Pipe Corrosion in the Vicinity of a Major Soda Bottling Plant

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NACWA Pretreatment & Pollution Prevention Workshop

Denver, Colorado

November 16, 2007

HAMPTON ROADS SANITATION DISTRICT

Identification of Problem

- HRSD and one of its member jurisdictions are experiencing significant problems with line corrosion in an area down-line from a major soda bottling plant.

Photo by: Eric Jackson, HRSD

Photo by: David Creque, HRSD

Line Corrosion

- The corrosion was atypical

Photo by: Eric Jackson, HRSD

Purpose

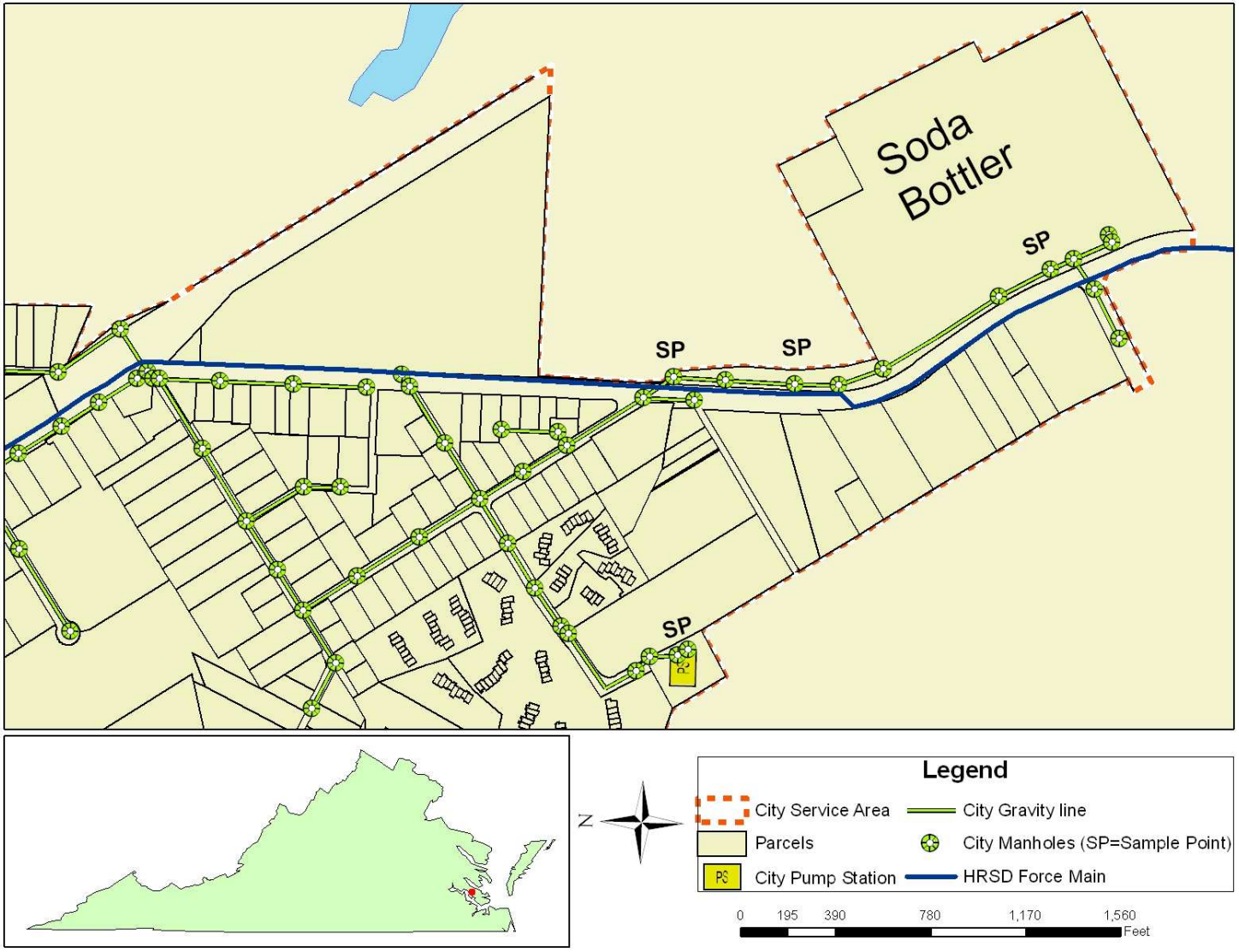
- To determine cause of the underlying problems associated with the corrosion of sewer lines in the vicinity of a major soda bottling plant

- Work with bottling plant to implement pretreatment modifications/additions to prevent future corrosion

Study Area

- Southeast Virginia
- Study Area is mixed residential & commercial
  - Soda bottler discharges to city collection system→
    City pump station→
    City force main→
    HRSD Interceptor System→
    HRSD Treatment Plant

Map of Study Area



Sampling Activities

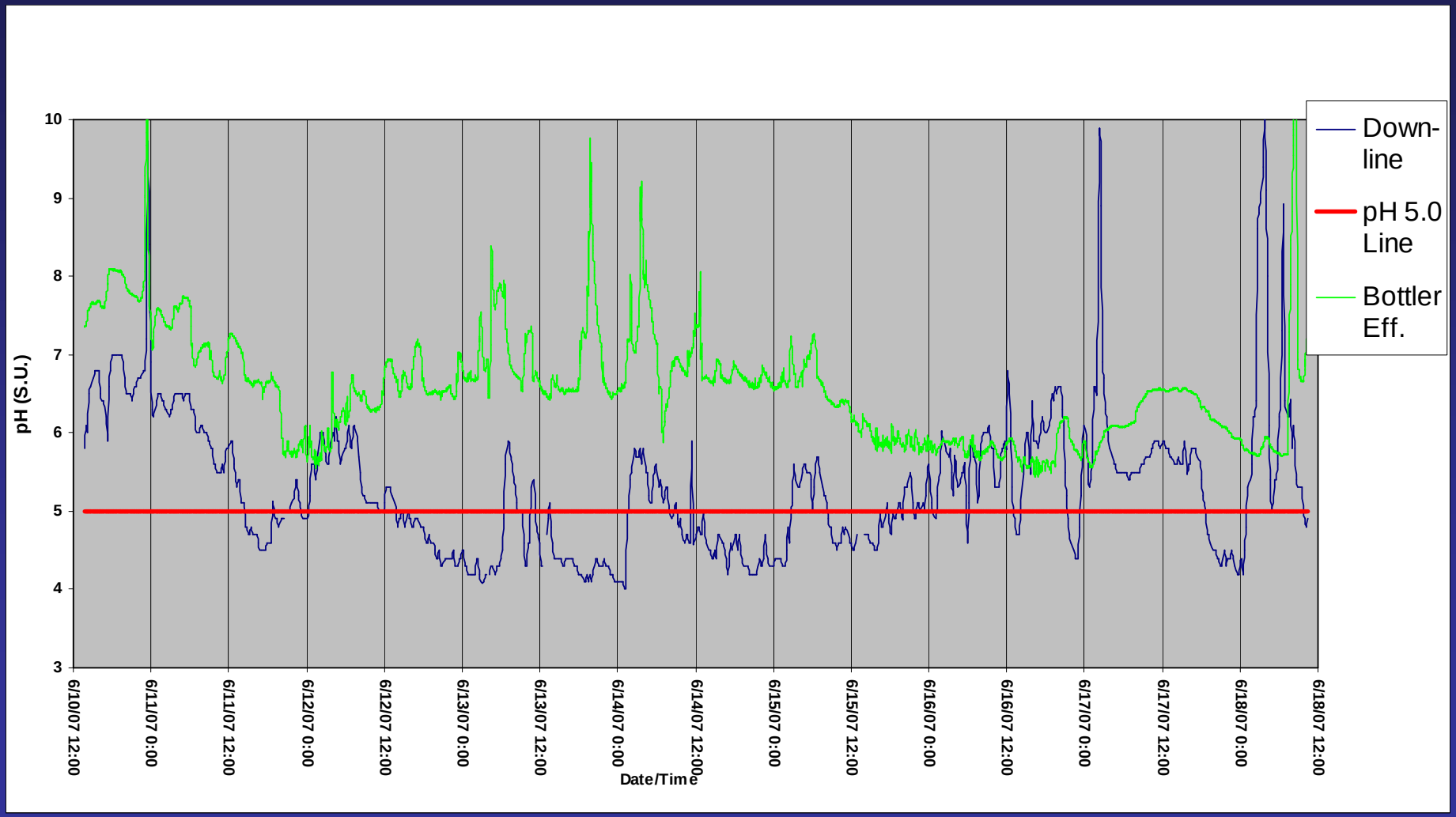
- Continuous pH Monitoring
  - MH ~1200 feet down-line of soda bottler
  - MH at influent to city pump station
    - ~3900 feet from bottler
  - Simultaneous at MH outside soda bottler and MH at influent to city pump station
- Alkalinity grab samples
  - Prompted by results from pH monitoring
    - MH outside soda bottler
    - MH ~1700 feet down-line of soda bottler
    - MH at influent to city pump station
    - HRSD Pump Station Wet Well (~5.75 miles from soda bottler)
    - HRSD Treatment Plant RWI (~8.5 miles from soda bottler)

pH Results
~1200 feet Down-line of Bottler

- Deployed from 6/10/07 through 6/18/07
- n=751
  - Average = 5.3 SU
  - Minimum pH = 4.0 SU(6/14/07 / 0100-0115)
  - Maximum pH= 10.2 SU (6/18/07 / 0345)
- 45 % of the samples were less than 5.0 SU

- The bottler's effluent pH was consistently above 5.4 SU

pH Results
Down-line of Soda Bottler



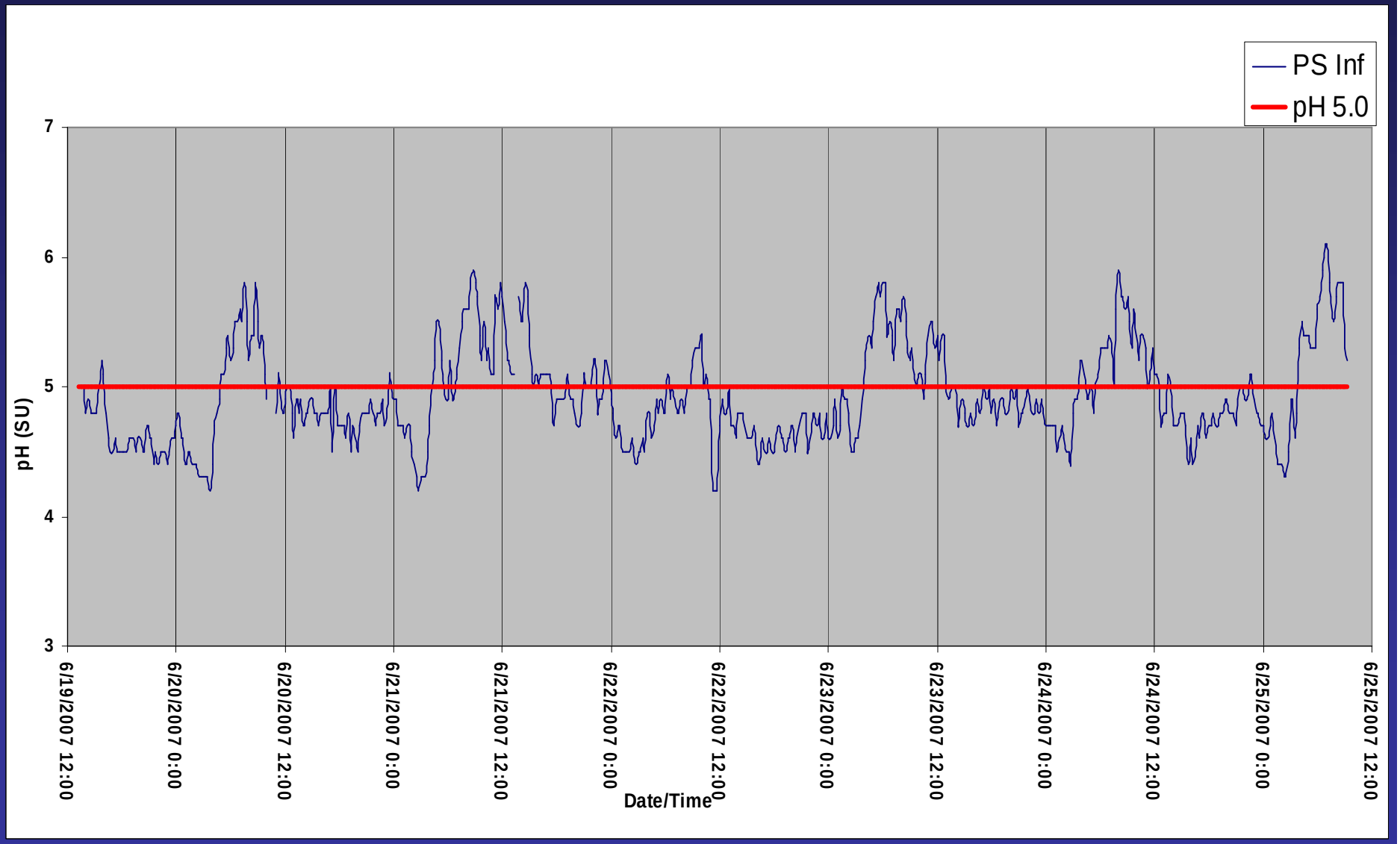
pH Results
City Pump Station Influent

- ~3900 feet from the bottler
- Deployed from 6/19/07 through 6/25/07
- n=557
  - Average = 4.9 SU
  - Minimum = 4.2 SU (6/22/07 / 1115-1145)
  - Maximum = 6.1 SU (6/25/07 / 0700)

- 70% of the samples were less than 5.0 SU

pH Results

City Pump Station Influent pH

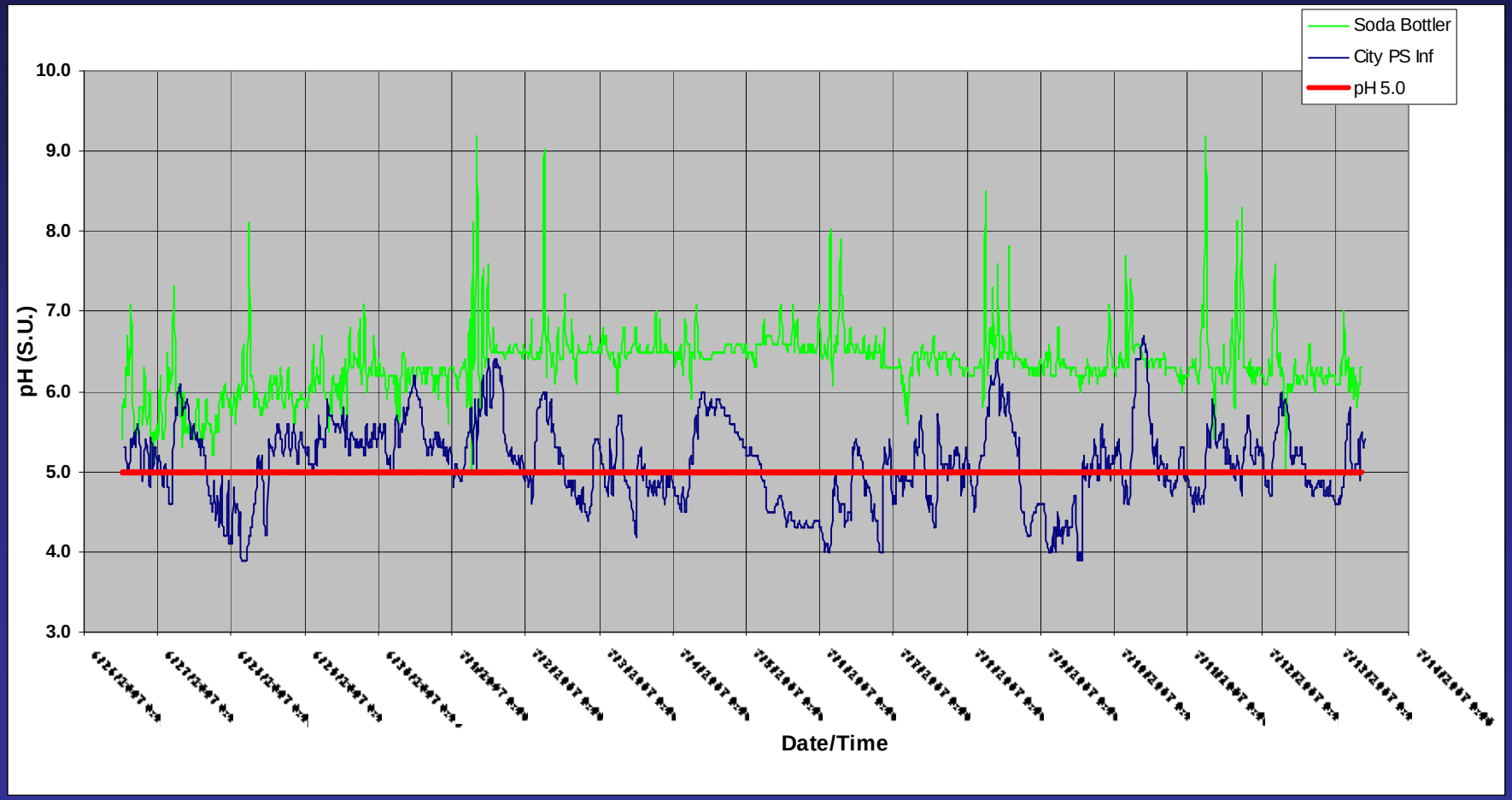


pH Results
Simultaneous Comparison

- Compared discharge from soda bottler to city PS influent from 6/26/07 through 7/13/07
- n= 1619

	Bottler	City PS Inf.
Average pH	6.3	5.1
Minimum pH	5.0	3.9
Maximum pH	9.2	6.7
% of samples <5.0 SU	0%	38 %

pH Results
Simultaneous Comparison



Alkalinity Results

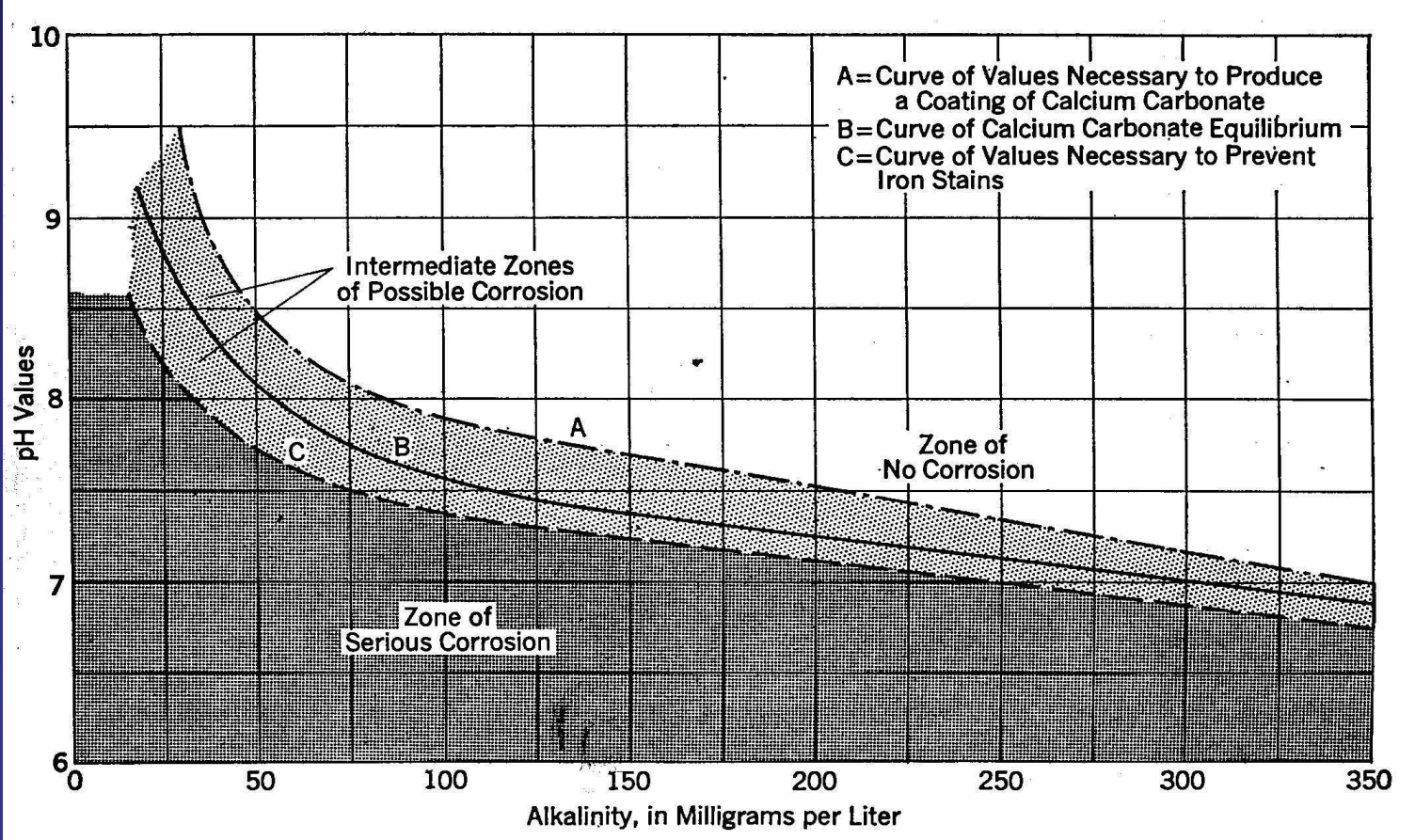
- Decreased between bottler and ~1700 feet down-line
- Started to increase after commingling with other wastestreams

Date	Bottler	1700 ft	City PS	HRSD PS	TP RWI
6/25/07	121	107	91	NS	NS
7/9/07	38	39	81	NS	NS
8/29/07	50	18	48	144	220
9/12/07	70	33	55	182	200

All concentrations are in mg/L of $CaCO_3$
NS= No Sample taken

Conclusions

- Low pH and low alkalinity are the probable causes of the interior corrosion in the HRSD and city-owned force mains.
  - "The lower the alkalinity, in milligrams per liter, the higher the pH value must be to prevent corrosive action." (Hardenbergh 1960)



Hardenbergh 1960

Conclusions

- The drop in pH and alkalinity can be attributed to:
  - Sugars from soda product (high BOD, citric acid) decompose producing organic acids. This in turn lowers the pH and could cause a further drop in alkalinity.
  - Retention time in soda bottler's equalization tank (5750 gallon tank, 10-20 minutes) is not sufficient to allow the solution to reach equilibrium following the addition of sodium hydroxide. The pH and alkalinity decrease as the solution approaches equilibrium further down the line.

Recommendations

- Study is on-going
  - Recently requested further information from the bottler
- Researching possible solutions
  - May include:
    - Increase pH permit limit
    - Increase alkalinity of wastestream prior to discharge
    - Increase retention time in equalization tank
    - Use existing processes (cleaning) to their advantage

Works Cited

- Hardenbergh, W.A., and Rodie, E.S. Water Supply and Waste Disposal. International Textbook Co, Scranton, PA 1960.
- HDR Engineering Inc. "Lee Hall Sanitary Force Main Failure Evaluation." July 2004.

Acknowledgements

- HRSD WQ-QST
- Ron Johnson- HRSD Pretreatment & Pollution Prevention (P3) Division
- Ed Hartman- HRSD P3 Division
- Jamie Mitchell- HRSD Technical Services Division
- Li Zhang- HRSD Central Environmental Laboratory

Questions?