CHARLOTTE WATER | CITY OF CHARLOTTE

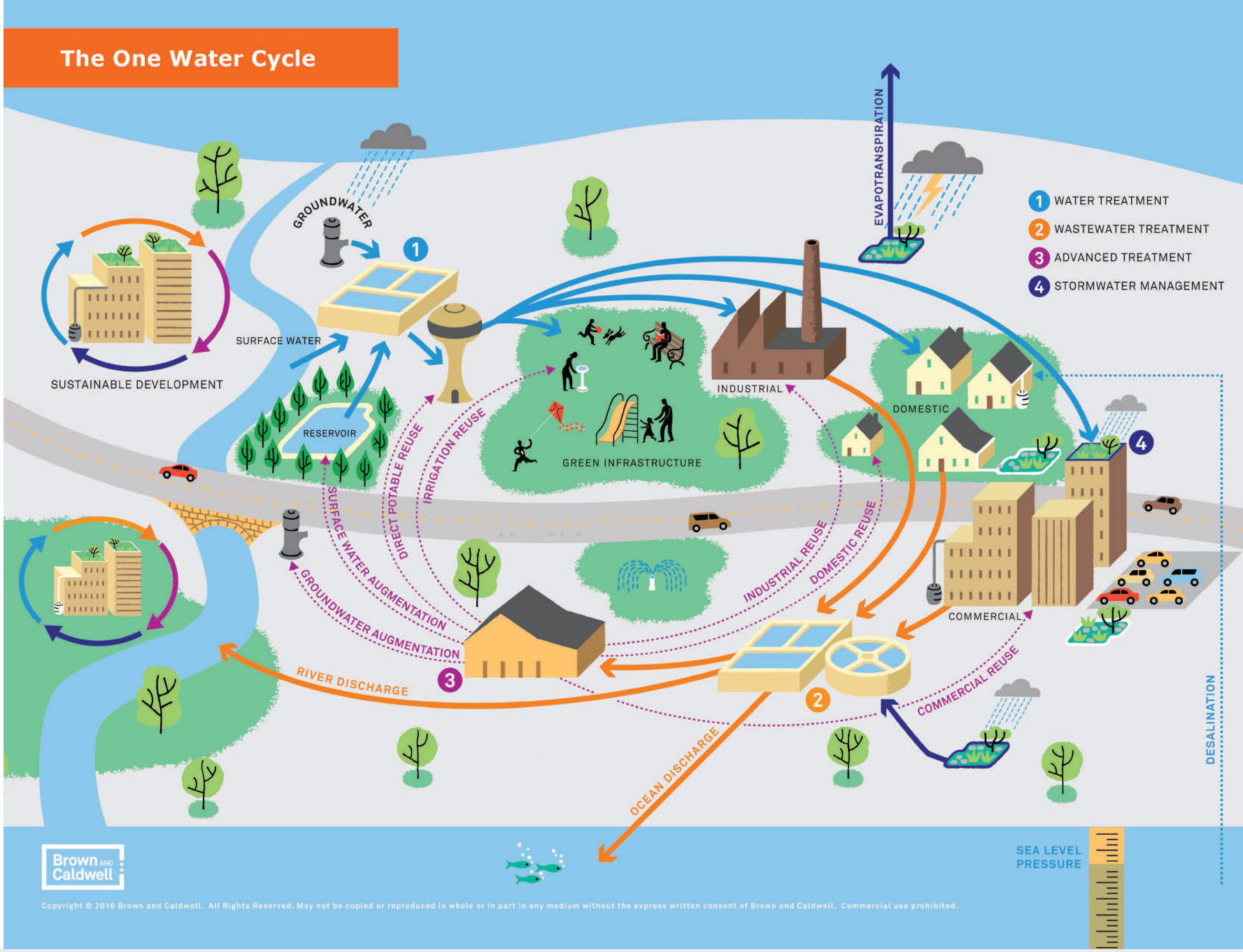
Water and Wastewater Treatment

CITIZEN'S WATER ACADEMY: SESSION 7

RON HARGROVE, DEPUTY DIRECTOR

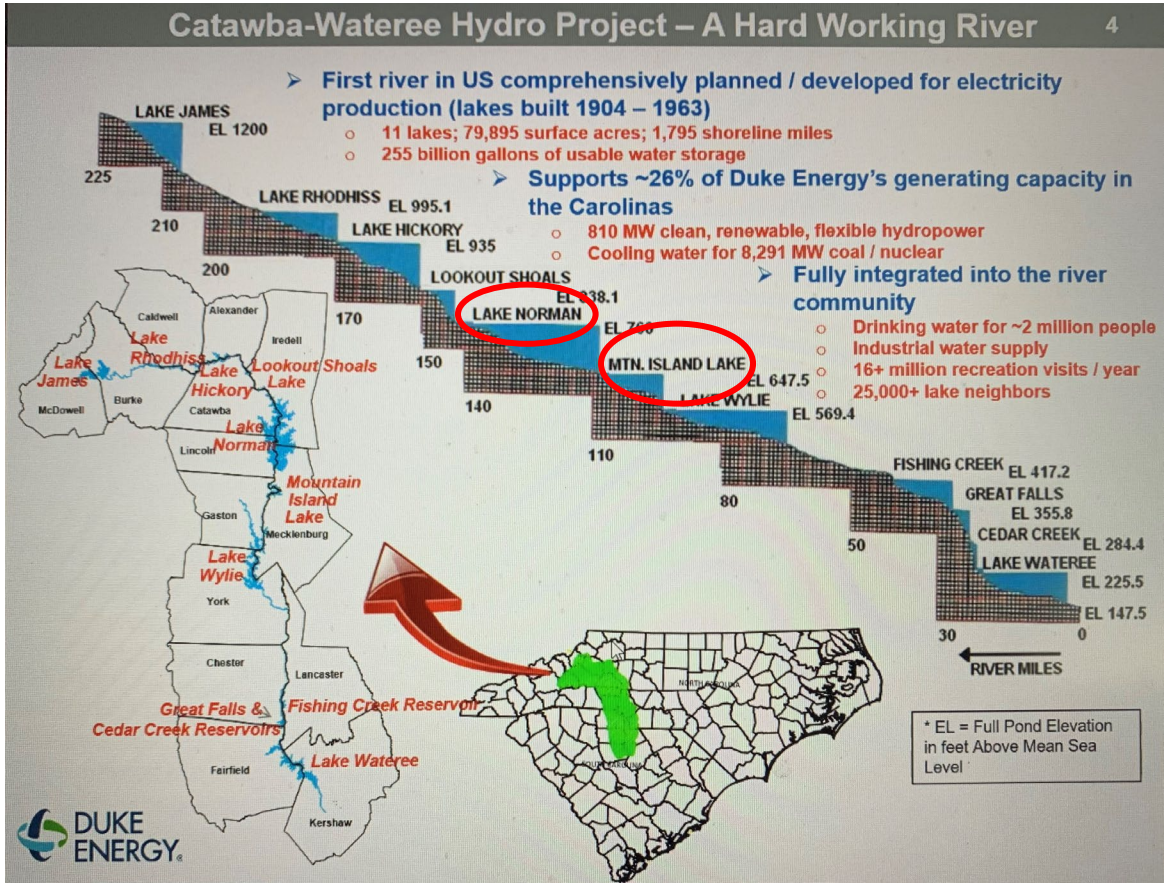
Sustaining Resource

- **Serves growing population > 2 million (13.5% in the last 10 yrs)**
- **Power generation for >3.7 homes**
- **Industrial needs**
- **Agricultural needs**
- **> 16 million recreation and tourism activities**
- **Interstate commerce**
- **Increasing property values/tax base**
- **Ecological flow needs**



Catawba River supplies high quality source water

- **Mountain Island Lake: 2,788 ac**
- **Lake Norman: 32,475 ac**
- **Excellent, stable and very treatable source water**
  - Very clear with low Turbidity (2-5 NTU)
  - pH – consistently 6.8 - 7.2
  - Alkalinity – 12-14 mg/L
  - Minimal bacteriological concentrations
  - Low organic content TOC <2 mg/L
  - Quality Assurance Partnerships:
    - *Mecklenburg County LUESA*
    - *NCDEQ*
    - *Duke Energy*
    - *NCWRC*



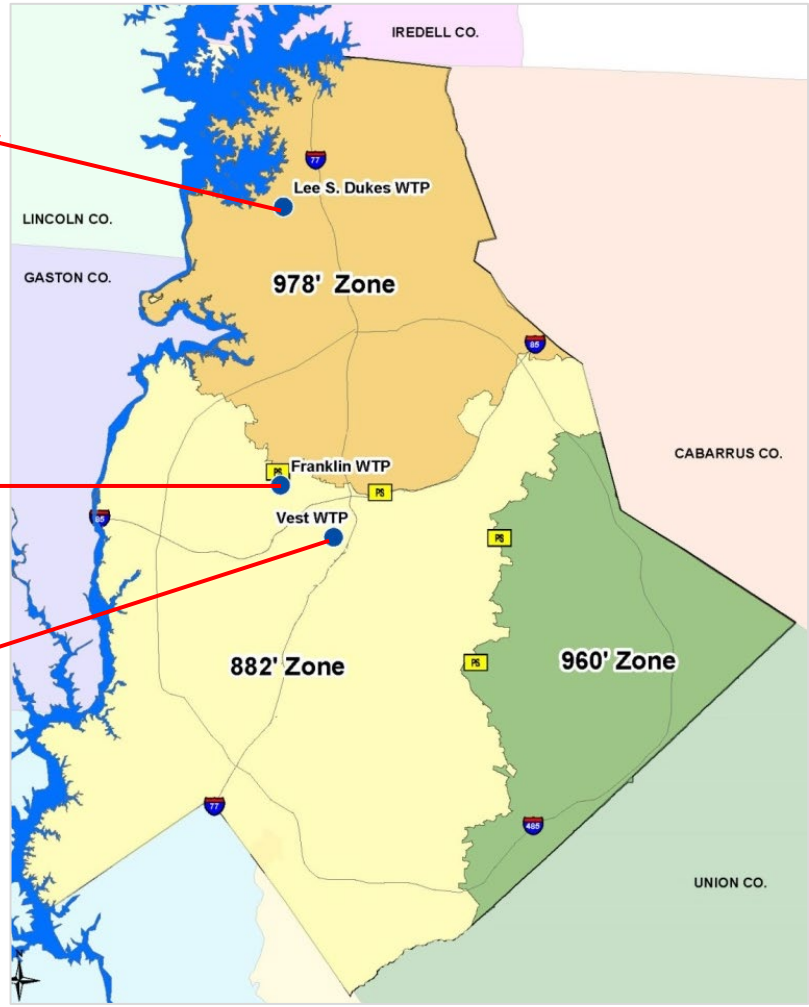
Catawba River Pump Station

- **Initial intake 1911**
- **Supplies 2 water treatment plants**
- **330 million gallons per-day (MGD) capacity**

“The attention of the reader is directed to the small streams shown in the cuts, from which Charlotte now obtains its water supply, and requests you to compare them with the pictures in which is portrayed the bold onward sweep of the Catawba river, then the mind can quickly grasp why this grand river should be selected for the terminus of our pipe line, and where an unlimited water supply is waiting for Charlotte to tap it.”

Excerpt from 1903 Annual Report

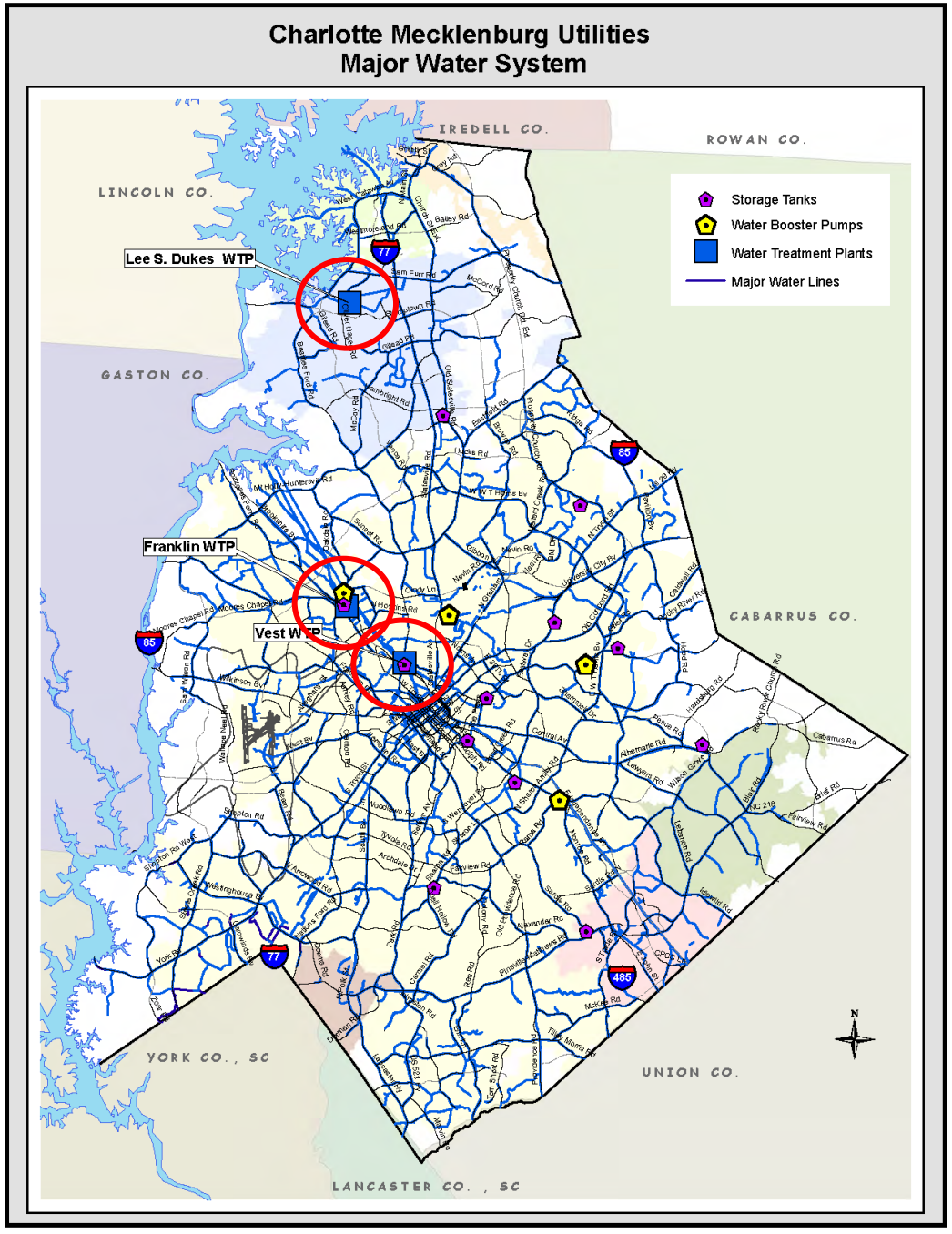
Water Treatment



- **Vest (1924)**
  - Treatment Capacity (24 MGD)
- **Franklin (1959)**
  - Treatment Capacity (132 MGD)
- **Dukes (1998)**
  - Treatment Capacity (18 MGD)
  - Intake in Lake Norman (108 MGD)

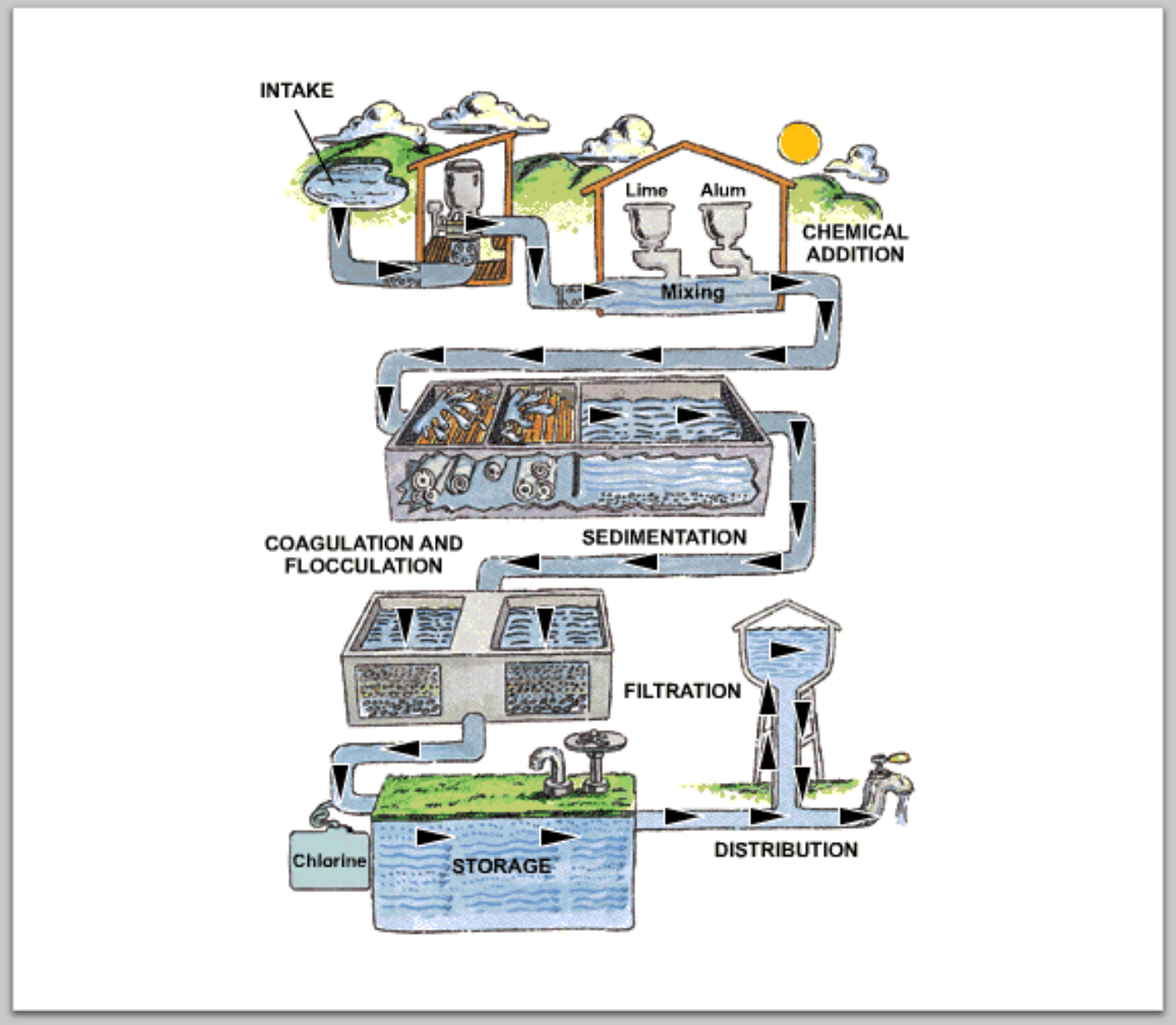
Water Supply/Demand

- **Total Treatment Capacity = 174 MGD**
- **2021 Demand = 115.7 MGD**
- **2020 Demand = 105.0 MGD**
- **2019 Demand = 110.8 MGD**
- **5 yr Avg Demand = 107.3 MGD**
- **Historic Peak Demand = 169.2 MGD (8/20/2007)**
- **Current LIP Stage 0**

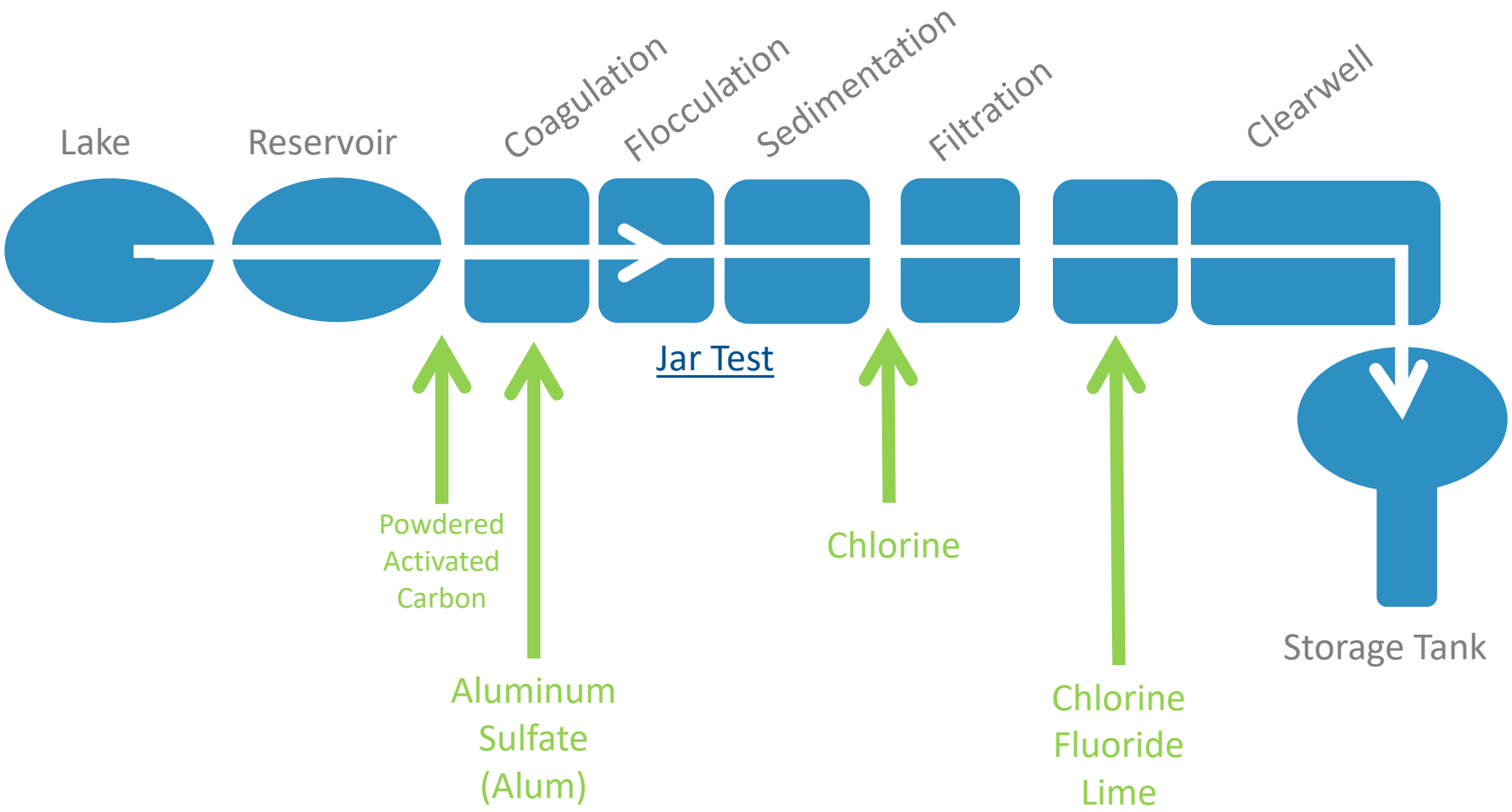


Water Treatment Process

- **Conventional treatment**
  - Coagulation
  - Flocculation
  - Sedimentation
  - Filtration



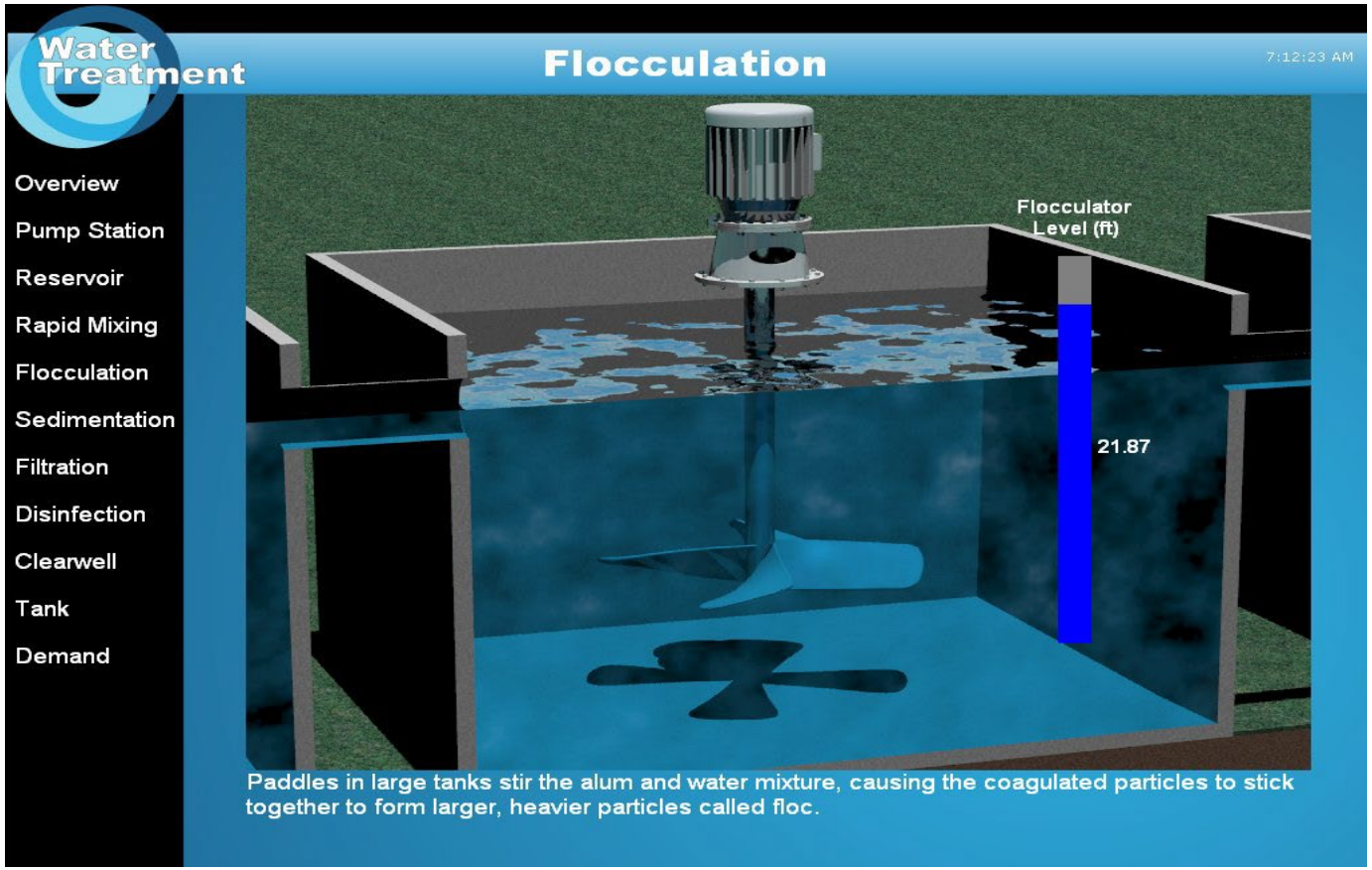
Water Treatment



Rapid Mix

- **Coagulant (Alum, Ferric, etc.)**
- **Alkalinity addition (Lime, NaOH, others)**

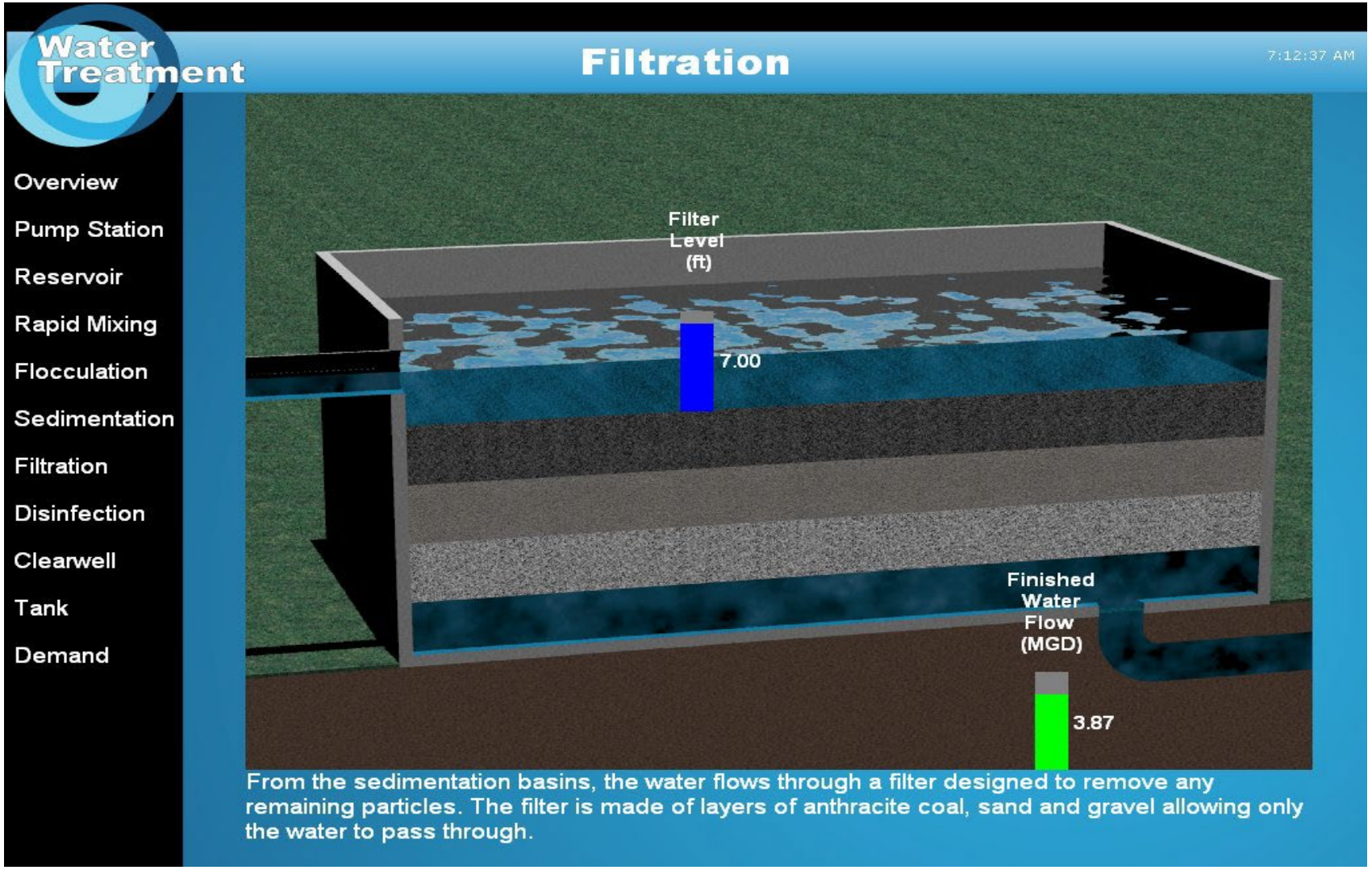
Flocculation



Sedimentation

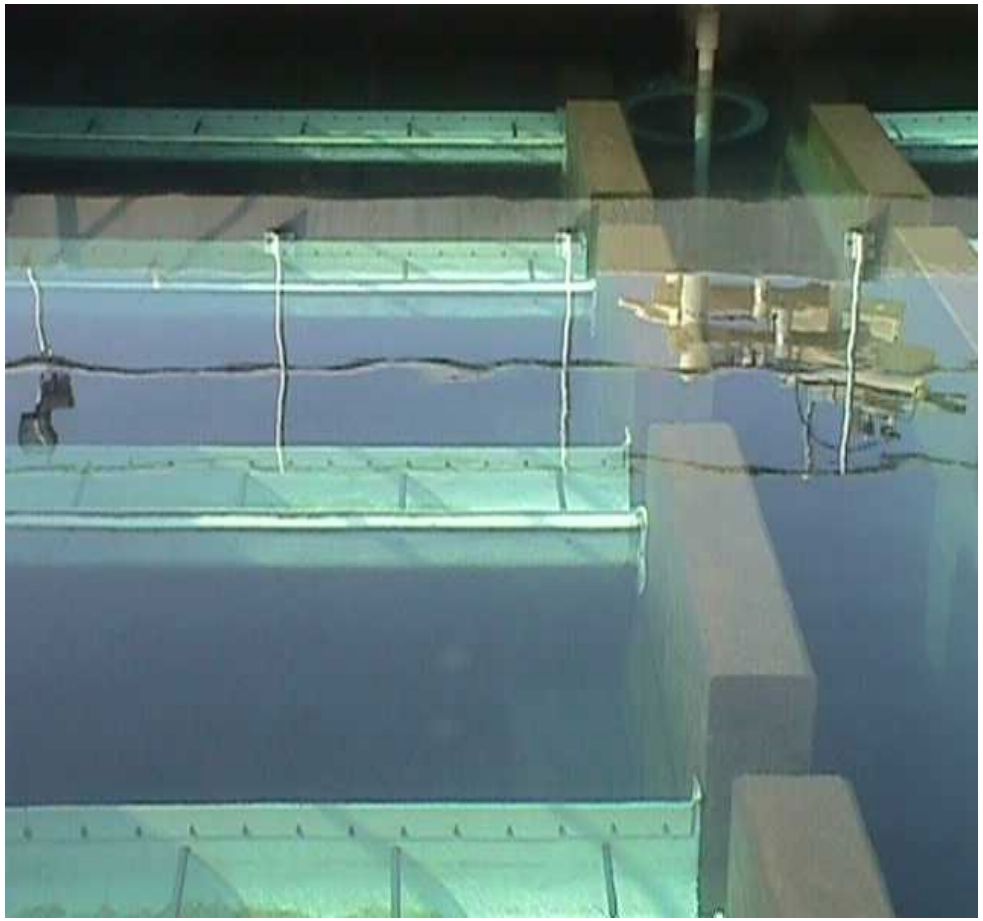
- **Minimum detention time = 4 hours at design capacity**
- **Floc settles out to the bottom of the basin**
- **Mechanical devices in basins are typical for solids removal system or to enhance clarification**
- **Clear water layer on top flows to filters**

Filtration



- **Chlorine is added for disinfection**
- **Process removes remaining particulate matter from water**
- **Particulate impurities can harbor bacteria and shielded from disinfection**

Filtration



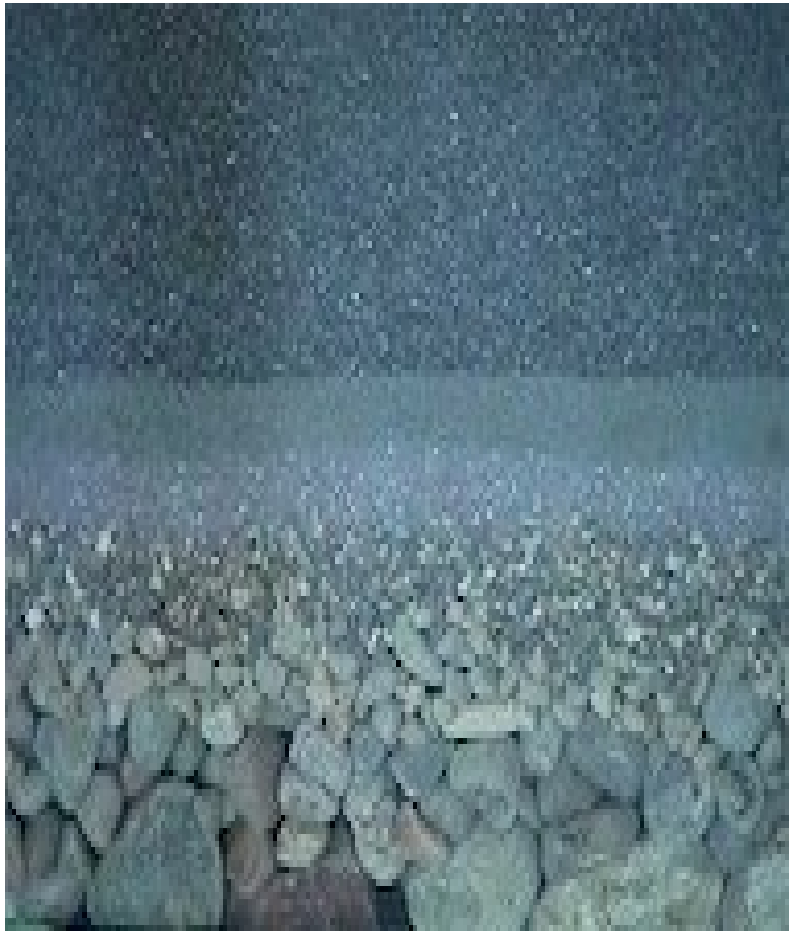
Anthracite Coal

Fine Sand

Coarse Sand

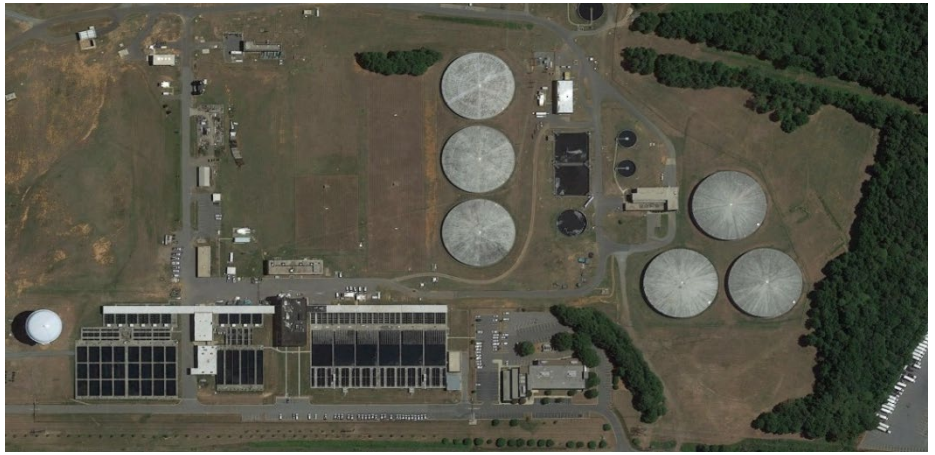
Small Gravel

Large Gravel



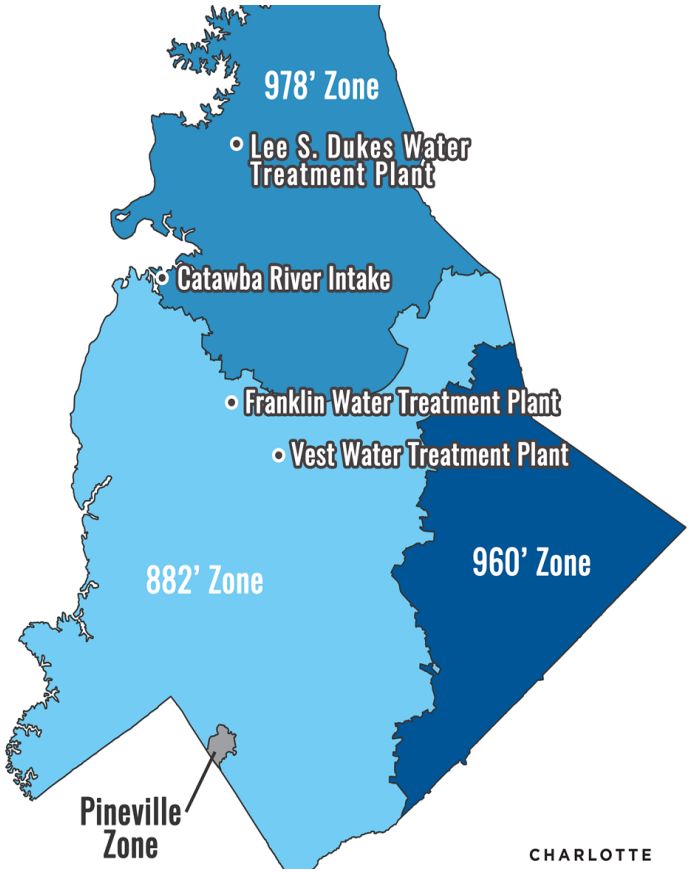
Post Filter Chemical Addition

- **Chlorine is to disinfect water and establish a free chlorine residual**
- **Since 1949, fluoride has been added to the water supply in Charlotte**
- **Hydrated Lime is added as a corrosion inhibitor and for pH adjustment**
- **“Finished” water is stored in on-site clearwells (tanks) to allow contact time for chlorine disinfection before distributing to customers**



Three Major Pressure Zones

- **Plants pump drinking water into distribution system; controlled by level in elevated tanks**
- **System water pressure is set by elevation of storage tanks within geographical boundaries termed “pressure zones”**
- **Water is transferred between zones by booster pump stations**



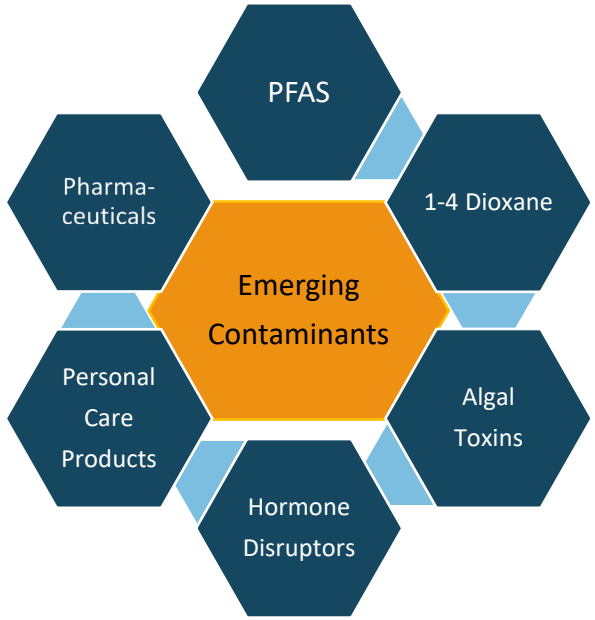
Drinking Water Regulatory Framework

EPA
Environmental Protection Agency

SDWA
Safe Drinking Water Act of 1974 (Amended in 1986 and 1996)

NCDEQ
North Carolina Dept. of Environmental Quality (Primacy)

DW Rules/Regulations



Revised Total Coliform Rule
Lead and Copper Rule
Disinfection/Disinfectants Byproducts Rule
Chemical Contaminants Rule (IOC, SOC, VOC)
Arsenic Rule
Radionuclides Rule
Surface Water Treatment Rule
Ground Water Rule
Public Notification Rule
Consumer Confidence Report Rule
Unregulated Contaminants Monitoring Rule
Source Water Protection/Assessment

Member of

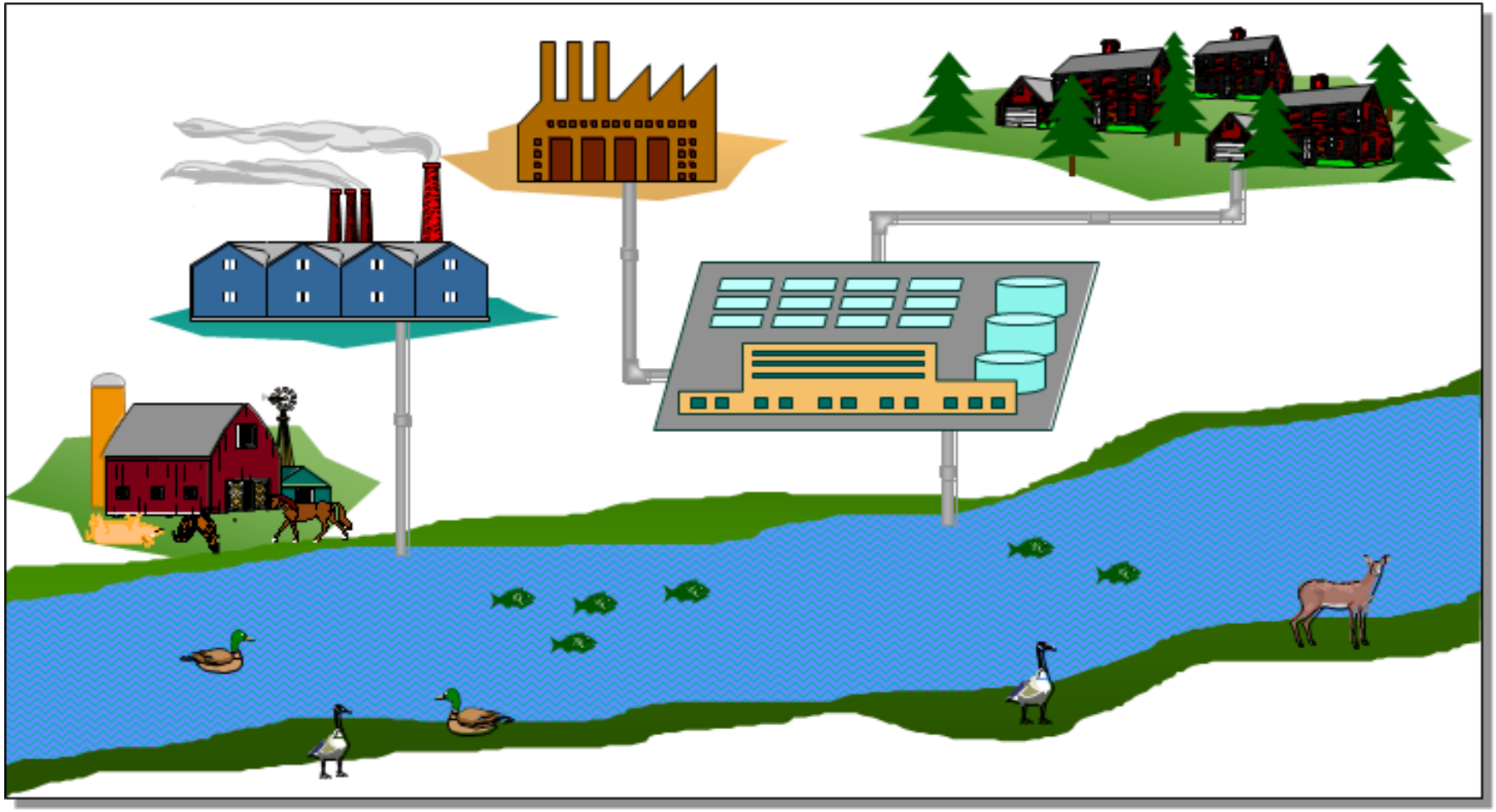
AWWA PARTNERSHIP FOR SAFE WATER

Water Treatment & Distribution

Meeting even more stringent limits than set by EPA or NCDEQ

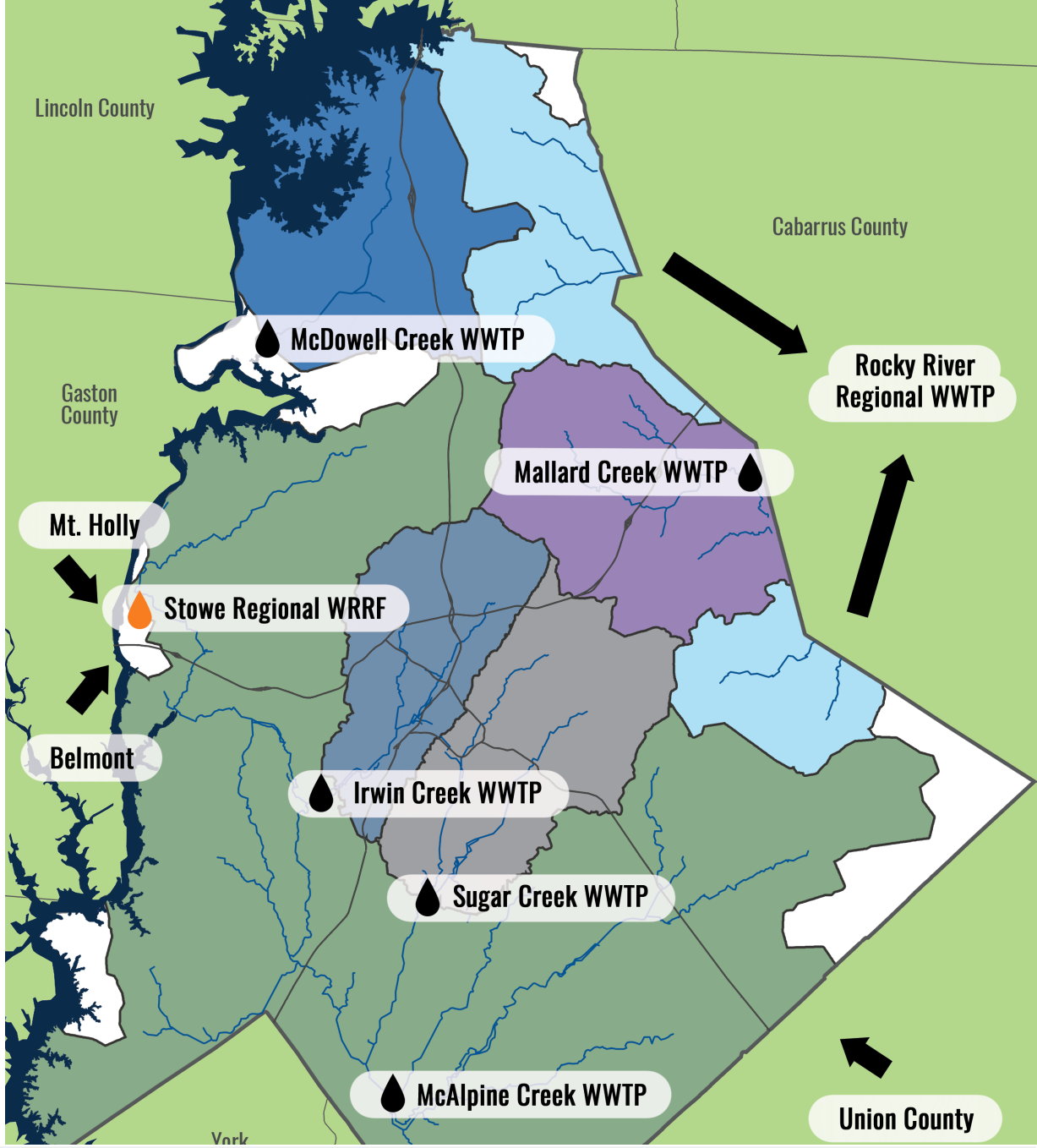
Image Courtesy BVRT Water Resources

Point and Non-Point Sources

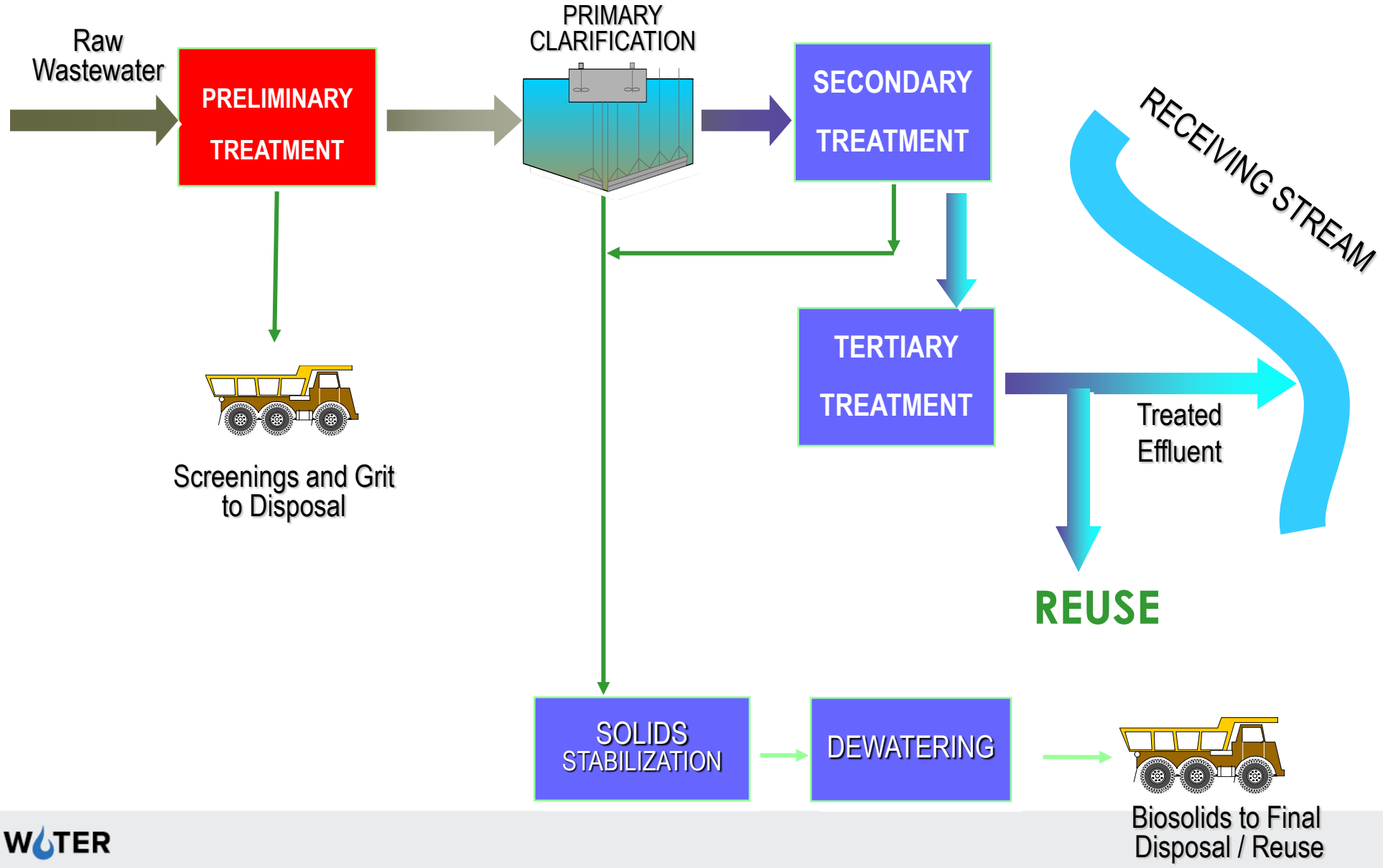


Environmental Management Division

- **5 major treatment facilities**
- **Capacity: 123 MGD**
- **2021 flows: 83.9 MGD**
- **High flow peak ~ 500MGD (Hurricane Florence 2018)**
- **EQ storage: 173 MG**
- **Permit Compliance: 99.9%**
- **3 of 5 facilities under construction**
- **2020 NACWA Awards for all facilities!**
  - **Platinum – McDowell, Mallard, Sugar, and McAlpine**
  - **Gold – Irwin**



Treatment Process Overview



Plant Influent

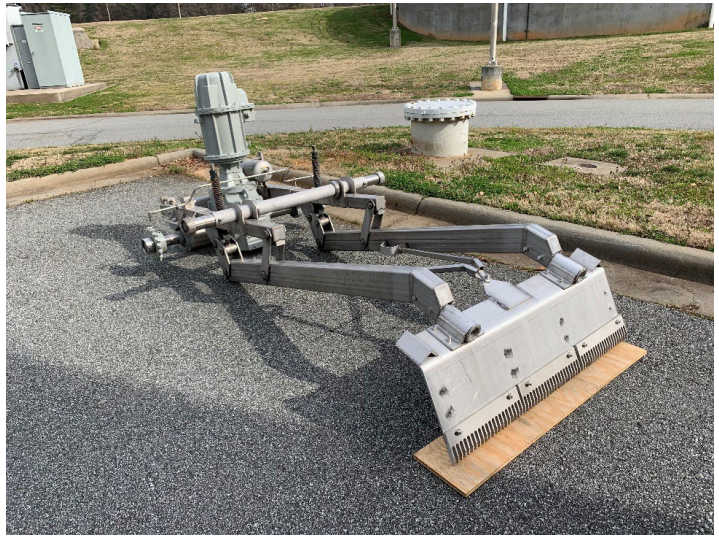
Typical Influent Concentrations

- **cBOD** ~300mg/L
- **TSS** ~300 mg/L
- **NH_3** ~30 mg/L

BOD – biochemical oxygen demand **TSS – Total Suspended Solids** **NH_3 - Ammonia**

Preliminary Treatment Process

- **Screening and Grit Removal**
- **Bar screens to catch trash and debris**
  - Bars typically ¼ inch opening
  - Cleaned by automatic rake
  - Conveyor to dumpster
- **Grit Removal**
  - “Vortex” units to separate grit from water
  - Dumpster disposal



Influent Pumping and Storage

Primary Clarifiers

- **Two Processes**
  - Sedimentation to removal settling solids
  - Skimming to remove floating solids
- **Goal to remove portion of oxygen demanding pollutants**
- **Primarily organic matter**
- **Removed solids transferred to anaerobic digesters**

Typical Primary Clarifier Effluent Concentrations

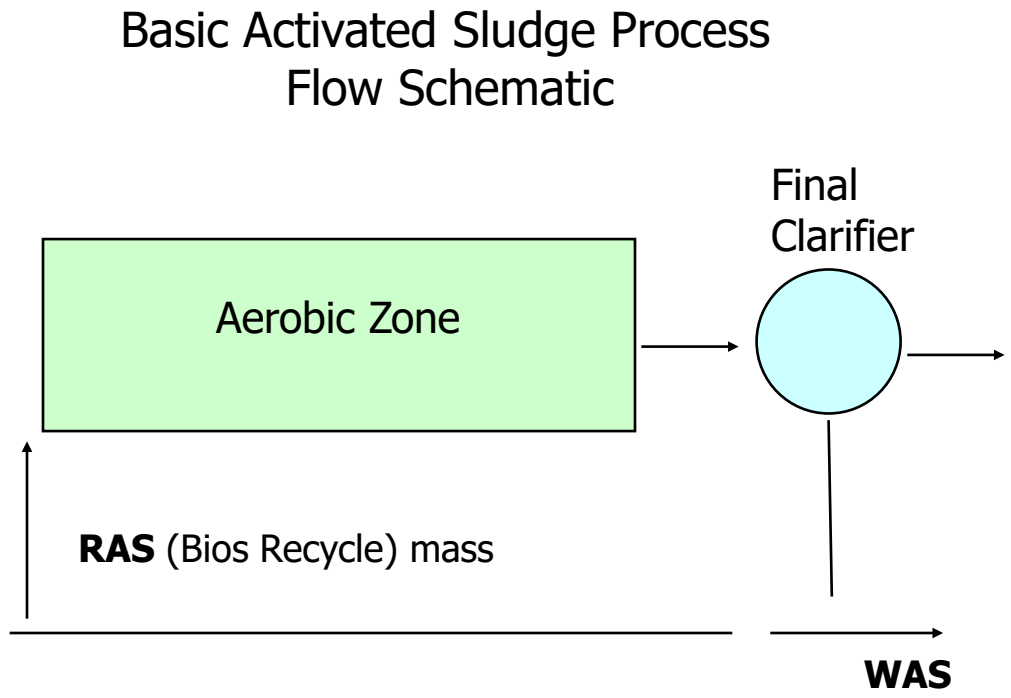
cBOD 120mg/L

TSS 120mg/L

NH3 30mg/L

Basic Activated Sludge Process

- **Goal is to process soluble containments with micro-organisms**
- **Stabilizes insoluble organic matter (TSS)**
- **Similar to process in a stream**
- **Achieves nitrification**



Role of Microorganisms

- **Bacteria derive energy from oxidation reactions**
- **Convert nutrients to biomass or other degradable forms**
- **Form settleable floc**
- **Heterotrophs and Autotrophs**

Aeration Basin

Secondary Clarification

- **Two Processes**
  - Primarily sedimentation to remove settling solids
  - Skimming to remove any remaining floating solids
- **Goal to remove the microbes via flocculation and settling**
- **Removed solids either recycled (reseeding) to the aeration tank or transferred to anaerobic digesters**

- **cBOD <2.0 mg/L**
- **TSS 0-10 mg/L**
- **NH3 <1.0 mg/L**

Tertiary Treatment and Disinfection

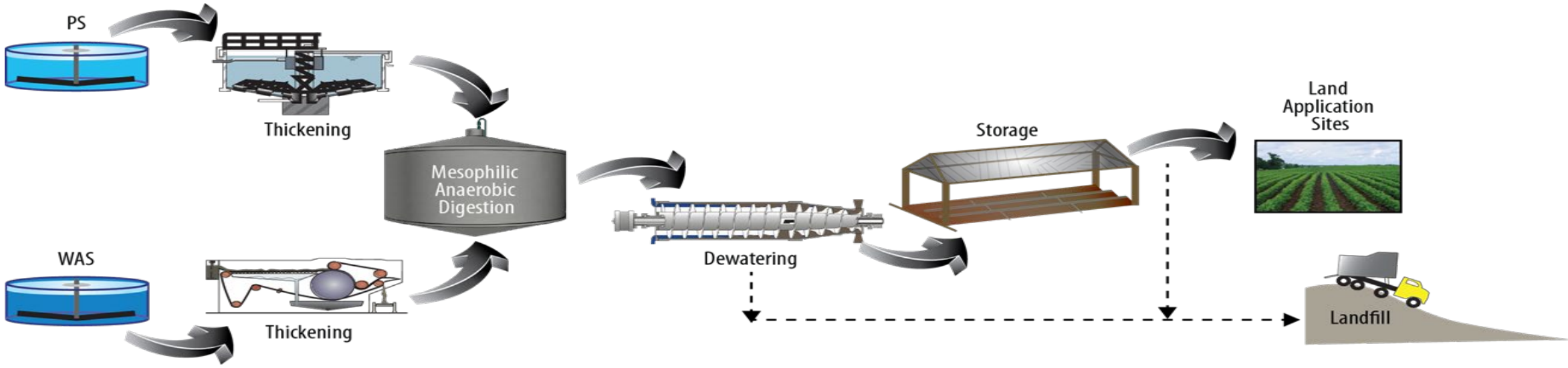
- **Primary goal is to remove remaining particles after clarification**
- **Filters may also be built to assist with nitrogen removal where required to meet permit limits**
- **TSS < 5.0 mg/L**

Disinfection Process & Final Effluent

- **Primary goal is to disinfect water to safe levels**
- **Typically completed using UV light or chlorine**
  - Chlorine must be removed before discharging water to stream
- **Effluent aerated prior to discharge**

Biosolids

- **Class B biosolids are land applied to farmland**
- **Biosolids are landfilled when weather prohibits land application**
- **Current program is ISO 14001 certified**
- **Excellent regulatory compliance**



Solids Digestion

- **Reduces Odor**
- **Reduces Solids Volume**
- **Stabilizes the Product**
- **Reduces Pathogens**
- **Produces a product that can be dewatered.**

Solids Dewatering

- **Dewatering reduces moisture and water**
- **Produces a product that can be hauled and beneficially reused by land application**

Beneficial Use and Land Application of Solids

- **Land Application**
  - Useful to famers to amend soil and reduce use of fertilizer
  - Improves soil health
  - Reduces and can eliminate solids going to landfills
  - Sustainable

Wastewater Treatment Regulatory Framework

EPA
Environmental Protection Agency

CWA
Clean Water Act of 1972 (Amended in 1977 and 1987)

NCDEQ
North Carolina Dept. of Environmental Quality (Primacy)

CWA Rules/Regulations

Federal Regulations:
➢ 40 CFR Part 123 – Delegated State Requirements
➢ 40 CFR Part 125 – NPDES Criteria & Standards
➢ 40 CFR Part 127 – Electronic Reporting Rule
➢ 40 CFR Part 133 – Secondary Treatment Standards
➢ 40 CFR Part 136 – CWA Approved Analytical Methods
➢ 40 CFR Part 403 – General Pretreatment Regulations
➢ 40 CFR Part 503 – Biosolids Use & Disposal Regulations
State Regulations:
➢ 15A NCAC 02H .0100's – Point Sources Regulations
➢ 15A NCAC 02H .0900's – Pretreatment Regulations
➢ 15A NCAC 02T .0900's – Reclaimed Water Systems
➢ 15A NCAC 02T .1100's – Residuals Management

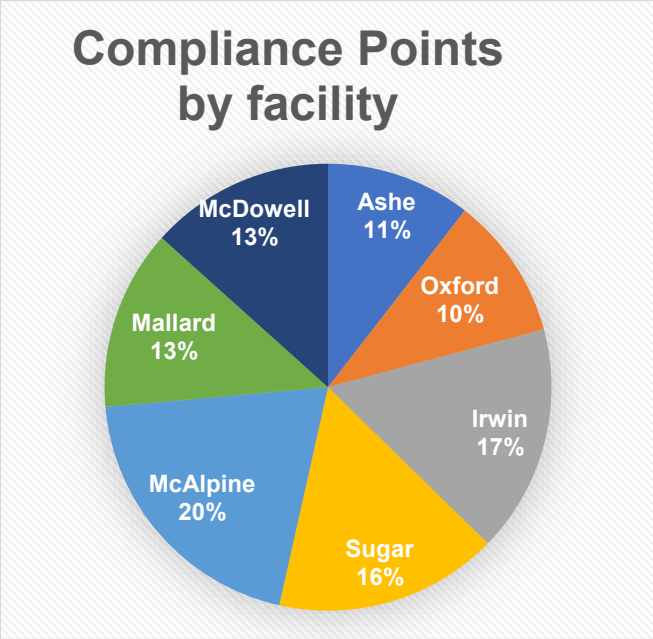
NPDES Permits

- **6 Major NPDES Permits**
  - McDowell Creek (12 MGD)
  - Mallard Creek (12 MGD)
  - Irwin Creek (15 MGD)
  - Sugar Creek (20 MGD)
  - McAlpine Creek (64 MGD)
  - Stowe Regional (in design) (15 MGD)
- **NPDES Permit Requirements**
  - **Numeric limits**
    - *Found in the effluent limitations table of our permit*
      - **Frequency**: continuous, "daily" 2/week, monthly, quarterly,
      - **Sample type:** composite, grab
      - **Location:** influent, effluent, upstream, downstream
  - **Narrative requirements**
    - *Found through the body of our permit*

PARAMETER CHARACTERISTICS	Parameter Code	EFFLUENT LIMITS			MONITORING REQUIREMENTS		
		Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Location
Flow	50050	64.0 MGD			Continuous	Recording	Influent or Effluent
CBOD, 5-day (20°C) [2] (April 1 -October 31)	80082	4.0 mg/L	6.0 mg/L		2/Week [3]	Composite	Influent and Effluent
CBOD, 5-day (20°C) [2] (November 1- March 31)	80082	8.0 mg/L	12.0 mg/L		2/Week [3]	Composite	Influent and Effluent
Total Suspended Solids [2]	CO530	15.0 mg/L	22.5 mg/L		2/Week [3]	Composite	Influent and Effluent
NH_3 as N (April 1 -October 31)	CO610	1.0 mg/L	3.0 mg/L		2/Week [3]	Composite	Effluent
NH_3 as N (November 1- March 31)	CO610	1.9 mg/L	5.7 mg/L		2/Week [3]	Composite	Effluent
Fecal Coliform (geometric mean)	31616	200/100 mL	400/100 mL	1000/100 mL	2/Week [3]	Grab	Effluent
pH	00400	Between 6.0 and 9.0 standard units			Daily	Grab	Effluent
Dissolved Oxygen	00300	Daily Average ≥ 6.0 mg/L			Daily	Grab	Effluent
Conductivity (µmhos/cm)	00094				Daily	Grab	Effluent
Temperature (°C)	00010				Daily	Grab	Effluent
Total Residual Chlorine [4]	50060		17 µg/L	28 µg/L	Daily	Grab	Effluent
Total Silver [5] (µg/L)	01077				Quarterly	Composite	Effluent
Total Phenolic Compounds (µg/L)	32730				Quarterly	Grab	Effluent
Dichlorobromomethane (µg/L)	32101				Quarterly	Grab	Effluent
Total Nitrogen (NO_2+NO_3+TKN) (mg/L)	CO600				Monthly	Composite	Effluent
Total Phosphorus (mg/L)	CO665	1,067 lbs/day [6]	See Special Condition A. (7) and A. (8)		Monthly	Composite	Effluent
Chronic Toxicity [7]	TGP3B				Quarterly	Composite	Effluent
Hardness- Total as [$CaCO_3$ or (Ca + Mg)] (mg/L)	00900				Quarterly	Composite	Effluent
Effluent Pollutant Scan	NC01	Monitor and Report			Footnote 8	Footnote 8	Effluent

Monitoring Data & Results

- **Over 53,000 analysis performed**
- **Over 8,000 Compliance Points in 2020**
- **No violations!**



Member of

National Association of Clean Water Agencies (NACWA) 2020

Platinum Awards:

McAlpine Creek WWMF

McDowell Creek WWTP

Sugar Creek WWTP

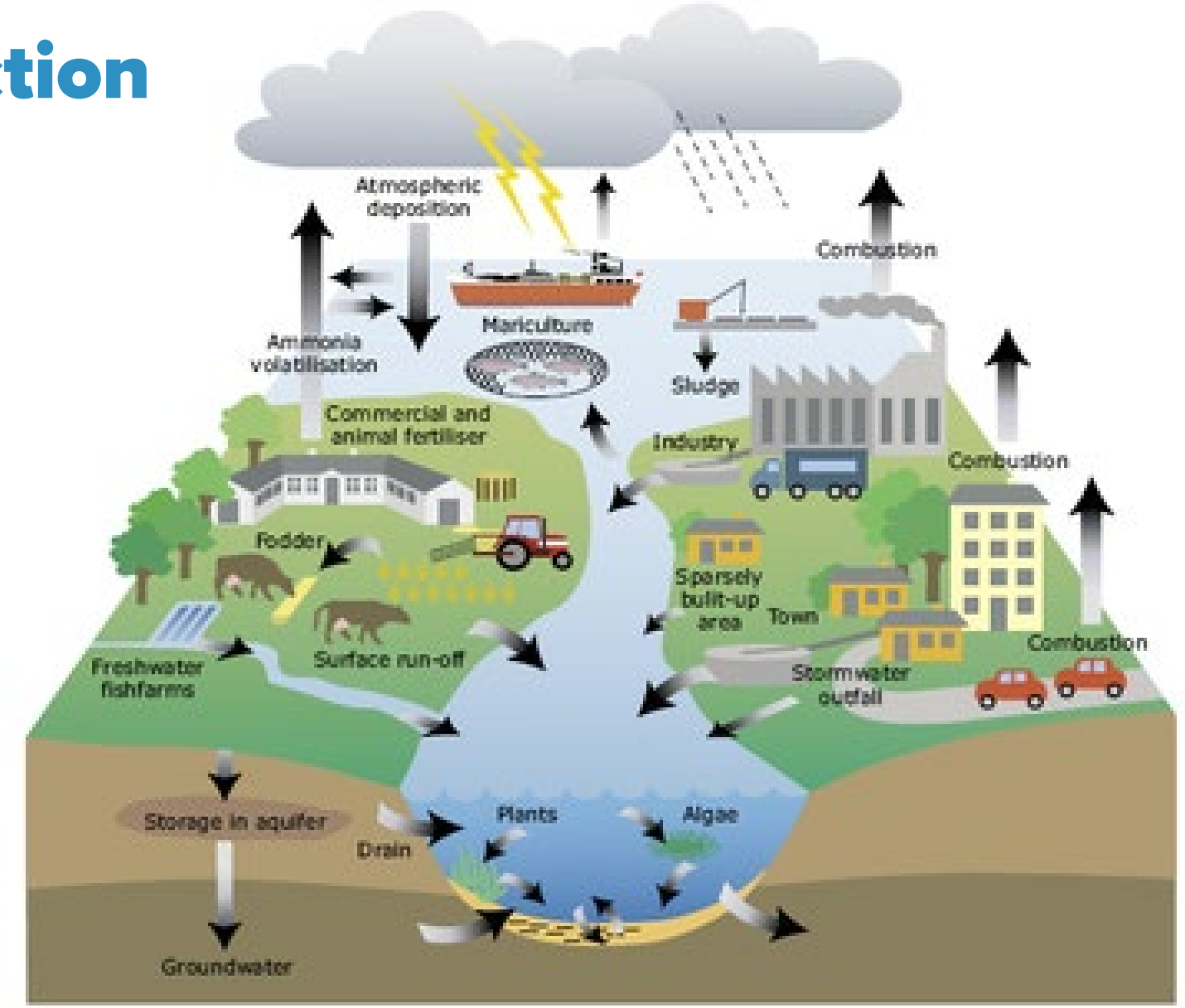
Mallard Creek WRF

Gold Awards:

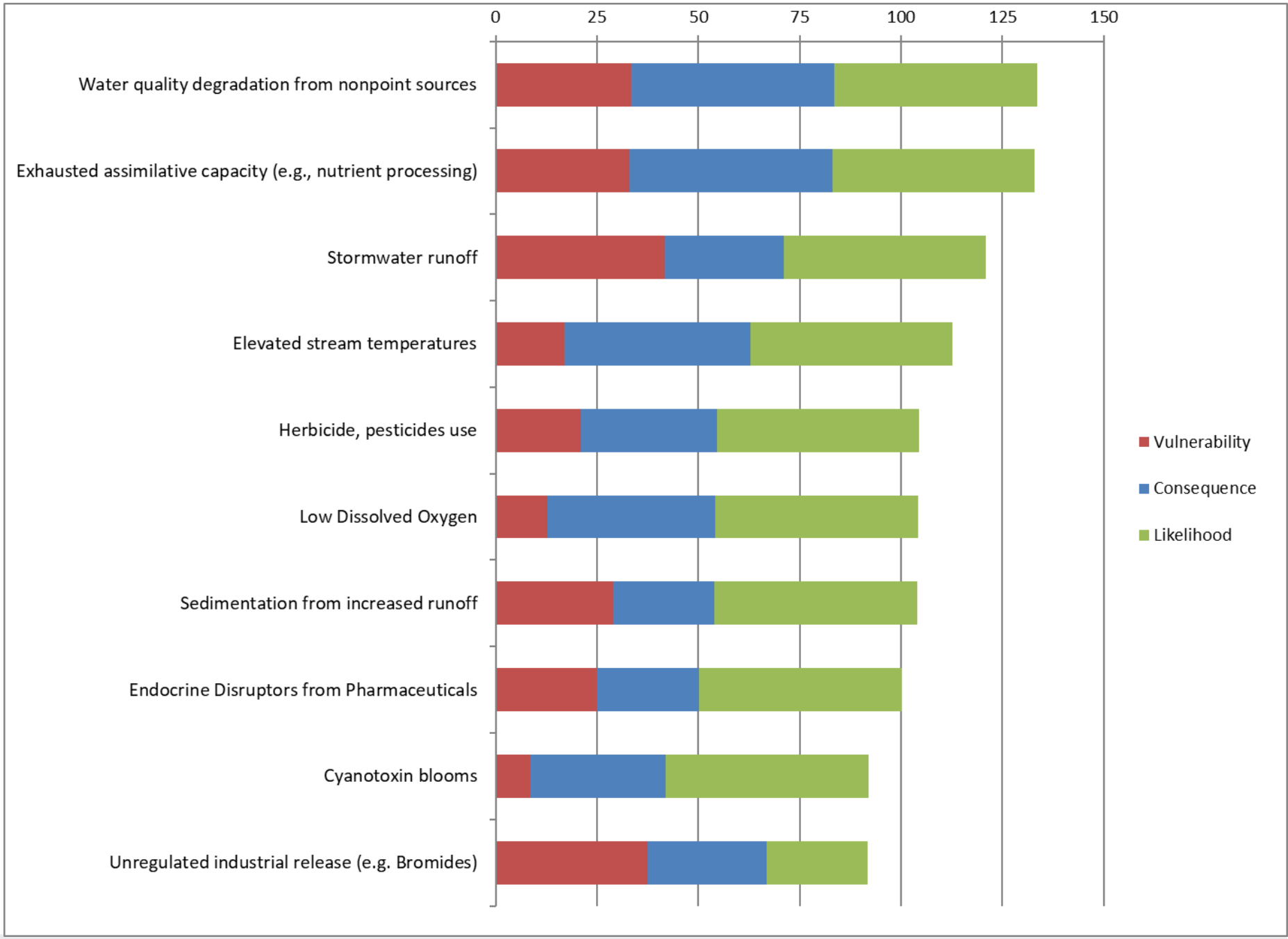
Irwin Creek WWTP

Source Water Protection

- **Water is critical to life and is becoming increasingly stressed**
- **Where are potential pollutants?**
- **What can we do about the pollutants?**
  - Current
  - Future
- **Develop a plan to address potential risks**

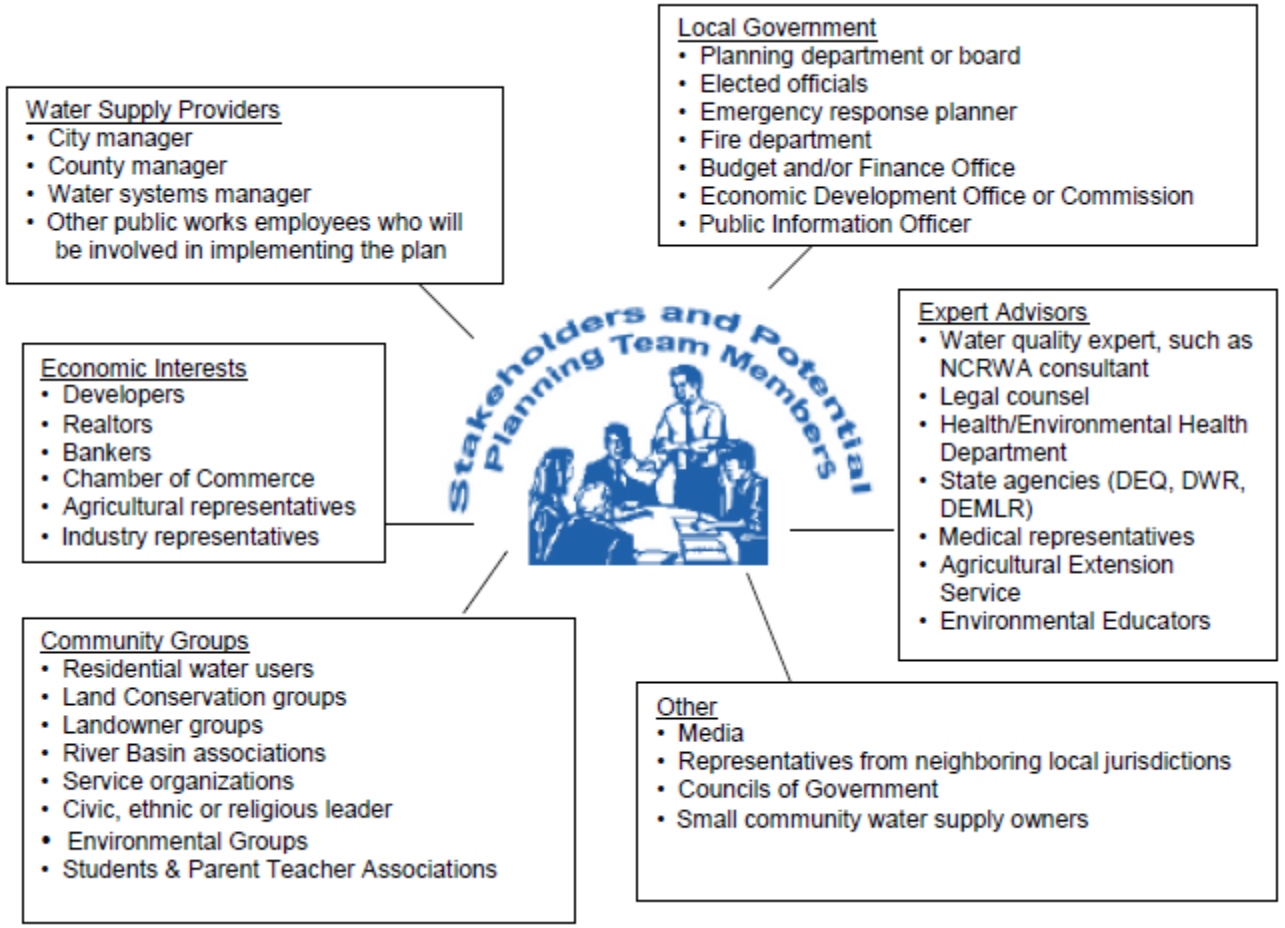


CWWMG Risk Analysis



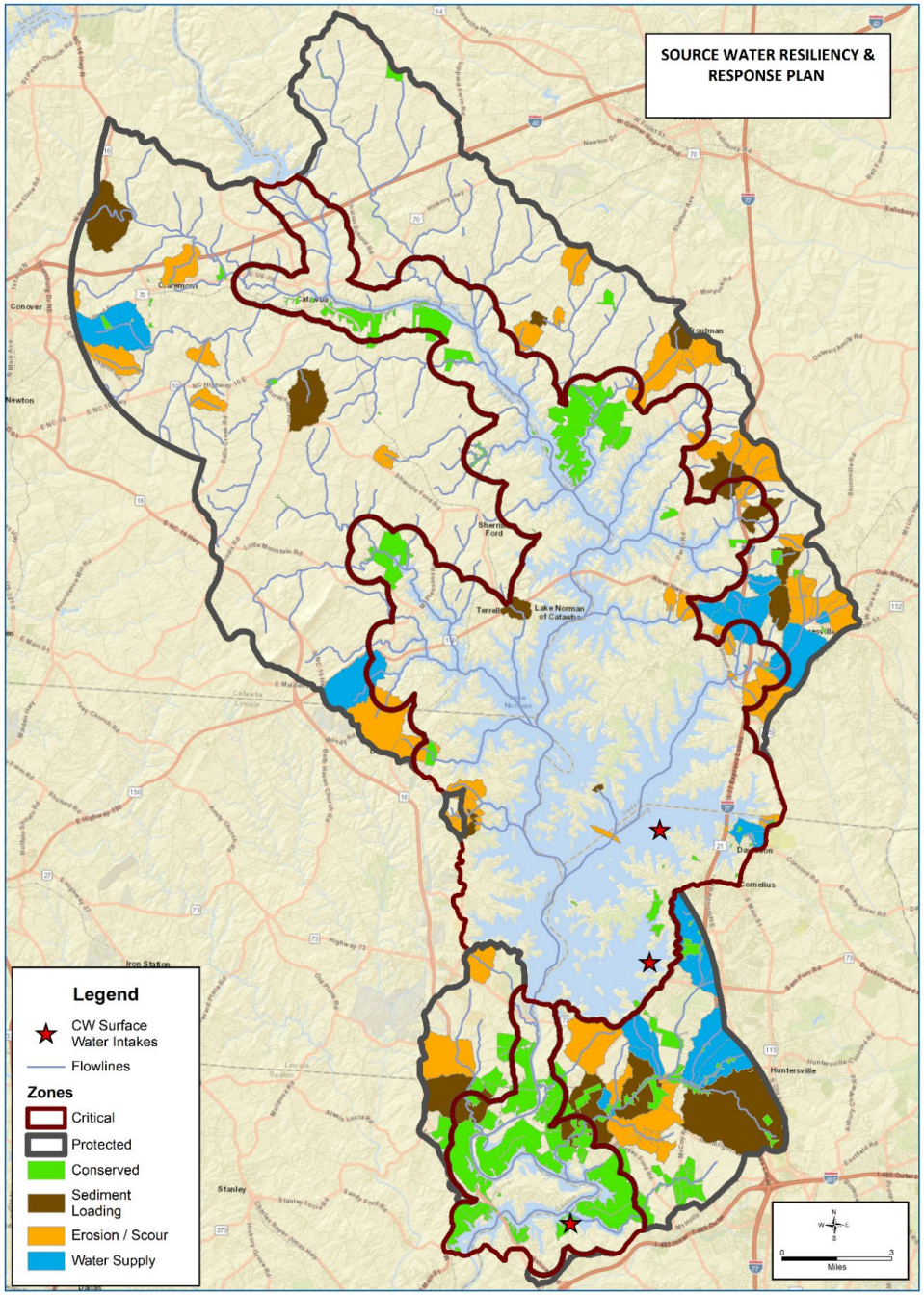
What To Do?

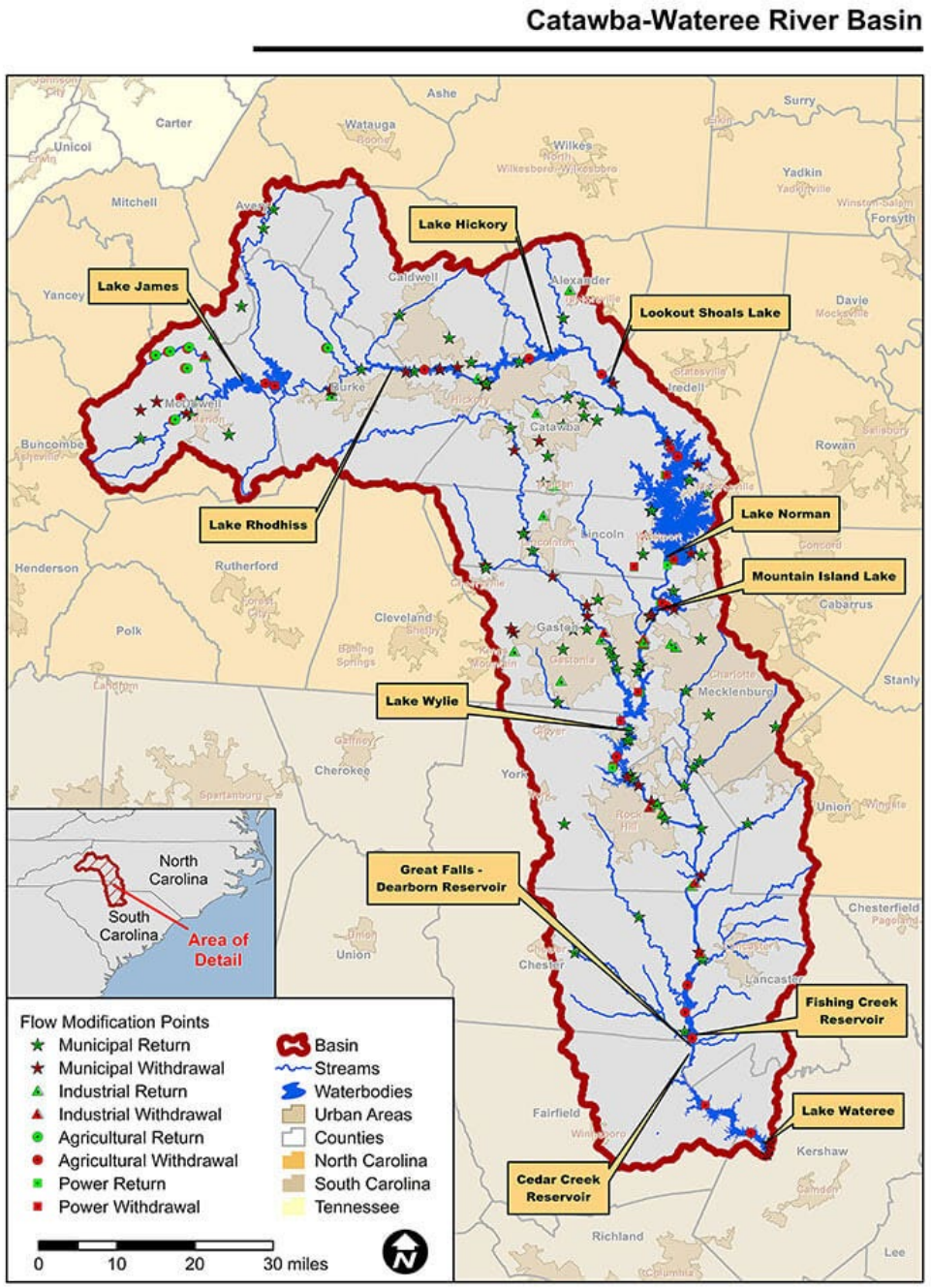
- **Let's work together**
  - Many interested in protecting source waters
  - Identify potential partners
- **Develop a list of potential ways to clean up/mitigate**
  - Identify goals of mitigation approaches
  - Estimate realistic benefits of each mitigation project



Funding

- **Mitigation efforts can be expensive**
- **Identify potential funding**
  - Federal, state grants/loans
  - Nutrient trading, mitigation banking
- **Leverage opportunities for source water protection**





Who relies on the Catawba-Wateree?

- American & Efird
- Catawba River WTP –
- (Lancaster Water & Sewer District & Union County, NC)*
- Charlotte Water*
- Chester Metropolitan District*
- City of Belmont*
- City of Camden*
- City of Gastonia-Two Rivers Utilities*
- City of Hickory*
- City of Lenoir*
- City of Morganton*
- City of Mount Holly*
- City of Newton
- City of Statesville*
- Duke Energy Carolinas*
- Invista
- Lincoln County*
- Lugoff-Elgin Water Authority*
- NCDEQ-DWR
- NC Wildlife Resources Commission
- New-Indy Catawba
- SCDHEC
- SCDNR
- Town of Granite Falls*
- Town of Mooresville*
- Town of Valdese*
- US Geological Survey (USGS)
- Bessemer City
- Clariant Corporation
- City of Cherryville
- City of Lincolnton
- City of Marion
- City of Rock Hill*
- Dominion Energy
- National Marine Fisheries Service
- Siemens Westinghouse
- Springs Industries
- Sylvamo (International Paper)
- Town of Dallas
- US Fish and Wildlife Service
- City of Lancaster
- HDR Engineering, Inc. of the Carolinas
- Lake Norman Marine Commission
- NC Dept. of Public Safety
- The Conservation Fund
- Town of Fort Mill

* CWWMG member

Catawba-Wateree – The life of our community

Water is the lifeblood of modern society. Our lakes and rivers supply our water and are a key, yet often overlooked, contributor to our local economy and quality of life. Water feeds us, cleans us, entertains us (recreation) and is integral to the production of energy and economic vitality in the Region.

- excerpt from "The Charlotte Region's Water Story" – Envision Charlotte

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