

OVERCOMING WATER QUALITY CHALLENGES DURING THE INTRODUCTION OF A NEW SOURCE OF SUPPLY

Prepared by:

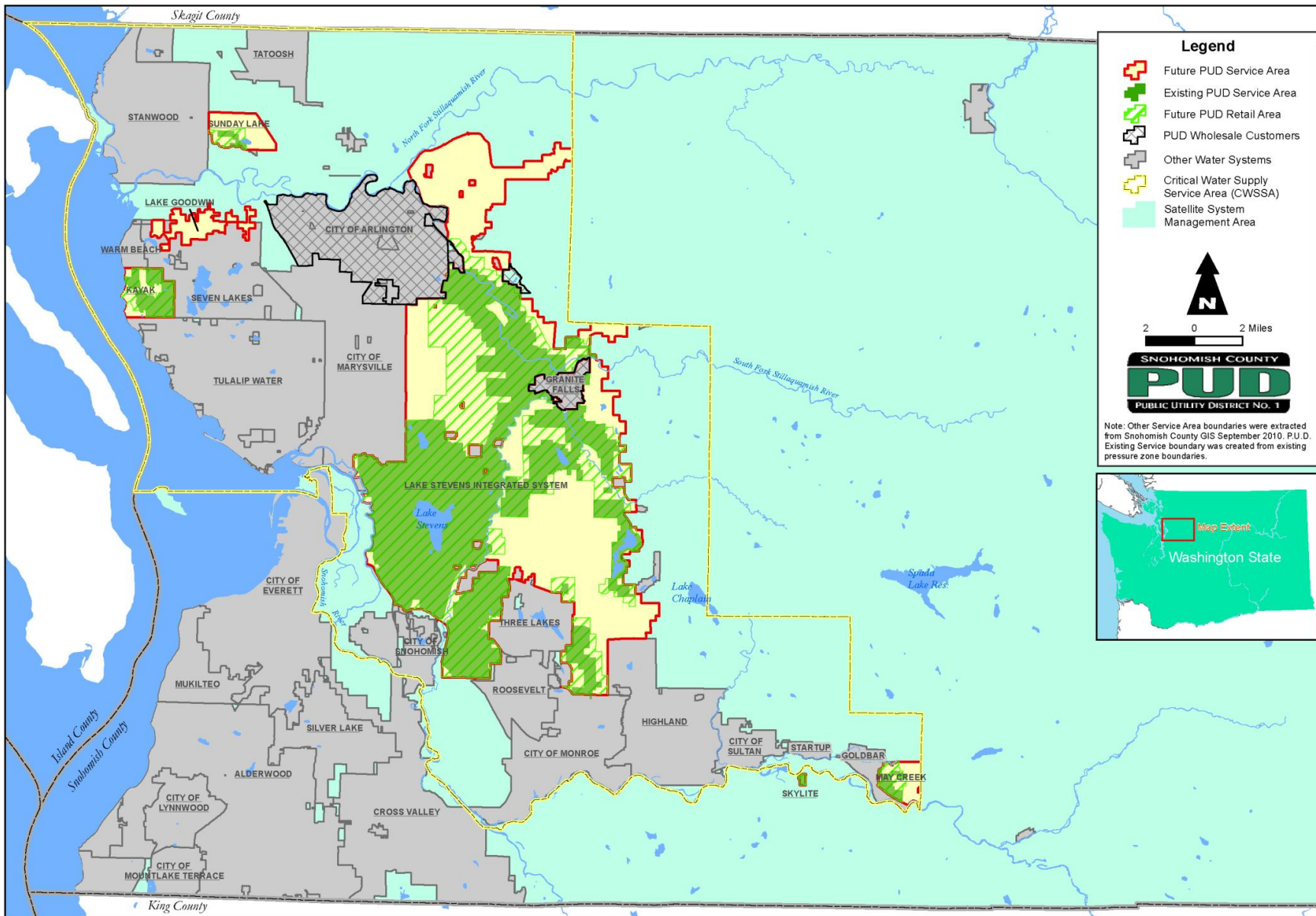
Brant Wood, PE

Stephen Booth, PhD



Snohomish County PUD Water:

- Approximately 20,000 connections in 10 separate water systems
- 382 miles of pipelines
- 15.3 million gallons of storage
- 12 booster pump stations
- 6 water supply pump stations
- 3 water treatment plants
- 8 well sites
- Combined pumping capacity of approx 11 MGD
- 19 major pressure zones in the Lake Stevens System
- Purchase the majority of our water from the City of Everett



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Figure 2-2 Proposed PUD Water Service Areas

Lake Stevens Wells – Historical Background

- Wells served the system from 1947-1961
- 1961 – PUD begins purchasing water wholesale from Everett
- 1983 – PUD decides to bring wells back online due to wholesale rate increases
- 11/5/84 to 3/20/85 – LS Wells brought online with no treatment and many complaints



Softball is shining on the diamond
See page 4

Volume 4, Issue 12

April 12, 1985

Valhalla

Pariahs sweep third match — on to state

by Scott Steckler

The Pariahs, one of LSHS's three Knowledge Bowl teams is on to state for the third year in a row after winning the third competition and setting a new record for points against schools from Snohomish, Skagit and Whatcom counties.

The Knowledge Bowl team took first place in regional competition at Western Washington University with a new Educational Service District (ESD) record of 128 cumulative points.

The Pariahs are also the top team in cumulative points through the three meets held this year. The four top teams continue to state.

Team members include captain Jim Gort, Mark Ely, Melissa Bremick and Brian Edwards. Their adviser is Stan Turtis.

Team member Jim Gort said, "I'm very happy and I hope we do well in state."

"In the same competition, there are 40 teams so the competition is much tougher. After winning this ESD competition last year, the Pariahs placed 22nd in state."

The team has higher expectations this year after a disappointing finish at state last year.

Safe Ride sputters but refuses to catch on

by Kerri Ormiston

Safe Ride appears to be dying due to lack of student participation and organization, yet there is still hope that it might survive.

The original starting date of Safe Ride was scheduled for the beginning of February. However, not all of the required forms were in on time.

Mark Draper, organizer of the program commented, "Success of Safe Ride depends on the student body and how many people volunteer."

When asked what it would take to get Safe Ride going, LSHS vice-principal, Mary Jane Frazer stated, "One person or a group of people with enough time to go out and hustle up some volunteers."

One student who volunteered last time said she would definitely volunteer again.

Principal Brian Egan feels that Safe Ride is an outstanding program and should be used everywhere.

Safe Ride was originally designed to operate Friday and Saturday nights from 10 p.m. to 3 a.m., and for the entire week of graduation.

Anyone interested in being a volunteer or helping to find volunteers, please contact Ms. Frazer as soon as possible.

After lengthy waiting and worrying, most Lake Stevens citizens feel they are finally able to safely drink the water in their faucets. (Photo by J. Jones)

Oh well, back to Everett water

by Angie Laird

Clean, usable water is finally here for 4,500 Lake Stevens water consumers due to a recent decision to return to using Everett city water.

The city of Lake Stevens has been on well water since November of 1984 with very unsatisfactory results. The water has been proven to be dirty, odorous and unhealthy.

The Water System then switched to city of Everett water on March 20 to the relief of many people.

"I was very pleased that the PUD commissioners put us back on Everett water. I feel we should probably go back on Everett water on a long term contract," stated Irv Hansen.

Before 1952 Lake Stevens was on private well water. When they started pumping sand they decided to go to the city of Everett for their water and had been using it until November of 1984.

The EPA (Environmental Protection Agency) then forced Everett to put in a \$30,000,000 filter. The PUD paid for \$10,000,000 of the cost, paying for it by raising the electric bills.

Lake Stevens citizens decided that they weren't up to paying the extra cost and dug their own wells, one mile away from an old, very large garbage dump.

When drilling started, nearby privately owned wells started to run dry and two minerals in the ground, manganese and iron, got shook up and affected the quality of the water. It was bad tasting and had smelling. It stained clothing, toilets, sinks, tubs, water closets, dishwashers, washing machines, dishes and silverware.

It was plugging faucets and causing small holes in clothing. Some people have even complained of itchy skin and diarrhea and have resorted to bottled water.

Carol Cassidy stated, "We got what we wanted and now we're back on Everett water. I couldn't be happier."

Lake Stevens will be on city of Everett water for the next year. During that period of time Lake Stevens will form an advisory committee to decide whether or not to stay on Everett water long term or build their own filter plant and use Lake Stevens water.

Carolyn Johnson pursues free enterprise in S.E.

Susan Lockrap

Carolyn Johnson, a junior, is competing in the National Phillips Petroleum Free Enterprise Project competition being held on April 1-5 at the Hilton hotel in San Francisco.

The project (Free Enterprise) has taken a lot of time and effort. I have spent approximately two hundred hours of my spare time," exclaimed Carolyn.

She competed in state competition in Yakima on March 10, with second place.

In order to participate in the San Francisco project, Carolyn must achieve the following goals: a five hundred word essay on how the Phillips Enterprise will affect her life, along with a presentation and discussion of the Free Enterprise system for community groups, all of which will be viewed in front of a panel of judges.

Cheersquad tryouts co-ed

by Sarah Birtwell

Tryouts for next year's cheer squad are being held for any junior or sophomore (including guys) in the LSHS cafeteria starting April 15, and will last for two or three weeks.

Leslie Withrow, senior captain, commented, "I think we're going to get lots of girls to try out and we'd like guys to try out too (as spirit leaders)."

Each of the cheerleaders will take turns teaching the routines so that all students get a chance. There are 14 spots open on the squad. All juniors on this year's squad must try out again for next year's squad.

Lisa Duskin, wrestling cheerleader, stated, "It should be better than last year's tryouts because of extended workouts. Students who try out must learn one dance routine, one cheer, and one routine that they've made up themselves."

Jennifer Clarke, girls basketball captain, stated that it's going to be a bit tougher than last year. They want people to try out who know the responsibilities and are going to be dedicated because it takes a lot of time.

Key senior deadlines

by Debbie L. Merrill and Ethan Loby

Seniors, there are only 39 school days left until graduation. Here are some dates and events to remember as the excitement of graduation draws near.

May 31-The Senior dinner dance which will be held at the 128th St. Holiday Inn. Sorry, it's only for SHS seniors.

June 7-Last day for seniors. Caps and gowns will be given out on this day.

June 9-Baccalaureate, which will be held in the gym.

June 11-Graduation Day for most of the senior class, if all fines are paid and students have all of the required credits. Following the graduation ceremony will, of course, be the all night party.



Senior, Denise Miller will spend a year in Sweden through the EF program. Sherri James, sophomore, will spend July and August in Portugal through the AFS language/culture program. Stephanie Petersen, sophomore, will travel to Europe.

There will also be a short June Exchange three days in late June. At that time, 31 AFS foreign students will be in Lake Stevens and Everett. Host families are needed for this event. The deadline is soon, so those wishing to host a foreign student should contact Mr. Tremaine as soon as possible.

Recently the Drill Team traveled to Yakima to compete and received a "good" rating. Competition was tough. Seventy-three of the teams received a "good" rating," stated Heidi Highly, who is team captain.

The ratings are participant, good, excellent, and superior. Six people tried out for state in the dance drill category, Shawna Duttell, who is 1st Assistant, and Viki King tried out.

Shelli City and Stacy Mitchell tried out in high kick category. Jazz dance featured Heidi Highly and Renee Nilsen.

Lake Stevens Wells – Historical Background (cont.)

- Different treatment options were studied from 1985 to 1986 then it was decided to just leave the wells as an emergency only backup source
- 2009 – PUD worked with CH2M Hill and ATEC Systems to pilot test wells
- 2010 – PUD chose to begin design and permitting for a new treatment system



Design Issues:

- Limited Space in existing building
- Proximity to Catherine Creek and residences
- Local Sewer District would not take backwash
- Fluoridation of supplemental supply
- Interaction between new groundwater source and Everett's surface water source



Construction:

- Material Purchase of ATEC Filter system (\$237k)
- Public Works Contract for construction of the Infiltration Basin, Sedimentation Basin, electrical, new roof, filter support slab, grasscrete, and site landscaping (\$500k)
- PUD staff completed final design and permitting, installed filter system, plant piping, chemical feed system, and did all system startup and commissioning. (\$320k)
- Professional services (\$140k) – includes pre-design/pilot study, electrical design, controls engineering, design of sedimentation and infiltration basins, structural design, geotechnical engineering, and water quality analysis.
- Overall project cost including overheads (\$1.4 m)
- Estimated Savings / year (\$500k)
- Capital Payback in less than 3 years

Sedimentation and Infiltration Basins













Piping / Filter Installation:

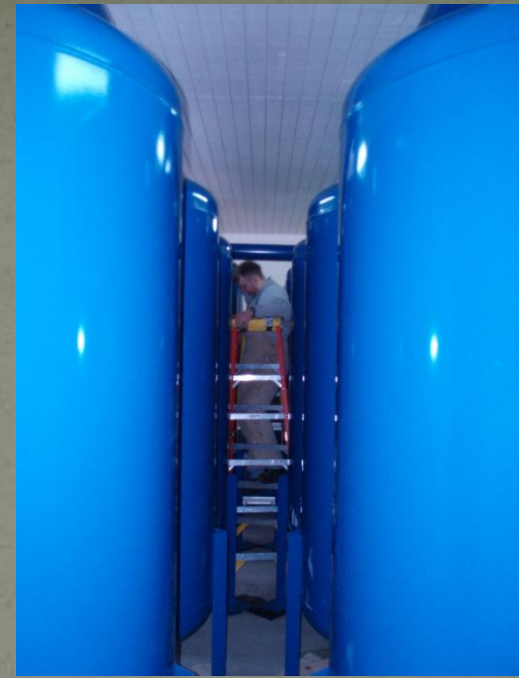






ATEX
SYSTEMS
MEDIA FILTERS
HOLLISTER, CA



















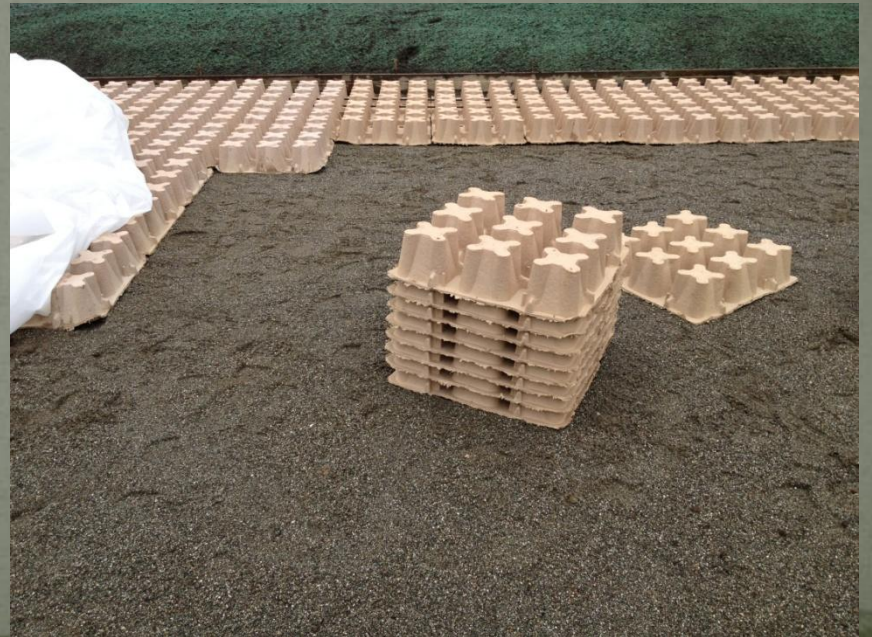
Misc Improvements:







Grasscrete:









Filter Backwash













Water Quality:

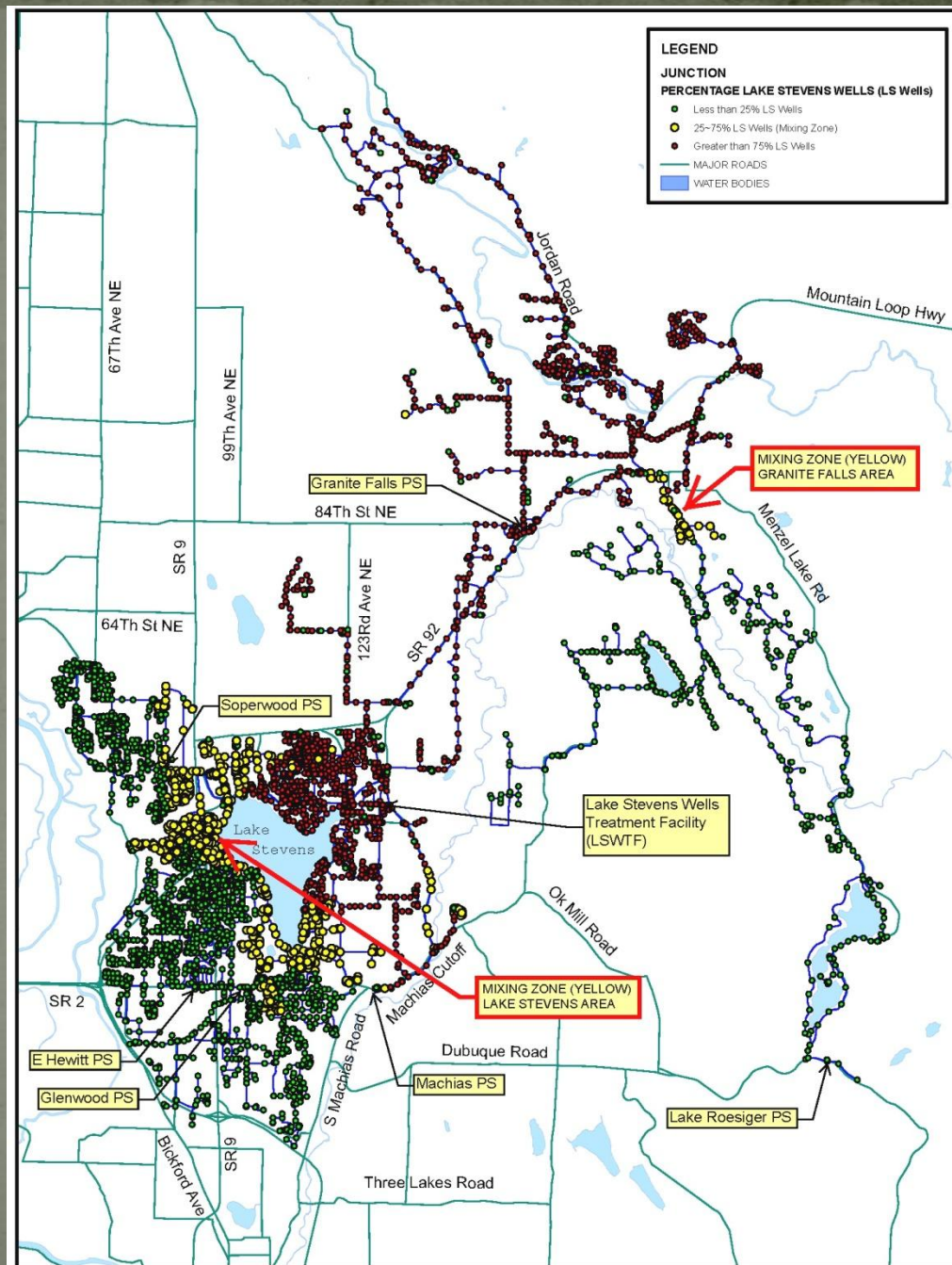
Lake Stevens Well Water - Average from
8/12/12-1/31/13

Raw Water				
Fl (mg/L)	Fe (mg/L)	Mn (mg/L)	Ammonia	pH
0.12	0.33	0.33	0.08	7.55

Finished Water						
Cl (Free)	Cl (Total)	Fl (mg/L)	Fe (mg/L)	Mg (mg/L)	Ammonia	pH
0.88	1.17	0.70	0.05	0.02	0.02	7.57

Hydraulic Modeling:

- Used our existing hydraulic model to look at water age and mixing of the well water with Everett water
- Looked at 3 different flows (800 gpm, 1,000 gpm, and 1,200 gpm) at Winter and Summer conditions.
- Challenge is to maximize Q_a while minimizing changing water quality observed by our customers



More Detailed Look at Water Quality

- Stephen Booth

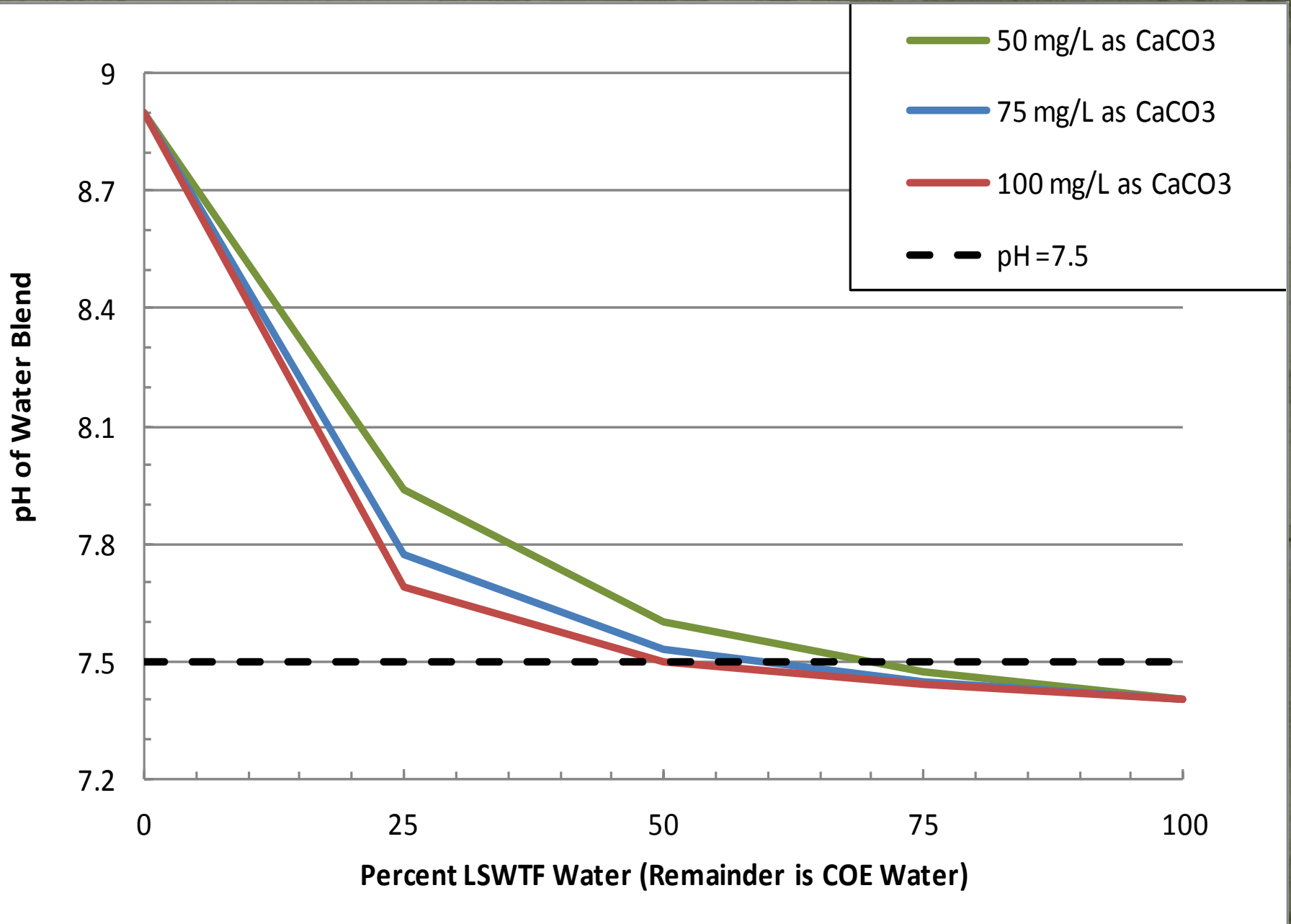
Blending Study

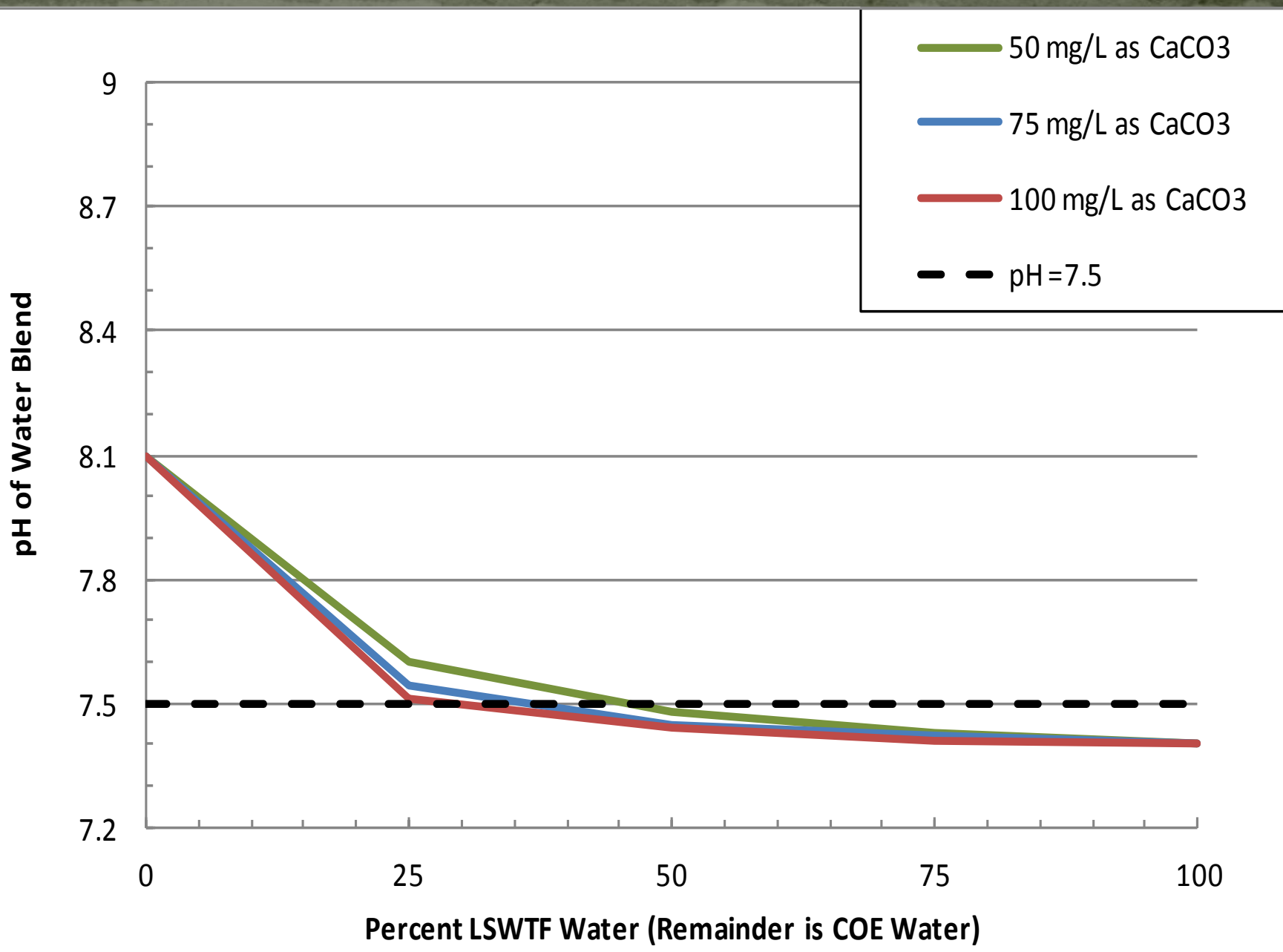
- Water quality modeling
- Impact of ammonia
- Organics and DBPs

Raw Water Quality Comparison

Parameter	Well No. 1	Well No. 2	City of Everett
pH	6.9	6.9	8.5
Temperature (°C)	11.9	11.9	23.5
Alkalinity (mg/L as CaCO ₃)	68	74	14.5
Conductivity (µMho/cm)	180	177	58
Hardness (mg/L as CaCO ₃)	84	83	12
Total Ammonia (mg/L)	0.08	0.07	ND
Iron (mg/L)	0.35	0.23	ND
Manganese (mg/L)	0.16	0.41	ND

Water Quality Modeling





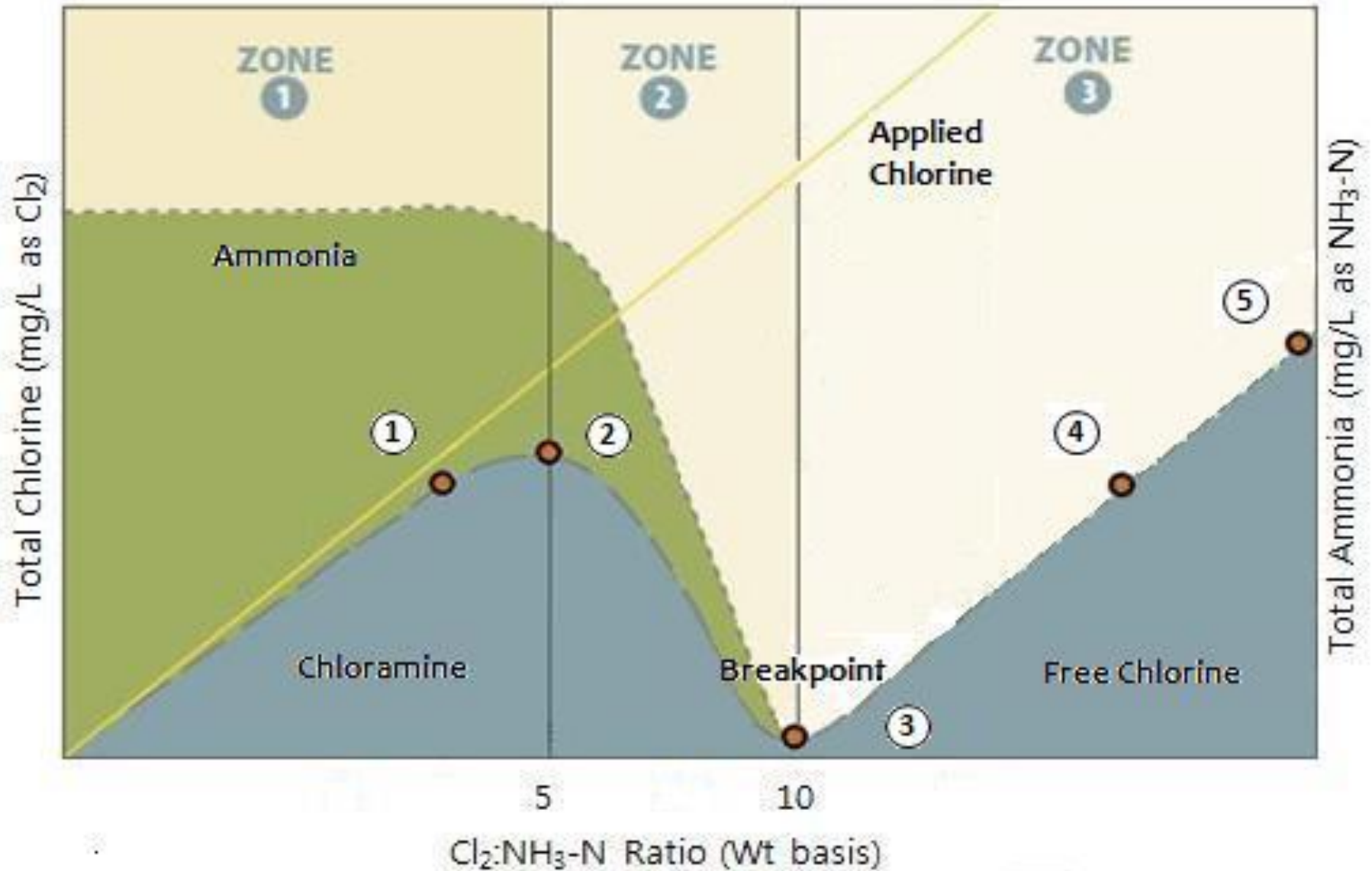
pH of Water Blend

- 50 mg/L as CaCO₃
- 75 mg/L as CaCO₃
- 100 mg/L as CaCO₃
- pH=7.5

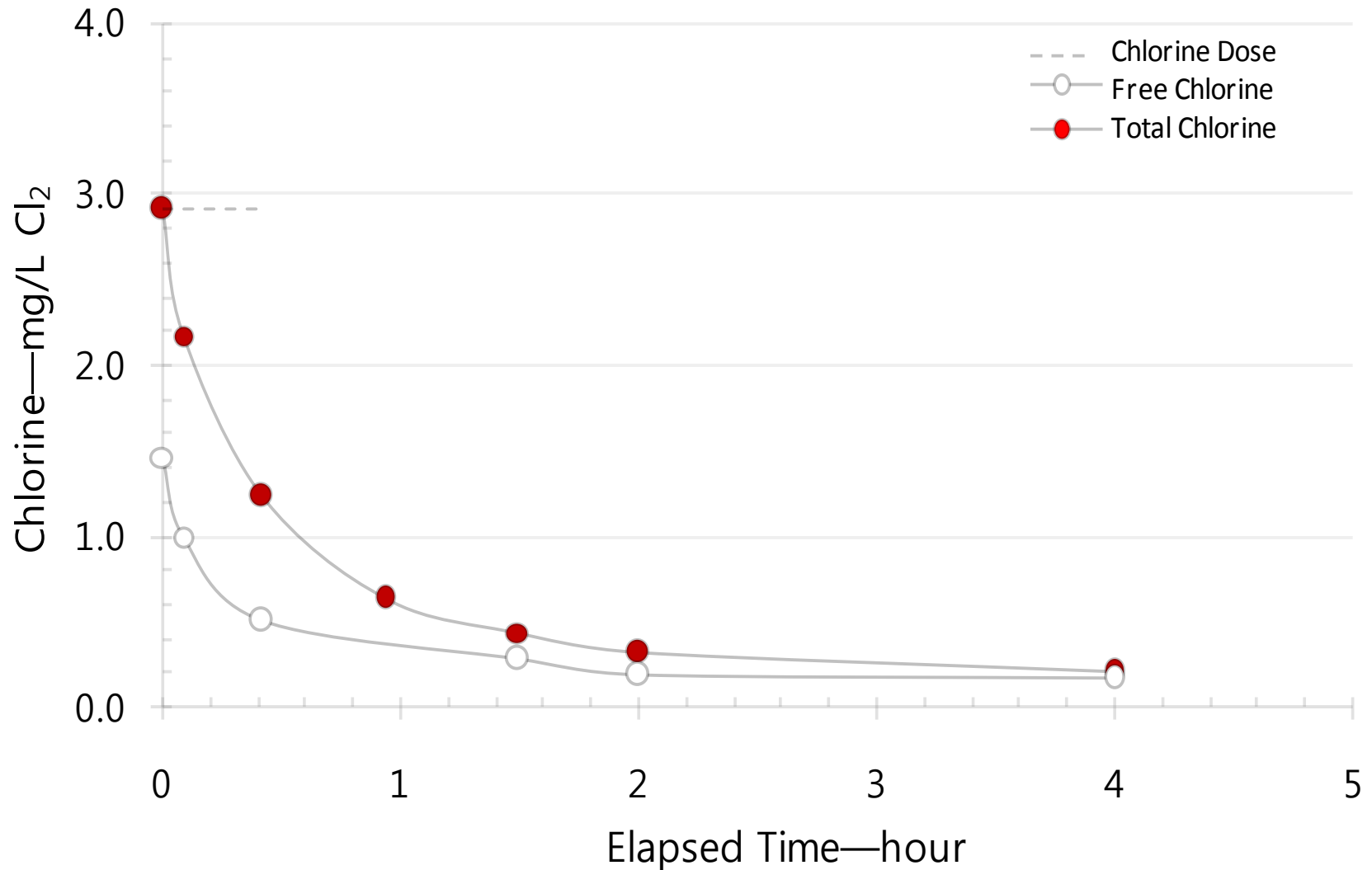
Percent LSWTF Water (Remainder is COE Water)

Impact of Ammonia

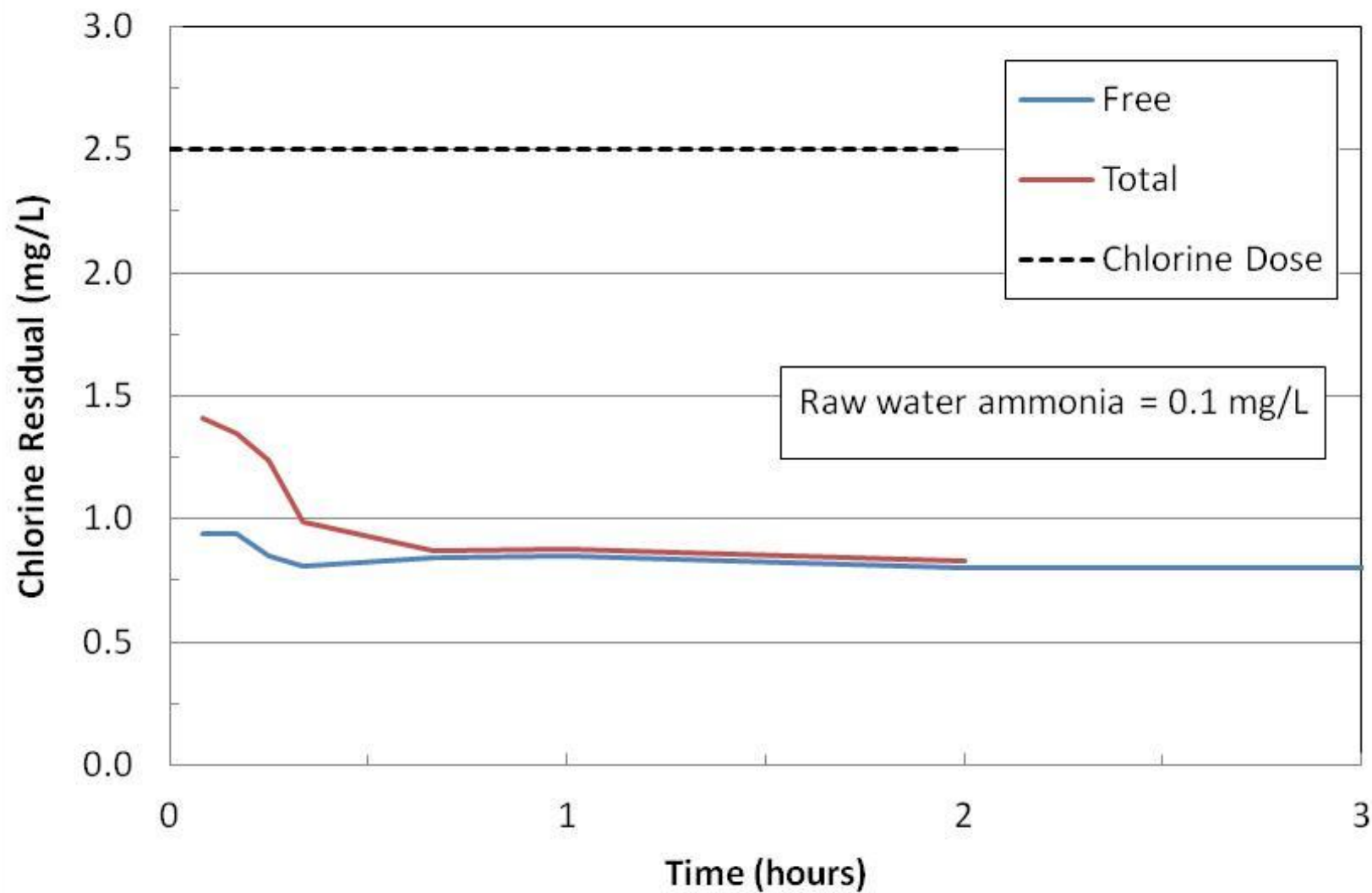
Theoretical Breakpoint Curve



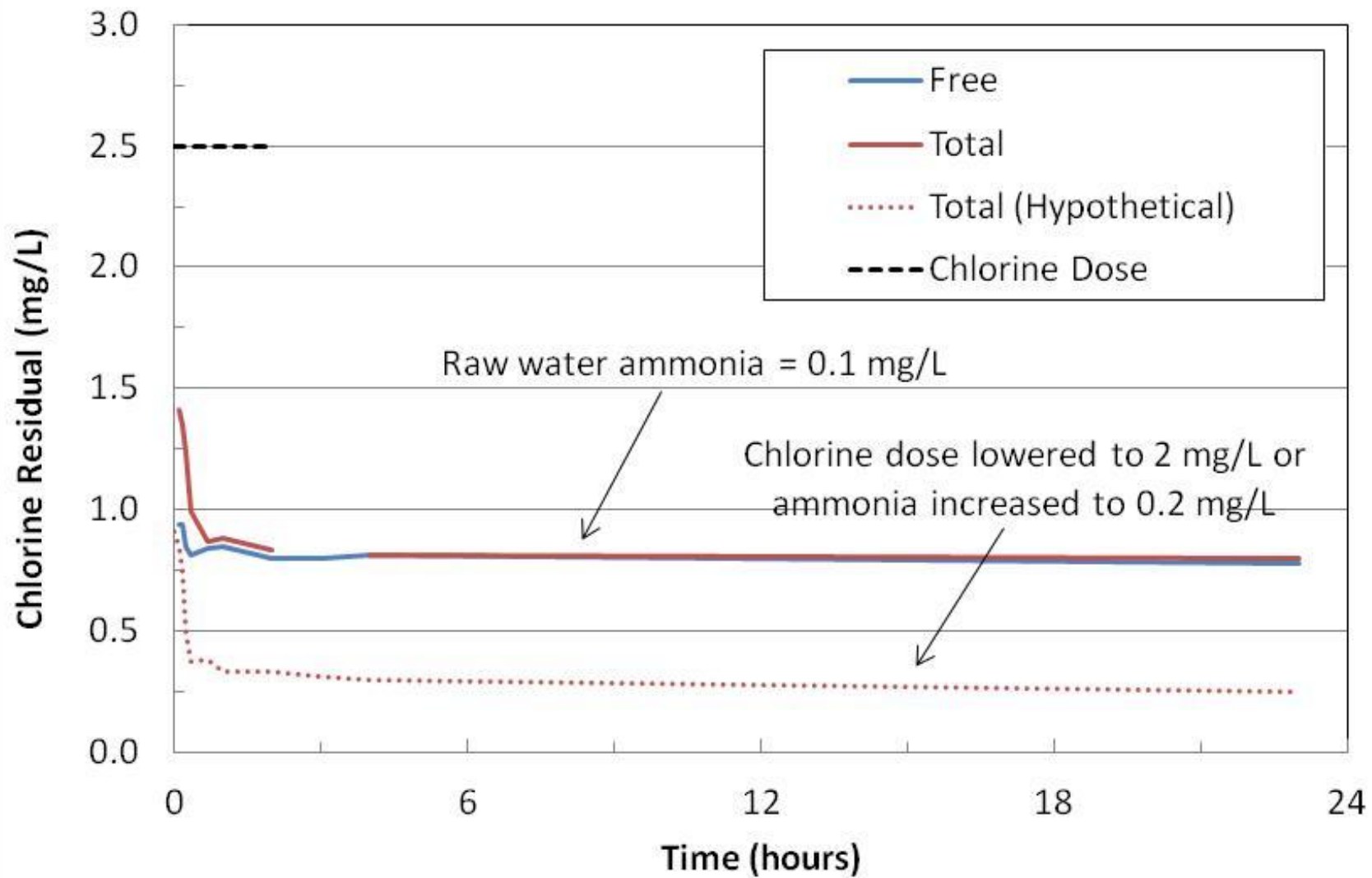
Example Chlorine Demand/Decay (CDD)



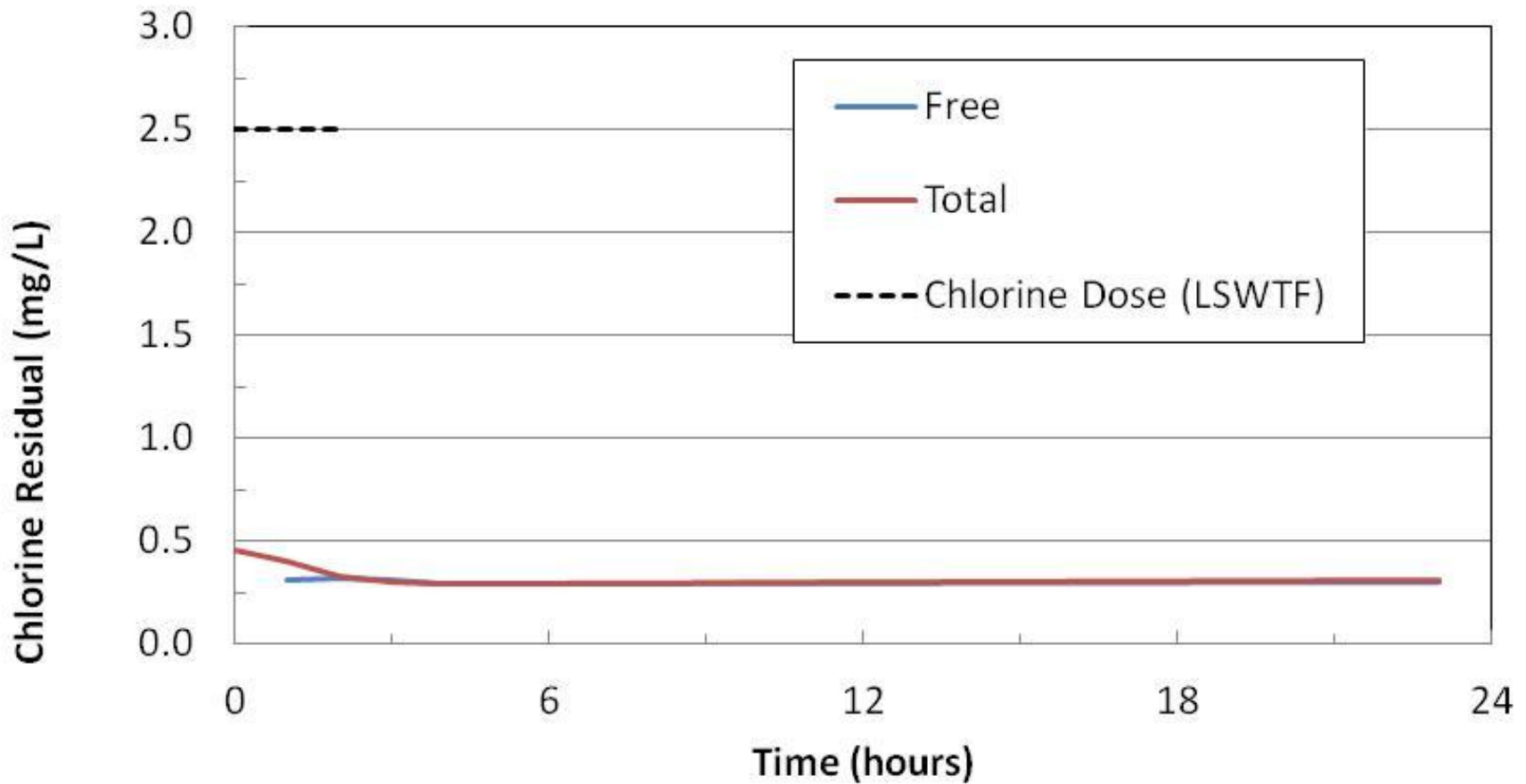
Initial CDD - LSWTF



Longer Term CDD - LSWTF



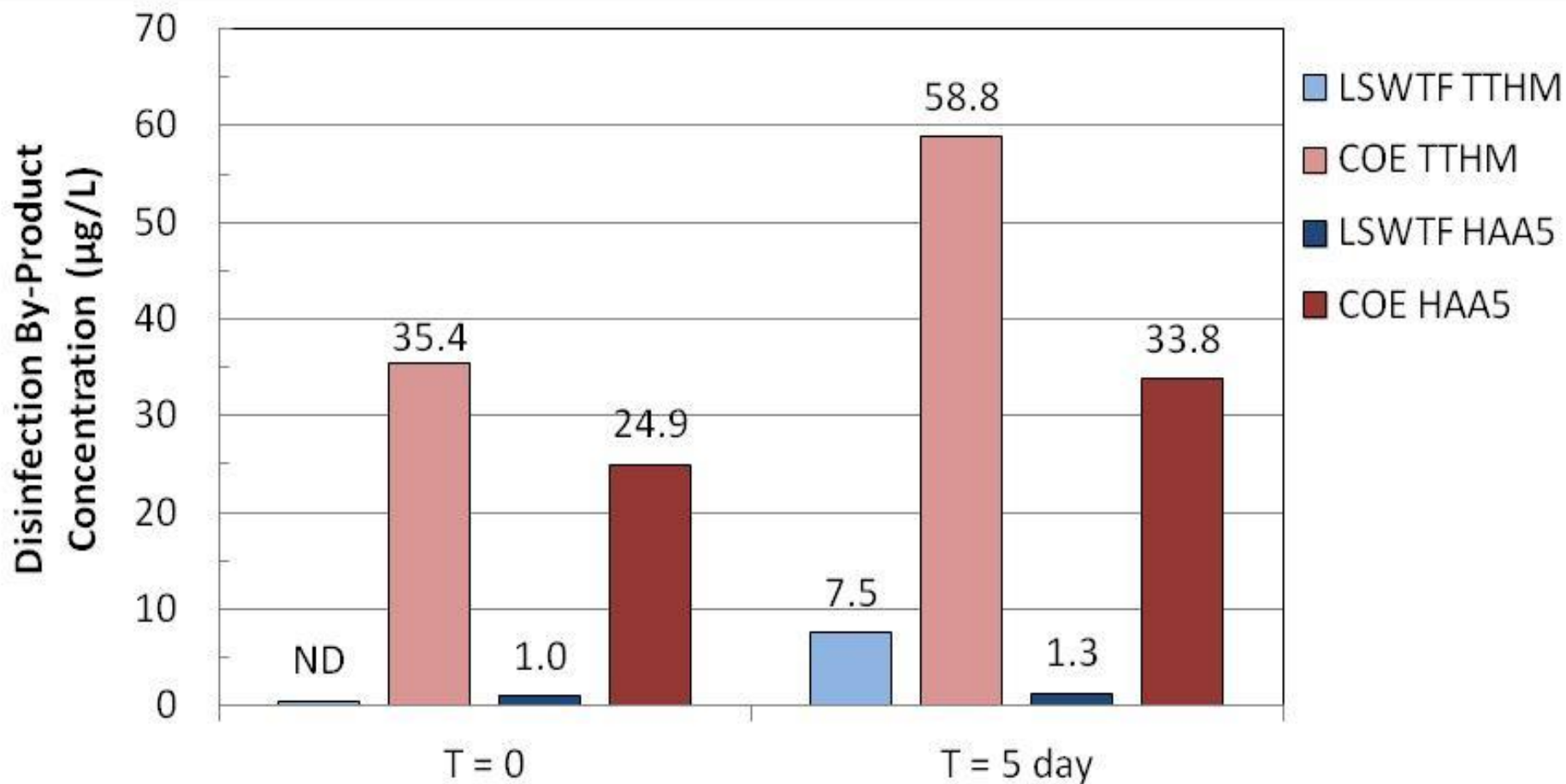
CDD for 25% LSWTF / 75% COE



DBP Formation

- Total Organic Carbon measured during bench-scale testing:
 - LSWTF = 0.33 mg/L
 - COE = 0.58 mg/L

DBP Formation Comparison



Blending Study: Summary and Conclusions

- **Water quality modeling**
- Impact of Ammonia
- Organics and DBPs

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Acknowledgements:

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- Bill Ketchum, ATEC Systems
- Dave Williams, Terracon – Geotechnical Engineering
- PCS Structural Solutions – Structural Engineering
- Stephen Booth, Confluence Engr – Distribution system water quality analysis
- McClure and Sons, Inc - Contractor
- PUD Water Crew – completed all of the piping, installation of filter system, chemical feed system, and system startup