WATER SYSTEM DISINFECTION RECOMMENDATIONS

April 4, 2019

Public Open House

Water System Information

- City of Hastings
  - Population ≈ 23,000
  - 7,500+ service connections
  - 2.75M Gallons of Storage (3 tanks)
  - Six wells (Jordan Aquifer)
  - ≈90 miles of watermains
  - Two pressure zones
  - Thousands of irrigation systems
  - 1 Water Treatment Plant built in 2007 (Nitrate Removal)
  - Largest Public Water Supplier in MN to not have disinfection treatment
  - Largest Wellhead Protection Area in MN

Contamination Incident – Fall 2018

- September 20, 2018 – three positive *E. coli* results discovered on routine test sample group
  - Three of 13 samples analyzed that week showed sign of contamination
- September 22 – follow-up testing by MN Dept. of Health (MDH) showed positive *Total Coliform* tests in the same area, but *no E. coli*
- Environmental Protection Agency (EPA) & MDH regulations require treating back-to-back positive test results as a contamination incident, and responding with Boil Water Advisory Order

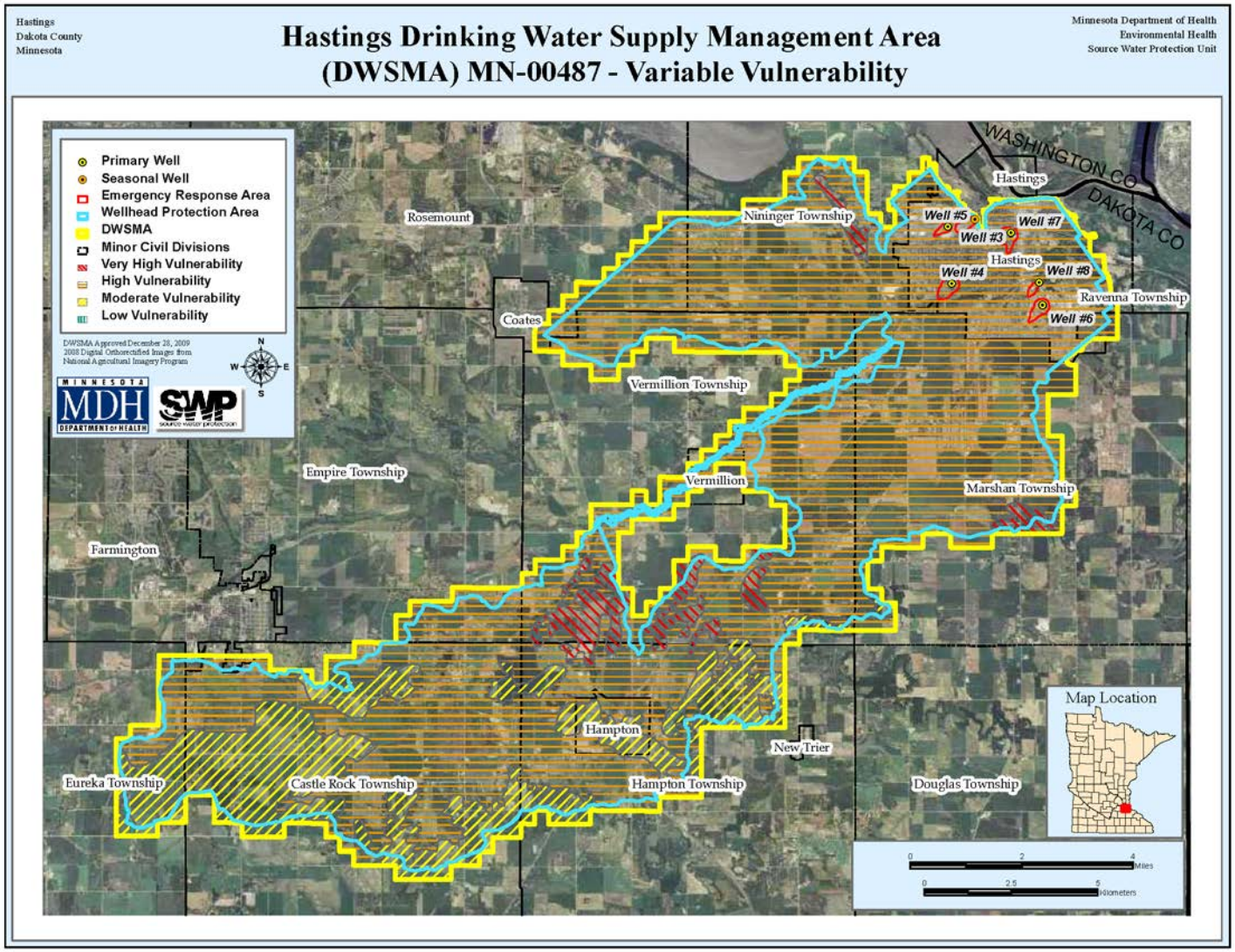
How did this happen?

- Source is unknown
  - Possible causes include:
    - Backflow event (i.e. improper Backflow prevention equipment or malfunction)
    - Construction of new/replacement watermain
    - Seasonal change of flow patterns can cause a disturbance in biofilm accumulations in pipes or storage facilities
  - Tracing back the source is extremely difficult, and the overwhelming majority of incidents do not result in a source being determined.

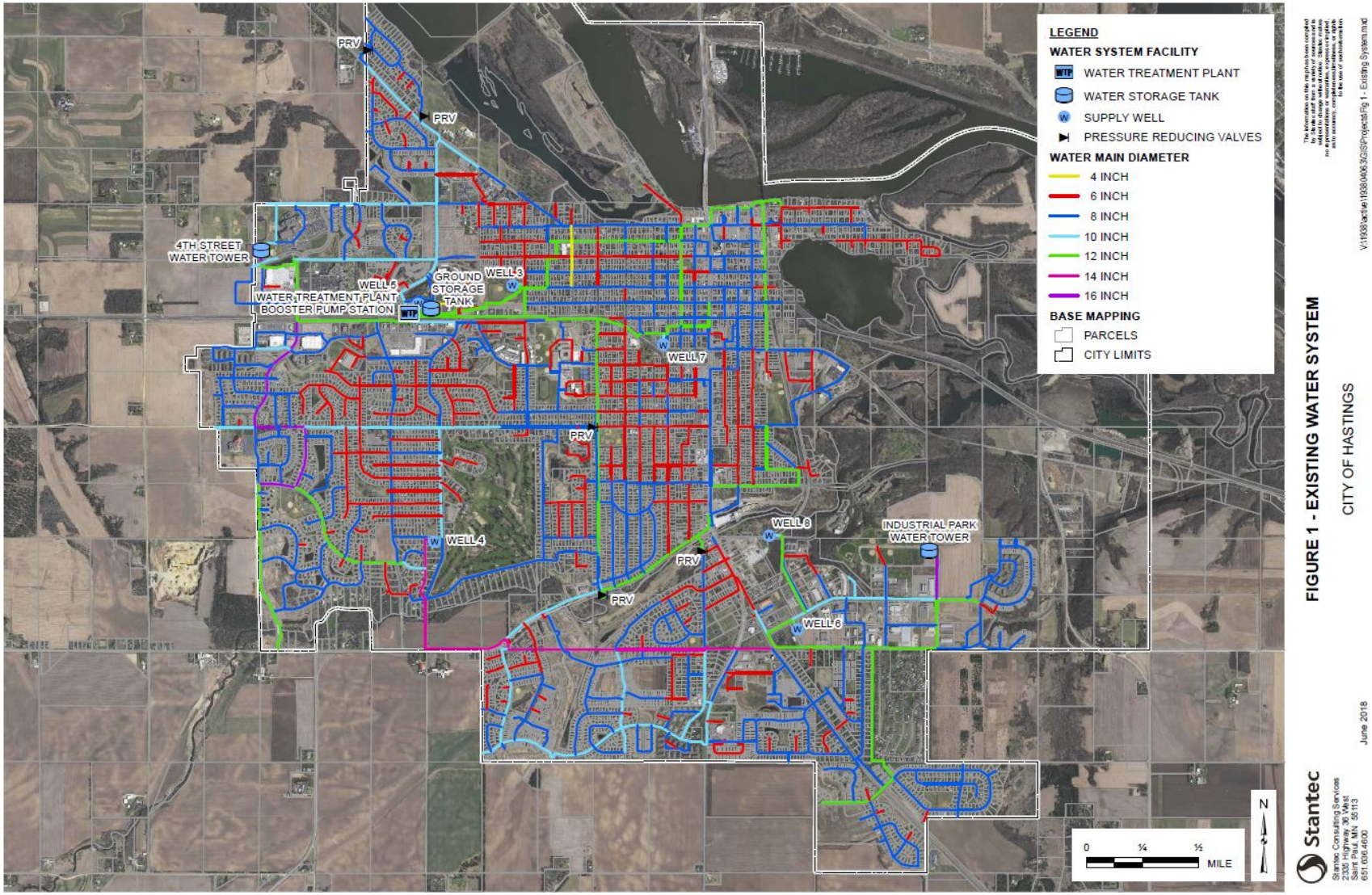
Post-Event Evaluation

- All wells were tested and cleared for bacterial contamination
- MDH Conducted EPA Level 2 Assessment Review
  - Findings of Level 2 Assessment indicate no deficiencies with City operations or infrastructure
  - MDH recommends moving to permanent disinfection
- City moves to conduct feasibility study of various disinfection treatment options
  - Objective: to protect the health, safety, and welfare of the public
  - Consider all forms of microbiological threats, such as additional bacteria and viruses found in water systems nationwide
- City Council held two workshops to learn about disinfection, discuss study results, and discuss community concerns

Vulnerabilities – Source Water



Vulnerabilities – System



Vulnerabilities – System

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Study of Alternatives

- Performed with assistance from Stantec
  - Liquid Chlorine Solution *(Sodium Hypochlorite)*
  - Chlorine Gas
  - Ozone (Primary), with Chlorine residual
  - Ultraviolet (UV) Light, with Chlorine residual
  - Shock Chlorination
  - Filtration
  - Comprehensive Inspection & Enforcement of backflow prevention and cross-connection violations
  - Do Nothing

Evaluation Matrix

City of Hastings

Water System Disinfection Alternatives Analysis

Alternative	*Provide Residual Protection in Distribution System by itself?*	*Additional Disinfection Implements Needed for Distribution Protection?*	*Risks of Microbiological Contamination Reduced?*	*Physical Space/Facility Modification Needs*	*Can Additional Treatment Types (i.e. Nitrates, PFCs) be integrated afterward?*	*Operational Management Effort*	*Initial Capital Costs*	*Annual Operational Costs*	*Capital Cost when paired with method for residual protection*	*Annual Operational Cost when paired with method for residual protection*	*Costs per singular action*
Chlorine Gas	Yes	No	Yes - continual protection.	Small to Modest, depending on facility	Yes - easily configured. System can be designed in anticipation of future treatment methods.	Low - dosing levels can be set and do not require frequent checking.	$440,000	$44,000	N/A	N/A	N/A
Sodium Hypochlorite (Liquid)	Yes	No	Yes - continual protection.	Small to Modest, depending on facility	Yes - easily configured. System can be designed in anticipation of future treatment methods.	Low to moderate - management of dosing levels requires more attention than Gas option.	$195,000	$99,000	N/A	N/A	N/A
Ozone	No - eliminates pathogens and microbiological contaminants only from source water.	Yes - required by standards.	Only when paired with method for protection in distribution system.	Small to Modest, depending on facility	Yes. Moderate to significant impact depending on size, scale, and type of additional treatment.	Significant	$3,750,000	$104,000	$3,155,000 to $3,351,000	$148,000 to $203,000	N/A
Ultraviolet Light	No - eliminates pathogens and microbiological contaminants only from source water.	Yes	Only when paired with method for protection in distribution system.	Significant	Yes. Moderate to significant impact depending on size, scale, and type of additional treatment.	Moderate	$938,000	$22,000	$905,000 to $1,101,000	$66,000 to $121,000	N/A
Shock Chlorination	No - temporal and performed only once or twice annually.	No	No. This method does not offer continual protection.	None	N/A	Moderate and intermitent - intense staffing needs during operation, with significant communcations efforts.	N/A	N/A	N/A	N/A	Estimated $10,000 of staffing costs and chemicals
Filtration	No - removes contaminants only from source water.	Yes - required by standards.	Only when paired with method for protection in distribution system.	Small to Modest, depending on facility	Yes. Moderate to significant impact depending on size, scale, and type of additional treatment.	Low to moderate depending on type of filtration.	$15 to $20+ Million, depending on type*	$50,000-$120,000 (sand filtration) Minimal for membrane filtration, but periodic replacement of membrane is required ($600,000)	$15.2-$20.5+ Million	$100,000-$220,000 (sand filtration) $50,000-$100,000 (membrane filtration) Periodic membrane replacement ($600,000)	N/A
Ongoing Comprehensive Inspection & Enforcement	No	N/A	No, but likelihood of discovering potential risks is increased.	N/A	Yes. Moderate to significant impact depending on size, scale, and type of additional treatment.	Significant - requires examination of all private plumbing work on 7,800+ served properties in the City. Requires intense efforts in scheduling visits to properties, and consent of owners.	None	Significant - would require several full-time staff dedicated to task.	N/A	N/A	N/A
Do Nothing	No	N/A	No	None	N/A	None	None	None	None	None	N/A

Membrane filtration requires extensive operational efforts and costs, and process results in up to 30% of source water being sent to waste. Sand filtration system requires large amount of space, but minimal operation and maintenance efforts.

Recommendation: Continue Permanent Disinfection

- Why?
  - Public Health and Safety
    - A variety of threats, such as illness-causing bacteria, viruses, and protozoa, are creating problems in public water systems nation-wide
    - Fortunate to have gone this long without some form of contamination incident
  - Permanent Disinfection is widely used (see handout)
  - A water system of Hastings' size, serving a population of 23,000, is extremely vulnerable
  - Consequences of an unchecked threat could be severe
  - MN Dept. of Health *strongly recommends* permanent disinfection
    - After third occurrence, permanent disinfection would be REQUIRED
  - Lessen impact on businesses and homeowners by avoiding negative impacts of water emergencies

Recommended Form: Gas Chlorination

- Why?
  - Highly effective at protecting against bacteria, viruses, protozoa, and more
  - Proven and safe technology is widely used with great track record for safety and effectiveness
  - Consistent chlorine concentrations from entry point to your tap
    - Can help minimize taste/odor issues
  - Lower operations and maintenance efforts compared to liquid chlorination method
  - Lower long-term operational costs than liquid chlorination method
- Estimated Upfront Capital Cost = $440,000
  - City has existing funds to cover capital expense
- Estimated Annual Operating Cost = $44,000
  - Less than $2 per resident per year

Gas Chlorination: Brief History & Facts

"Chlorine effectively kills a large variety of microbial waterborne pathogens, including those that can cause typhoid fever, dysentery, cholera and Legionnaires' disease. Chlorine is widely credited with virtually eliminating outbreaks of waterborne disease in the United States and other developed countries."

-Scientific American, 2019

Life magazine recently cited the filtration of drinking water and use of chlorine as *"probably the most significant public health advance of the millennium."*

Independent Opinion: Timothy LaPara, Ph.D, P.E.

- Internationally recognized researcher in the microbiology of drinking water and of municipal wastewater.
- Instructor for *Water and Wastewater Treatment*, *Environmental Microbiology,* and other courses at University of Minnesota (since 2000)
- No prior association or conflict of interest with the City of Hastings
- Voluntary participation in this event (public outreach is an explicit job duty as a professor)
- Tenure provides complete academic freedom; all stated opinions are strictly mine

Topic Tables - One on One Conversations

- Taste/Odor & Home Treatment
  - Kim Larsen, Brian Noma, & Anna Arkin – Minnesota Dept. of Health
- Safety of Gas Chlorination
  - Henry Croll – Stantec; Prof. Tim LaPara – University of Minnesota
- Water System Basics
  - Nick Egger & Mark Peine – City of Hastings
- Health Concerns
  - Karla Peterson, Stew Thornley, Doug Schultz – Minnesota Dept. of Health
- Wellhead Protection & Vulnerability
  - Scott Hanson – Minnesota Rural Water Association

Next Steps

- Bring final recommendation before City Council
  - City Council will consider final decision
- If approved, full implementation of system changes could take up to a year
  - Final design, public bidding, construction
  - Expect staged implementation
    - Five different sites where equipment changes would take place

Questions for Panel?