# Mannheim WTP Optimization and Facility Plan

Region of Waterloo

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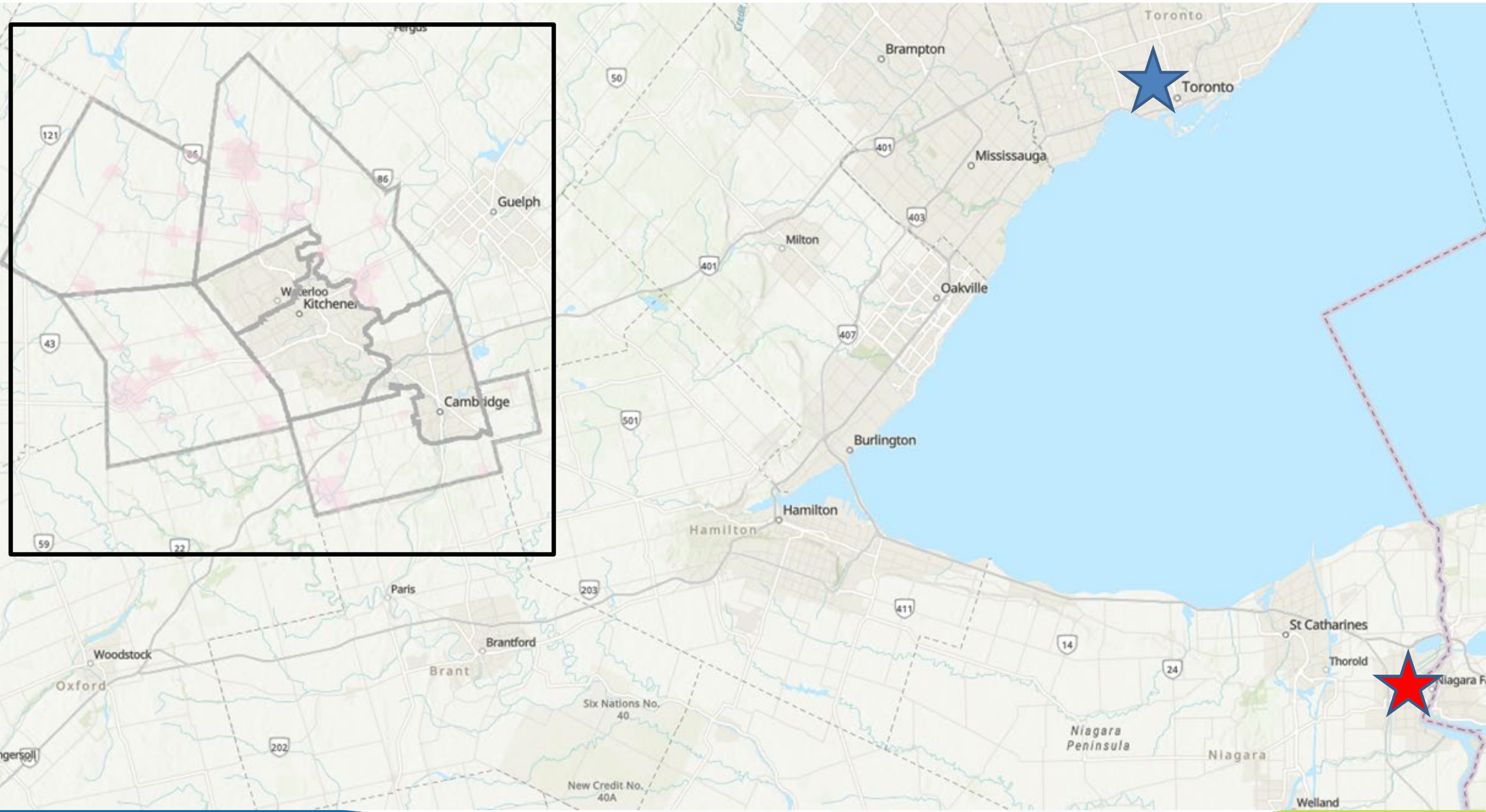
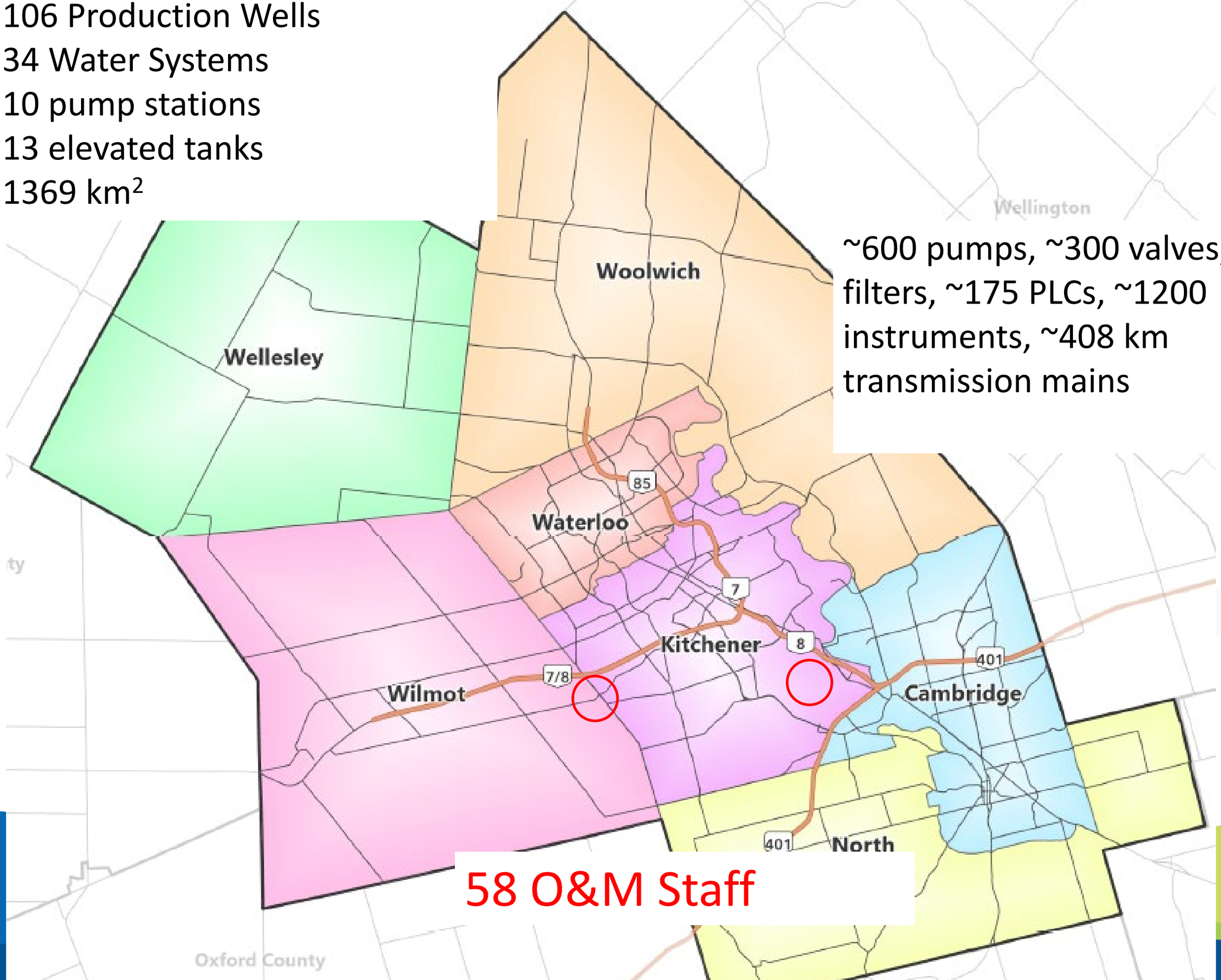

Fergus
Guelph
Waterloo
Kitchener
Cambridge
Paris
Brantford
Woodstock
Oxford
Brant
Six Nations No. 40
New Credit No. 40A
Hamilton
Hamilton
Burlington
Milton
Oakville
Mississauga
Brampton
Toronto
Toronto
St Catharines
Thorold
Niagara Peninsula
Niagara
Welland
Credit
121
86
86
50
401
403
401
407
501
59
22
43
203
411
14
24
202

106 Production Wells
34 Water Systems
10 pump stations
13 elevated tanks
1369 km$^2$




~600 pumps, ~300 valves, ~50 filters, ~175 PLCs, ~1200 instruments, ~408 km transmission mains

58 O&M Staff

# Mannheim Water Treatment Plant

- Commissioned in 1992; asset renewals
- Max **design** flow of 840 L/s; maximum operational flow is ~600 to 650 L/s
- 20 – 35 % of Region Water demand


Source: Google Maps

# Project Overview

## Why are we doing it?

**Water Services –** One of the fastest growing regions in Canada; we need to maximize our supply resources

**O&M** – Mannheim is the most operationally intensive plant in the Region

**Asset Renewals** – Aging infrastructure

**Holistic Approach** to evaluating the Treatment plant performance

# Treatment Train

Hidden Valley Raw Water Reservoirs

Mannheim Raw Water Tanks

Pretreatment - coagulation, flocculation, sedimentation

Ozonation

Filtration

UV Radiation - First in Canada

Chlorination

# Key Information

- Treatment process is robust
- Fully redundant – flow is split equally between two identical trains
- Treatment is flow paced; flow is controlled through butterfly valves
- Aging infrastructure
- pH control was implemented (H2S04) – but discontinued

# PROJECT SUMMARY

# Project Goals

- Complete a comprehensive Performance Evaluation to identify bottlenecks
- Develop Quantitative and Qualitative key performance indicators (KPIs)
- Baseline current performance to track potential improvements over time
- Identify process upgrades and operational improvements prioritized based on impact to KPIs
  - Opportunities for automation
  - Short term / low capital upgrades projects
  - Long term / major capital projects
- Create a 10 year facility plan to implement aforementioned projects
- **GAIN OPERATOR BUY-IN****

# KEY FINDINGS

# Bottlenecks/ Opportunities

1. Sedimentation basins are significantly undersized

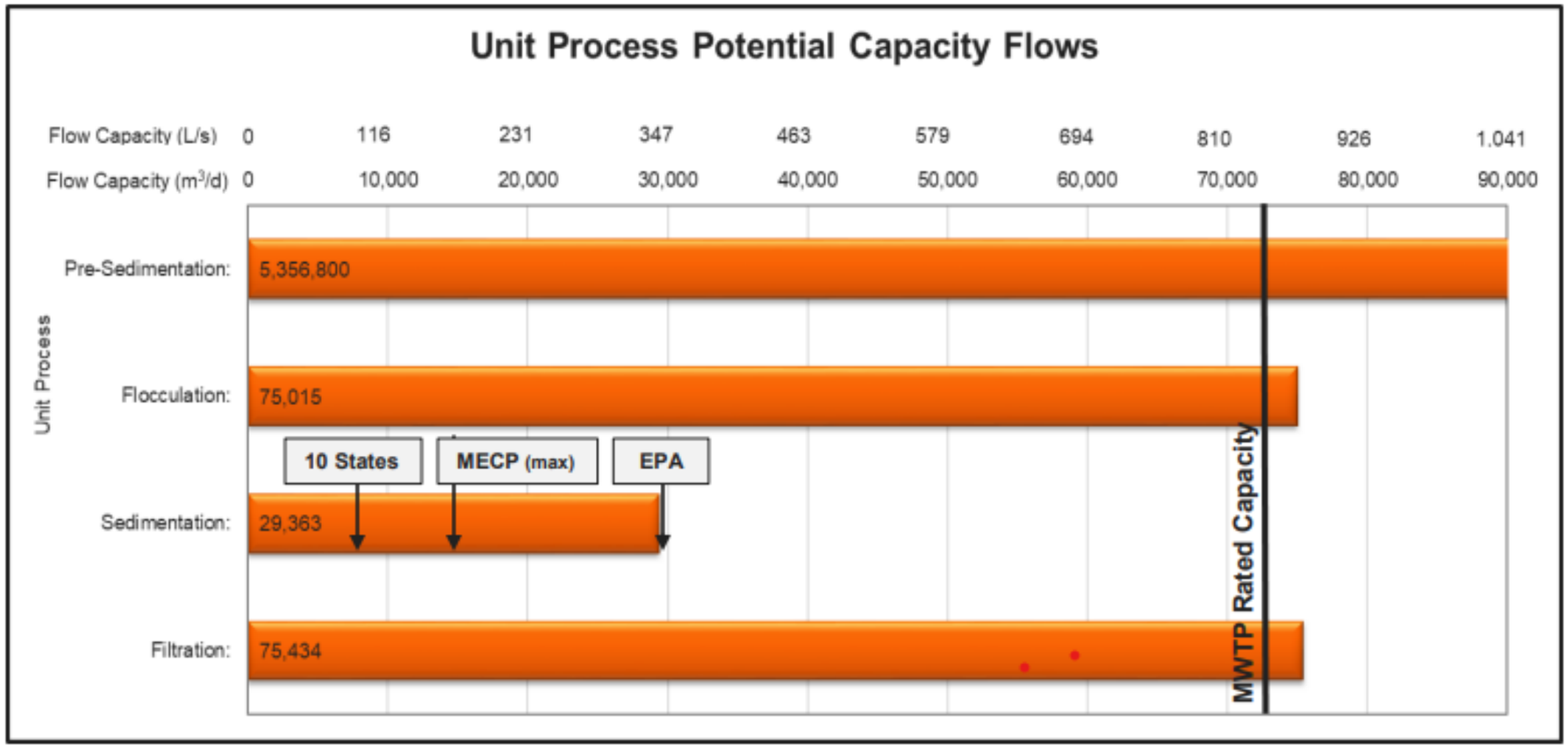
2. Blender flow control is critical for Mannheim Operations

3. Reviewing potential for pH control (peak shaving)

# 1. Sedimentation Basin Sizing

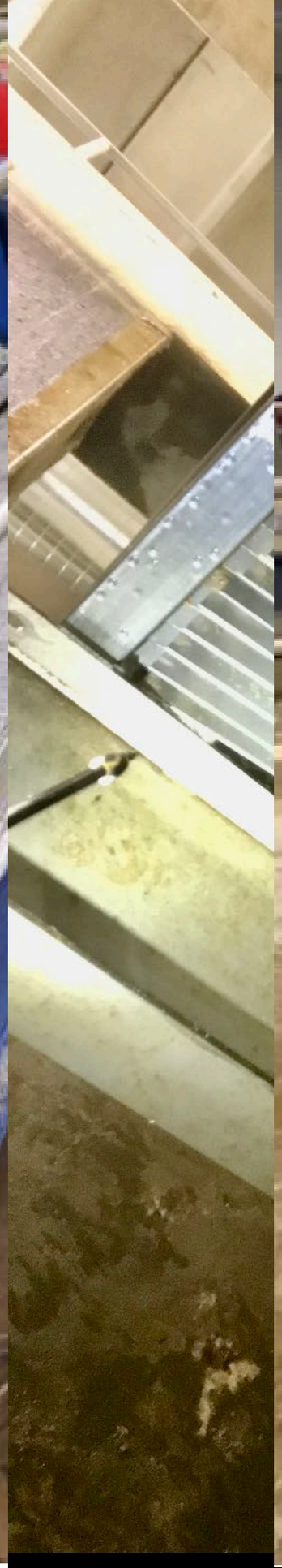
# Sedimentation Basins Undersized

***Sedimentation is a key performance limiting factor for Mannheim WTP.***

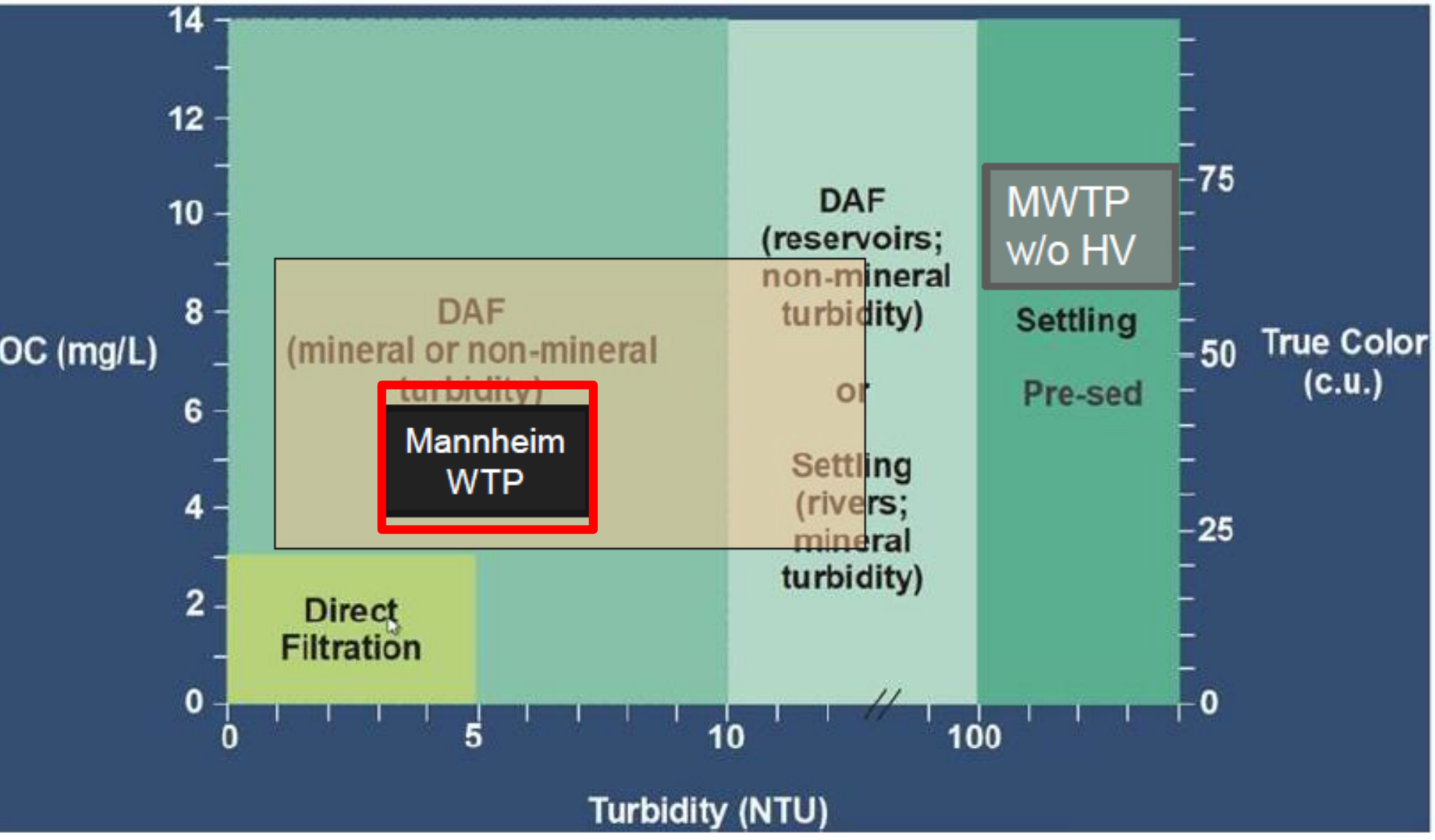



**RECOMMENDED PLATE SETTLER SOR VALUES**

| Source | SOR (m/h) | Capacity (m³/d) | Capacity (L/s) | Notes |
|---|---|---|---|---|
| 10-State Standards | 2.4 | 7,206 | 86 | |
| MECP | 2.5 - 5.0 | 15,012 | 180 | (5 applied) |
| EPA | 9.78 | 29,363 | 352 | |

# Pre-Treatment




- **Black box:** Average; Orange box: Range
- **Grey box:** MWTP without Hidden Valley

- DAF is recommended for relatively high quality waters with average river turbidity <10NTU, or <100NTU from settled reservoirs
- No upper limit of TOC or colour for DAF processes
- Ballasted flocculation is recommended for water with highly variable water quality and maximum non-mineral turbidity >200NTU

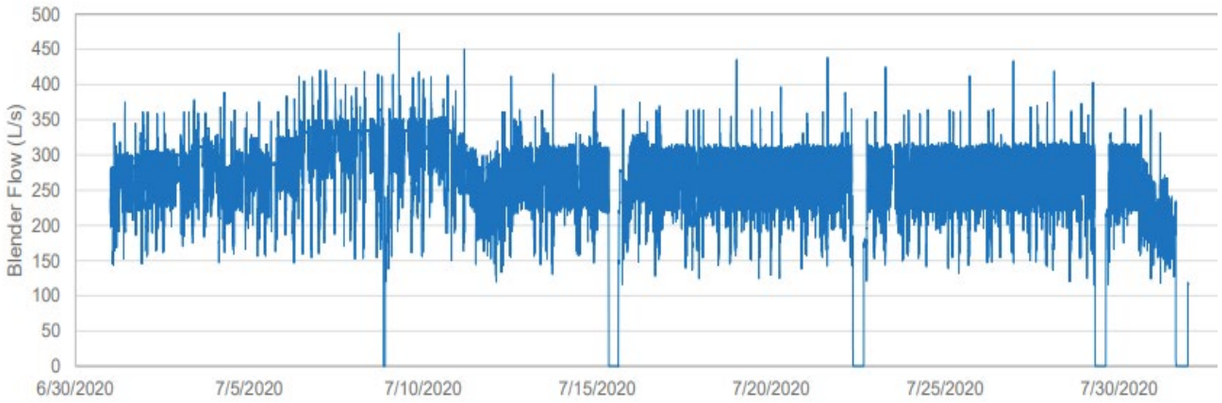
Valade, M. T., W. C. Becker, and J. K. Edzwald. "Treatment selection guidelines for particle and NOM removal." *Journal of Water Supply: Research and Technology—AQUA* 58.6 (2009): 424-432.

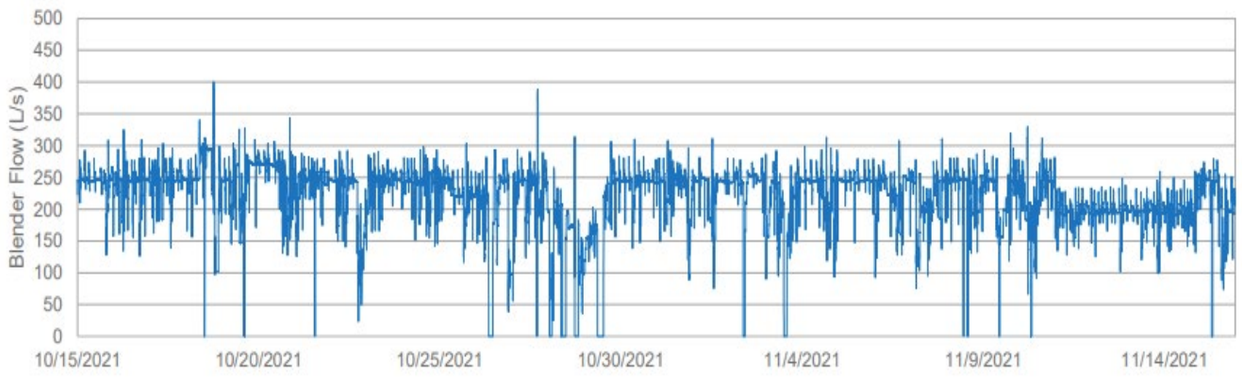
# Site Visits

| Parameter | Typical Range | | | |
|---|---|---|---|---|
| | **Mannheim** | **Belleville** | **Brantford** | **Union** |
| Temp (C ) | 0.5 to 25 | 0.5 to 32 | 3 to 29 | 4 to 24 |
| Turbidity (NTU) | 5 to 15 | 4 to 25 | 2 to 200 | 1 to 117 |
| pH | 7.8 to 8.5 | 7.4 to 8.8 | 7.4 to 8.5 | 7.25 to 8.23 |
| DOC (mg/L) | 5 to 7 | 4 to 7 | 4 to 6 | 2 |
| Alkalinity (mg/L) | 160 to 230 | 90 to 150 | 164 to 256 | 94 |
| Hardness (mg/L) | 210 to 315 | 115 to 145 | 293 to 411 | 106 |
| Pre-treatment | Plate Settlers | **DAF** | **Ballasted Flocculation and pH control** | **DAF and pH control** |

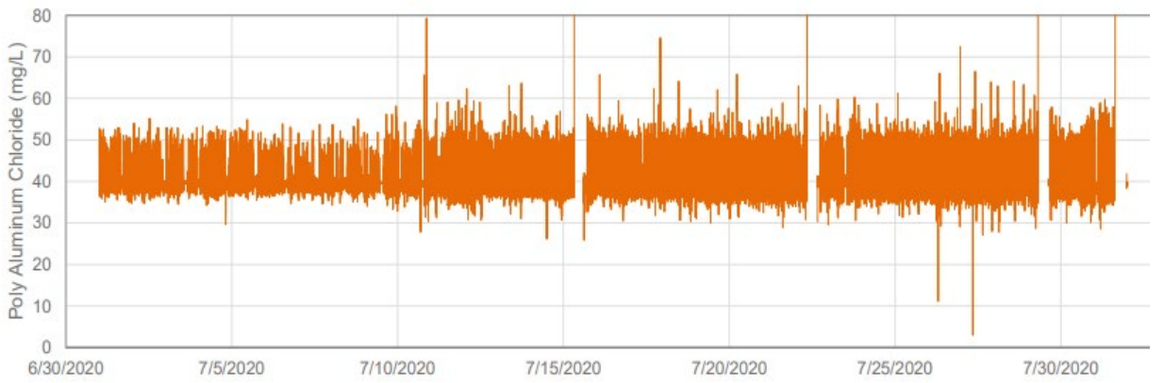
# 2.0 Blender Flow Control

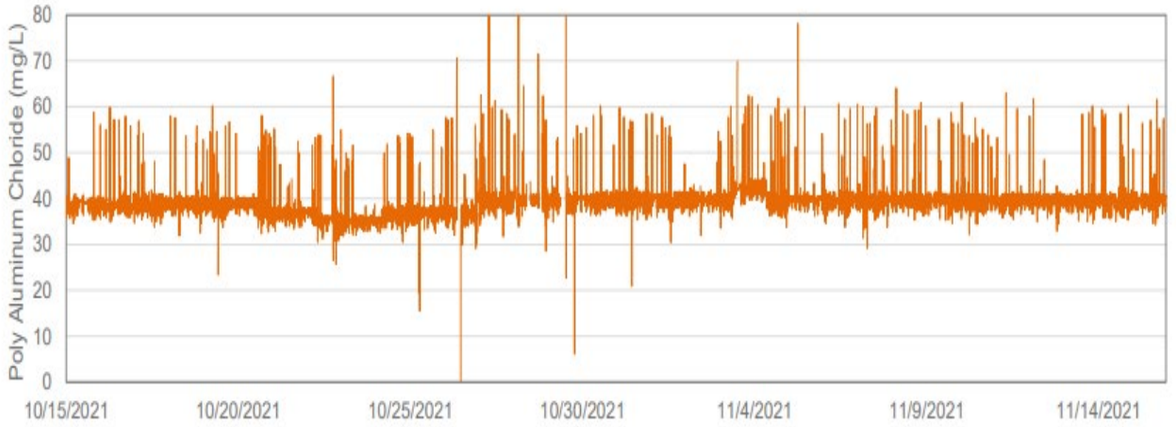
# Blender #1 Flow – 31-Day Trend



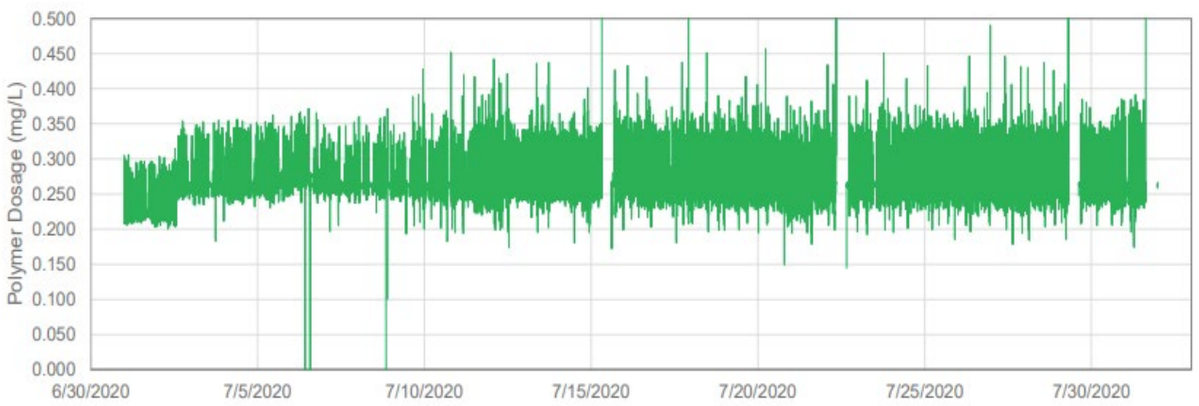



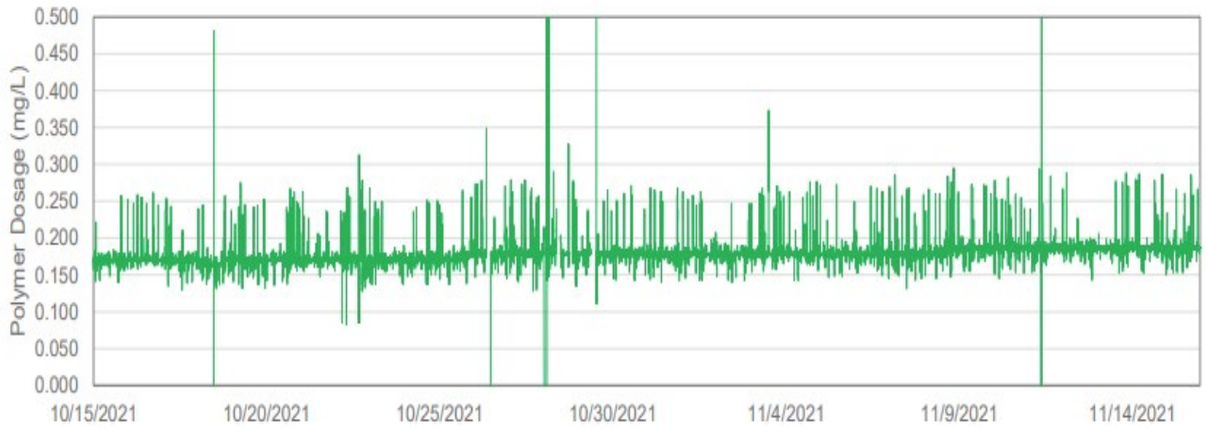

# Side 1 Coagulant Dose – 31-day Trend



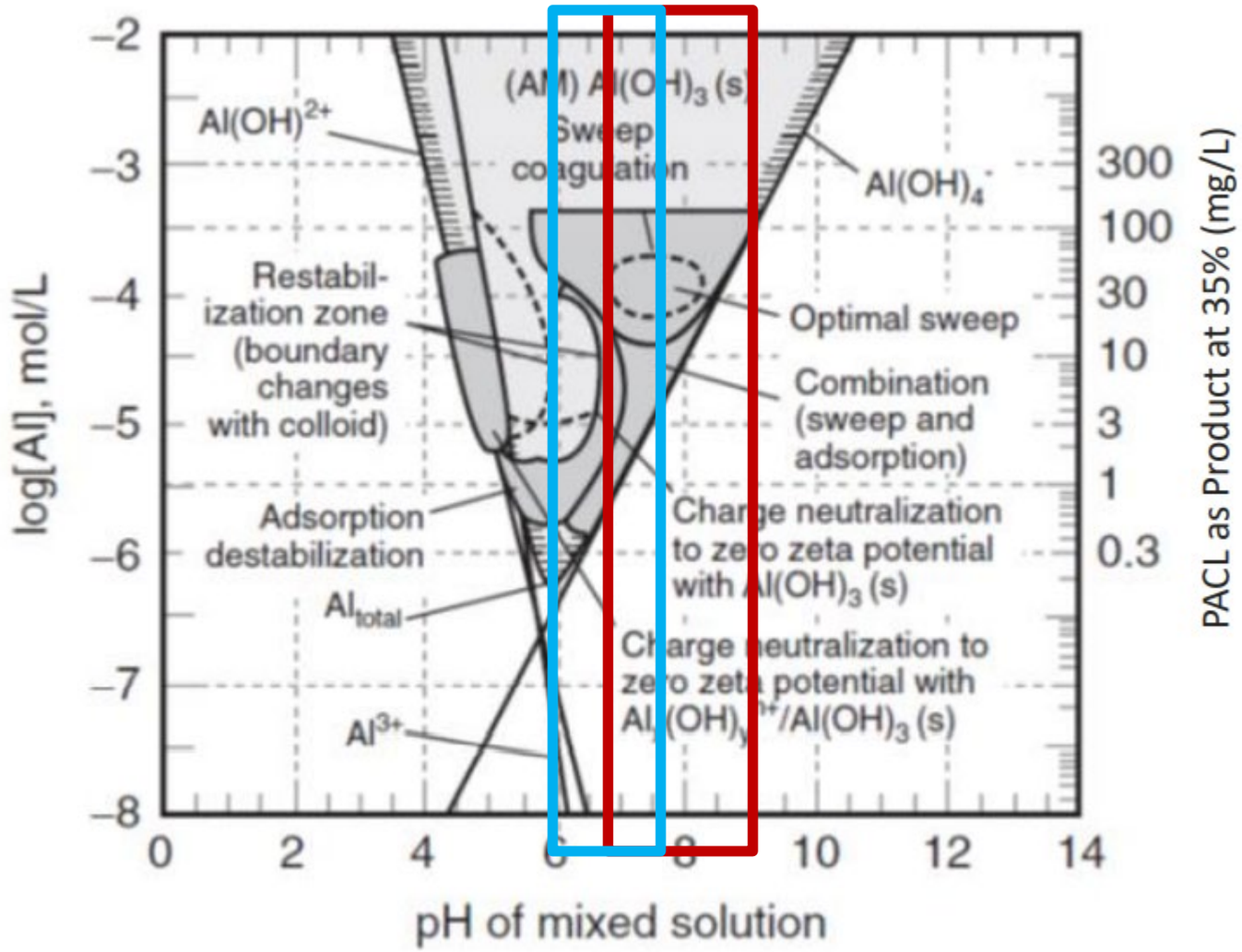

# Side 1 Polymer Dose – 31-day Trend



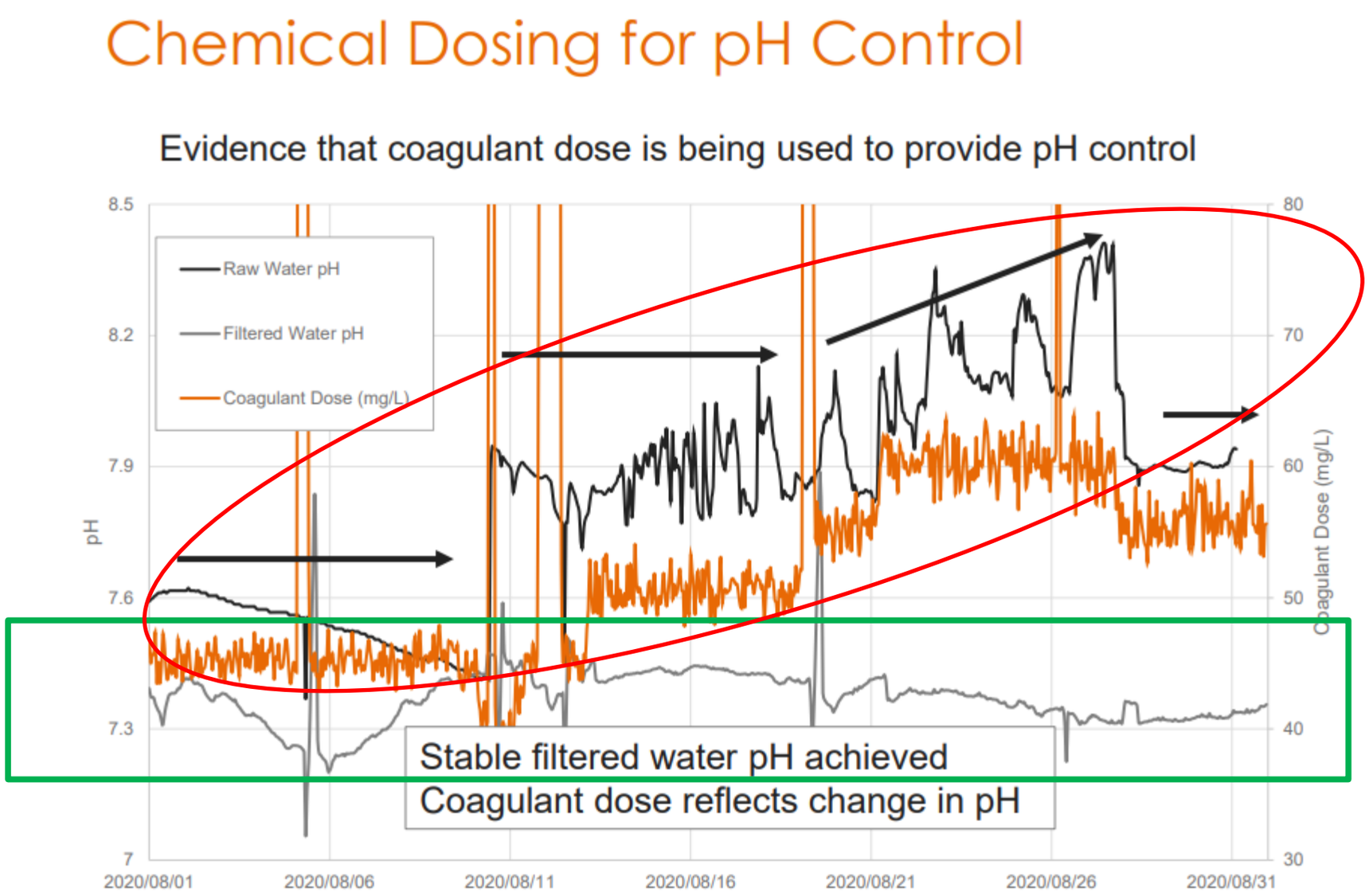



# 3.0 pH control

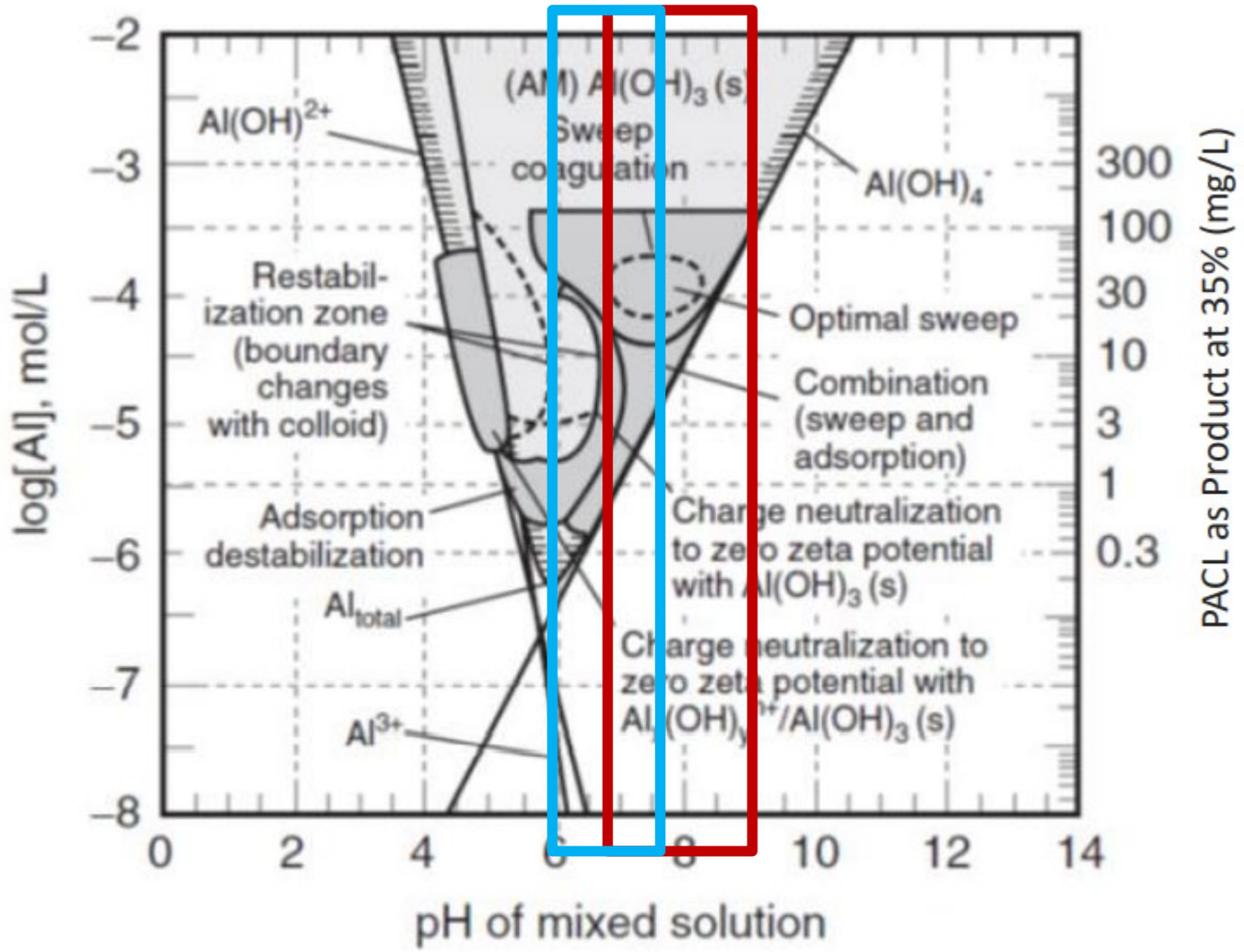
# Coagulation is pH Dependent



# Inherent pH control



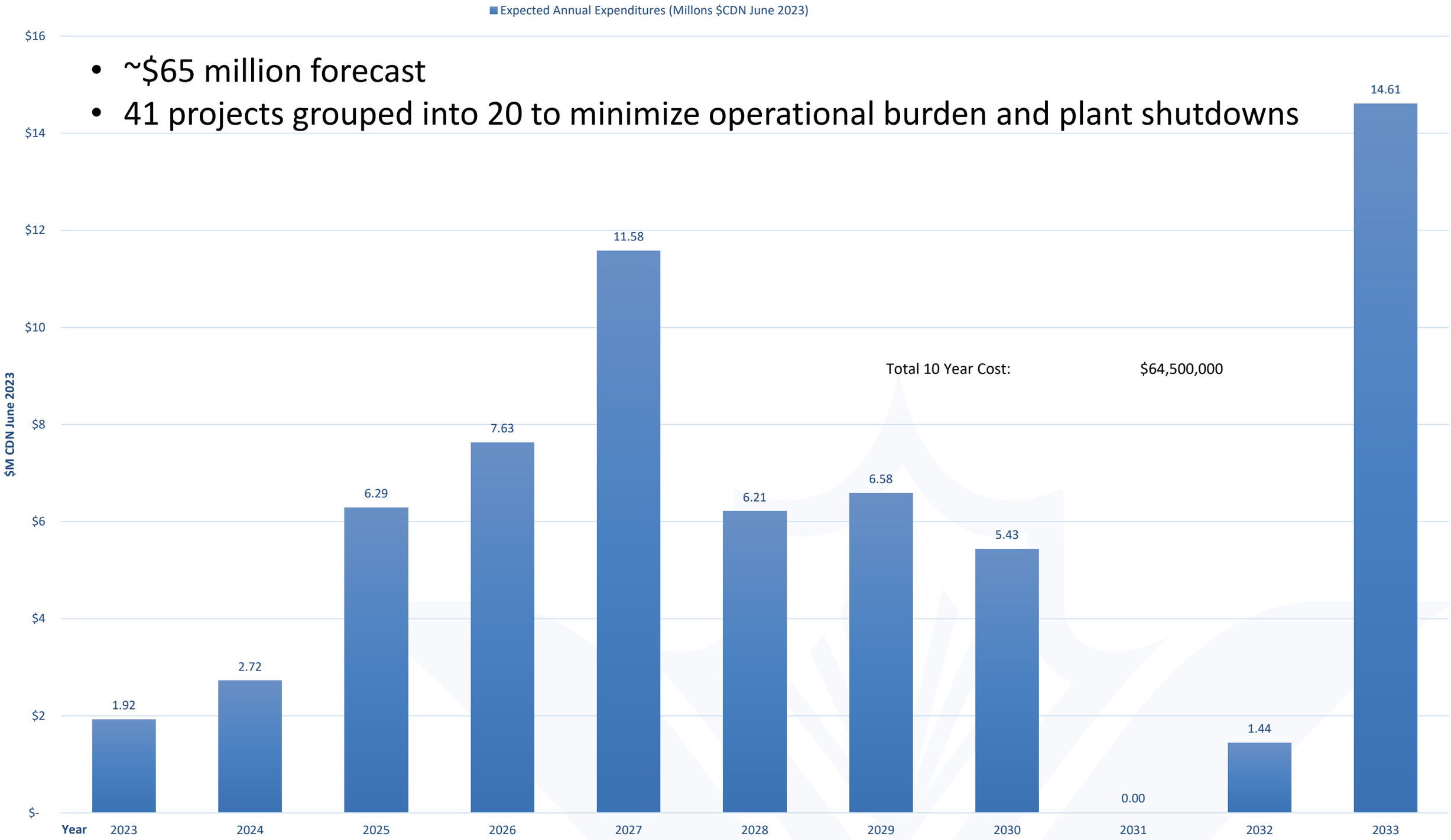
# ph Shaving


−2
−3
−4
−5
−6
−7
−8
log[Al], mol/L
0
2
4
6
8
10
12
14
pH of mixed solution
Al(OH)2+
(AM) Al(OH)3 (s)
Sweep coagulation
Al(OH)4−
Restabil-ization zone (boundary changes with colloid)
Optimal sweep
Combination (sweep and adsorption)
Charge neutralization to zero zeta potential with Al(OH)3 (s)
Adsorption destabilization
Altotal
Charge neutralization to zero zeta potential with Al(OH)y3−y+/Al(OH)3 (s)
Al3+
300
100
30
10
3
1
0.3
PACL as Product at 35% (mg/L)

# NEXT STEPS & LESSONS LEARNED

# C2021-10 Mannheim 10-Year Facility Spending Plan

- ~$65 million forecast
- 41 projects grouped into 20 to minimize operational burden and plant shutdowns



# Lessons Learned

- Permitted/design flows may not accurately represent plant capacity
- Change is hard!
- Operator input is essential through out the process;
  - Site Visits
  - Workshops
  - Demonstration Study

# Thank you!

- Nicole McLellan – Stantec
- Dennis Mutti – C3 Water
- Perry Decola – Belleville
- Duane Ayres – Brantford
- Rodney Bouchard – Union WTP