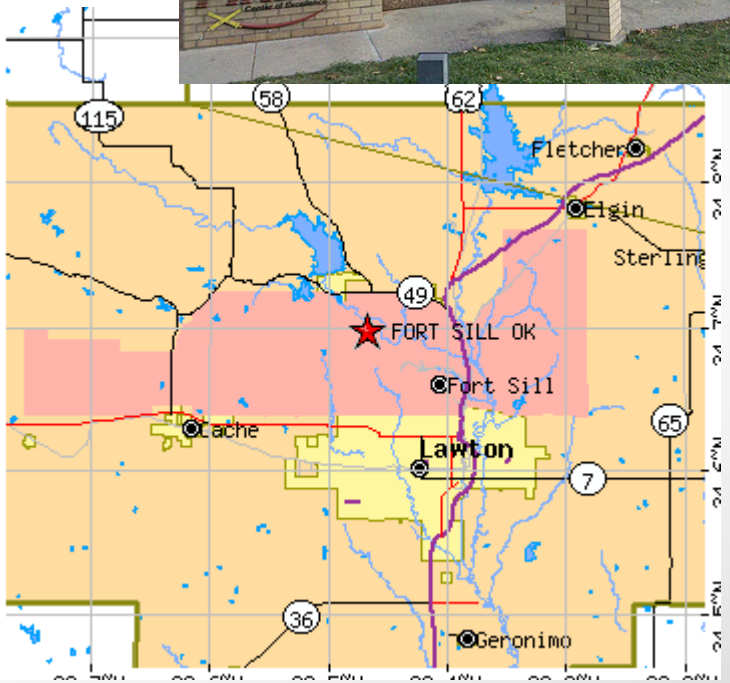
Causing a Splash – The First Cat. 2 Reuse Drops Fort Sill, Oklahoma

Mary Elizabeth Mach, PE

Fort Sill Established in 1869

- U.S. Army Installation in Lawton, OK
- Population: 53,000
  - 20,000 military and civilian personnel
  - 33,000 military family members
- American Water Enterprises
  - Utility Owner/Operator



Base facilities can consume over 2.0 MGD of potable water

- Historically, potable water demands:
  - Domestic
  - Cooling Towers
  - Irrigation
    - Parade Grounds
    - Golf Course
    - Cemetery
    - Equestrian Center
- A consecutive system that purchases water from City of Lawton

Fort Sill WWTP can discharge up to 4.3 MGD to E. Cache Creek

Fort Sill WWTP:

- Primary Clarifiers
- Activated Sludge Aeration Basins
- Secondary Clarifiers
- Tertiary Dual-Media Filtration
- UV Disinfection (2005)

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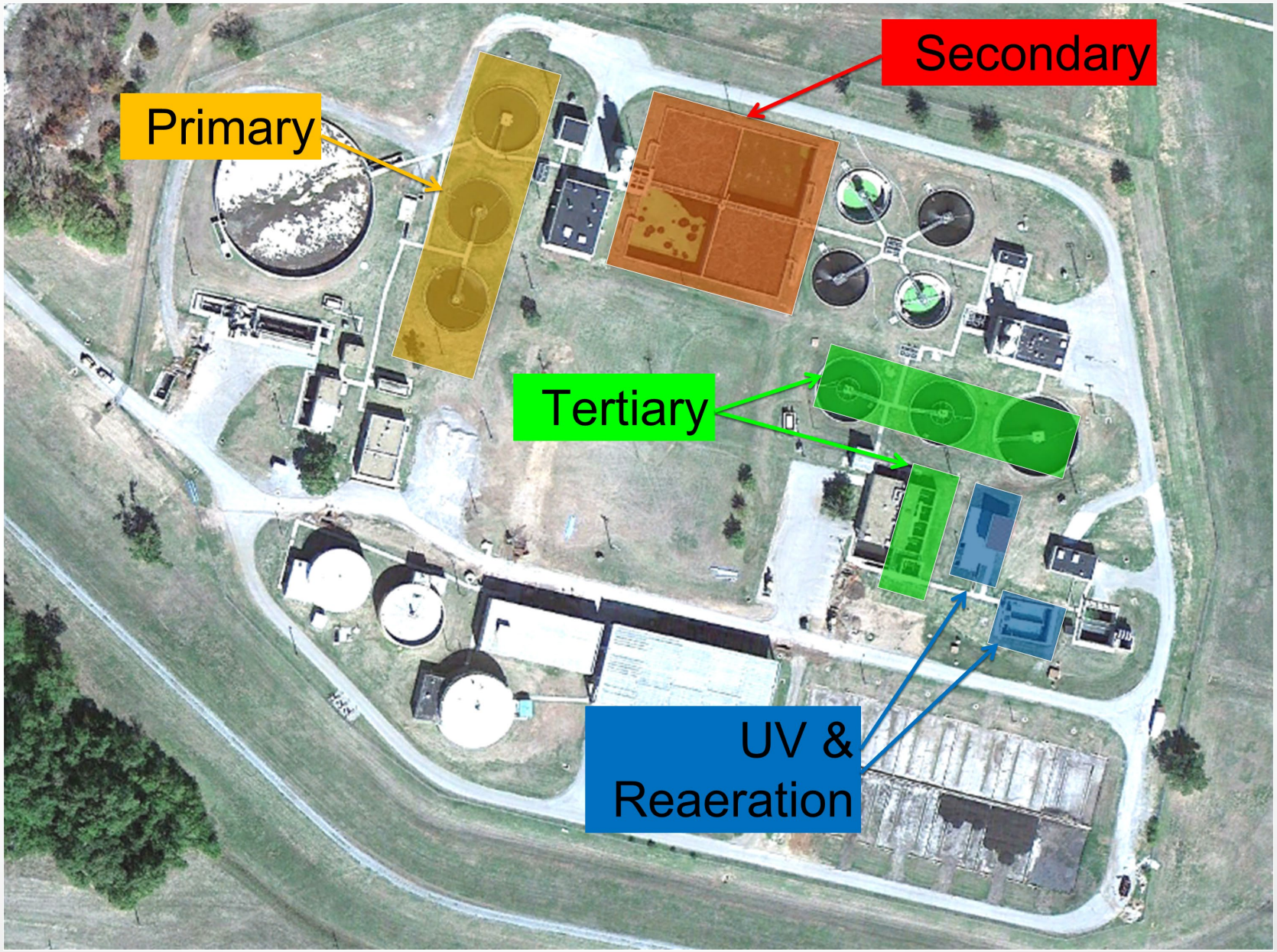


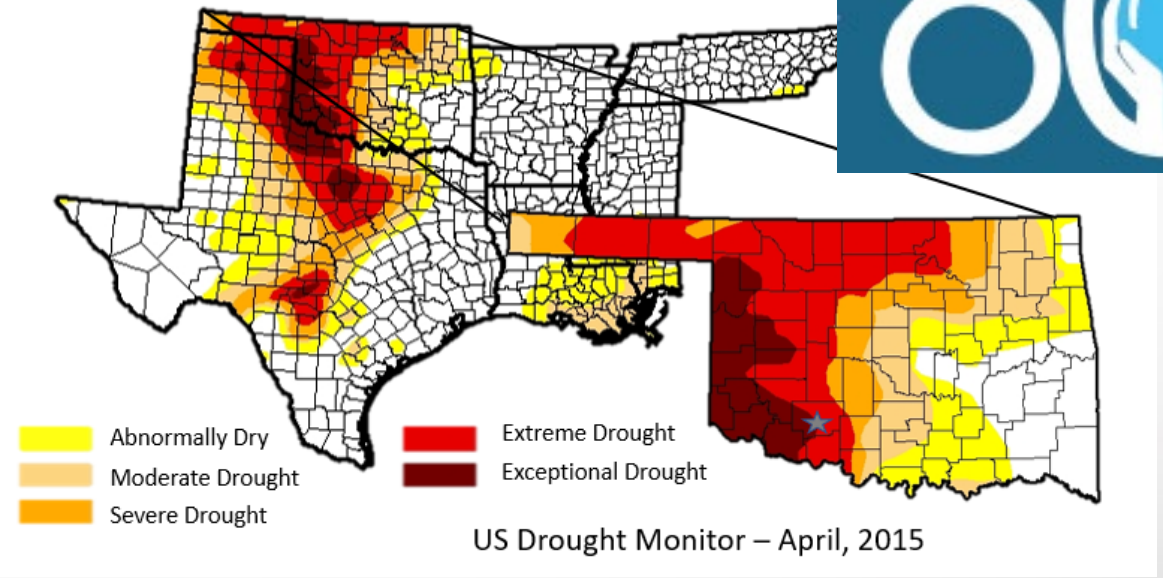
Typical Effluent Water Quality

Parameter	Value
TSS	< 1 mg/L
BOD	< 3 mg/L
NH_3	< 0.5 mg/L
Fecal Coliform	~10 cfu/100ml
Flow	1.7 – 2.0 MGD

What can we do with such a high quality effluent….?

Federal and State Agencies Committed to Water Conservation and Reclamation

- Executive Order 13423 (2009): Federal Agencies to “lead by example in advancing nation’s energy security and environmental performance”
- Oklahoma Water for 2060 (2012)
- Exceptional Drought (2015)



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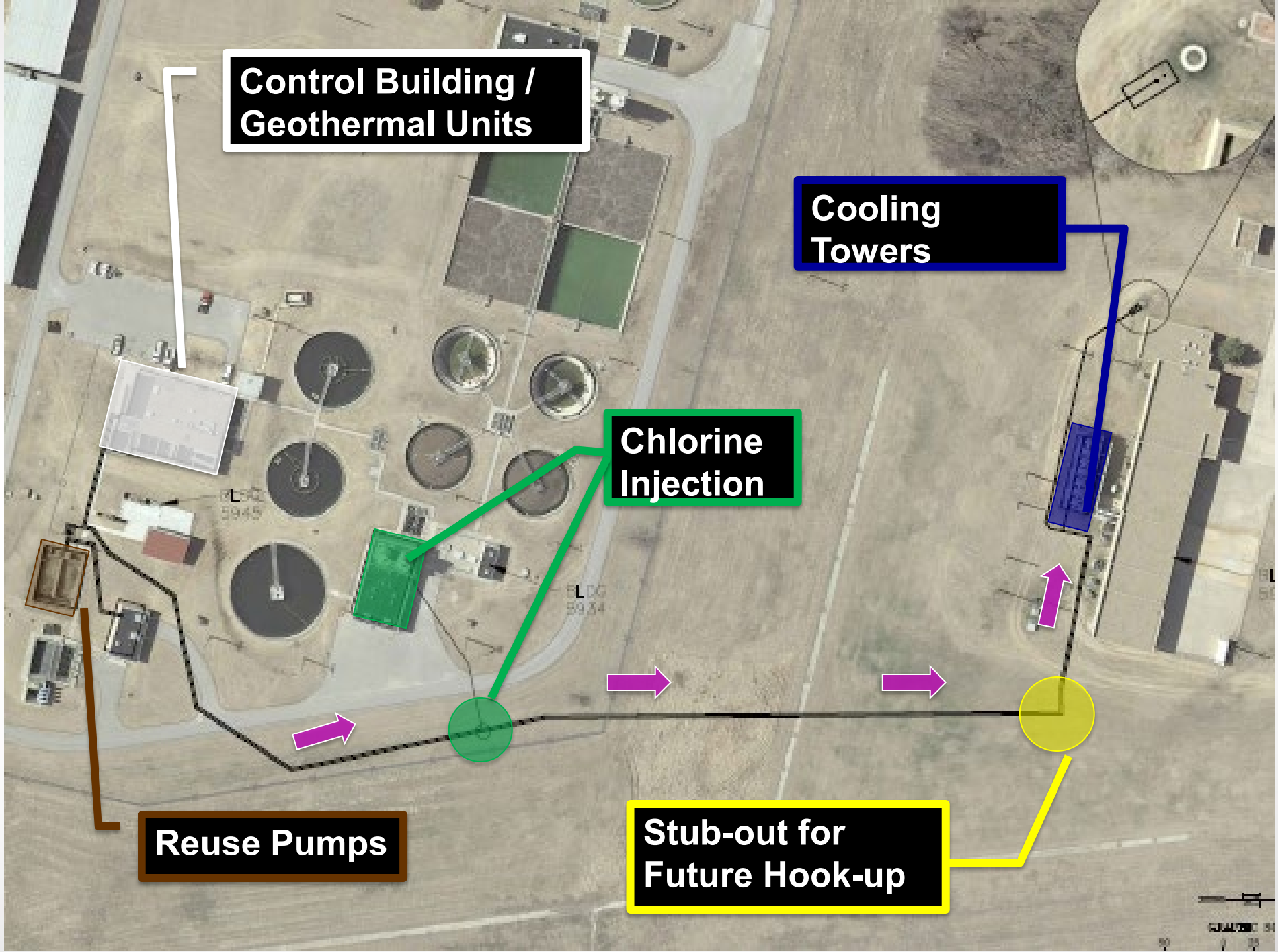
Phase 1: Restricted Reuse at Fort Sill

Fort Sill Constructed Phase 1 of Wastewater Recycling Distribution Network

- Prior to OK Reuse Regulations (2012)
- Supplies Reclaimed Water for
  - Geothermal Heat Pumps
  - Cooling Towers for Energy Plant
- Approx. 700,000 gal/day
  - Chlorinated Effluent (up to 5 mg/L)


Control Building / Geothermal Units
Cooling Towers
Chlorine Injection
Reuse Pumps
Stub-out for Future Hook-up

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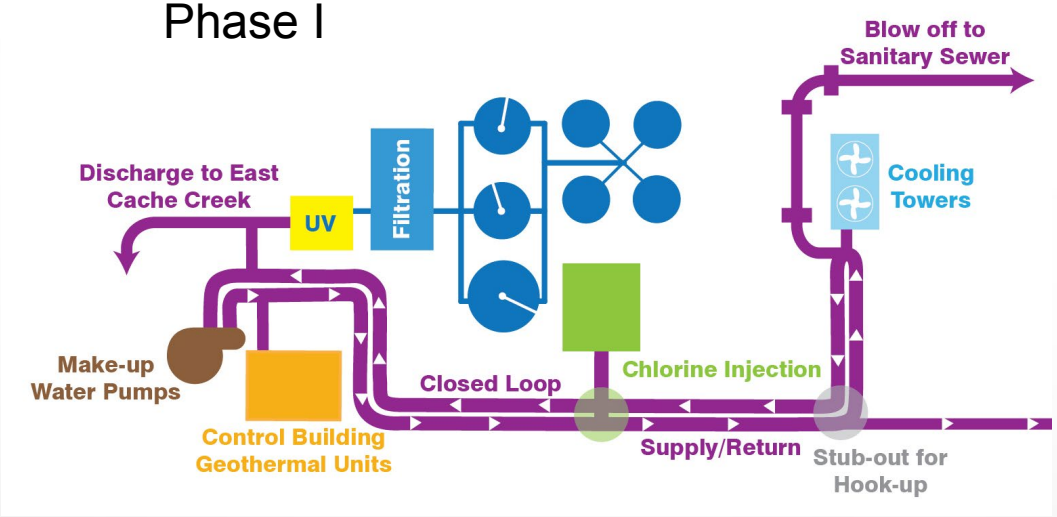
Phase 2: Unrestricted Irrigation at Fort Sill

American Water and Garver developed a road map to obtain the first Category 2 Reuse Permit in the State.

Phase I



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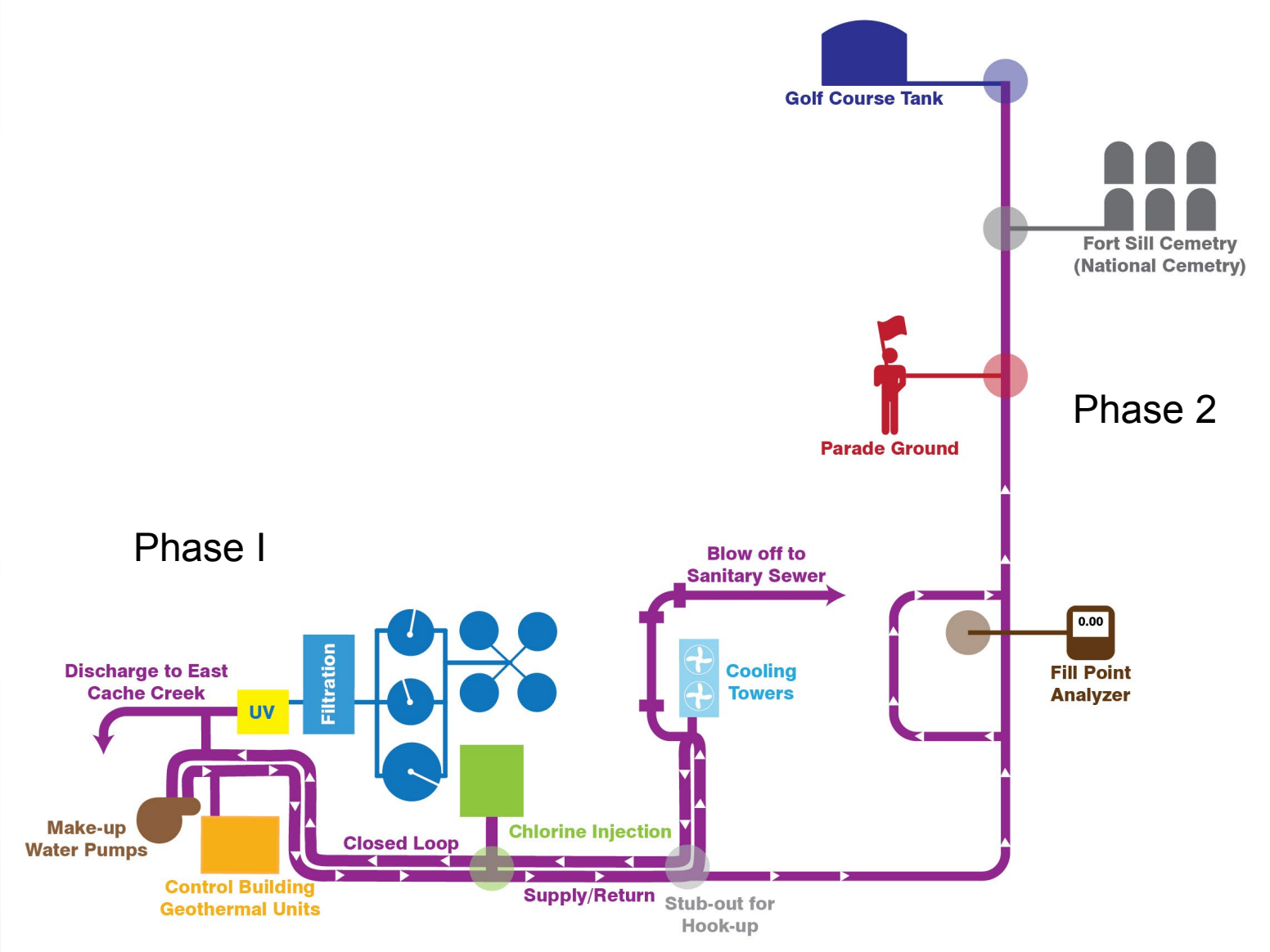
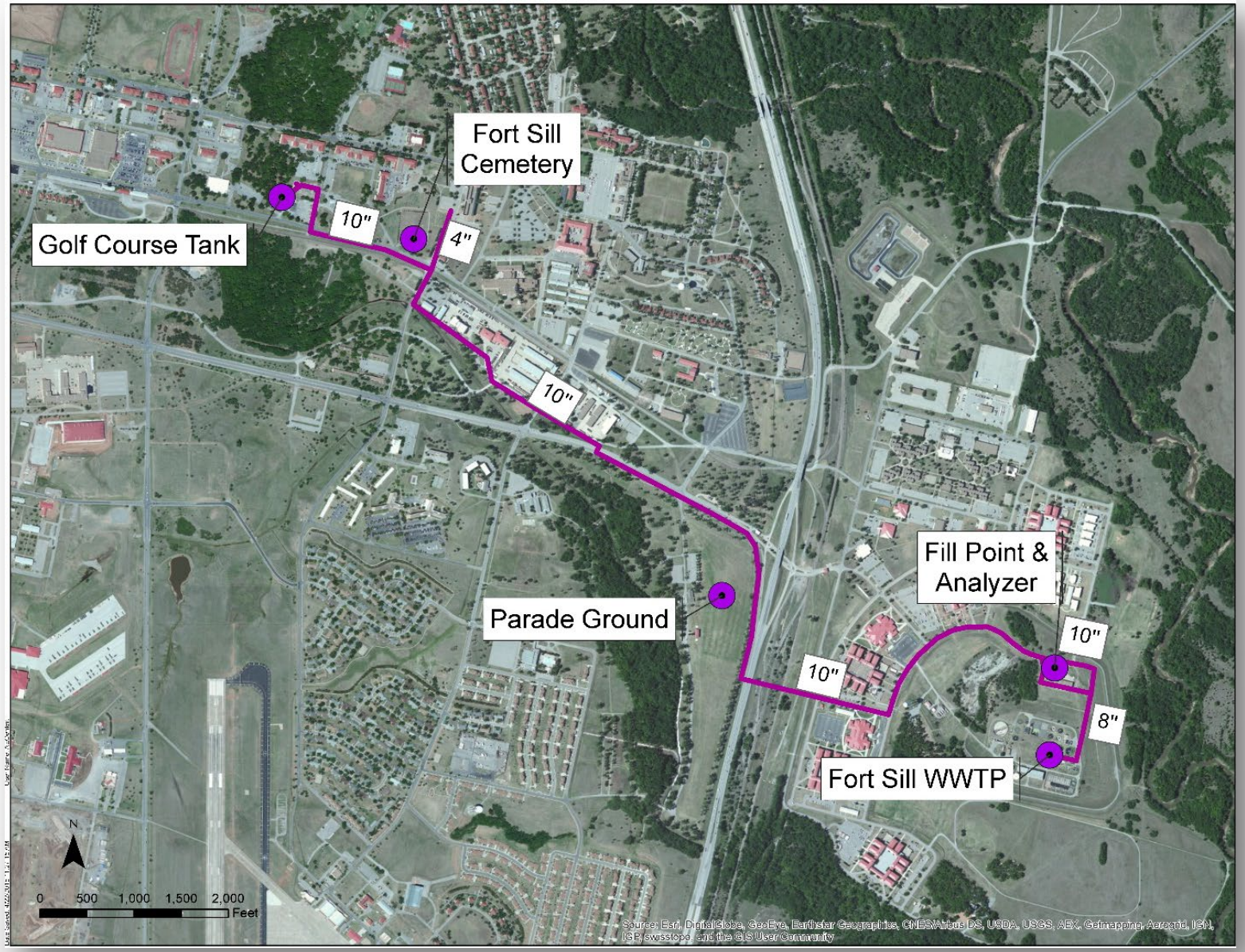


Fort Sill's Planned Expansion of Water Recycling Network



Oklahoma Reuse Regulations (2015)

Category	Treatment	Reuses
1	Reserved (for potable reuse)	IPR, DPR, Aquifer Recharge
2	Secondary Treatment: nutrient removal, coagulation, filtration & disinfection	Drip irrigation on orchards & vineyards; spray or drip on sod farms, public landscapes, golf courses, and toilets, fire protection, vehicle washing, and range cattle watering.
3	Secondary Treatment plus disinfection	Subsurface irrigation of orchards or vineyards; restricted access landscapes; livestock pasture, concrete mixing, dust control, restricted golf course
4	Primary Lagoon Treatment and Lagoon Storage plus disinfection	Soil compaction, similar construction activities, and restricted access golf course.
5	Primary Lagoon Treatment and Lagoon Storage	Restricted access pasture irrigation for range cattle, fiber, seed, forage, silviculture.
6	Varies	WWTP Plant Process Water

Chiller Tower Water at Bldg. 5900

Oklahoma Reuse Regulations (2015)

Category	Treatment	Reuses
1A, 1B, 1C	Reserved (for potable reuse)	IPR, DPR, Aquifer Recharge
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Unrestricted Irrigation On Base

Developing a roadmap to Cat. 2 required evaluation of the existing treatment infrastructure

Treatment Level	Category 3 Requirements	Category 2 Requirements	Fort Sill WWTP
Nutrient Removal	✓	✓	
Coagulation	✗	✓	
Filtration	✗	✓	
Disinfection	✓	✓	

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Nutrient Removal	✓	✓	✓
Coagulation		✓	✗
Filtration		✓	✓
Disinfection	✓	✓	✓

In 2014, AWE and Fort Sill Approached ODEQ Regarding Coagulation and Disinfection

- To meet Category 2 Reuse Requirements Fort Sill must continue to produce high-quality reuse effluent. . .

Parameter	Ft. Sill Reuse	Category 2 Requirements
BOD	2.2 mg/L	≤5.0 mg/L
NH_3	< 0.5 mg/L	≤ most stringent agronomic rate
Turbidity	< 1 NTU	2 NTU daily average
Chlorine	up to 5 mg/L	≥ 1.0 ppm at POE ≥ 0.20 mg/L at end of pipe

In 2014, AWE and Fort Sill Approached ODEQ Regarding Coagulation and Disinfection

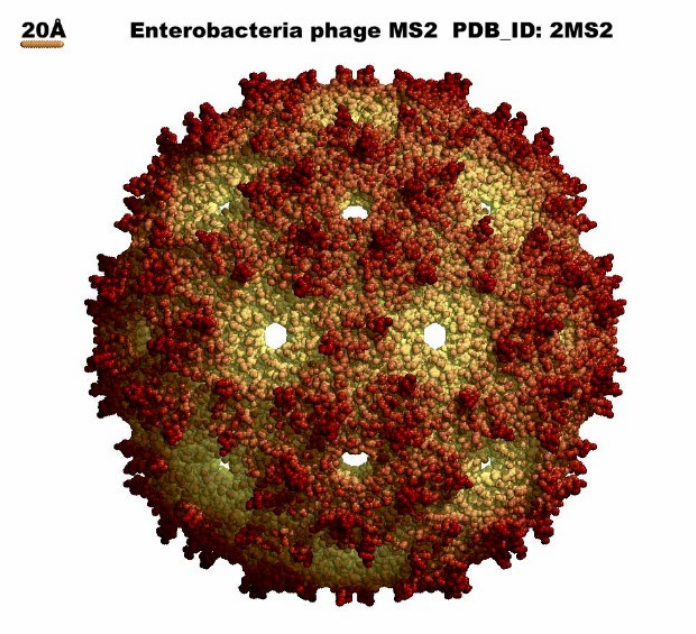
- . . . and demonstrate multi-barrier disinfection capacity for removal of Cat. 2 priority pathogens

		Fort Sill Disinfectants	
Parameter	**Total Treatment**	**UV**	**Cl_2**
Giardia	> 3-log-Removal	?	?
Salmonella	> 5-log-Removal	?	?
Adenovirus	> 5-log-Removal	?	?

Fort Sill had already converted its chlorine-contact basin to a LPHO UV system in 2005

Garver, AWE, ODEQ agreed upon a testing protocol to assess existing UV system at Ft. Sill WWTP

- Key Components of Testing
  - Relatively UV-resistant Coliphage (MS2 virus) as Challenge Organism
  - Viable MS2 injected into the influent of the UV system at controlled rate
  - Influent and effluent sampling at the UV system was observed MS2 inactivation



www.virology.wisc.edu

Establishing the worst-case (peak flow, fouled/aged lamps) UV Dose of 40 mJ/cm^2

- Gave Garver/AW/ODEQ the benchmark needed to establish a level of inactivation credit for Category 2 reuse

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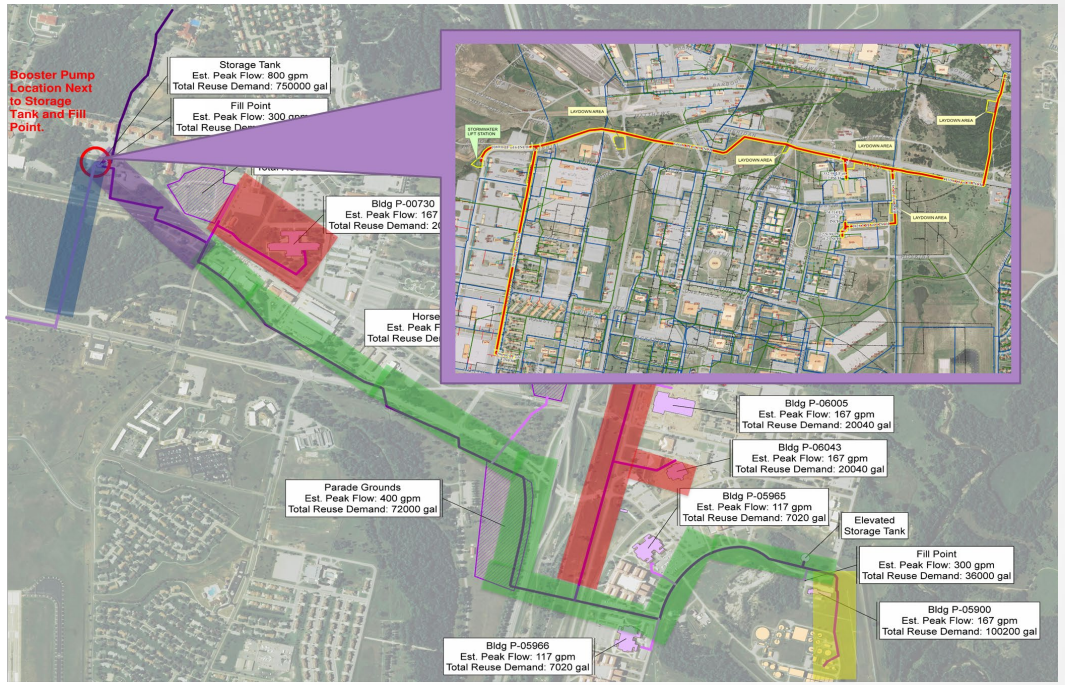
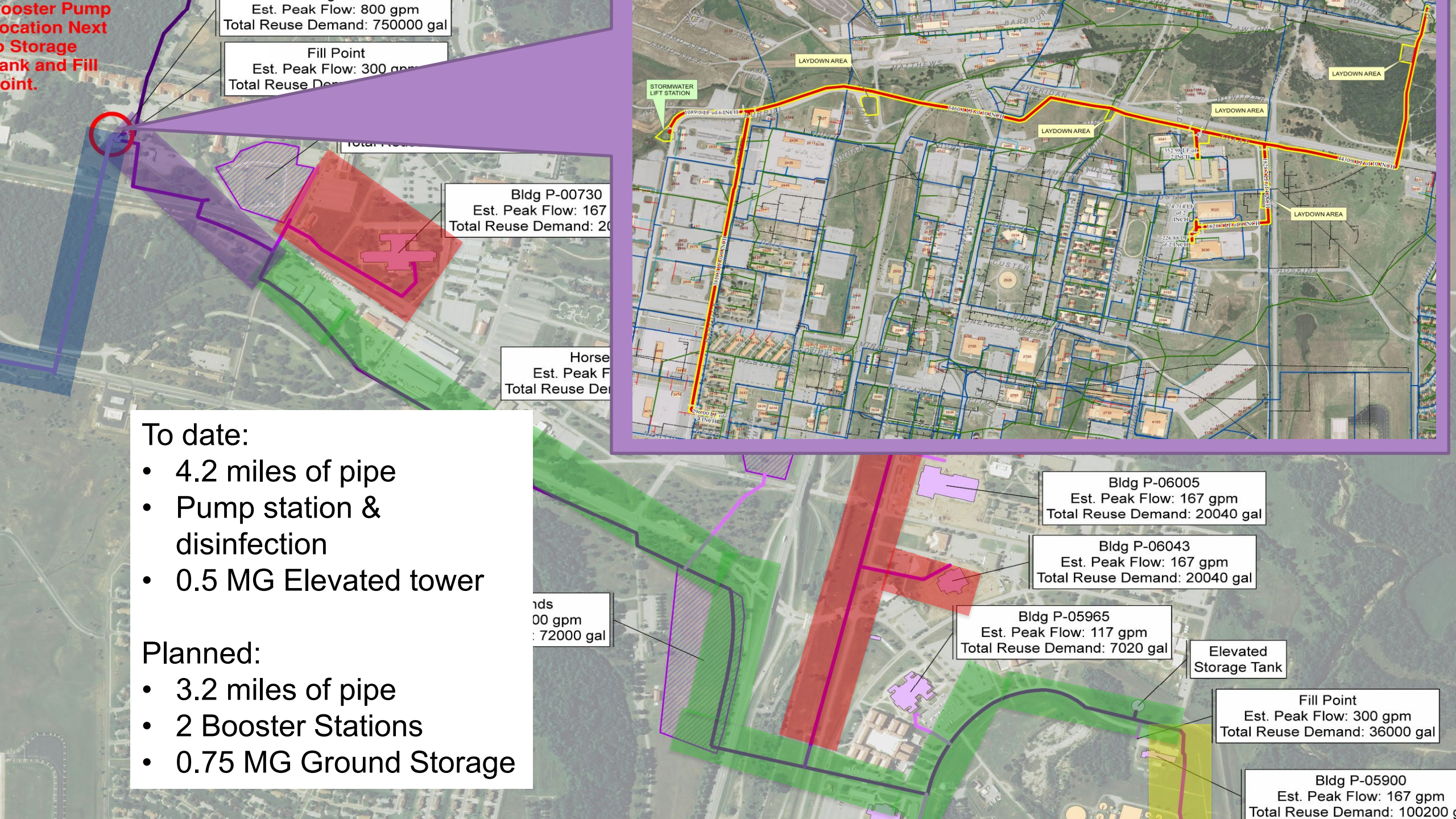
		Fort Sill Disinfectants	
Parameter	**Total Treatment**	**UV**	**Cl_2**
Giardia	> 3-log-Removal	3	-
Salmonella	> 5-log-Removal	2	3
Adenovirus	> 5-log-Removal	0.5	4.5

With no additional capital improvements!

Oklahoma's First Category 2 Permit was granted to Fort Sill August 13, 2015.

- Since then…
  - System ability to supply over 700,000 gallon/day
  - Saves up to 37 million gallons/year
  - Offset fresh water use from Lawton





To date:

- 4.2 miles of pipe
- Pump station & disinfection
- 0.5 MG Elevated tower

Planned:

- 3.2 miles of pipe
- 2 Booster Stations
- 0.75 MG Ground Storage

So….

What's Next…?

- AWE and Fort Sill looking to decrease their fresh water consumption further

- Improve resiliency and decrease drought impacts

…Potable Reuse

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