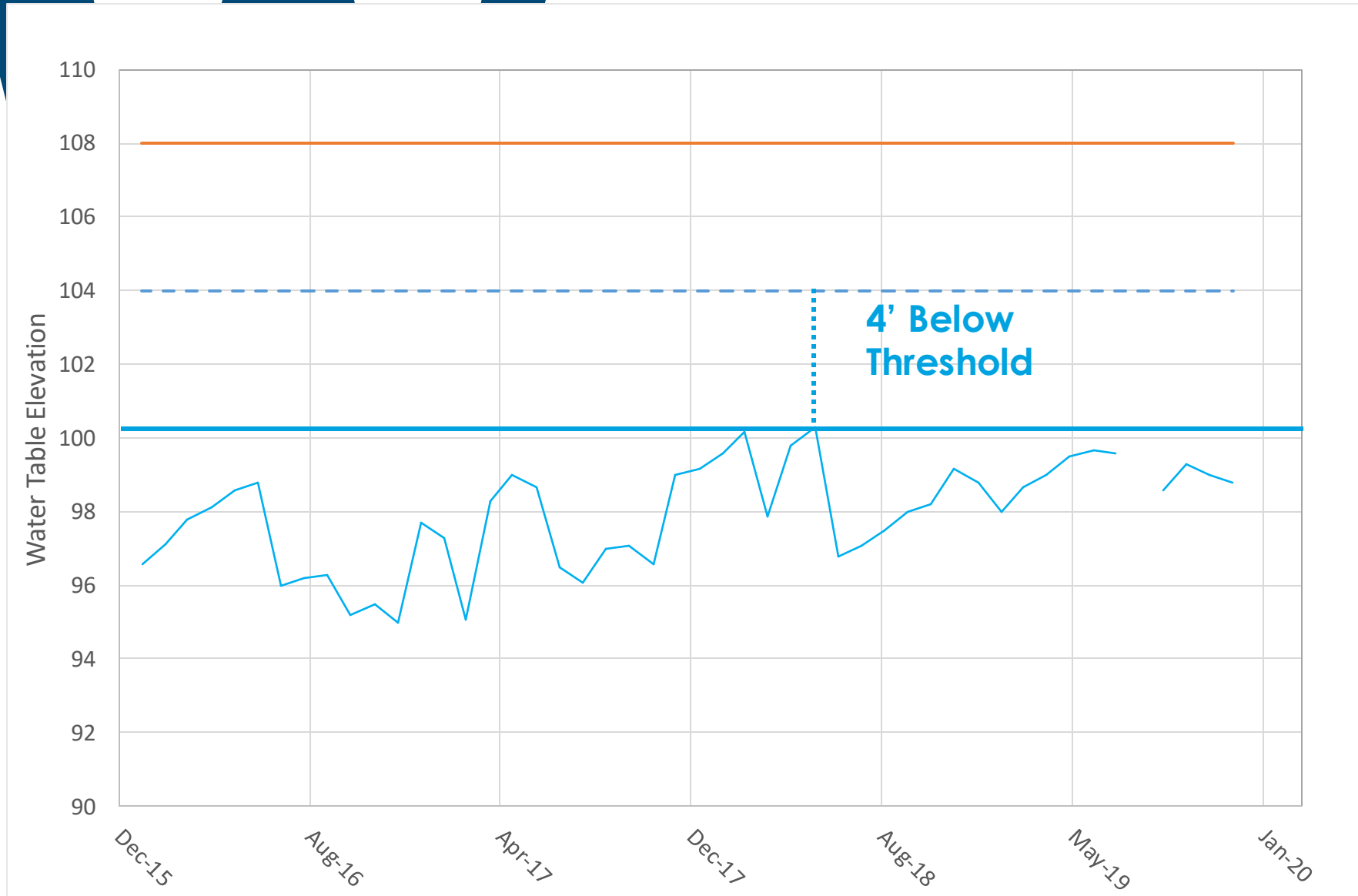
WTF P[illegible]rmanc[illegible] – Flow Over Time



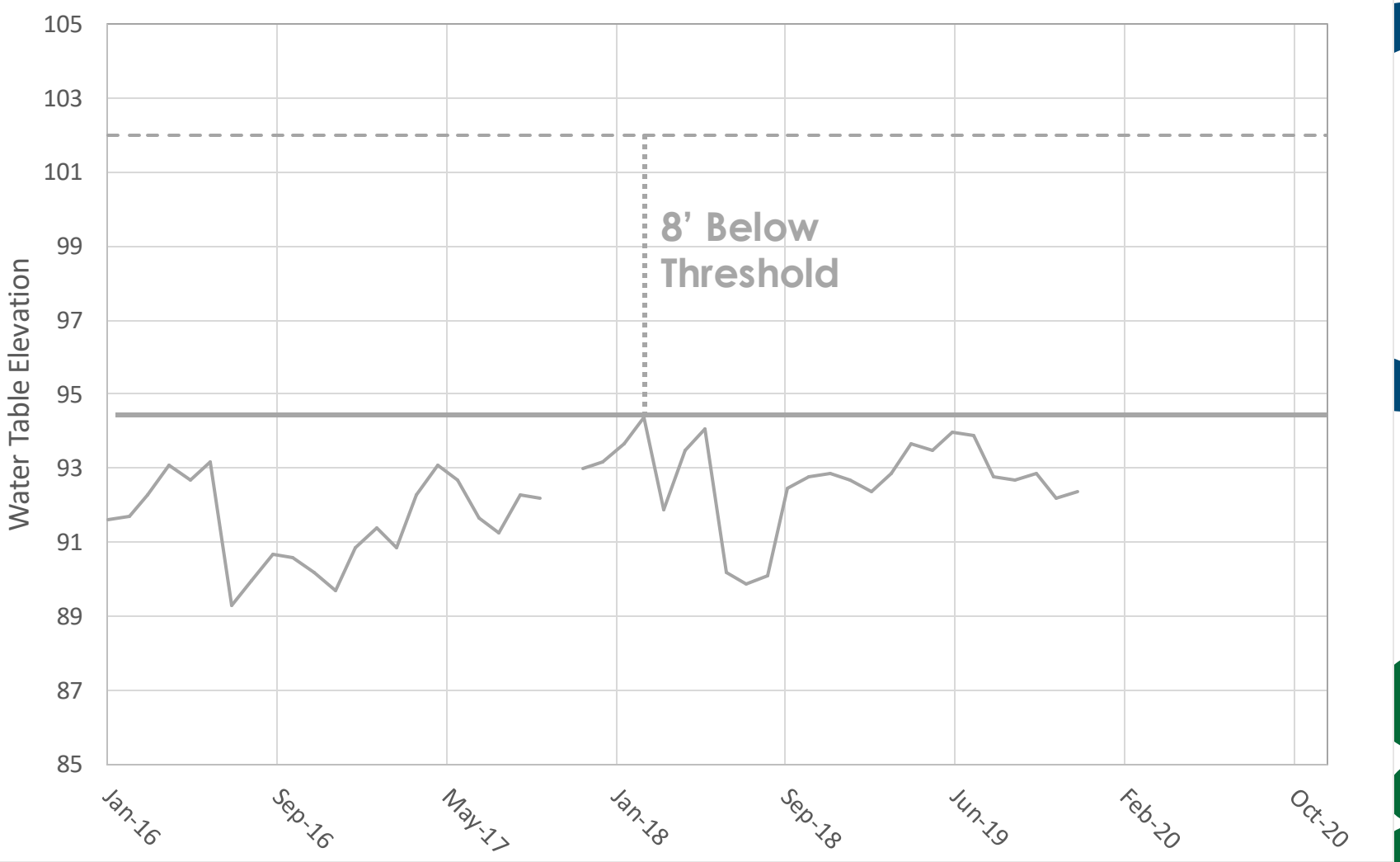
3 Perf[illegible]ance – Water Table Over Time, DEP Wells



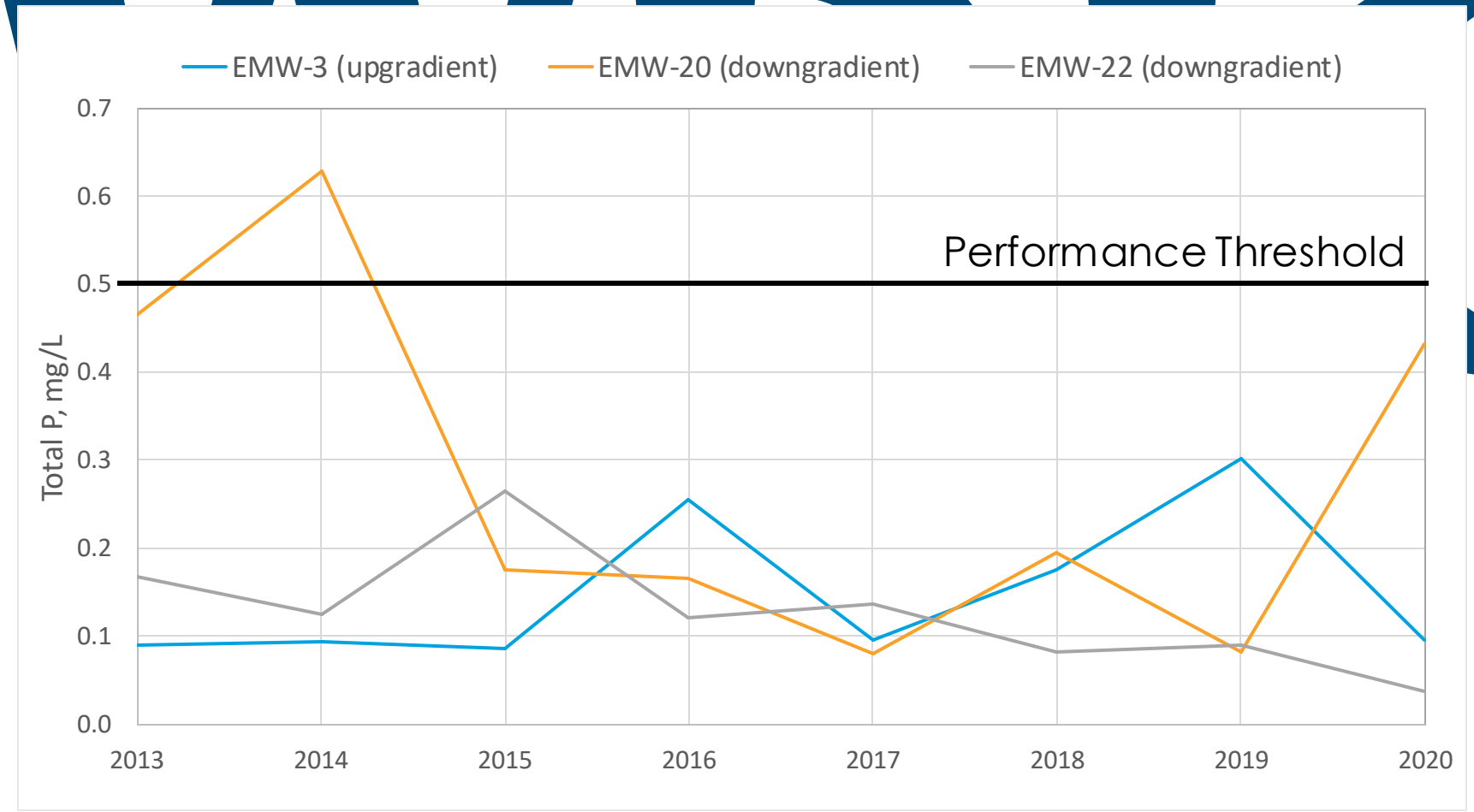
B Perf ance Water Table Over Time, MW-4DG



3 Perf[illegible]ance – Water Table Over Time, MW-6DG

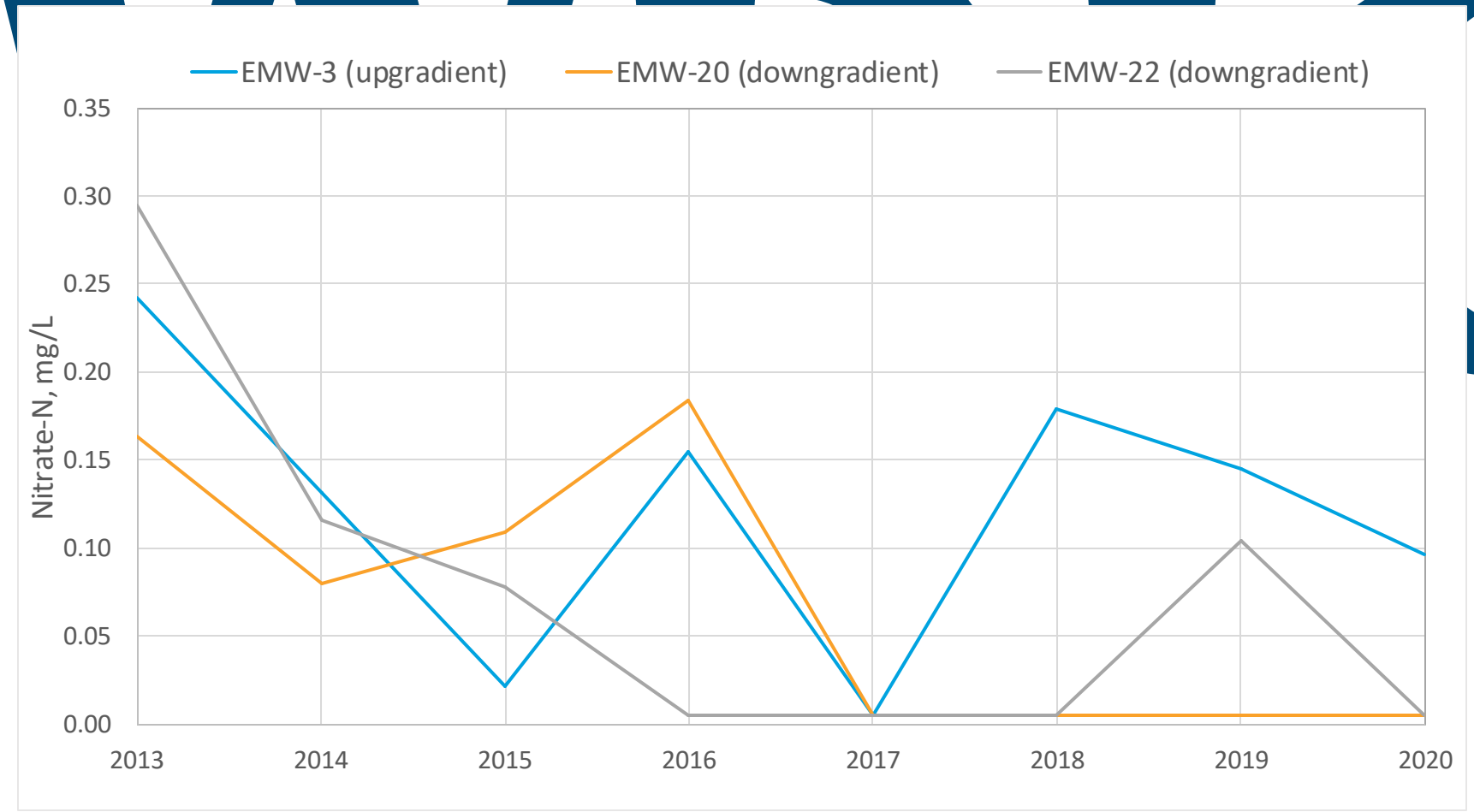


3 Perf[illegible]ance – Phosphorus Over Time, DEP Wells



- Consistent over time
- Below 0.5 threshold
- Sometimes Below Upgradient Values

3 Perf[illegible]ance – Nitrate Over Time, DEP Wells



- Very low concentrations
- Consistent results over time
- No appreciable difference between up and downgradient

Conclusions/Summary

- Very Difficult Site for Treated Effluent Disposal
- Complicated Hydrogeologic Investigations and Evaluation
- MassDEP Approved Study and Design, Typical Permit Issued
- Protection of Town Water Supply Led to Stringent Monitoring and WWTF Design
- 9 Years of Excellent WWTF and Effluent Disposal Performance
  - Proven WWTF and Disposal Design
  - Met 4 Groundwater Discharge Goals

Acknowledgements

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THANK YOU
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