MANAGING THE FLOW: COMBINED SEWERS IN BURLINGTON

A Conversation on CSOs

Echo Center

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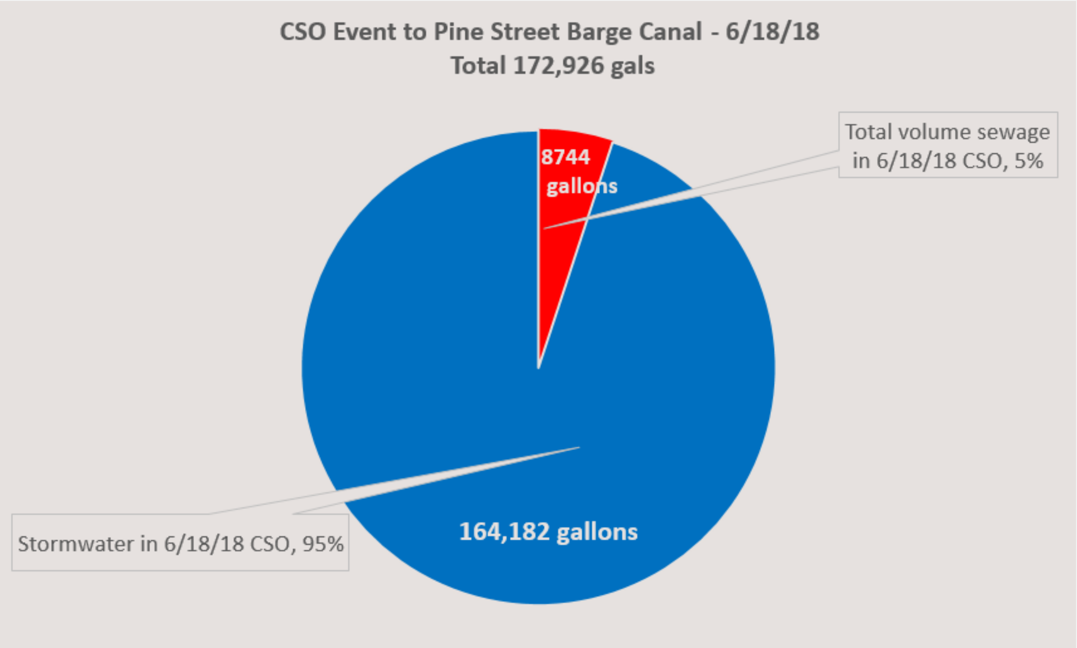
2018: SEWAGE OVERFLOWS IN BURLINGTON

- The majority of the overall volume of under-disinfected discharge in Burlington this year was related to infrastructure issues failures and process challenges at the Main WWTP → 12.2 MG
  - *Root causes*:
    - Valve failure on wet weather disinfection system
    - Computerized control failure on wet weather disinfection system
    - Period of stress in the biological system due to increasing concentration of organics and variability of loading from food/beverage industries.
    - SSO caused by a blockage on a separate sanitary sewer line which caused raw sewage to surface and enter a separate storm sewer system
  - These root causes and other areas of WW infrastructure risk are being addressed by:
    - **$19.8M** of $30M bond proposal for November 2018

- A smaller proportion of the volume was from untreated collection system CSOs
  - These are not caused by any "failures", they are unfortunately part of the legacy of our sewer collection system.
    - To date 2018 →~1.04 MG of untreated collection system combined sewer overflow
    - 2017 → ~1.41 MG untreated CSO (volumes are driven by rainfall patterns)
  - November 2018 bond proposes **~$3.82 M** of combined sewer related improvements ($10.1 M total Stormwater)

CSO FACTS

- CSOs are driven by intense rain storms, and are predominantly comprised of stormwater (understandable remaining concern!)
- Approximately **6 lbs** phosphorus/million gallons of overflow (2004 *Report to Congress on Impacts and Control of Combined Sewer Overflows and Sanitary Sewer Overflows)*
- 2018 Total YTD Untreated Collection System CSOs = ~1.04 MG



- Bacteria is the chief issue of concern with untreated CSOs when/where there is a high probability of human health risk (i.e. contact recreation, especially full body/immersion)
  - Generally this risk to human health is short duration until bacteria levels return to normal through dilution and die off
  - There are many other sources of bacteria (stormwater especially) in a watershed.
- Combined sewers conveyance (when not overflowing) do have the benefit of providing better treatment (at the WWTP plant) to a significant portion of annual stormwater flows than those flows would receive in a separate storm sewer system.

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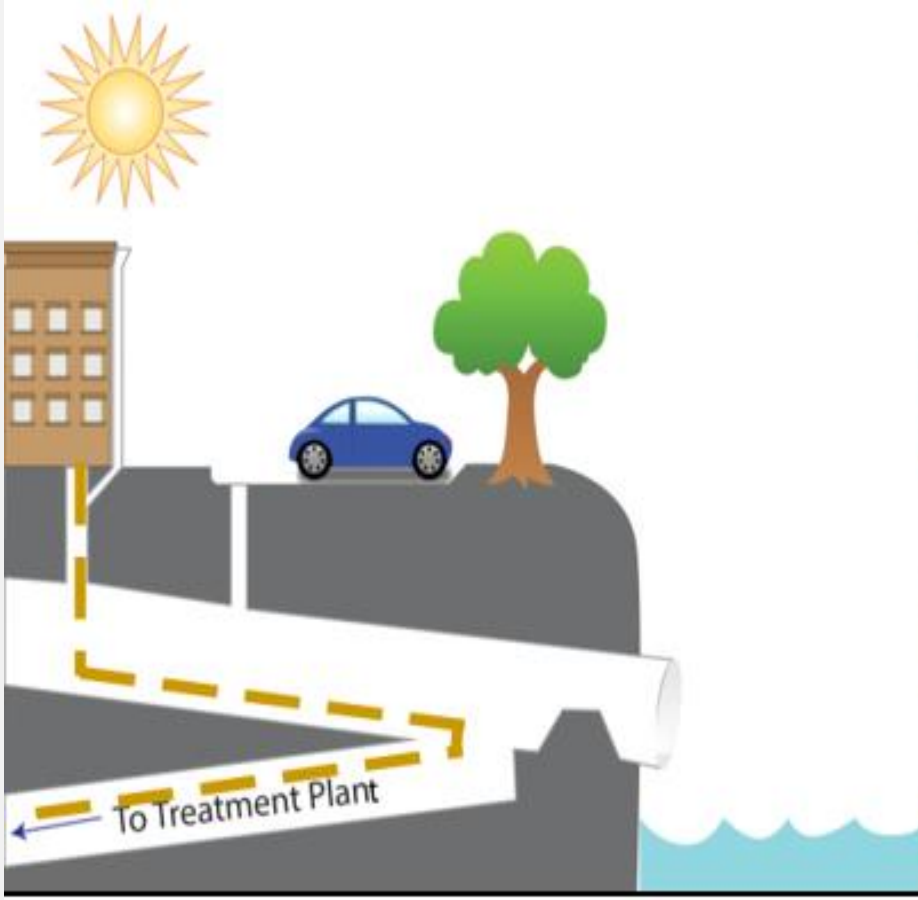
COLLECTION SYSTEM – UNTREATED CSO PRIMER

Prior to 1994, the City had 11+ Untreated Combined Sewer Overflow points



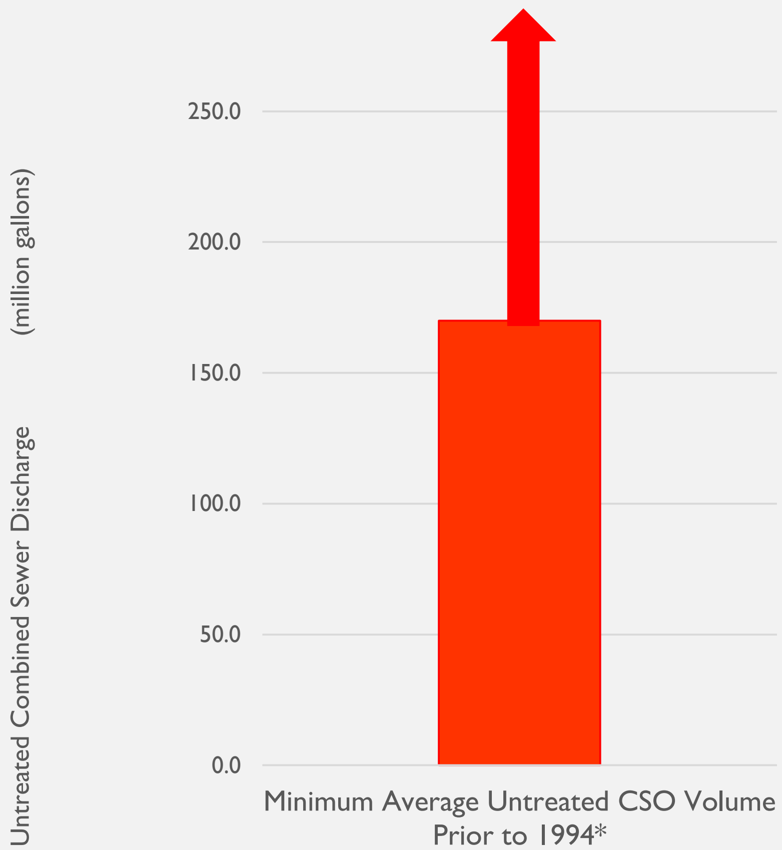
Under normal conditions, wastewater goes directly to the wastewater treatment plant

When a large rain event occurs, stormwater joins wastewater and excess flows get discharged into nearby streams

This prevents sewage backups into properties and onto roadways/sidewalks

ESTIMATED COMBINED SEWER DISCHARGES PRE 1994

Untreated and not disinfected

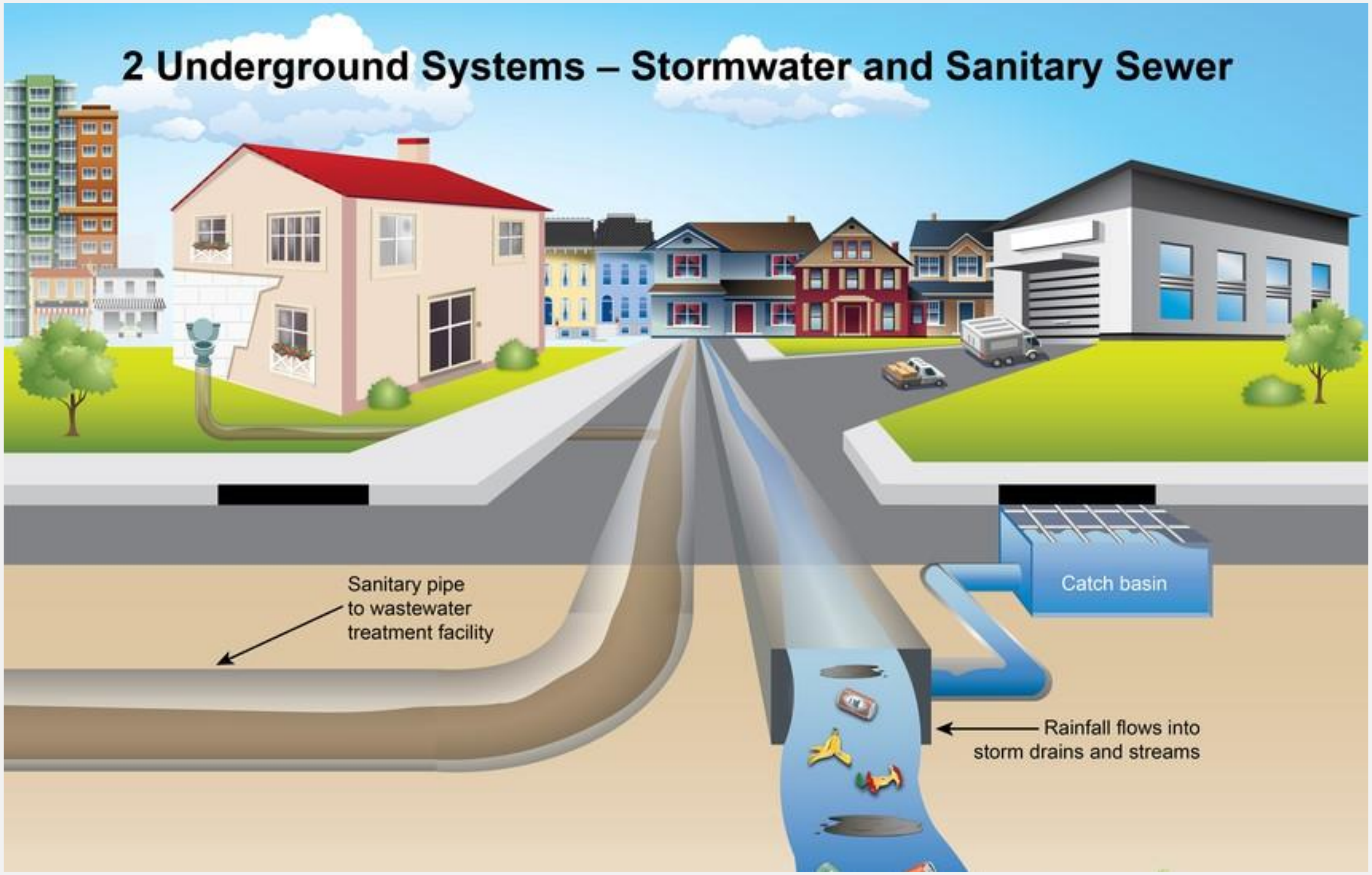


- > 170 MG Pre-1994 estimate is calculated based on average annual combined sewer wet weather flows treated by Vortex between 2001 and 2017. [this is best available data]
- In reality, a much larger volume was likely discharged when calculations take into account all wet weather flows that are being treated by full plant.
  - For example, the total storm flows treated by Main WW year to date 2018 are in the realm of **306 MG**

COLLECTION SYSTEM – CSO ELIMINATION

THROUGH SEWER SEPARATION (UNFORTUNATELY WITHOUT TREATMENT)

~$22 M in 1994



Unfortunately we now know that untreated stormwater runoff can have long term chronic impacts such as nutrient loading and bacteria pollution.

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STORMWATER IS NOT CLEAN WATER

Table 4-4. Comparison of Water Quality Parameters in Urban Runoff with Domestic Wastewater (mg/l)

Constituent	Urban Runoff		Domestic Wastewater			Secondary with BNR
	Separate Sewers		Before Treatment		After Secondary	
	Range	Typical	Range	Typical	Typical	
COD	200-275	75	250-1,000	500	80	
TSS	20-2,890	150	100-350	200	20	8.27
Total P	0.02-4.30	0.36	4-15	8	2	0.29
Total N	0.4-20.0	2	20-85	40	30	1.8 – 3.5*
Lead	0.01-1.20	0.18	0.02-0.94	0.10	0.05	
Copper	0.01-0.40	0.05	0.03-1.19	0.22	0.03	< 0.02
Zinc	0.01-2.90	0.02	0.02-7.68	0.28	0.08	
Fecal Coliform per 100 ml	400-50,000	**	10^6-10^8		200	2-4 *E.coli/100 mL*

* Medians at N and E Plant

Source: Bastian, 1997

** There are E. coli > 235 col/100 mL measured from time to time at SW only influenced beaches

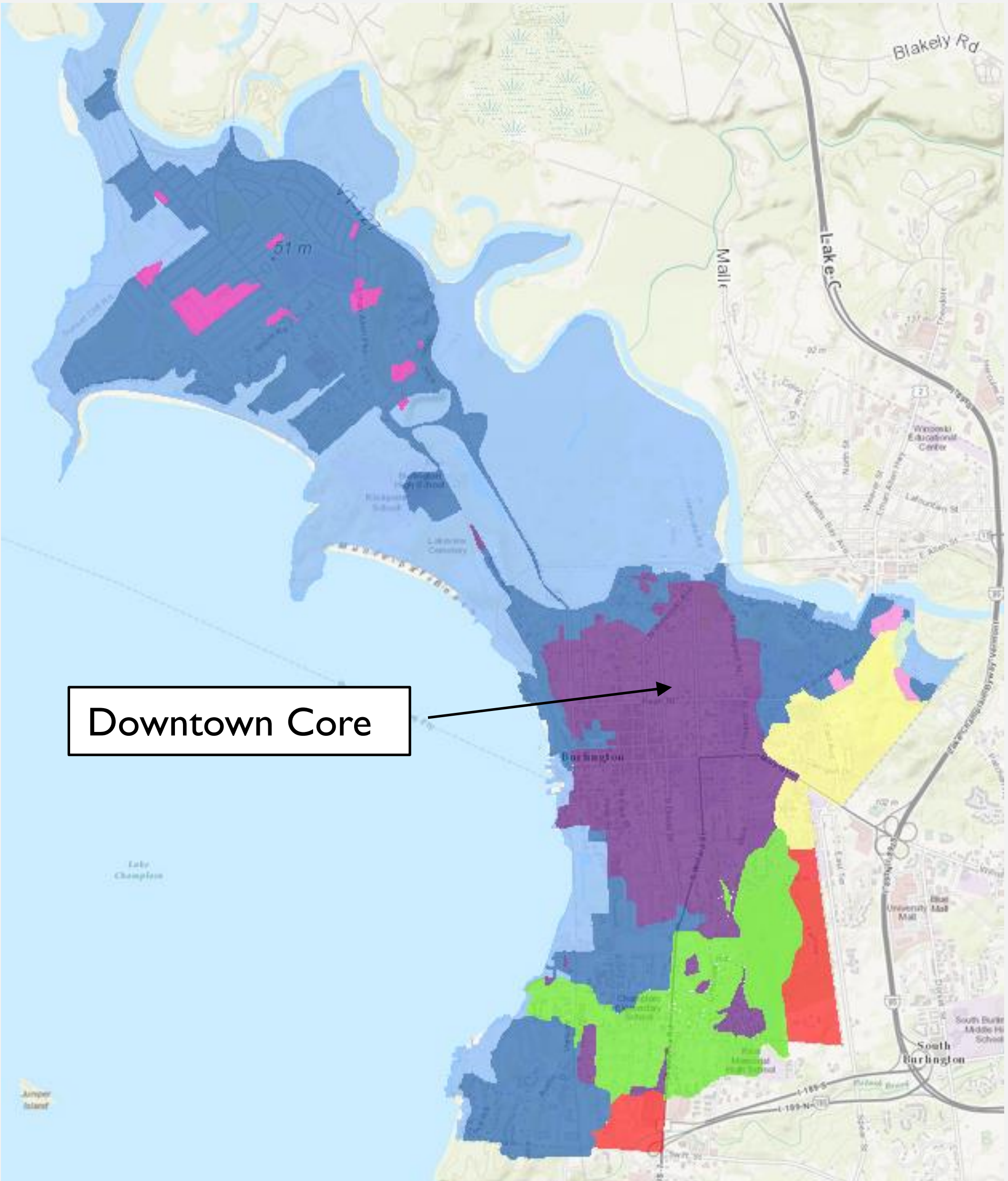
As indicated in Table 4-4, the concentrations of select water quality parameters in urban runoff is comparable to that found in untreated domestic wastewater. When untreated urban runoff is discharged directly to receiving streams, the loadings of pollutants can be much higher than the loadings attributable to treated domestic wastewater.

https://www3.epa.gov/npdes/pubs/usw_b.pdf

FROM THE EPA CSO MANAGEMENT FACT SHEET: SEWER SEPARATION (1999)

- "Separating CSSs may contribute to improvements to water quality due to the reduction or elimination of sanitary discharges to receiving water bodies. However, the increased storm water discharges resulting from sewer separation could decrease the positive impacts of the separation unless storm water discharges are mitigated. Without mitigation, increased loads of storm water pollutants, including heavy metals, sediments, and nutrients, may run off into local water bodies. For example, in Atlanta, GA, sewer separation was predicted to increase pollution to local creeks (AMSA, 1994) as polluted storm water previously reaching the treatment plants now is discharged directly into receiving waters…"

Complete Separation Not Deemed Feasible/Cost Effective, Particularly in the Downtown Core and Could Have Long-Term Water Quality Impacts



Drainage Area

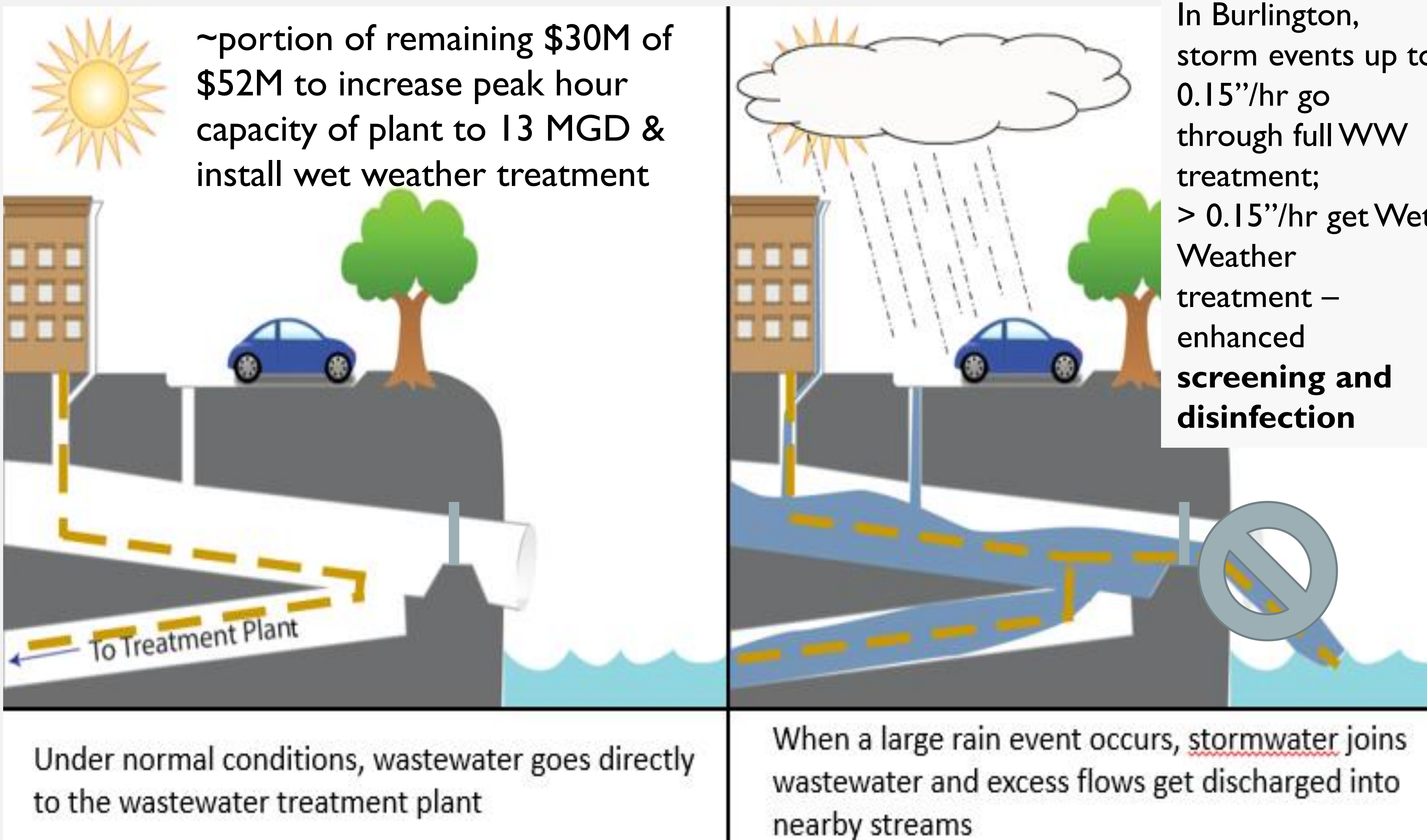
- 1.1 Main Plant
- 1.2 North Plant
- 1.3 East Plant
- 2.1 Englesby Brook
- 2.2 Centennial Brook
- 2.3 Potash Brook
- 3 MS4 (Non Impaired)
- 4 Direct Discharge (Non Impaired)

Remaining Combined Sewer (1.1 Main Plant, 1.2 North Plant, 1.3 East Plant)

- 26% of sewered land area is served by a combined sewer
- 37% of City's total impervious area drains to **Combined Sewer** (3 WWTPs)
  - Main WWTP Plant Combined Sewer Area has **very high % imperviousness (~57% avg)**

COLLECTION SYSTEM – CSO TREATMENT
THROUGH END OF PIPE WET WEATHER TREATMENT @ MAIN PLANT

~portion of remaining $30M of $52M to increase peak hour capacity of plant to 13 MGD & install wet weather treatment

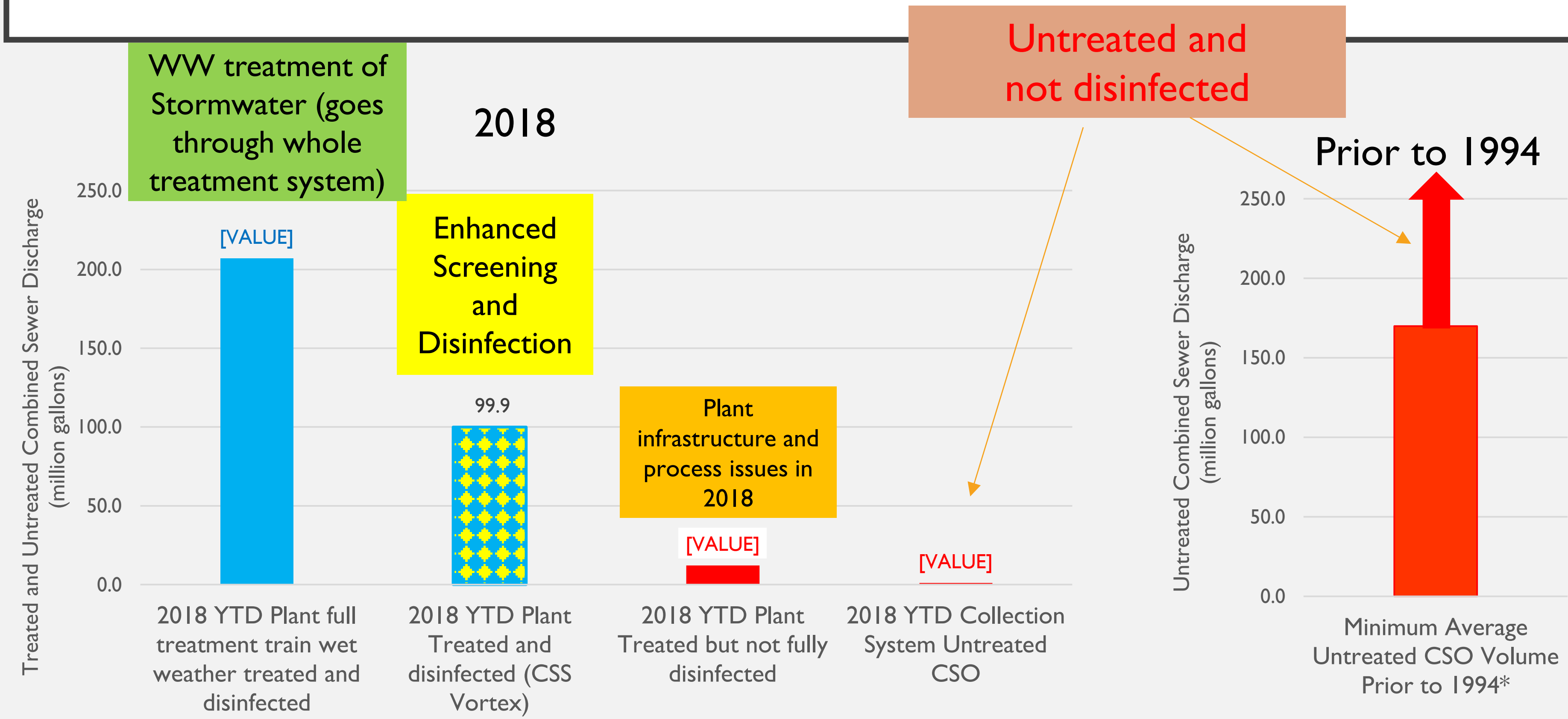


In Burlington, storm events up to 0.15"/hr go through full WW treatment;
> 0.15"/hr get Wet Weather treatment – enhanced **screening and disinfection**

Overall reduced CSO locations from 11+ to 5 and greatly reduced untreated CSO volume

MAIN WASTEWATER PLANT

COMPARISON OF ESTIMATED COMBINED SEWER DISCHARGES PRE 1994 TO 2018 (THROUGH 9/17/18)



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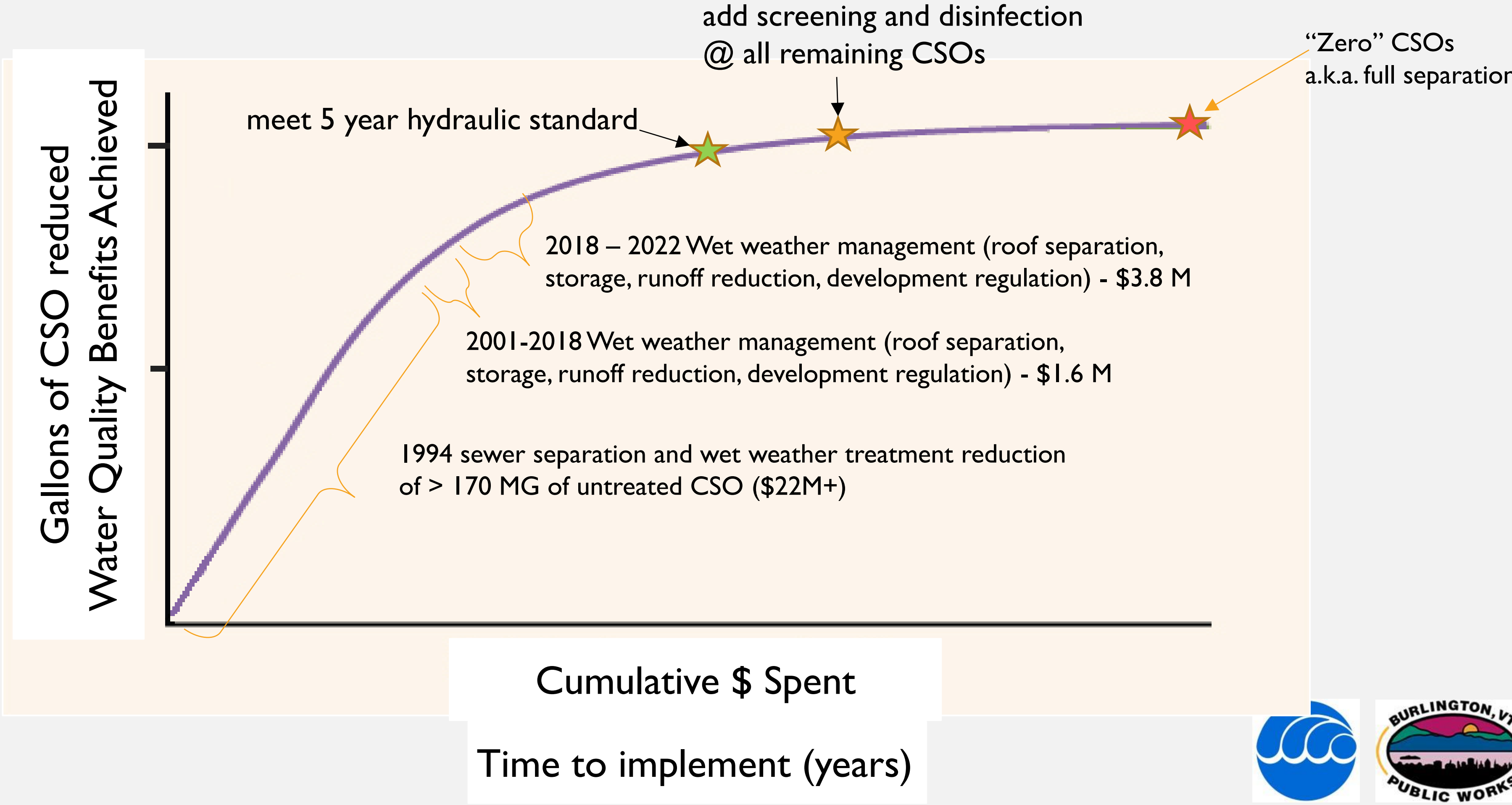
NEXT PHASE OF CSO MANAGEMENT

CSO MANAGEMENT TRAJECTORY: COST EFFECTIVENESS IS KEY

- Burlington has a long history of managing CSOs and has made great progress in reducing the # of CSO outfalls and the overall volume of untreated CSO discharges
- Our work is not complete and we are committed to completing CSO management to minimize human health risk – but the benefits of "zero" CSOs must be balanced within context of water quality cost effectiveness



MODERN CSO MANAGEMENT APPROACH

- **Sewer separation is not the answer; we caution against a legal and policy framework which drives CSO communities in this direction**
  - Costly → ~$400+/linear foot in an urbanized area
  - Many buildings have internally combined sewer/roof drain lines
  - Trading a short term benefit (reduction of bacteria) for long term stormwater pollution
  - Learn lessons from other CSO communities

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THE "BIG KIDS" HAVE ALREADY GONE THROUGH THE ANALYSES

Philadelphia Green City, Clean Water Program

http://www.phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan

DC Water & Sewer Authority Green Infrastructure Challenge

https://www.dcwater.com/green

New York City's Green Infrastructure Program

http://www.nyc.gov/html/dep/html/stormwater/using_green_infra_to_manage_stormwater.shtml

LTCPU Implementation Alternatives Evaluated

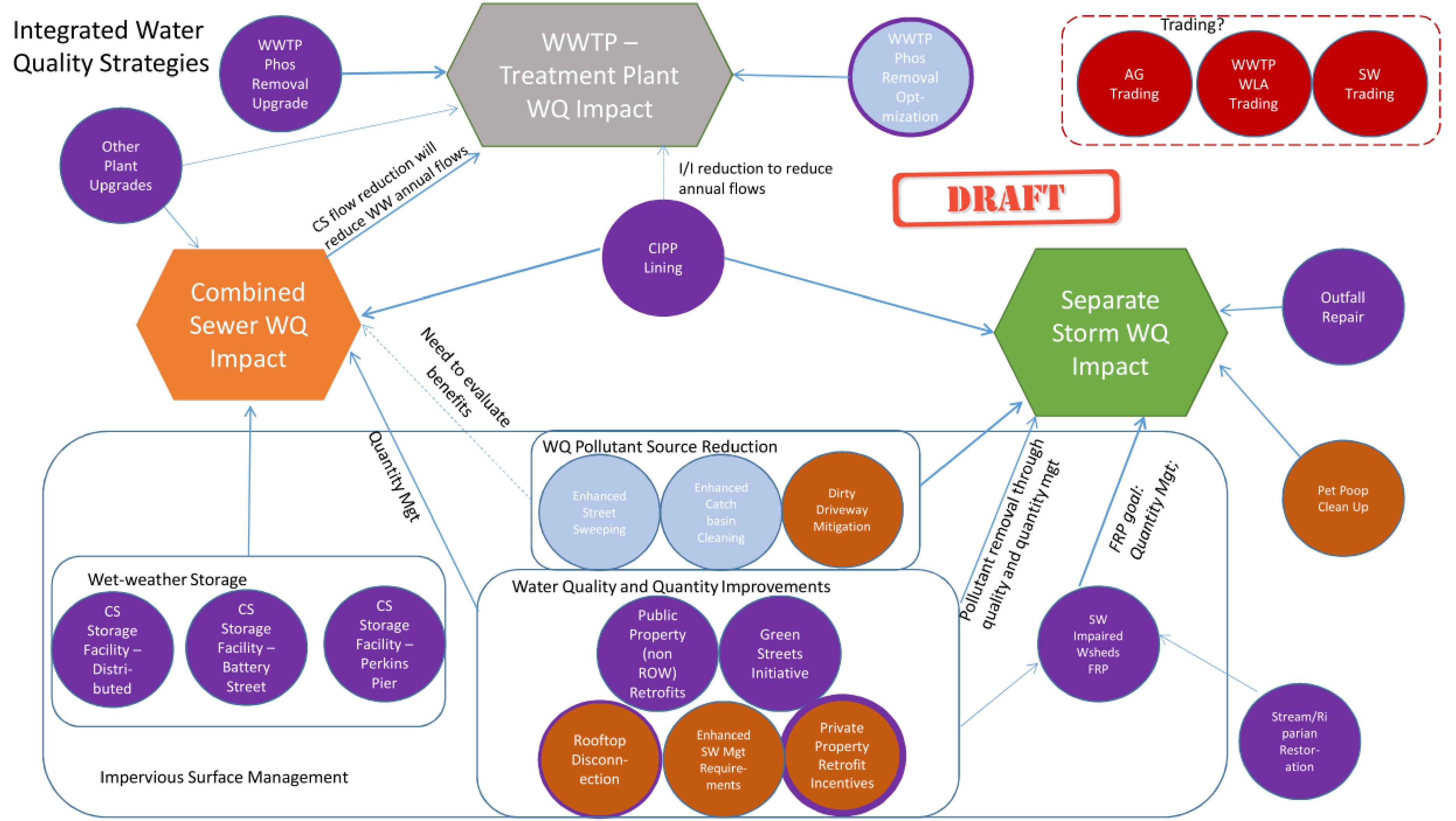
In order to compare the costs and benefits for multiple implementation approaches, we performed a comprehensive alternatives analysis on a number of implementation approaches (summarized below). Each infrastructure alternative was analyzed in detail for each watershed. Green Stormwater Infrastructure with Targeted Traditional Infrastructure was clearly the best alternative for several reasons. First, this alternative reduced combined sewer overflow in a cost-effective manner. Second, it meets the broader goals of PWD's Integrated Watershed Management approach while maximizing environmental, social, and economic benefits. Third, this alternative is the only one that meets all watershed goals without causing severe economic hardship for PWD's ratepayers. Finally, public feedback has expressed a clear and unambiguous preference for an alternative focused on green stormwater infrastructure.

					Economic Benefits	Social Benefits			Environmental Benefits				
	Affordable	Scalable	Meets Combined Sewer Overflow Policy Goals	Meets Watershed-based Planning Goals	Creates Jobs; Reduces Social Cost of Poverty	Enhances Recreation	Improves Community Quality of Life	Reduces Effects of Excessive Heat	Restores Ecosystems	Improves Air Quality	Saves Energy and Offsets Climate Change	Public Support	Benefits Accrual Method
Complete Sewer Separation • construct new sanitary sewer infrastructure • convert existing combined sewers to a municipal separate storm sewer system (MS4) • separate combined sanitary and storm laterals on private property • reconnect private properties to new system • reconstruct streets and sidewalks to their existing conditions	○	○	●	◐	○	○	○	○	○	○	○	○	at completion
Large-scale Storage (Tunnels) • construct traditional tunnel storage to temporarily store combined sewage • dewater stored sewage when capacity at water pollution control plants is available	○	○	●	◐	○	○	○	○	○	○	○	○	at completion
Plant Expansion, Satellite Treatment • construct decentralized satellite treatment facilities • construct new consolidation sewers to convey waste water to new satellite facilities	◐	◐	●	◐	○	○	○	○	○	○	○	○	at completion
Green Stormwater Infrastructure with Increased Transmission and Treatment • implement large-scale application of green stormwater infrastructure • construct new interceptors to increase capacity • increase wet weather wastewater treatment capacity	◐	◐	●	●	◐	●	◐	◐	●	◐	◐	◐	immediate incremental
Green Stormwater Infrastructure with Targeted Traditional Infrastructure • implement intensive large-scale application of green stormwater infrastructure • increase wet weather wastewater treatment capacity in targeted locations	●	●	●	●	●	●	●	●	●	●	●	●	immediate incremental

MODERN CSO MANAGEMENT APPROACH

- **Modern flow monitoring and alarm capability**
  - to maximize public notification capability in order to minimize human health risk
  - H/H modeling is expensive, but can yield maximally optimized abatement solutions
- **Evaluate strategies based on maximizing long term water quality cost effectiveness and prioritizing area with highest human health risk – considering:**
  - Runoff reduction via distributed green infrastructure retrofits (public and private)
  - Runoff reduction via distributed grey infrastructure (storage tanks)
  - Separation of roof drains (limited opportunity)
  - Larger scale storage – optimize for some % of annual storms (Perkins Pier, Battery Street)
  - Wet weather satellite disinfection at CSO locations where human health risk higher
  - Enhanced wet weather treatment – finer screening, possible dual use (dry and wet weather) filtration
- **Evaluate CSO strategies <u>within the context</u> of all Water Quality Challenges**

LARGER CONTEXT:
WHAT SOLUTIONS WILL HAVE THE MOST COST EFFECTIVE IMPACT ON WATER QUALITY?



DON'T FORGET: EXISTING INFRASTRUCTURE DEFICIT

SUMMARY

- **CSO management needs to be prioritized appropriately – within the context of:**
  - All needed water resource/water quality improvement work, long term benefits
  - Current existing infrastructure deficit (maintenance and repair/renewal of existing critical infrastructure)
  - Cost Effectiveness (including what co-benefits a project may provide)
  - Rate payer financial capacity and
  - CSO outfall location, risk to human health/recreation
- Use of sewer separation should be applied only where the benefits outweigh the negative impacts – not necessarily everywhere
- CSO reduction vs. elimination is a more cost-effective, water quality beneficial approach in many situations
- Green Stormwater Infrastructure is an important part of the CSO management portfolio; it is a better investment in our communities than buried pipes and storage vaults

Questions? Megan Moir, mmoir@burlingtonvt.gov, 734-4595