Ponds Provide Sustainable Treatment for Honoka‘a

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Presentation Overview

- Background
- Current Ponds Capacity
- Alternatives
- Pond Modifications
- Cost Comparison
- Design Features
- Conclusions

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Background

- Partially Sewered Community
- Multiple (37) Large Capacity Cesspools (LCCs)
- EPA Outlawed LCCs after 2005
- County of Hawaii Authorized Facilities Plan
- Facilities Plan Recommended New Mechanical Plant
- Brown and Caldwell Conducts Analysis of Alternatives

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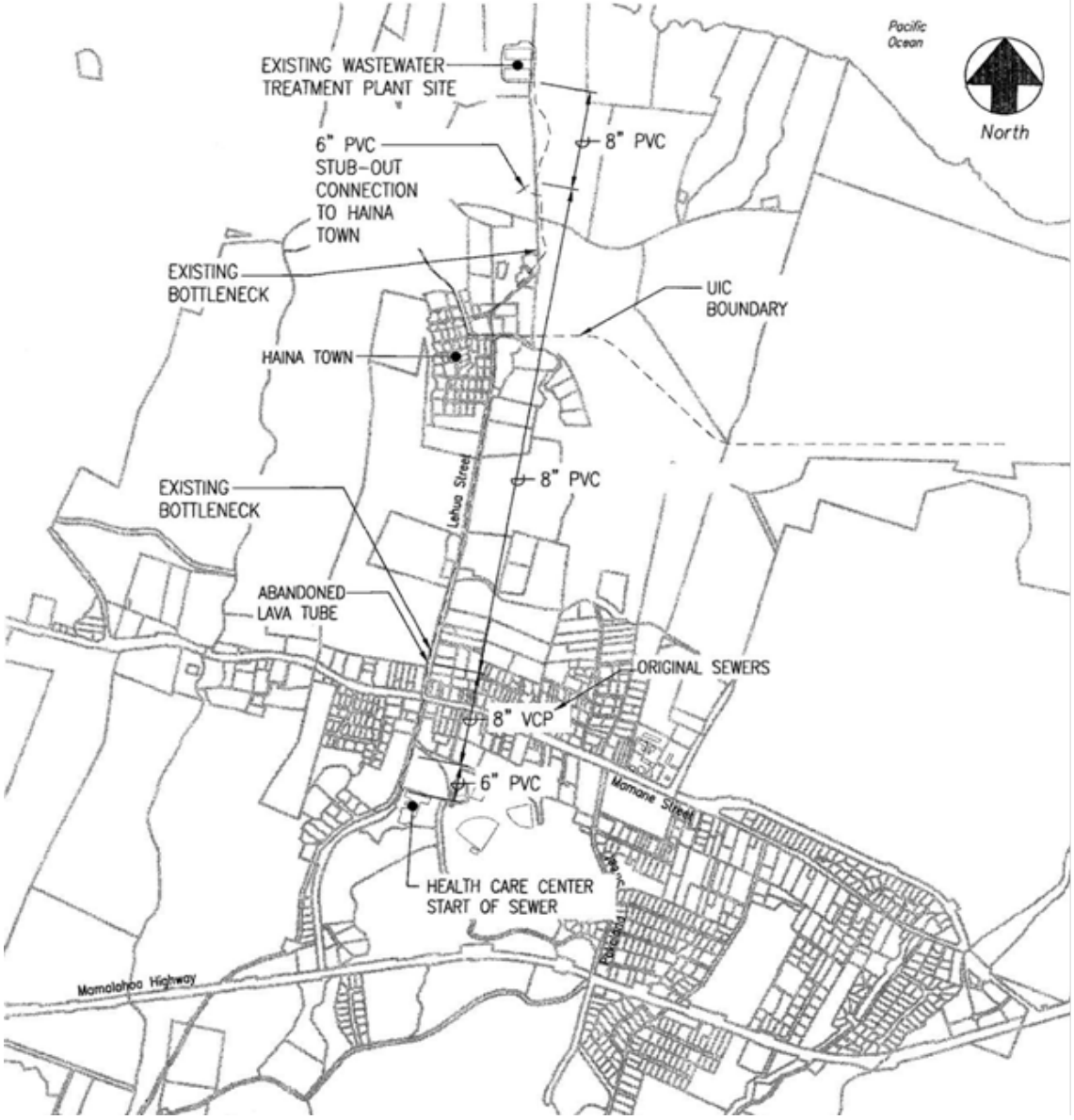
Existing Wastewater System



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Existing Unaerated Ponds

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Effluent Discharge

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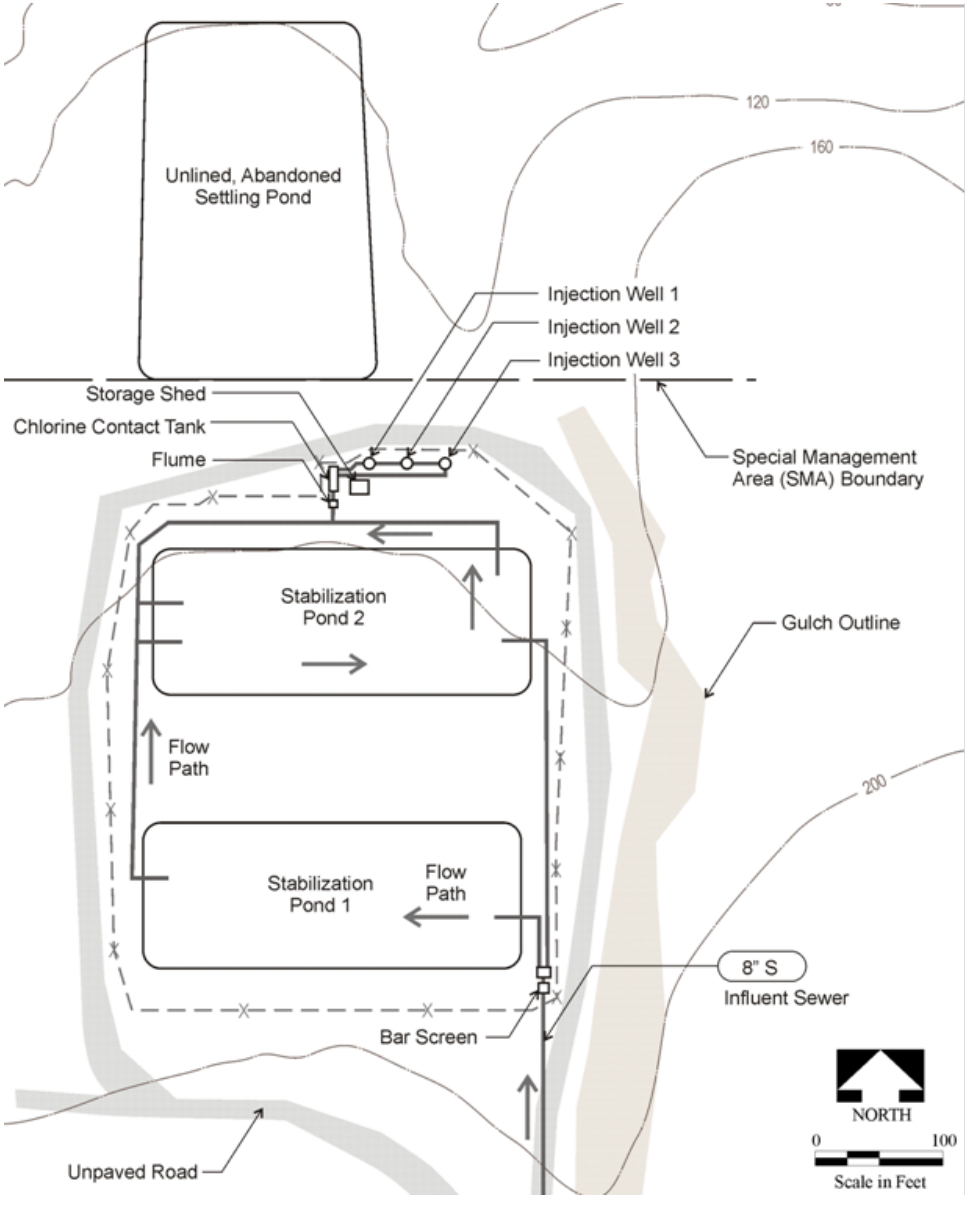
Schematic Layout of Honoka'a WWTP



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Existing Ponds Capacity

- Ponds are 5 ft deep; 1.7 acres
- Areal Loading Method 55,000 gpd
- Plug Flow with Axial Dispersion 70,000 gpd
- Plug Flow 77,000 gpd

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Summary of Influent Composite Data

Parameter	Units	Average Value
5-day biochemical oxygen demand (BOD)	mg/L	261
Chemical oxygen demand (COD)	mg/L	735
Total suspended solids (TSS)	mg/L	389
Total Kjeldahl nitrogen (TKN)	mg/L	26.3
Ammonia nitrogen	mg/L	19.8
Nitrate nitrogen	mg/L	2.5
Alkalinity	mg/L	183
Total dissolved solids (TDS)	mg/L	336
Electrical conductivity	µmhos/cm	688
pH	units	7.4
Temperature	ºC	27

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Alternatives for 0.2 mgd

- Pond Modifications
- Expansion of Current Ponds
- Sequencing Batch Reactors

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Pond Upgrading Factors

- Number of cells
- Pond depth
- Aeration level
  - Partial-mix
  - Complete-mix

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Partial-mix Design Model

$$\frac{Cn}{Co} = \frac{1}{[1+(kt/n)^{n}}$$

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Effect of Number of Cells on Required Detention Time

- N = 2
- N = 3
- N = 4
- N = 5

- T = 11 days
- T = 9.4 days
- T = 8.7 days
- T = 8.2 days

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Pond Modifications

- Add baffles to increase the number of cells from 2 to 4
- Deepen ponds from 5 to 10 ft
- Add surface aeration to first three cells
- Cover fourth pond for settling and algae control

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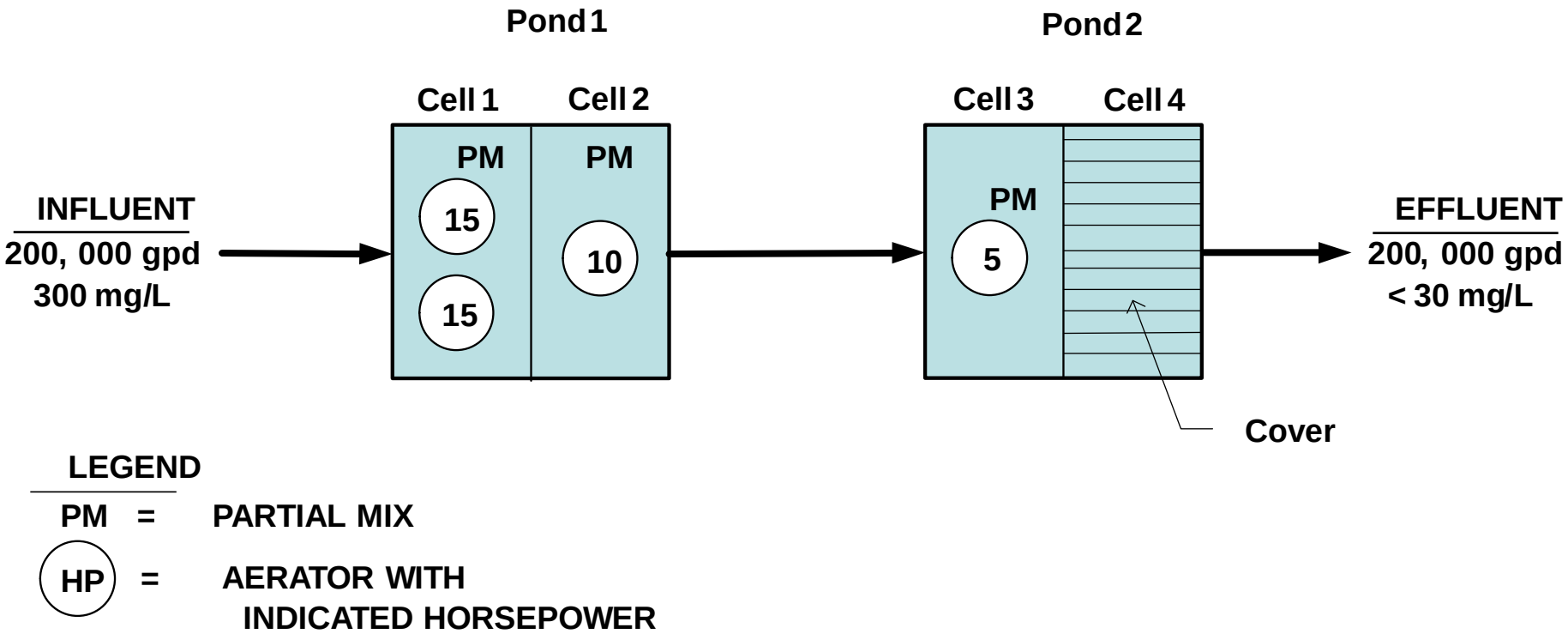
Pond Configuration Schematic



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Cost Comparison of Alternatives

Option	Capital Cost	Annual O&M Cost	20-Year Present Worth
Partial-mix aerated ponds	$4.2m	$184,000	$6.8m
Sequencing batch reactor	$7.6m	$1.07m	$23.5m

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Aeration and Mixing Requirements

Cell	Influent BOD (mg/L)	Effluent BOD (mg/L)	Minimum Aerator Requirement (hp)	Mixing Density (hp/Mgal)
1	300	126	22	22
2	126	53	9	9
3	53	<30	4	4
4	<30	<30	2	2

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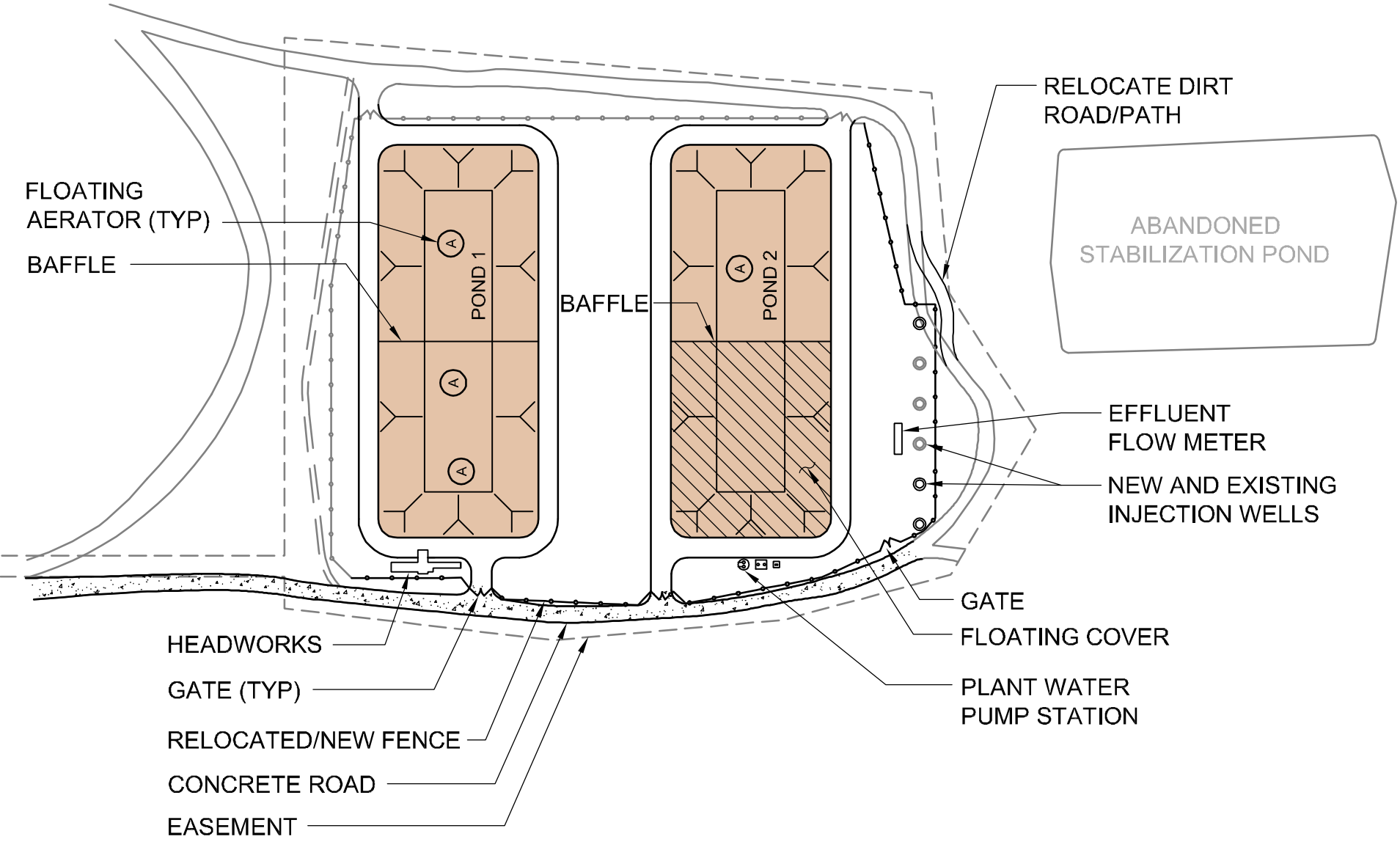
Preliminary Site Plan



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Designing for Future Pond Maintenance

- Reasons to take a pond out of service:
  - Sludge removal
  - Liner repair
  - Liner replacement

Complete-mix Design Model

$$\frac{Cn}{Co} = \frac{1}{[1+(kt/n)^{n}}$$

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Reaction Rate Constants

- Partial Mix = 0.276 day^{-1} @ 20°C
- Complete Mix = 2.5 day^{-1} @ 20°C

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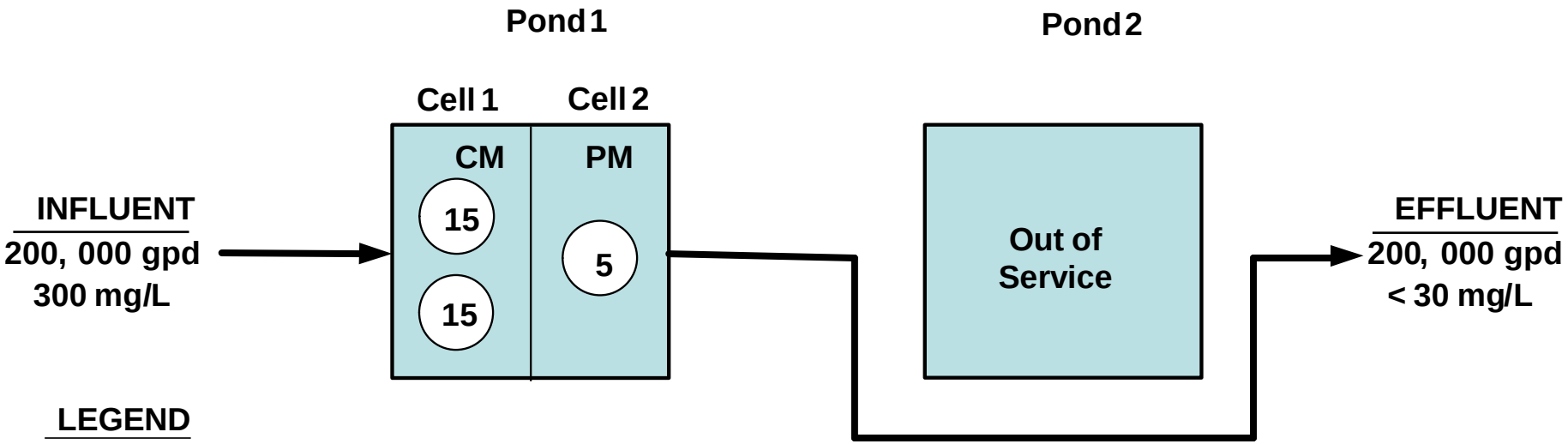
Pond Maintenance Configuration



LEGEND

CM = COMPLETE MIX

PM = PARTIAL MIX

HP = AERATOR WITH INDICATED HORSEPOWER

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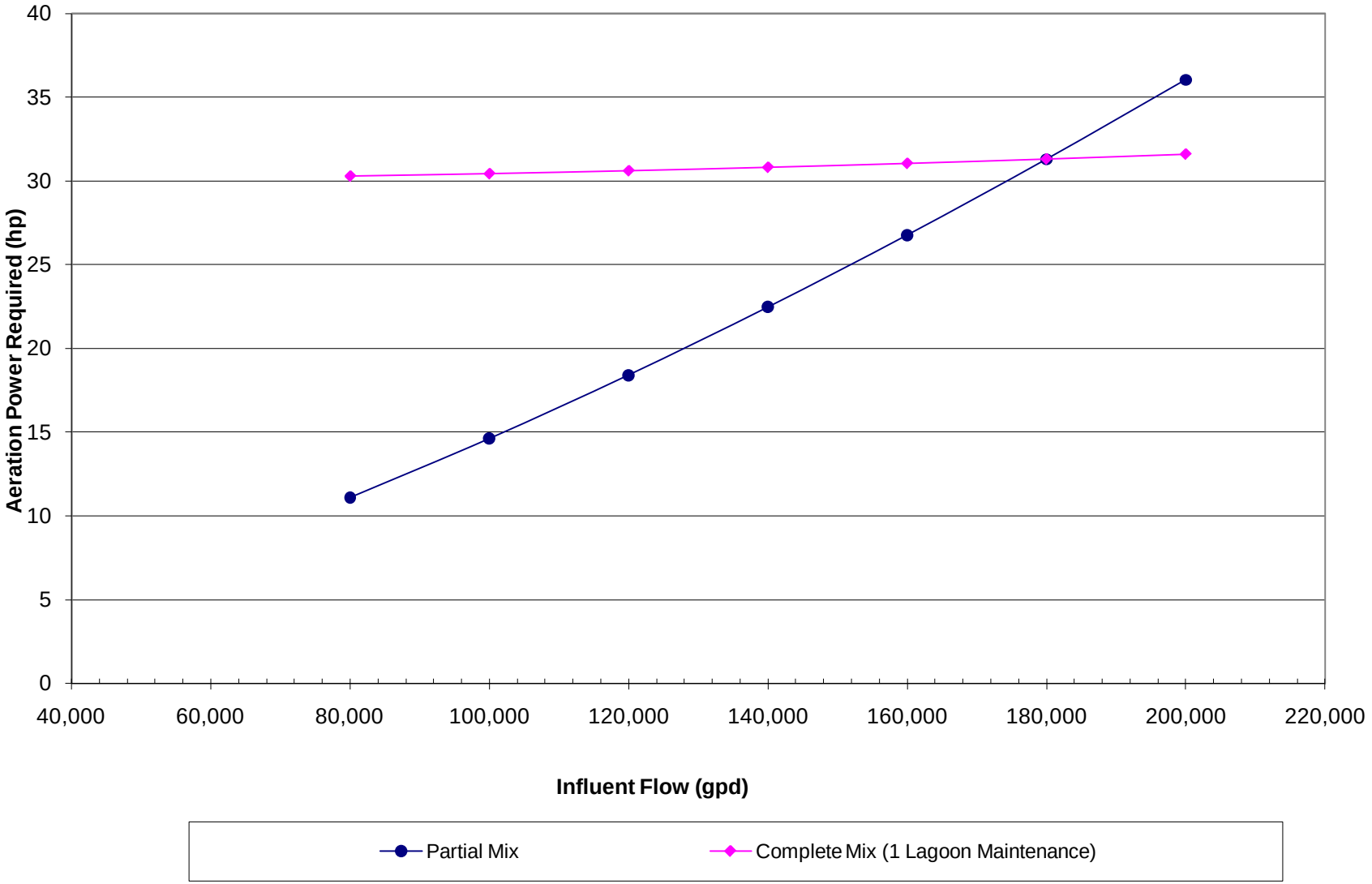
Energy Use: Partial vs. Complete Mix



Conclusions

- Pond capacity can be increased by
  - Adding more cells
  - Deepening ponds
  - Adding aeration
  - Covering the final cell for algae control
  - Resulting in sustainable treatment on the original footprint
- Future pond maintenance can be facilitated using complete mix cell

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Questions

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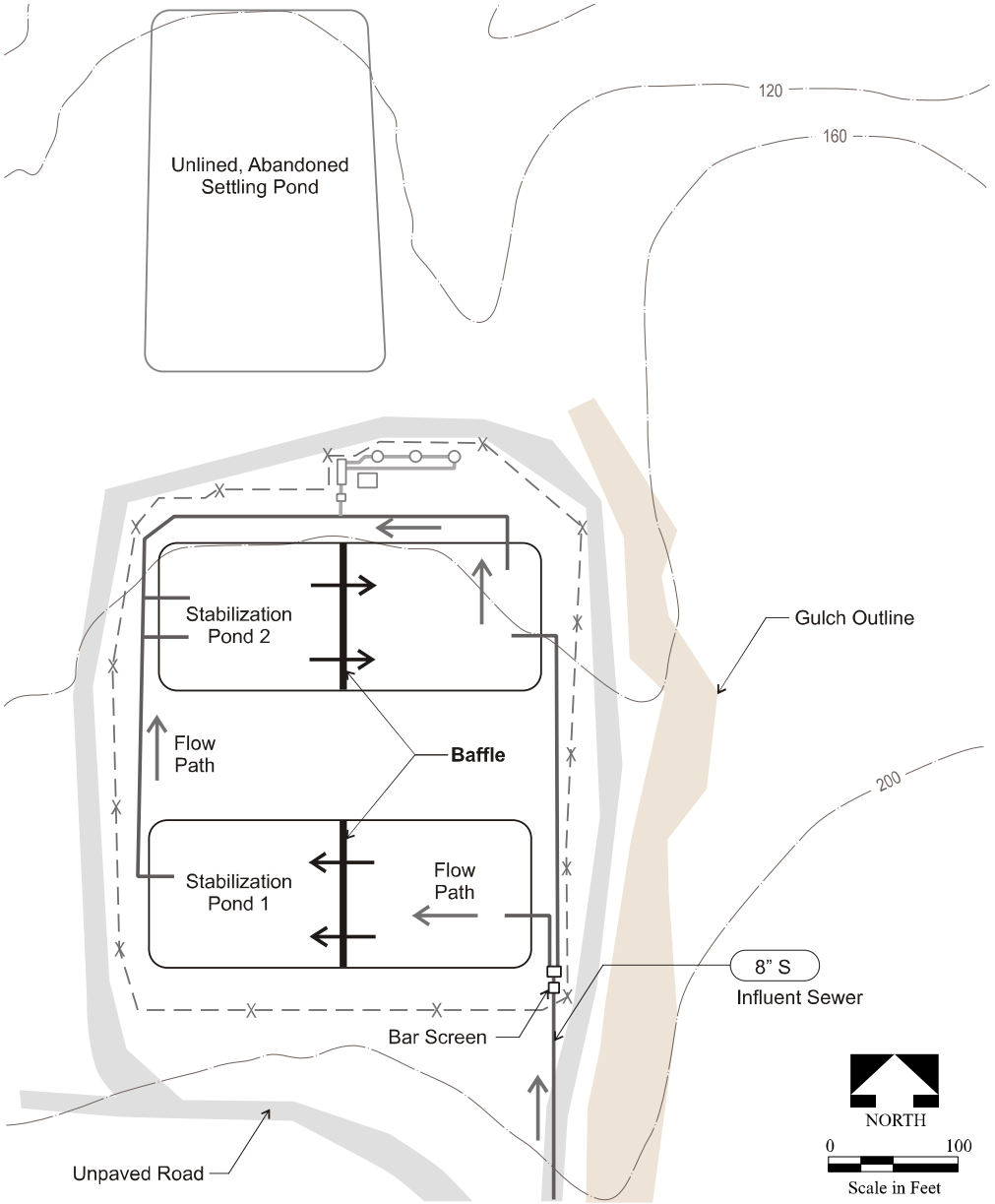
Pond Division Using Baffles



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