Developing a Cyanotoxin Management Plan Case Study: Highlands MWC

USEPA supported effort

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Presented by Amy Little, CA SWRCB- Division of Drinking Water

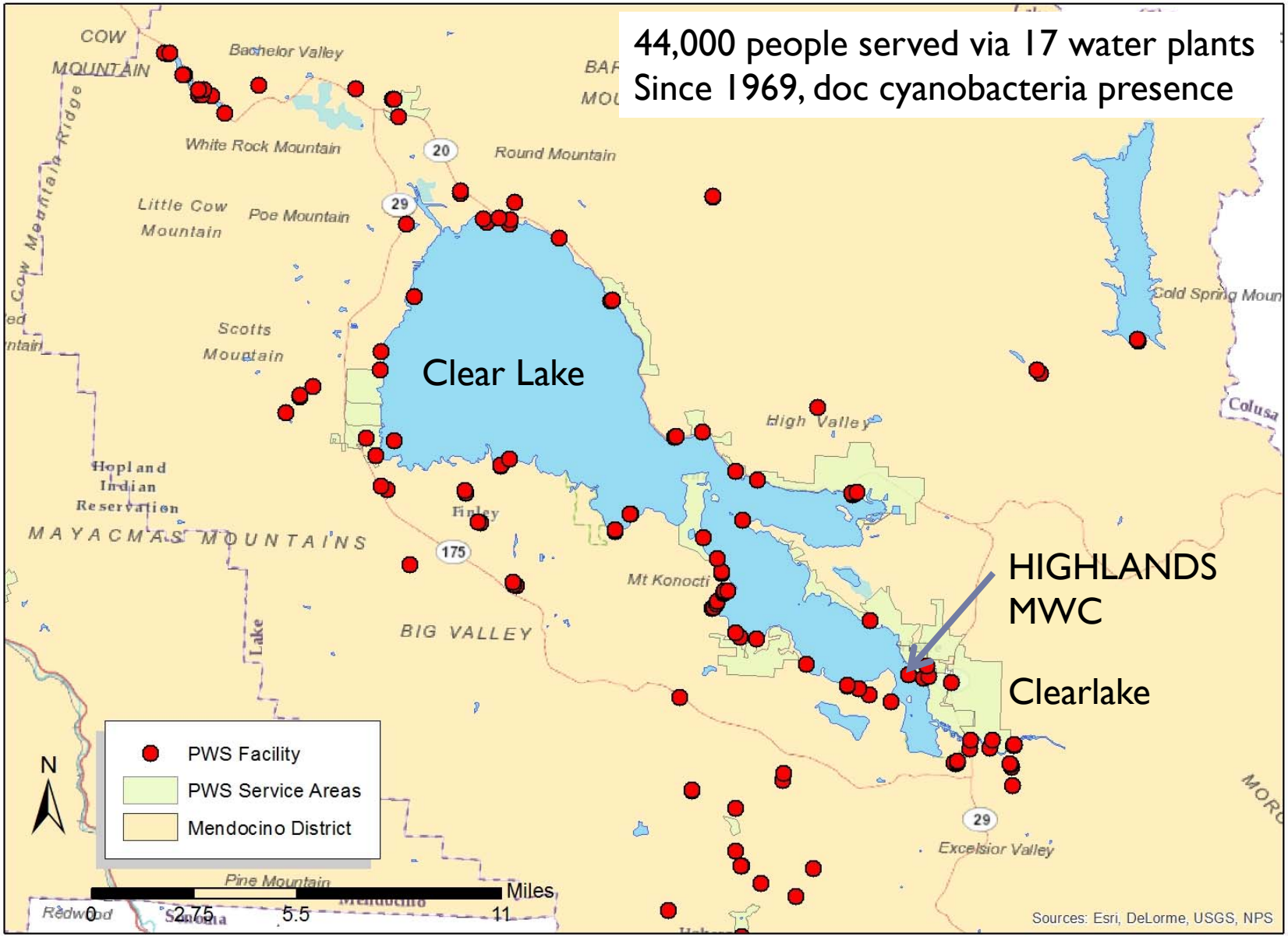
Why develop a plan in Clear Lake?

- **17 water treatment plants around Clear Lake, CA:** developing one could serve as a template for others
- **UC Davis research (1969-1991)**: ID cyanobacteria and
- cell concentrations exceed WHO recreation values
- **Thick algal mats, neurological disorders reported in cats following a bloom event in 1989**
- **Snapshot of microcystin monitoring at drinking water intakes** in 2011 (max 8 ug/L), 2013 (2.4 ug/L) and 2014 (2.4 ug/L) demonstrates **EPA Health Advisory of 0.3 ug/L is exceeded in raw water (and WHO DW level, 1 ug/L)**
- **Recreational monitoring**: 2010 and 2011 County/SWAMP monitoring, ongoing (Big Valley Rancheria Band of Pomo Indians and Elem Colony) – total microcystins exceeding 10,000 ug/L at the shoreline.
  - **Q: Is my water safe to drink? Customers are inquiring**

Cyanotoxin Monitoring Plan Highlights

- Step 1. Assess Source Water: EPA DWMAPS tool
- Step 2. Monitor for early warning signs
  - Sludge turns green, diel pH swings (7.7 to 9.7)
- Step 3. Raw Water Monitoring and Treatment Adjustments
  - Treatment adjustment: seasonal PAC operations+
- Step 4. Finish Water Monitoring/Treatment Adjustments/Public Communication
  - Hemodialysis centers & notice in English/Spanish
  - Using MC ADDA-specific ELISA for decision making
  - Focused on 0.3 ug/L for total MC for PN
- Step 5. Continued Finished Water Cyanotoxin Monitoring/Treatment Adjustments/Public Communication: Total coliform and tank sites used

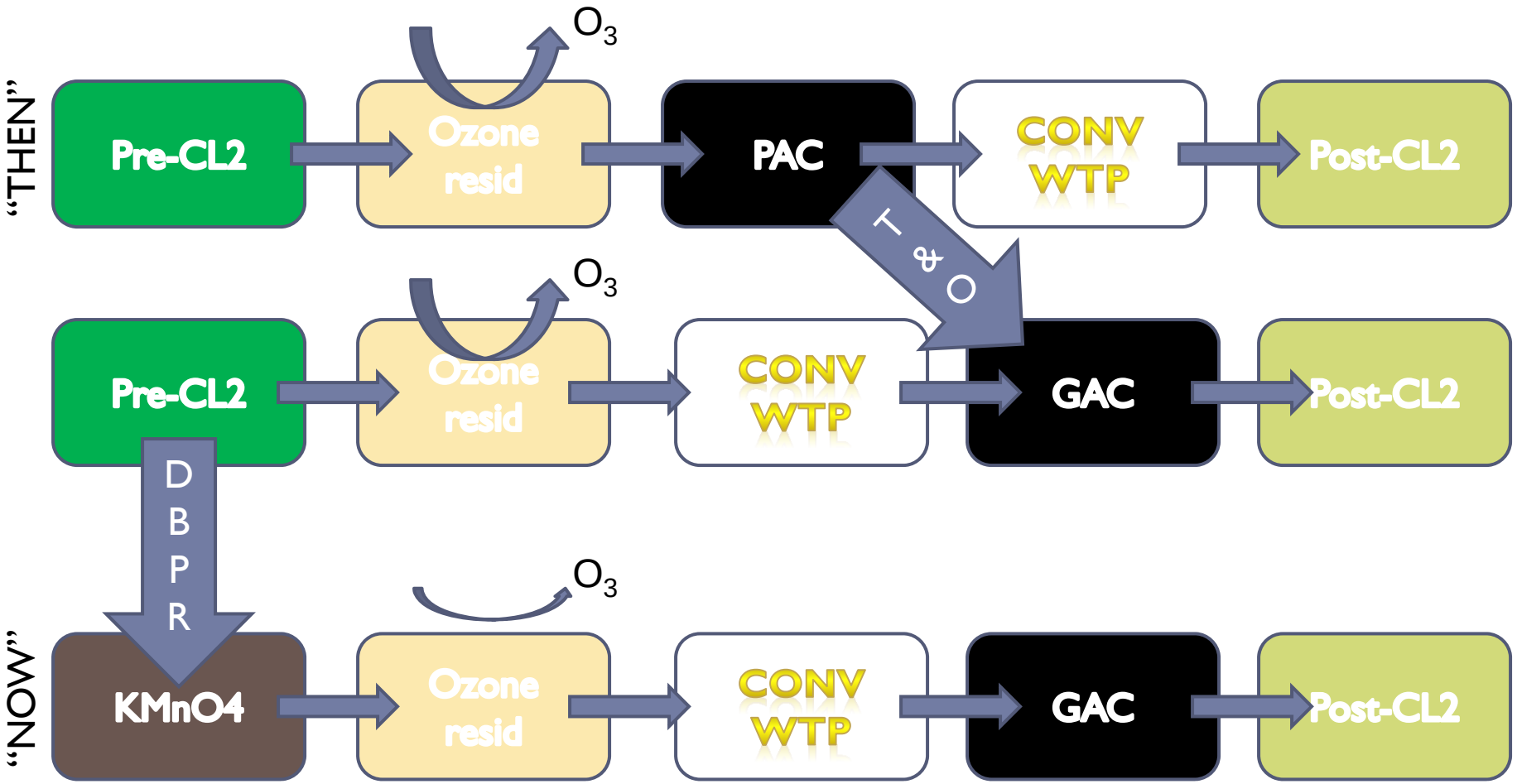
Public Water System Facilities Around Clear Lake, California



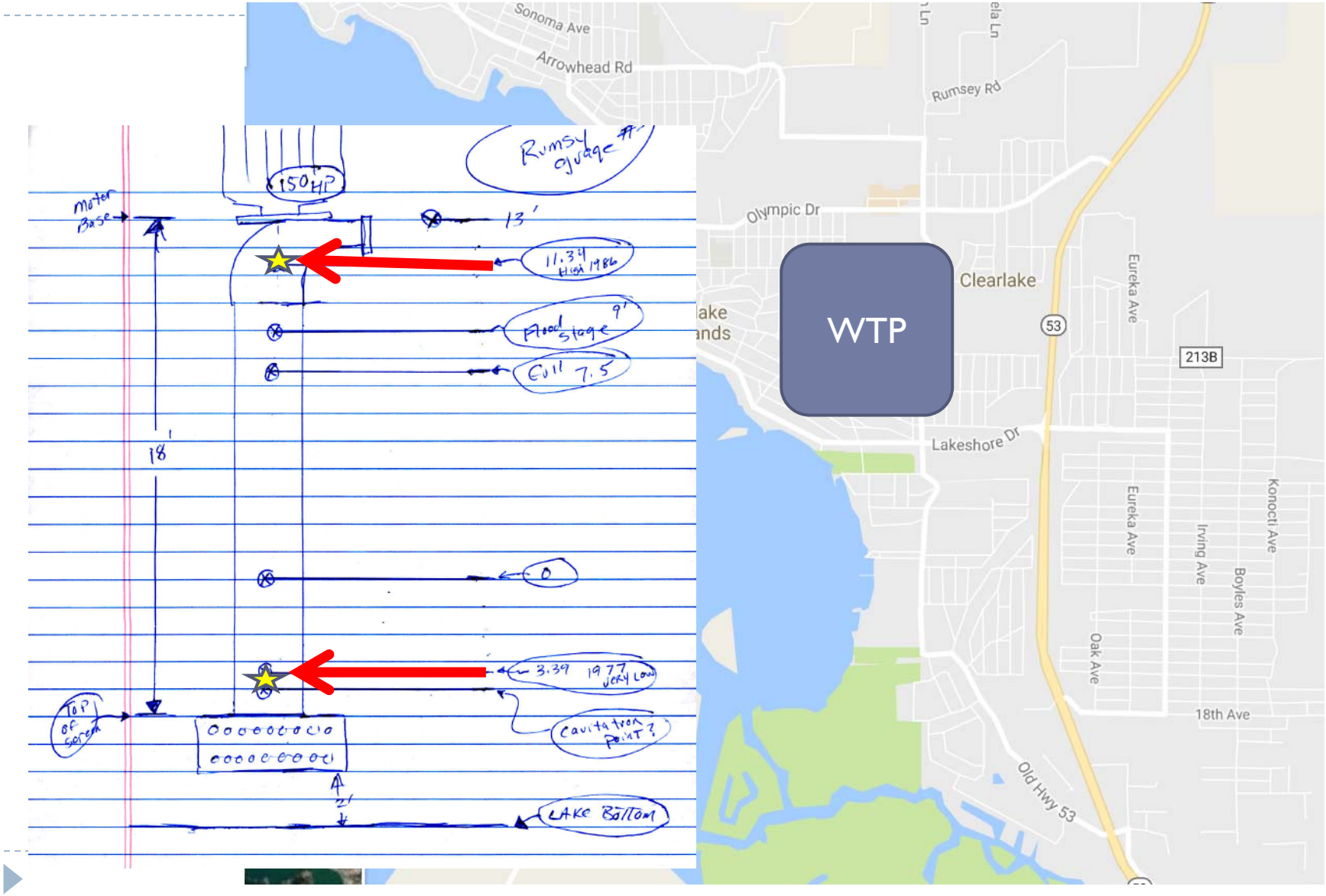
Cyanobacteria Water Treatment challenges

- Source Water Quality
  - Diel pH fluctuations can be extreme (acid additions to counter)
  - Elevated total organic carbon (at times >10 ug/L)
- Suite of Treatment Issues:
  - Short filter runs/Clogged filters
  - Increased pre-oxidation demand
  - Increased coagulant demands
  - Increased filter backwashing/clarifier sludge removal
  - Increase in disinfection applications to maintain required residuals
  - Incr. disinfection byproduct formation – installed aeration sys
  - Taste & Odor complaints – largely resolved
  - Unknown impacts from cyanotoxins

Clear Lake Treatment "50% Model" Treatment Strategies Evolve



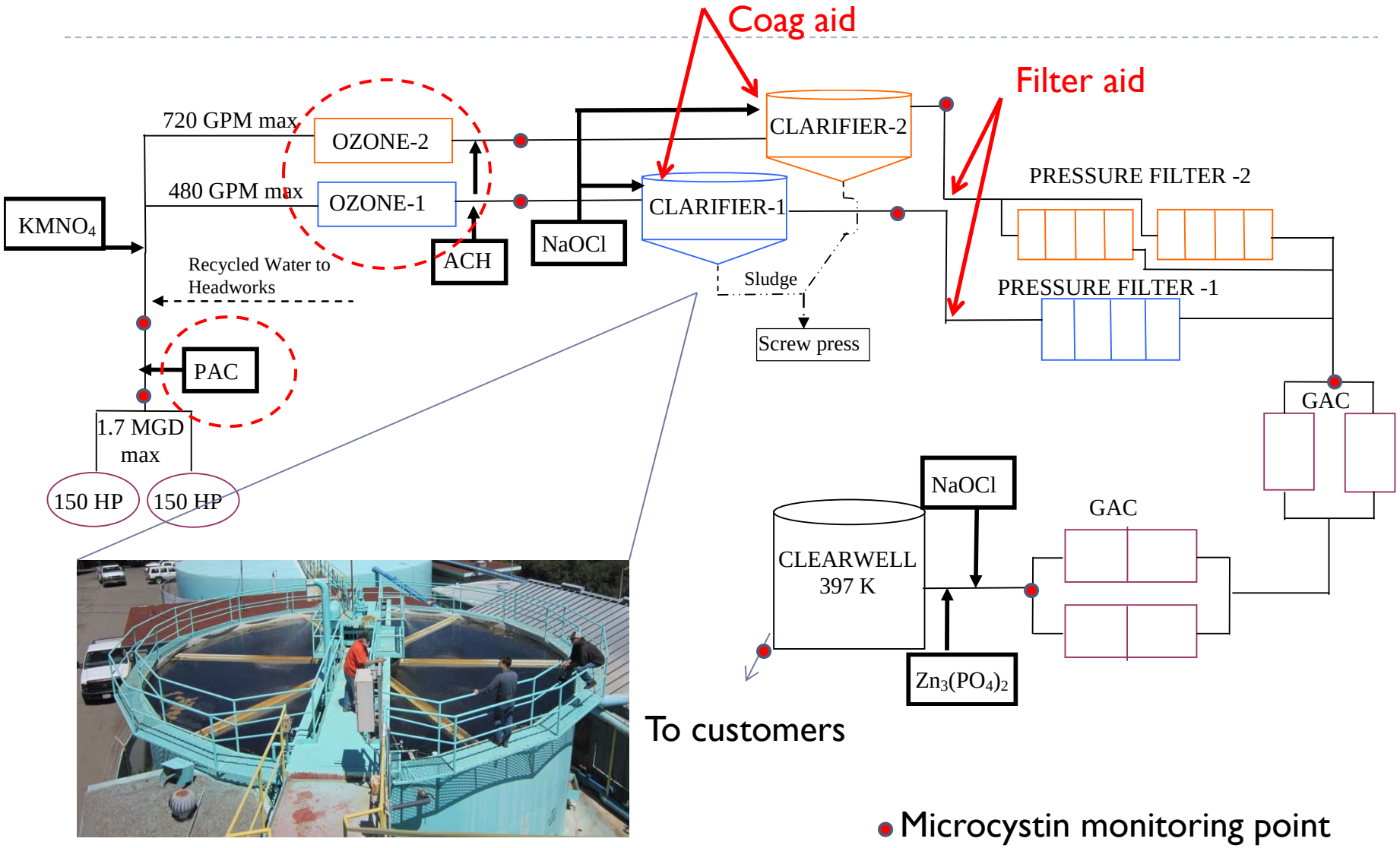
Highlands Treatment Plant and Intake



Highlands Mutual Water Company

- Serving a portion of Clearlake, CA, poorest county in the state
- Connections: **2,876** Population served: **6,170**
- Supply a hemodialysis center – improved communication in 2011
- Conventional → coag + floc + sedimentation + filtration
- Conventional treatment plant with additional treatment
  - In 2015, operating at1.4 MGD (1,000 gpm)
  - Pre-treatment: pre-oxidants (ozone and sodium hypochlorite), PAC
  - Process treatment: filter aid, coagulant aid
  - Post-treatment: two types of GAC
- Technical exchange partners

Highlands MWC Treatment Plant



- Microcystin monitoring point

Highlands MWC Treatment Plant cont…

- Filter Backwashing of One Multi-media Pressure Filter:
  - **Design: backwash a filter every 1 to 4 days***
  - 80% of the time: 1 filter backwash/day
  - 10% of the time: 2 filter backwash/day
  - **10% of the time: 3+ filter backwash/day**
  - Creates need for backwash disposal
- Empty Bed Contact Time in Carbon Filter:
  - Design: cyanotoxin references indicate minimum of 10 minutes
  - Highlands MWC: 30 minutes
  - Another conventional plant on Clear Lake: 38 minutes

** Water Treatment Principles and Design, 2nd edition, MWH (2005)*

Plan Development

- <u>Two days on-ground dedicated to effort</u>
  - Documented water treatment
  - Walked through scenarios: **triggers** on when to change monitoring and locations/operations & investigations/when to notify/when to lift notice, **stakeholders**, and **public notice**.
- <u>Season already underway</u>
  - Interim plan developed with backbone of discussions above; focused on those in bold
- <u>Fine-tune plan: back and forth discussions</u>
  - Bonus: Source water protection component

Challenges, Part 1

- Monitoring Frequency/Sampling Schedule
  - Questions wrestled with: (1) how best to capture peak in raw monitoring, (2) partnership restricted schedule to bi-weekly, (3) if raw > 0.3 ug/L MC, how do we collect finish sample?
  - Overcome: collected finish water samples at same time as raw
- Public water systems have many competing priorities and wear multiple hats: managers and operators
  - At time of development,
    - Backwash project in development
    - Granular activated carbon media filter change
    - Day-to-day operations: 5 operators on staff, turnover can be a problem
  - Overcome: schedule time/meetings to accomplish tasks

Challenges, Part 2

- Laboratory Method: which to use?
  - Interferences, turn-around time, partial MC vs. ADDA specific
  - Overcome: Introduced **flexibility** to use the ADDA specific ELISA with an option to use EPA Method 544 for confirmation
  - Now there's EPA Method 546, another consideration
- Knowing when to lift the notice
  - Do we flush the system/tanks? What amount of sampling ensures it is safe to drink?
  - Overcome: used routine bacteriological monitoring sites and storage tank sites.
    - 1st : strip test 2nd : confirm with laboratory or ADDA-specific ELISA

Challenges, Part 3

- Water System is ISOLATED from watershed activities
  - Over the years, more DW treatment and tools required (latest waves include PAC, coagulant aids, filter aids, bench top charge analyzers; many already have granular activated carbon)
  - Overcome: shift focus to partnerships to improve source WQ

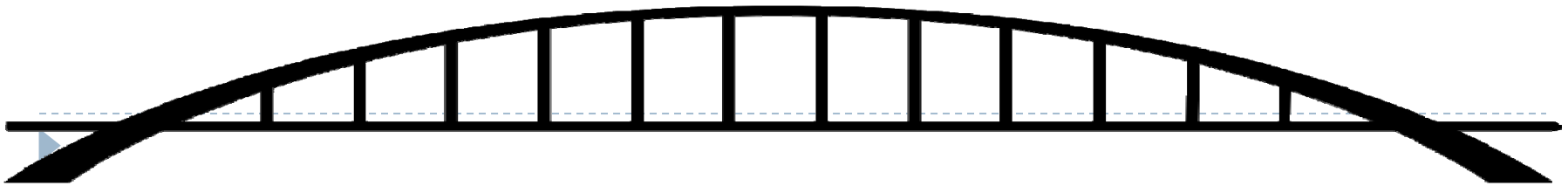
Source water protection = education

- HABs risk factors can be ranked: vulnerable April - Nov
- **Read the watershed reports**
  - Impaired water body for nutrients (and mercury)
  - TMDL developed in response – target: phosphorus, derived from sediment erosion
- **Use Tools**: USEPA DWMAPS – identify potential sources of contamination in watershed (tier 1- watershed boundary zone and tier 2 – 10 mi. upstream zone)
  - Point sources of P (and N) can be identified (2%)
  - Non-point sources of P carry the load (98%)

Activities ID'd most likely to be source of excess P

Building Bridges in Source Water Protection

- 17 Public water systems pool together resources to complete required CA Watershed Sanitary Survey (every 5 years)
  - Description/source WQ monitoring/activities/sources of contaminants/changes/management practices/ability to meet SWTR/**recommendations for corrective actions**.
- Piloting a new Watershed Sanitary Survey!
  - converting survey into a means to obtain funding for source water protection. Survey = funding application
  - Partnership: Entities/Agencies & Water Systems



Successful Cyanotoxin Management Plan

- Be prepared to notify customers
  - Comfortable with the language and triggers: are there any laboratory confirmation samples following screen?
- Carve dedicated time out to complete plan
  - Step through the tough scenarios and lifting the notice
  - Include a reference sampling table or guide for the operator to follow
- Are there any sampling restrictions?
  - Evaluate screening kits, including thresholds
  - Plan for laboratory turn-around time
- Get involved with source water protection

2016 Update and Next Steps

- Eight additional water systems adopted the abbreviated plan in 2016 and participated in the some form of monitoring
- 2016 range of concentrations at the intake: ND – 0.73 ug/L
- in finish water: ND – 0.18 ug/L
- Next Steps:
  - Continue quarterly water system meetings; started in 2016
  - Host two-day jar test workshop with benchtop charge analyzer tool to optimize coagulant dosages (last week)
  - Participate in 2017 Watershed Sanitary Survey
  - Use 0.45 um filters on raw water to potentially drive ozone operations (to examine [intra-, extra-cellular] distribution of MC), +sludge

Development Team

- Appreciate the support and assistance provided by the **EPA, including Hannah Holisinger**
- **Karen Sklenar of Cadmus**: implementer/head of development; tireless efforts and ability to educate, capture scenarios and absorb information
- Professional, accommodating, and informative: **Jeff Davis** and **Norm Birdsey**, Highlands MWC
- **Amy Little and Sheri Miller** of CA SWRCB Div. of Drinking Water

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Figure 2.1 Removal Capabilities of optimised treatment processes (Ryan Hanley, 2012)