

# Lincoln Woods WWTP Evaluation – Phase 2

## SLPAC/Planning Board Review Meeting

January 11, 2022

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## Project Team

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# Acknowledgements

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The Community  
Builders



Wastewater  
Environmental  
Management



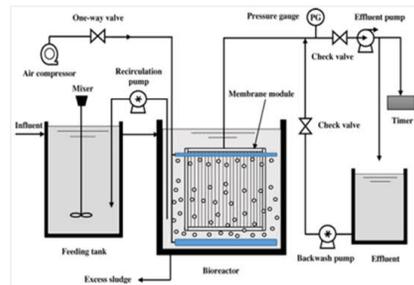
Town of Lincoln WWTP  
Working Group  
Paula Vaughn-MacKenzie  
Gary Taylor  
Rachel Drew  
Packy Lawler

# Presentation Overview

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Phase 1 Summary  
Project Scope – Phase 2  
Expansion of Current System  
Alternative WWTP Technologies  
Alternatives Analysis  
Selected Alternative – Costs  
Potential Design and Construction Schedule  
Summary

# Project Scope – Phase 2



## Expansion of Current System

- Flow capacity of existing WWTP and expansion limit (26,000 gpd)
- Treatment capacity of existing WWTP and expansion limit (40,000 gpd)
- Effluent disposal needs and restrictions

## Alternative Treatment

- Identify three options
- Pros and cons of each system
- Capital cost
- O&M cost
- Comparative analysis

## Selected Alternative Analysis

- Construction considerations
- Expansion
- 50,000 gpd vs. 60,000 gpd

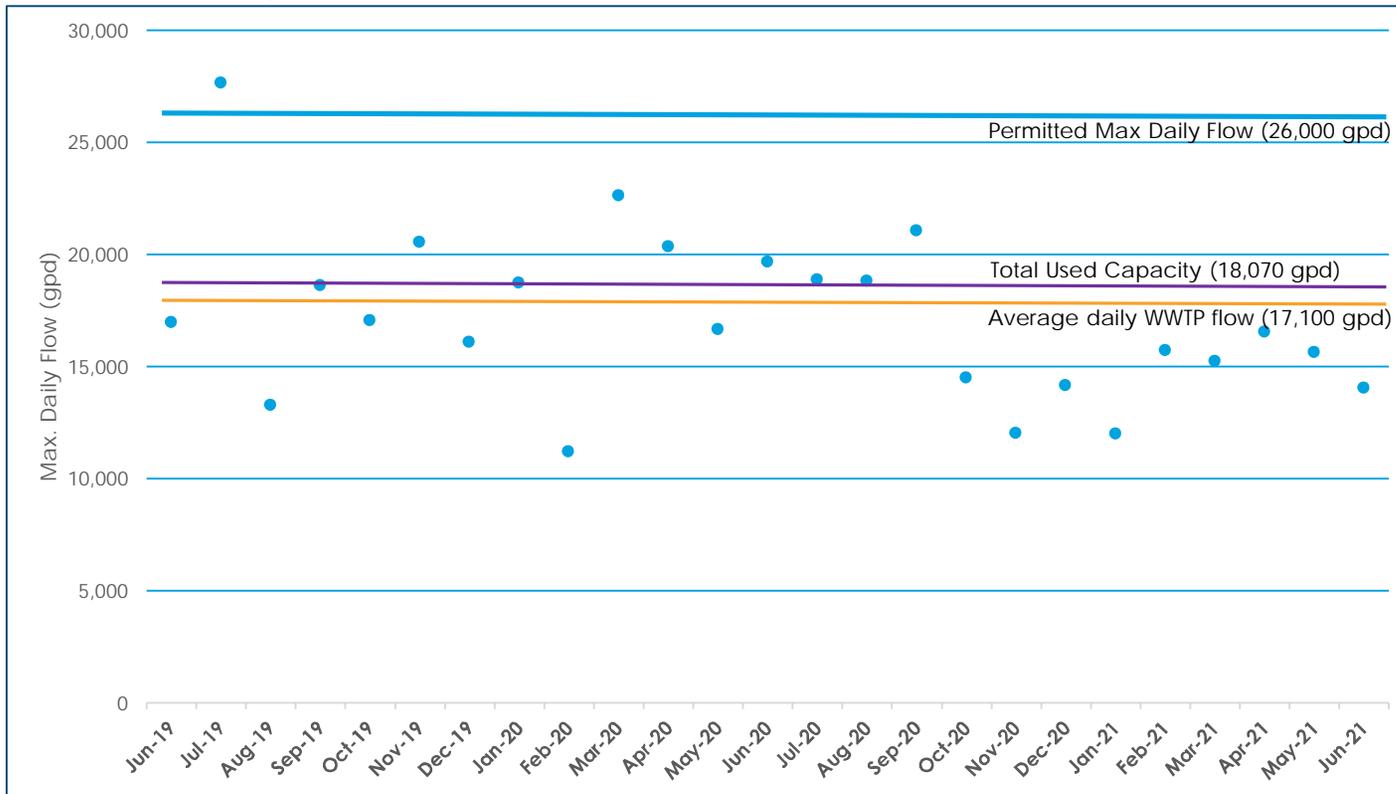
## Recommendations

- Design and construction schedule
- Overall project capital and O&M cost estimates
- Summary & conclusions



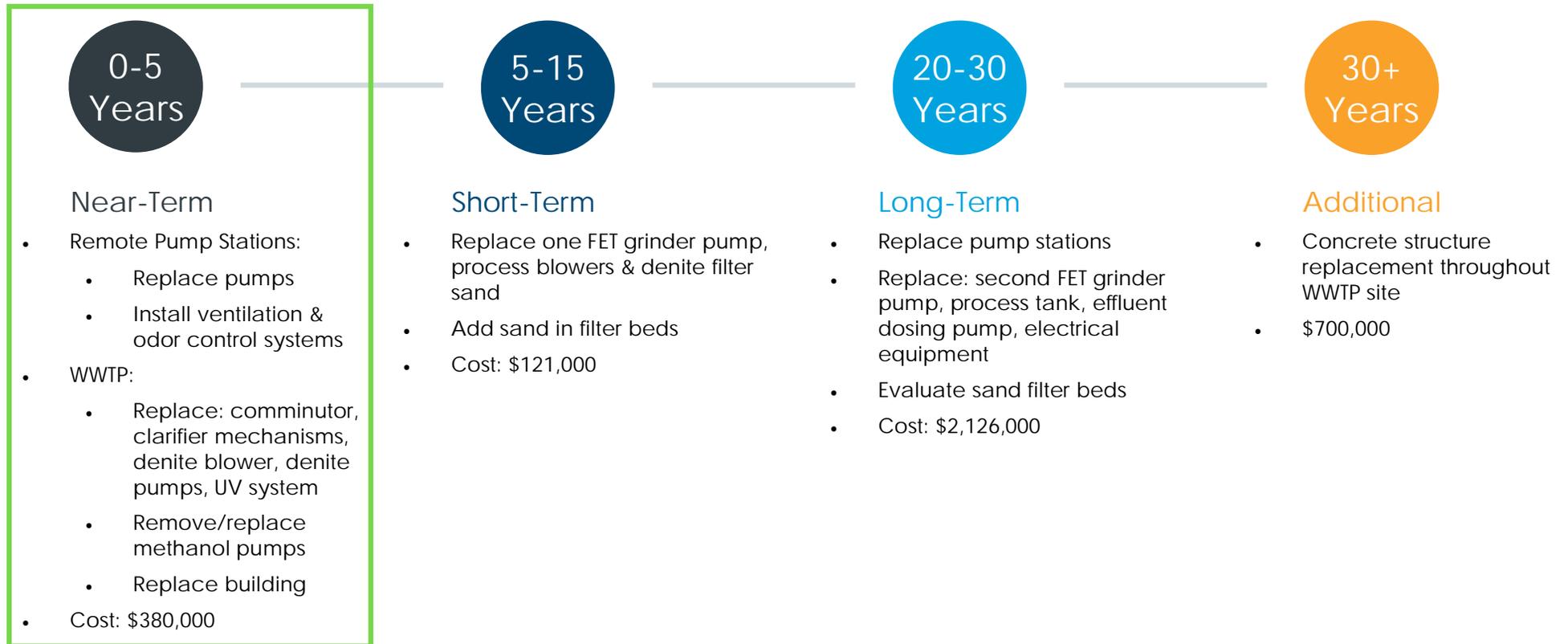
# WWTP Capacity – Existing Flows

Maximum Daily Flow Per Month, June 2019 – June 2021



- Consistently below permitted 26,000 gpd
- Total capacity of 18,070 gpd currently used
- Available Capacity 7,930 gpd (Permitted 26,000 gpd – 18,070 gpd)
- 72 Bedrooms (110 gpd/bedroom)

# Existing WWTP Recommendations – Construction Costs



## Existing WWTP – Cost to Increase to 40,000 gpd

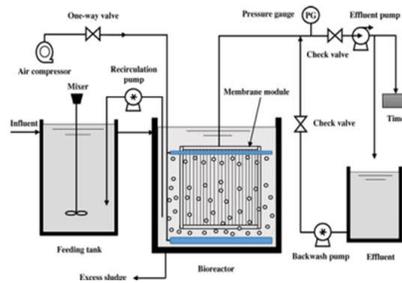
Parameter	Cost
Flow Equalization Tank	\$75,000
Denitrification Filter	\$100,000
Effluent Clearwell	\$60,000
Phase 1 Near-Term Improvements	\$380,000
Contractor Factors	\$115,000
<b>Subtotal, Construction Bid Cost</b>	<b>\$730,000</b>
Project Contingency	\$185,000
Inflation to Construction	\$85,000
<b>Total Estimated Construction Cost</b>	<b>\$1,000,000</b>
Engineering Services	\$400,000
Legal & Administrative	\$50,000
<b>Total Project Cost</b>	<b>\$1,450,000</b>

- Flow Equalization Tank (FET) – requires ~4,000 gallons more
- Denitrification Filter – sized for 26,000 gpd, needs additional small filter
- Effluent Clearwell – more volume required for additional small filter
- Effluent Disposal Sand Beds – unknown maximum capacity
  - Testing could cost between \$50-\$100,000
  - Additional disposal area could cost \$500-\$800,000

## Alternative Treatment Technologies Evaluation – Design Criteria

Parameter	Value	
	Influent	Effluent
Flow	-	50,000 & 60,000 gpd
BOD	400 mg/L	30 mg/L
TSS	400 mg/L	30 mg/L
Total Nitrogen	-	10 mg/L

# Alternative Treatment Technologies Evaluated



## Membrane Bioreactor (MBR)

- Highest quality effluent
- Low sludge disposal
- Similar electrical consumption
- Highest chemical cost
- Complex to operate
- Easiest to expand



## Amphidrome™

- Hardest to operate
- High chemical cost
- Low sludge disposal cost
- Similar electrical requirements as MBR
- Hardest to expand



## Sequencing Batch Reactor (SBR)

- Able to handle changing influent loads
- Easy to operate
- No chemical costs
- Highest sludge disposal
- Hard to expand
- Already redundant
- Tall/deep tanks needed

## Present Worth Analysis of WWTP Alternatives - 50,000 gpd System

Parameter	Cost		
	MBR	Amphidrome™	SBR
Capital Cost	\$1,375,000	\$1,201,000	\$1,134,000
Annual O&M Cost	\$112,000	\$88,000	\$139,000
Present Worth, 20-Year O&M <sup>1</sup>	\$1,666,000	\$1,309,000	\$2,068,000
Total Present Worth	\$3,041,000	\$2,510,000	\$3,202,000

1. 3% interest rate

## Non-Cost Analysis and Ranking of WWTP Alternatives

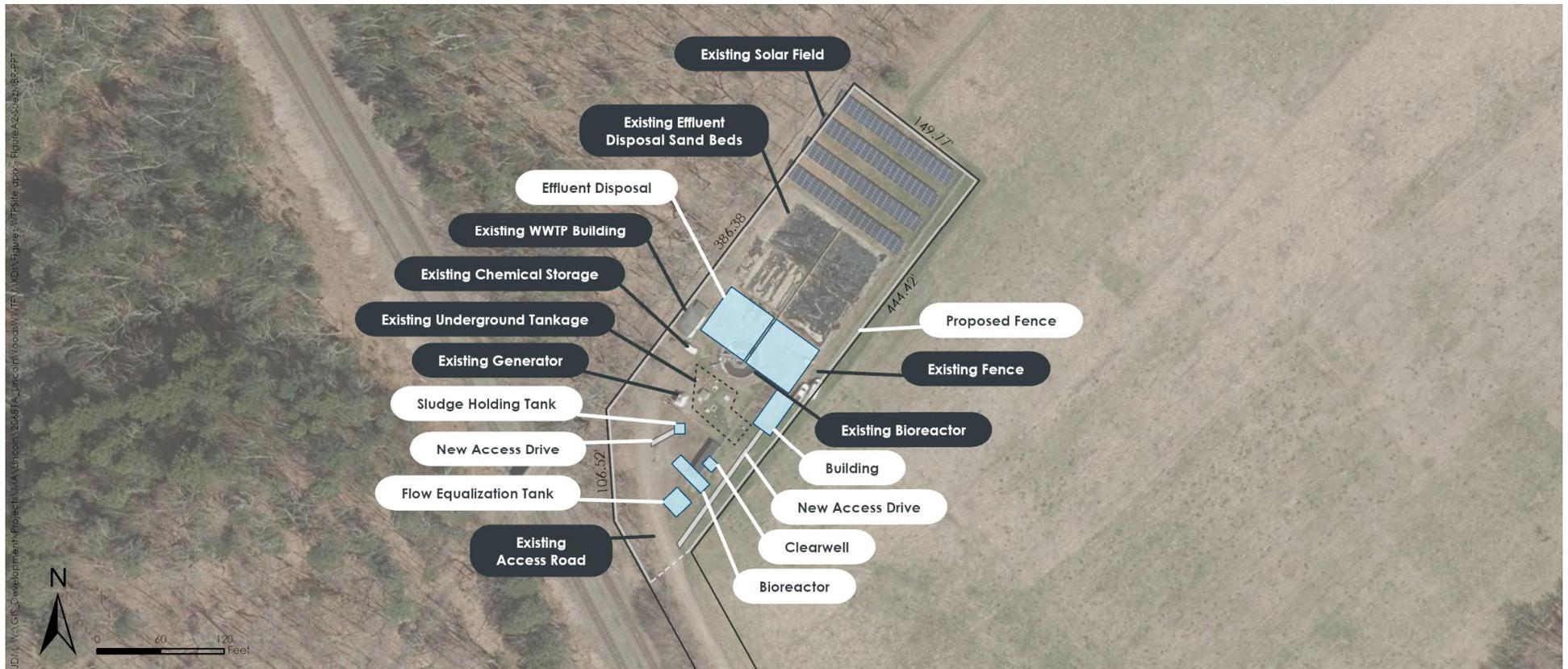
Parameter	Rank		
	MBR	Amphidrome™	SBR
Capital Cost	3	2	1
Annual O&M Cost	2	1	3
Complexity	2	3	1
Expandability	1	3	2
Effluent Quality	1	2	2
<b>Total</b>	<b>9</b>	<b>11</b>	<b>9</b>

## Recommended Plan – MBR Technology

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- Best effluent quality
- Comparable capital costs to other alternatives
- Annual O&M cost in the middle, but lowest sludge disposal quantity/cost
- Easiest to expand for additional flow
- Construct within existing parcel limit, but outside existing fenced area
- Indoor and underground equipment

# Site Layout – MBR, 50,000 gpd Capacity



## Recommended MBR System (50,000 gpd) – Overall Project Cost Estimate

Parameter	Estimated Cost
Civil	\$420,000
Architectural	\$250,000
Structural	\$620,000
Process	\$810,000
Mechanical (HVAC/P)	\$20,000
Electrical	\$400,000
Instrumentation	\$25,000
Specials	\$200,000
Contractor Factors	\$500,000
Project Contingency	\$812,000
Inflation to Construction	\$366,000
<b>Total Estimated Construction Cost</b>	<b>\$4,423,000</b>
Engineering Services	\$1,106,000
Legal & Administrative	\$221,000
<b>Total Project Cost Estimate</b>	<b>\$5,750,000*</b>

\* Sizing facility for 60,000 gpd but waiting to build redundant Bioreactor is ~\$6 million

## Recommended MBR System (60,000 gpd) – Overall Project Cost Estimate

Parameter	Estimated Cost
Civil	\$470,000
Architectural	\$250,000
Structural	\$905,000
Process	\$935,000
Mechanical (HVAC/P)	\$20,000
Electrical	\$450,000
Instrumentation	\$30,000
Specials	200,000
Contractor Factors	\$608,000
Project Contingency	\$967,000
Inflation to Construction	\$436,000
<b>Total Estimated Construction Cost</b>	<b>\$5,271,000</b>
Engineering Services	\$1,318,000
Legal & Administrative	\$264,000
<b>Total Project Cost Estimate</b>	<b>\$6,853,000*</b>

\* Sizing facility for 50,000 gpd then adding on later to treat 60,000 gpd is about the same cost. However, inflation must be accounted for since the project would occur in the future.

# Project Duration

Tasks	Duration Range
Design	
Preliminary Design & Permitting	9-12 Months
Final Design	9-12 Months
Bidding	3 Months
Construction	
Construction	14-18 Months
Total Design, Bidding, and Construction	3-4 Years

## Additional Considerations

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- Effluent disposal
  - Hydrogeologic investigation/evaluation of existing sand bed, cost estimate ranges from \$50,000 - \$100,000
  - If Additional effluent disposal area/system is necessary, cost estimate ranges from \$500,000 - \$800,000
- Land and WWTP ownership
- Annual operating costs for WWTP
- Permitting

# Summary and Conclusions

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## Phase 1 – Historical Flows

- 15,800 gpd used by TCB (Residential)
- 2,300 gpd used by The Mall (Commercial)
- Approximately 7,900 gpd unused under existing 26,000 gpd disposal permit
  - DEP allows historical data to be used to prove 110 gpd per bedroom design flow is conservative
- 7,900 gpd equates to 72 bedrooms using DEP-required 110 gpd/bedroom
  - MassDEP requires 110 gpd per bedroom be used for planning and permitting

## Summary and Conclusions – Continued

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### Phase 1 WWTP Recommendations – Construction Costs

- Near-Term Improvements, 2025 – \$380,000
- Short-Term Improvements, 2035 – \$121,000
- Long-Term Improvements, 2050 – \$2,126,000
- Additional Considerations, 2065 – \$700,000

## Summary and Conclusions – Continued

Flow	Expansion Potential	Cost of Improvements <sup>1</sup>	Cost Per Bedroom
“Do Nothing” 26,000 gpd	72 bedrooms	\$0.75 million	\$10,400/bedroom
40,000 gpd (Upsize existing WWTP)	199 bedrooms	\$1.5 million	\$7,500/bedroom
50,000 gpd (new WWTP)	290 bedrooms	\$5.8 million	\$20,000/bedroom
60,000 gpd (new WWTP)	381 bedrooms	\$6.9 million	\$18,100/bedroom

- Scenario 2, 3, and 4 require effluent disposal work
  - Hydrogeologic Evaluation cost \$50-\$100,000
  - Additional effluent disposal costs \$500-\$800,000
- Scenario 2 likely most favorable on cost basis

THANK YOU

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