

# **Water Reuse and Sustainable Water Resource**

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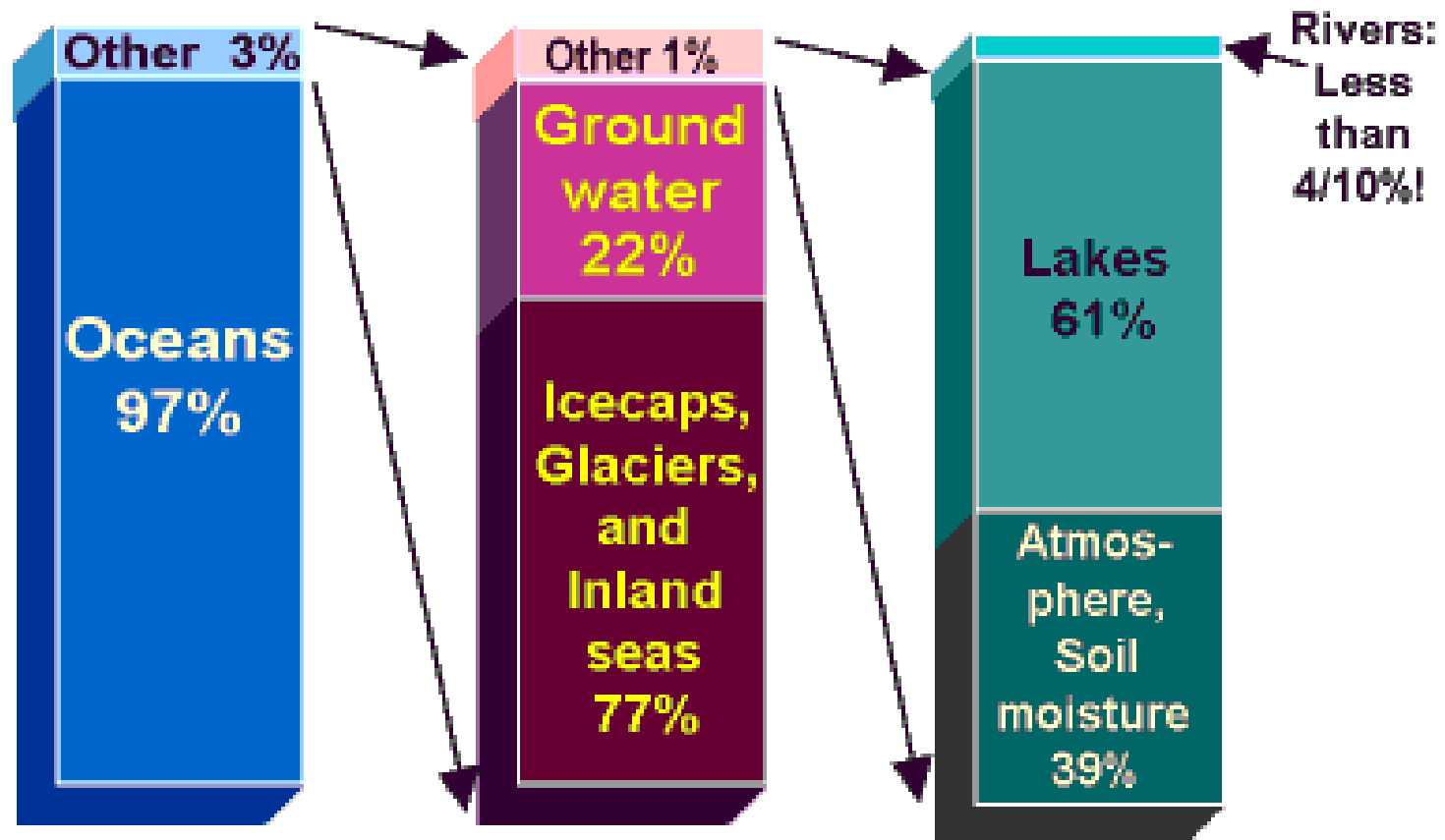
# Outline

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1. **Introduction**
2. **Climate Change and Availability of Water Resource**
3. **Water Reuse**
4. **Summary of the Maryland Department of the Environment (MDE) Guidelines for Use of Class IV Reclaimed Water**
5. **Case Study of Class IV Reclaimed Water Reuse Projects in Maryland**

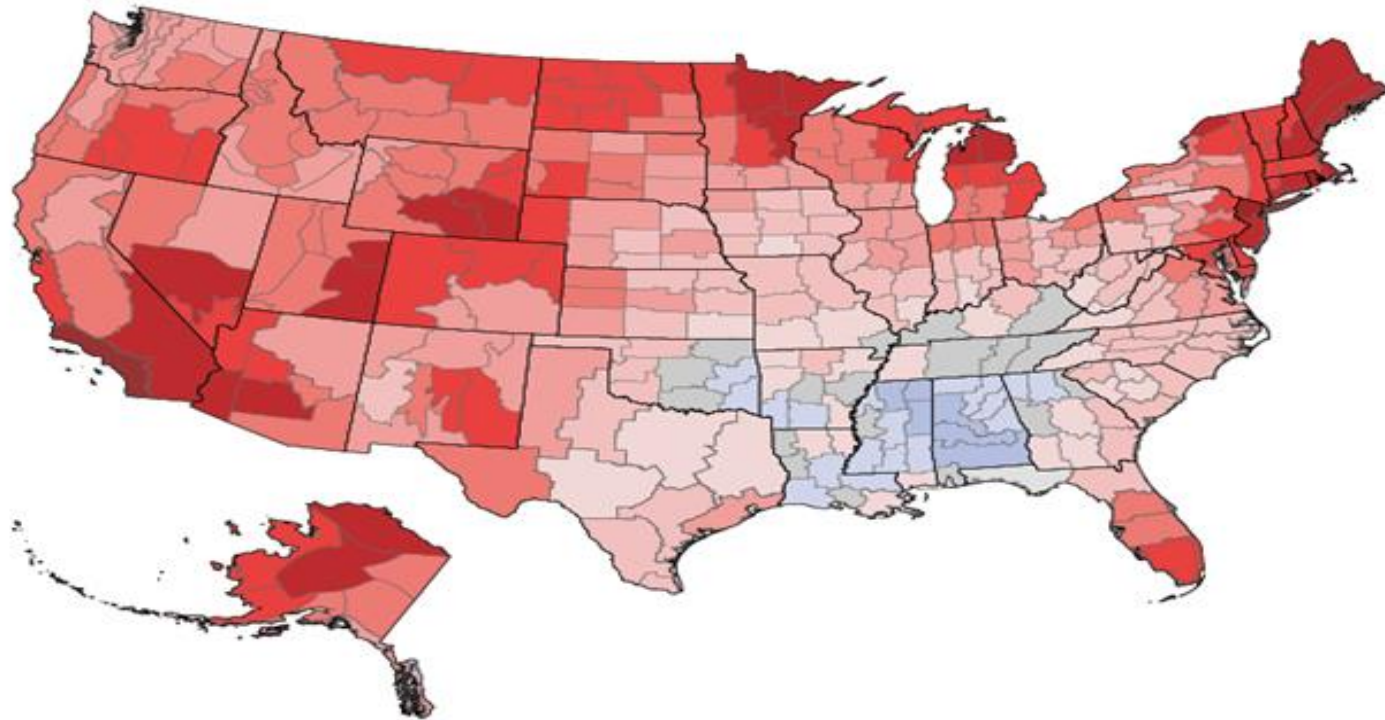
# Water Distribution on Earth

## Distribution of water on Earth



# Global Warming Effect and Temperature Change in USA

Rate of Temperature Change in the United States, 1901–2014



\*Alaska data start in 1925.

Data source: NOAA (National Oceanic and Atmospheric Administration). 2015. National Centers for Environmental Information. Accessed April 2015. [www.ncei.noaa.gov](http://www.ncei.noaa.gov).

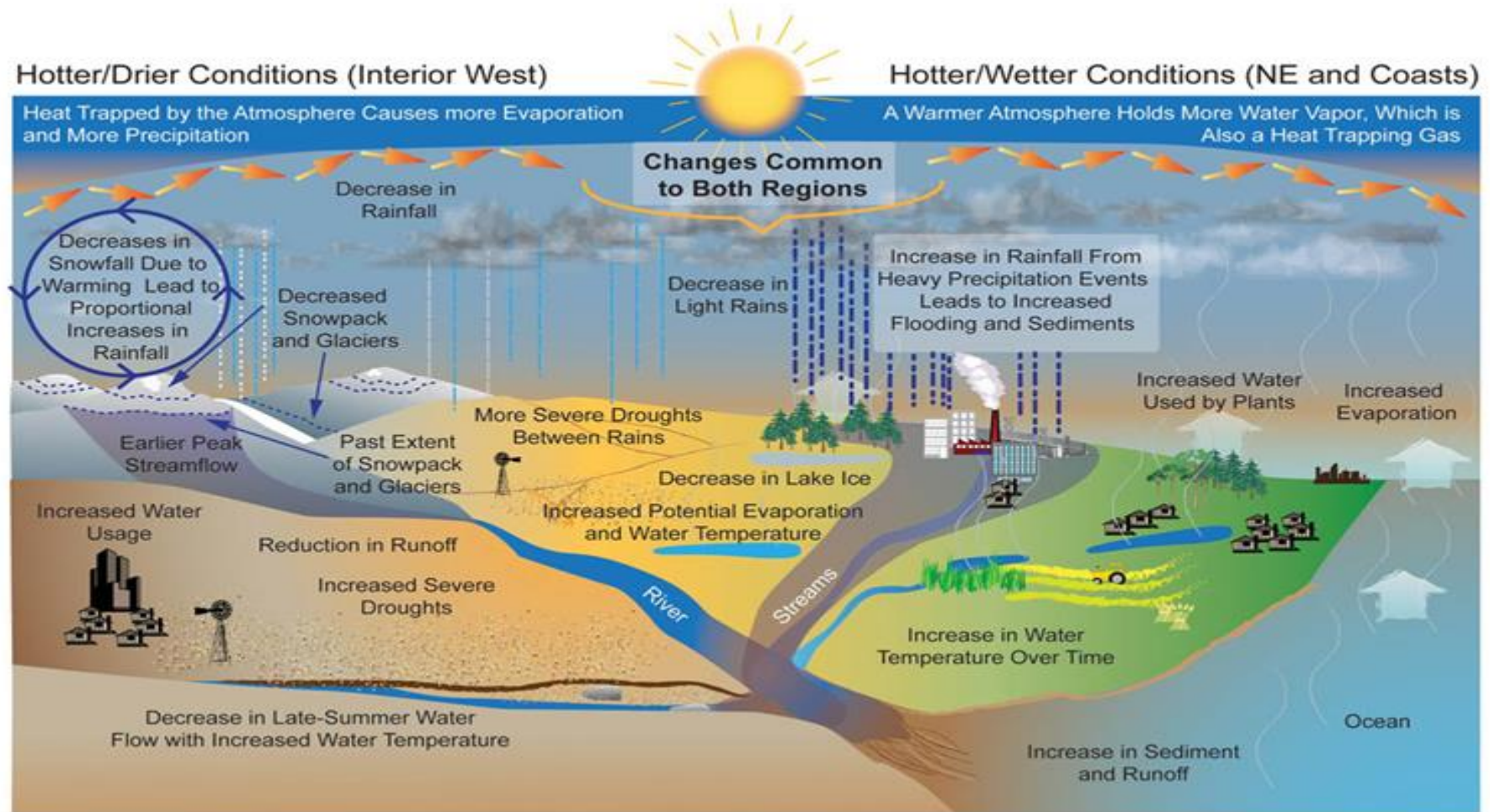
For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climatechange/indicators](http://www.epa.gov/climatechange/indicators).

# Effects of Global Warming on Water Resources

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- 1. Warming temperatures, changes in precipitation, and sea level rise have affected and will likely continue to affect water supply and quality.**
- 2. Changes will vary in different regions of the United States; potential effects include increased flooding and drought, water quality impairment, and salt water intrusion to coastal water supplies.**
- 3. Changes to our water resources affect many sectors, including energy production, infrastructure, human health, agriculture, and ecosystems.**

# Projected Water Cycle Changes in USA Due to Warming Effect



The U.S. Global Change Research Program (USGCRP) coordinates and integrates federal research on changes in the global environment and their implications for society. Thirteen departments and agencies, including EPA, participate in the USGCRP. The USGCRP publishes a National Climate Assessment every 4 years, along with other assessment products.



# Drought Image of Folsom Lake 25 Miles Northeast of Sacramento, CA



2011, a normal Rainfall year

2013-2014, a drought year

# Drought Images of Pretty Boy Reservoir in Baltimore County

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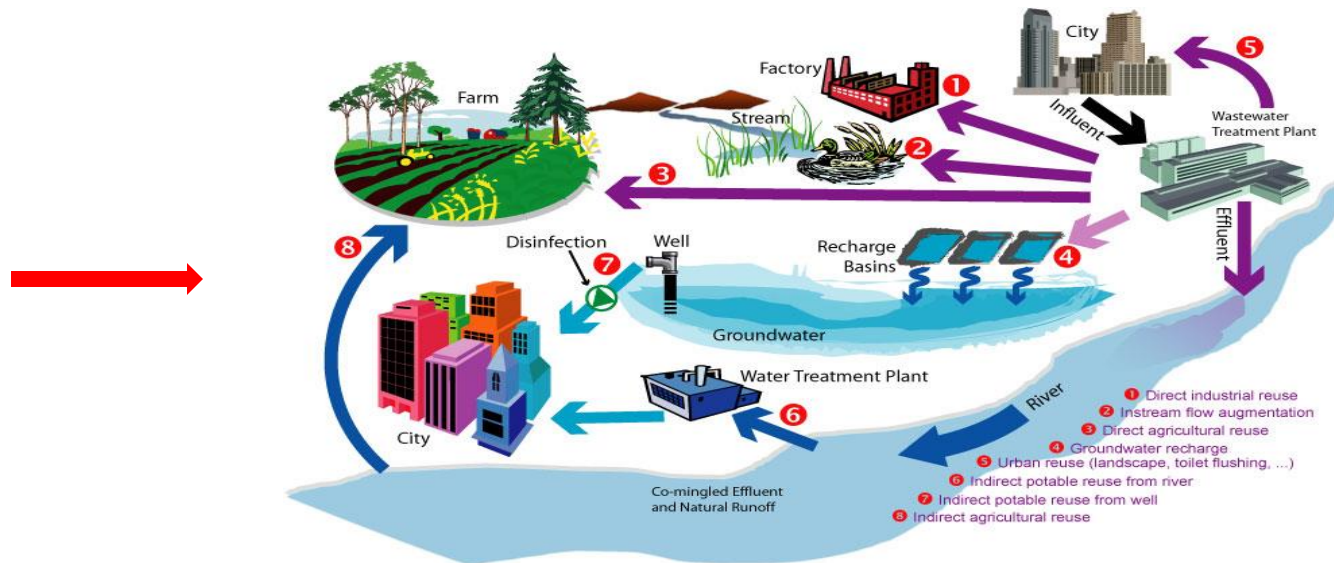
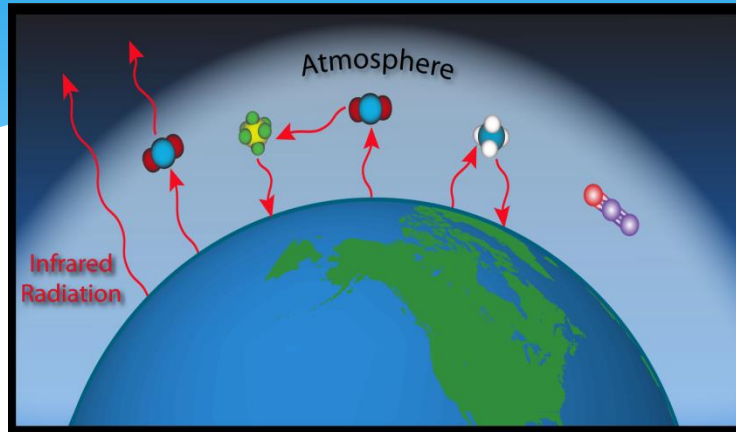
February 23, 2002, Dry year (34.6" rainfall in 2001 & 39.6" in 2002 at BWI Weather Station)

March, 2003, Wet year (62.7"//yr Rainfall at BWI)

Average Rainfall (1981-2010) at Baltimore Washington International (BWI) Airport Weather Station : 41.9"/year



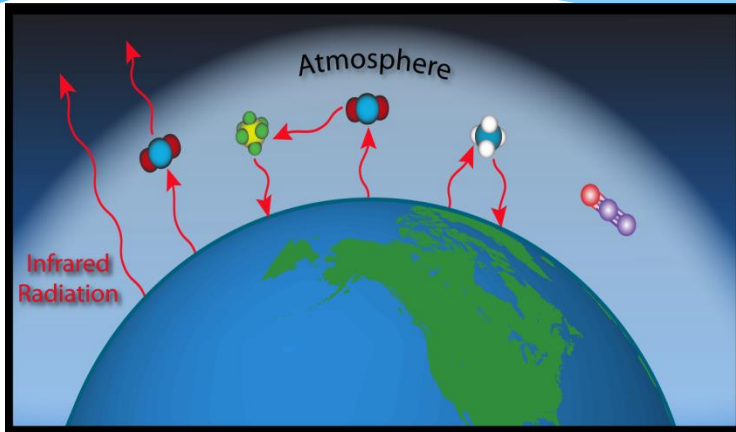
# Climate Change, Drought and Water Reuse



**Reuses of Municipal Treated Wastewater**

# Climate Change, Drought and Water Reuse

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# Definition of Water Reuse

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**"Reuse" or "Water reuse<sup>\*</sup>"** means the use of reclaimed water for a direct beneficial use, an indirect potable reuse<sup>\*\*</sup>, or a controlled use in accordance with these Guidelines

**\* Excerpted from “Maryland Department of the Environment (MDE) GUIDELINES FOR USE OF CLASS IV RECLAIMED WATER - High Potential for Human Contact (2019)**

**\*\* Example: Groundwater recharge**

# Water Reuse Rates in Top Four States of USA

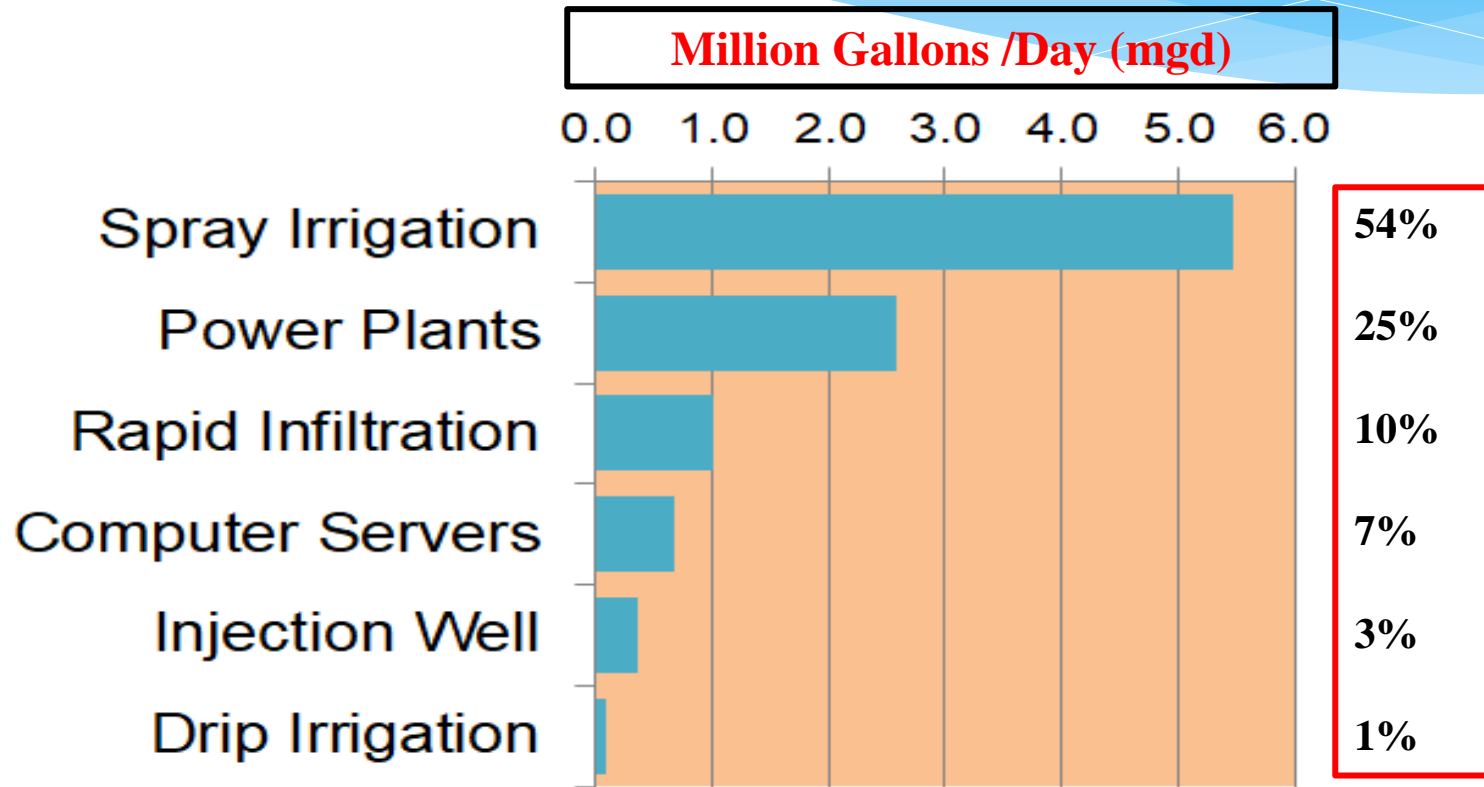
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State	Water Reuse Rate* (Million gallons per day, mgd)
Florida	584
California	525
Texas	230
Arizona	220

\*Water reuse rate in 2002

Source: 2004 US EPA Guidelines for Water Reuse, one mgd = 3,785.4 m<sup>3</sup>/day

# Water Reuse Systems in Maryland



**2018 Total Water Reuse Flow Rate : 10 mgd (37,854 m<sup>3</sup>/day)**

# **Introduction**

## **(History of MDE Class IV Guidelines)**

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- \* Starting 9/2009, members of Maryland Water Reuse Committee met once every 2-3 months to prepare the draft guidelines. The 25 Committee members are representatives from MDE, County agencies, consultant firm, plumbing board and non-profit environmental organization.**
- \* Existing water reuse regulations/guidelines from Arizona, California, Florida, Oregon ,Virginia and Maryland /National Plumbing Codes were used as references for drafting the guidelines.**



# **Introduction -Continued (History of MDE Class IV Guidelines)**

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- 1. The Draft Class IV Guidelines were posted on MDE web site in July 2015 for comment.**
- 2. The Guidelines were finalized in November 2019 after incorporating public comments.\***

**\* Class IV Guidelines can be downloaded from the MDE web site:  
<http://mde.maryland.gov/programs/Water/wwp/Pages/WaterReuseGuidelines.aspx>**

## **Introduction -Continued (Status of MDE Class IV Guidelines)**

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- 1. The Guidelines are currently used for reviewing and permitting projects using Class IV reclaimed water in Maryland.**
- 2. The numerical Class IV Water Quality Treatment Standards included in the guidelines will be added to Code of Maryland Regulations (COMAR )in the near future.**

# **Summary of the MDE Guidelines for Use of Class IV Reclaimed Water**

# **Classes of Reclaimed Water In Maryland**

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- **Categorized into four water quality Classes (I-IV).**
- **Use of each class is based on the level of treatment (or quality) attained.**
- \* **Use of Classes I-III shall in accordance with “MDE Guidelines for Land Application / Reuse of Treated Municipal Wastewaters”**

# **MDE Guidelines for Use of Class IV Reclaimed Water**

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**The guidelines include 14 chapters:**

- (1) Purpose and Scope; (2) General Conditions**
- (3) Types of Reuse vs Classes of Reclaimed Water;**
- (4) Water Quality Treatment Standards;**
- (5) Monitoring Requirements for Reuse of Class IV Reclaimed Water;**
- (6) Applying for a Permit; (7) Design Criteria**
- (8) Construction Requirements; (9) Operations and Maintenance;**
- (10) Requirements for the End-Use Location;**
- (11) Access Control and Advisory Signs;**
- (12) Recordkeeping; (13) Reporting; and**
- (14) Definitions**

# **Purpose and Scope of the Class IV Guidelines**

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- \* To provide additional approved uses for reclaimed water to promote water reuse.**
- \* To apply only to use of Class IV reclaimed water generated from a centralized wastewater treatment plant.**
- \* Not intended to address other non-potable water reuses such as graywater and rainwater which are addressed under applicable local plumbing codes.**
- \* To guide the facility owner or operator of a water reclamation facility to produce or distribute Class IV reclaimed water for proper use without compromising public health and environmental quality protections.**



# Water Quality Treatment Standards for Classes I- IV Reclaimed Water

<u>Parameter</u>	Slow Rate Irrigation For Restricted Public Access		Slow Rate Irrigation for Urban Reuse- Unrestricted Public Access	Unrestricted Water Reuse (High Potential for Human Contact)
	Class I	Class II	Class III	Class IV
Biochemical Oxygen Demand (5 day) (monthly average)	70 mg/l	10 mg/l	10 mg/l	10 mg/l
Suspended Solids (monthly average for Classes I & II) or Turbidity (NTU)	90 mg/l	10 mg/l	2 NTU (daily average) Not to exceed 5 NTU at any time	2 NTU (daily average) Not to exceed 5 NTU at any time
E. coli (MPN per 100 mL) (monthly median) Or meet the Fecal Coliform limit below	N/A	N/A	N/A	1 Monthly max not to exceed 23 MPN/100ml
Fecal Coliform (MPN per 100 mL) (monthly geometric mean)	200 3 (golf course)	3	2.2	2.2 (monthly median) Monthly max not to exceed 23 MPN/100ml
pH	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
Total Nitrogen ( monthly average)	Case by case	Case by case	Case by case	10 mg/l
Total residual chlorine at outlet of the wastewater treatment plant, wwtp)	Case by case	Case by case	Case by case	1.5-4 mg/l at outlet of WWTP 0.5-4.0 mg/l at monitoring locations in the distribution system nearby point of use

# Comparisons of Water Quality Requirements for Unrestricted Urban Reuse in 8 States

Table 4-3. Unrestricted Urban Reuse

	Arizona	California	Florida	Hawaii	Nevada	Texas	Washington
Treatment	Secondary treatment, filtration, and disinfection	Oxidized, coagulated, filtered, and disinfected	Secondary treatment, filtration, and high-level disinfection	Oxidized, filtered, and disinfected	Secondary treatment and disinfection	NS <sup>(1)</sup>	Oxidized, coagulated, filtered, and disinfected
BOD <sub>5</sub>	NS	NS	20 mg/l CBOD <sub>5</sub>	NS	30 mg/l	5 mg/l	30 mg/l
TSS	NS	NS	5.0 mg/l	NS	NS	NS	30 mg/l
Turbidity	2 NTU (Avg)	2 NTU (Avg)	NS	2 NTU (Max)	NS	3 NTU	2 NTU (Avg)
	5 NTU (Max)	5 NTU (Max)					5 NTU (Max)
Coliform	Fecal	Total	Fecal	Fecal	Fecal	Fecal	Total
	None detectable (Avg)	2.2/100 ml (Avg)	75% of samples below detection	2.2/100 ml (Avg)	2.2/100 ml (Avg)	20/100 ml (Avg)	2.2/100 ml (Avg)
	23/100 ml (Max)	23/100 ml (Max in 30 days)	25/100 ml (Max)	23/100 ml (Max in 30 days)	23/100 ml (Max)	75/100 ml (Max)	23/100 ml (Max)

Maryland  
Class IV  
Effluent

NS

10 mg/l

NS

2 NTU (avg)  
5 NTU (Max)

Fecal or E. coli

Fecal (2.2/100ml  
or E. coli 1/100ml  
(avg))

23/100 ml  
(max)

<sup>(1)</sup> NS - Not specified by state regulations

Source: 2004 US EPA Guidelines for Water Reuse

# Class IV Reclaimed Water Acceptable Types of Reuse

<b>Aesthetic Fountains</b>	<b>Manufacturing Processing Water</b>
<b>Aggregate Washing</b>	<b>Ornamental Nurseries Irrigation</b>
<b>Car Washing</b>	<b>Park Irrigation</b>
<b>Cemetery Irrigation</b>	<b>Parts Cleaning</b>
<b>Closed Loop Cooling</b>	<b>Pasture Irrigation For Foraging Livestock</b>
<b>Concrete Mixing</b>	<b>Play Ground Irrigation</b>
<b>Cooling Water System</b>	<b>Pressure Cleaning</b>
<b>Crops Irrigation *</b>	<b>Lawns Irrigation (residential and non-residential)</b>
<b>Dust Control and Soil Compaction</b>	<b>School Yards Irrigation</b>
<b>Equipment Washing</b>	<b>Silviculture irrigation</b>
<b>Fiber and Seed Crops Irrigation</b>	<b>Snow Making</b>
<b>Fire Protection</b>	<b>Sod Farm Irrigation</b>
<b>Forested Land Irrigation</b>	<b>Toilet and Urinal Flushing</b>
<b>Golf Course Irrigation</b>	<b>Turf (including Fodder) Irrigation</b>
<b>Green Open Spaces Irrigation</b>	<b>Water for Filling Ponds and Lagoons</b>
<b>Highway Landscape Irrigation</b>	<b>Window Washing</b>
<b>Laundry Water</b>	

**\* Allowing Irrigation on food Crops such as vegetable and fruit, advance treatment with filtration and disinfection is required**

# Highlights of MDE Guidelines for Use of Class IV Reclaimed Water

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1. The use of nonpotable water for recycle flows within the treatment works is excluded from the requirements of this guidance. (Chapter 1)
2. Use of Class IV reclaimed water must comply with the applicable County Water and Sewerage Plan. (Chapter 2)
3. A **new discharge permit** (or a modified NPDES permit for adding a reclaimed water outfall) and reclaimed system construction permit must be obtained from MDE. (Chapters 2&6)
4. Use of Class IV effluent for fire protection ( including sprinkler system), toilet and urinal flushing are permitted only for **commercial buildings** and condominiums managed by a property management company or other similar corporate entity acceptable to MDE.(Chapter 3)
5. Class IV applicable to commercial and industrial uses of reclaimed water involving high potential for human contact or other public health risks. The Department may allow lower quality water to be used on a case by case basis. (Chapter 3)

## Highlights of MDE Guidelines for Use of Class IV Reclaimed Water - Continued

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6. The Class IV Guidelines are not applicable to the use of reclaimed water for Power Plant operation which is regulated by the Maryland Public Service Commission. (Chapter 3)
7. Monitoring the reclaimed water quality including parameters shown in the Class IV water quality standard table. **On-line turbidity monitoring must be performed between filtration and disinfection process.** Total residual chlorine must be monitored at treatment works and distribution system. (Chapter 5)
8. All force mains for transmitting Class IV effluent must be **purple color** (or affixing purple adhesive tape) and must provide adequate separation from water mains. (Chapter 7)
9. A “Reclaimed Water, Do Not Drink” sign shall be posted in the impoundment and irrigation area to inform the public about use of reclaimed water. (Chapter 10 & 11)

# Case Study

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- 1. Little Patuxent Water Reclamation Plant – Fort Meade Federal System Use of Class IV Reclaimed Water Project.**
- 2. Smithsonian Environmental Research Center Use of Class IV Reclaimed Water Project**

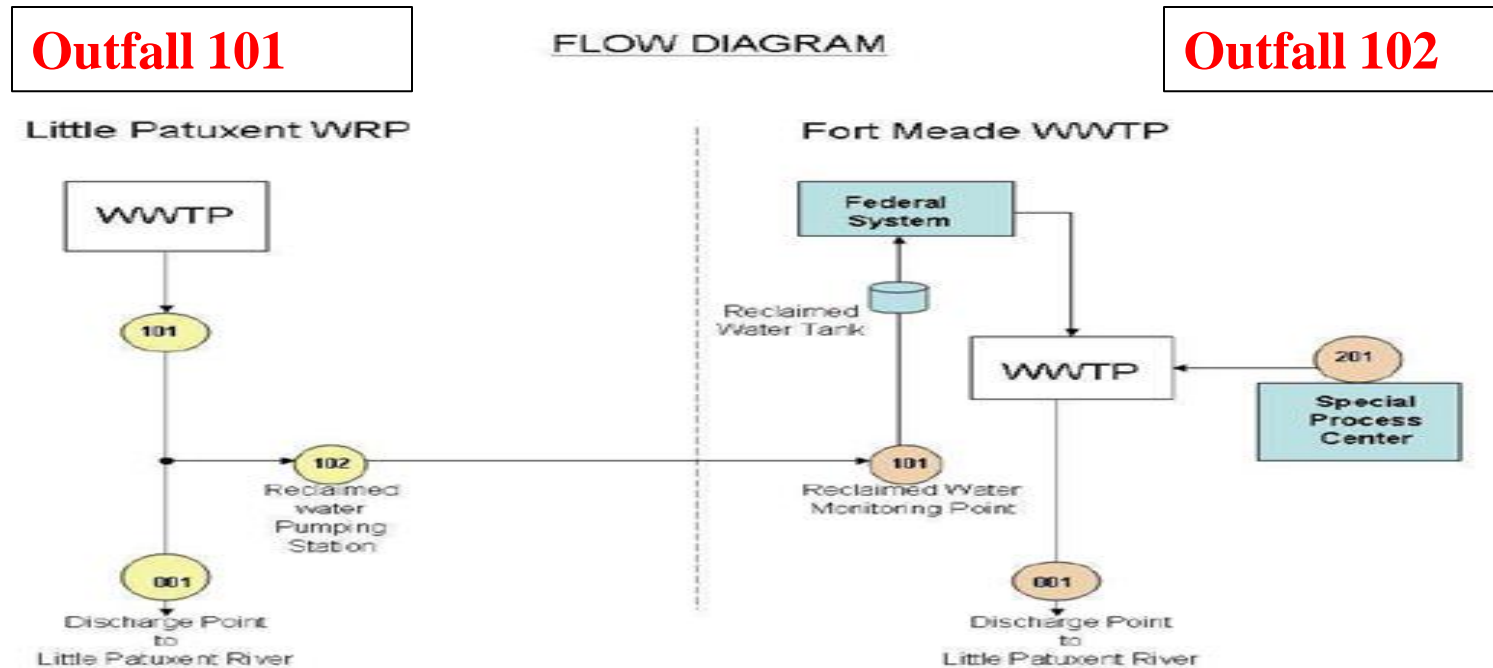


# Little Patuxent – Fort Meade Reclaimed Water Project.

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1. Use a total of 5 million gallons/day (or 18,925 cubic meters/day) reclaimed water from Little Patuxent Wastewater Treatment Plant (WWTP) for building, computer and equipment cooling at the Fort Meade Federal Facility.
2. The NPDES permit (13-DP-1421, effective 10/1/2014) of Little Patuxent WWTP was modified to include **Outfall 102** (Reclaimed Water Pumping Station) for delivery of reclaimed water.
3. The permit requires: (1) effluent must be chlorinated and maintain adequate level of free chlorine residual. Re-chlorination must be provided at reclaimed water tank of Federal facility; (2) use an alternate water source if the turbidity of the reclaimed water is greater than 5 NTU.

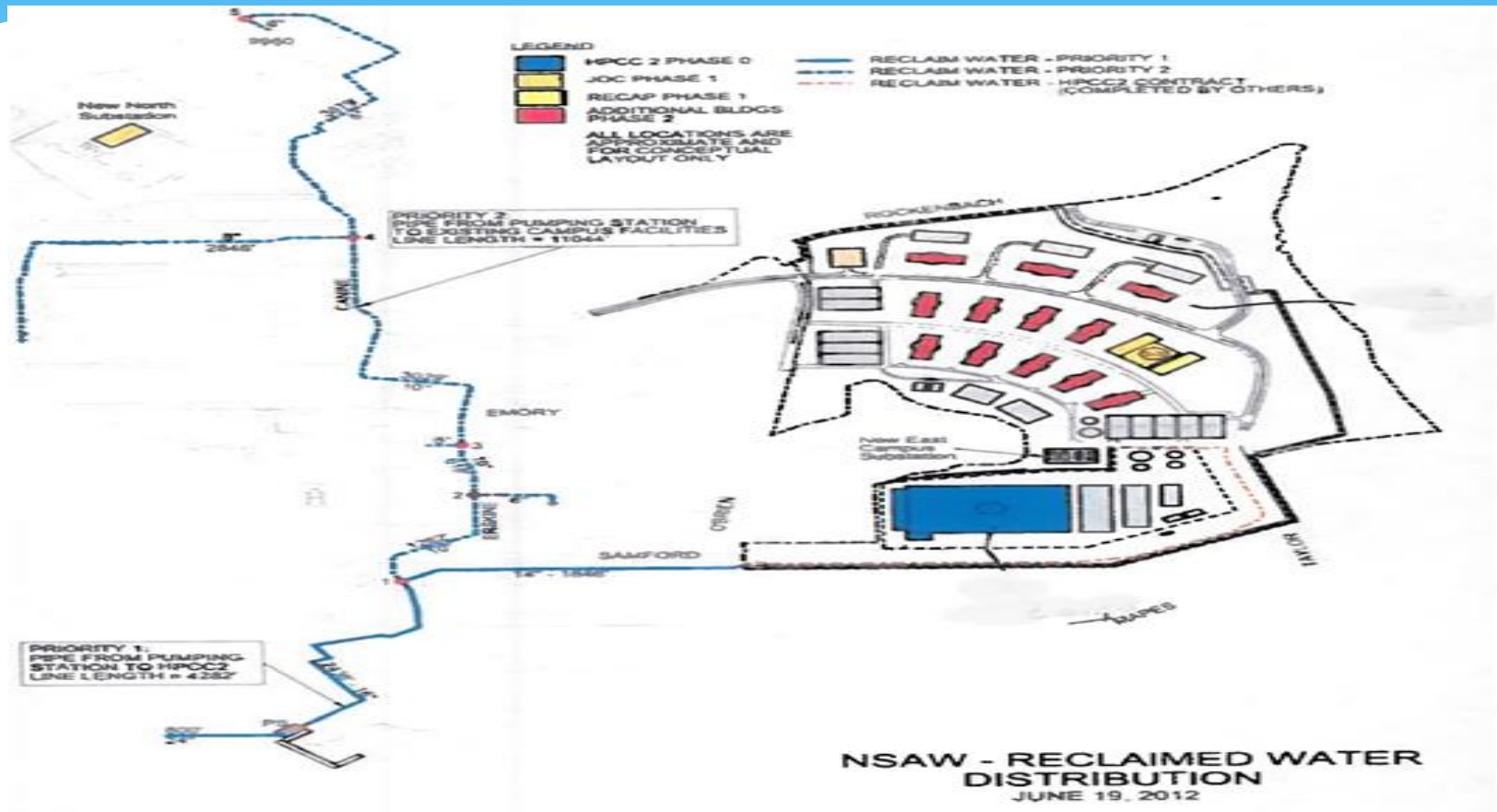
# Little Patuxent Reclaimed Water System Schematic Flow Diagram



## Parameters Monitored at Outfall 102:

(1) Total Residual Chlorine ; (2) Turbidity; (3) Flow; (4) Total Suspended Solids; (5) Total Nitrogen; (6) Total Phosphorus

# Conceptual Layout – NSA Reclaimed Water Distribution System Layout



Source: “Fort Meade Reclaimed Water Project” by Whitman Requardt & Associates, LLP and Ulliman Schutte Construction (11/28/2012)

# Fort Meade Reclaimed Water Pumping Station (FMRWPS)



**Project Completion Date: 9/1/2015**



# Reclaimed Water Pumps



**Projected Peak Flow: 1.6 mgd (2015); 4.56 mgd (2018); 4.9 mgd (2025)**  
**The Pumping rate of 9/12/2017: 0.72 million gallons/day (mgd) or 2,725 m<sup>3</sup>/day**  
**Designed Station Capacity: 5.5 million gallons/day (mgd) or 20,826 m<sup>3</sup>/day**

# Purple Reclaimed Water Pipe and Potable Water Pipe





# Backflow Prevention Device

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# Chlorine Tanks and Dosage Control Panel





# On-Line Turbidity and Chlorine Meters



# Chlorine Residual and Turbidity Measurements at FMRWPS on 9/12/2017



**Chlorine Residual = 8.35 PPM**



**Turbidity = 0.741 NTU**

# Reclaimed Water Quality at FMRWPS (Excerpted from Little Patuxent WWTP 2018 Discharge Monitoring Reports (DMRs))

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Month	Chlorine residual (mg/l)	Flow (million gallons/day)
1/2018	5.18	0.502
2/2018	5.15	0.756
3/2018	1.35	0.757
4/2018	1.2	0.698
5/2018	1.51	0.774
6/2018	1.72	0.851
7/2018	1.76	0.819
8/2018	1.49	0.891
9/2018	1.96	0.88
10/2018	1.77	0.856
11/2018	2.11	0.88
12/2018	0.72	0.71
<b>Yearly Average</b>	<b>2.22</b>	<b>0.79 or 2,990 cubic meters/day</b>
<b>Discharge Limits</b>	<b>Adequate</b>	<b>5 mgd or 18,925 cubic meters/day</b>



# Smithsonian Environmental Research Center (SERC) Water Reuse System

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# **Smithsonian Environmental Research Center (SERC) Reclaimed Water Project.**

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- 1. Permit Modification A effective on 8/25/2016 creates Outfall 002 for effluent Reuse. Outfall 001 is for effluent disposal at drainfield (20,000 gal/day or 75.7 cubic meter/day).**
- 2. Effluent reuse includes use of Class IV reclaimed water for fire protection, toilet flushing, outdoor irrigation, replenishing storm water management pond for vegetation maintenance and replenishing a lined ornamental pond.**
- 3. The permit requires effluent quality must meet Class IV water quality standards shown in next slide.**

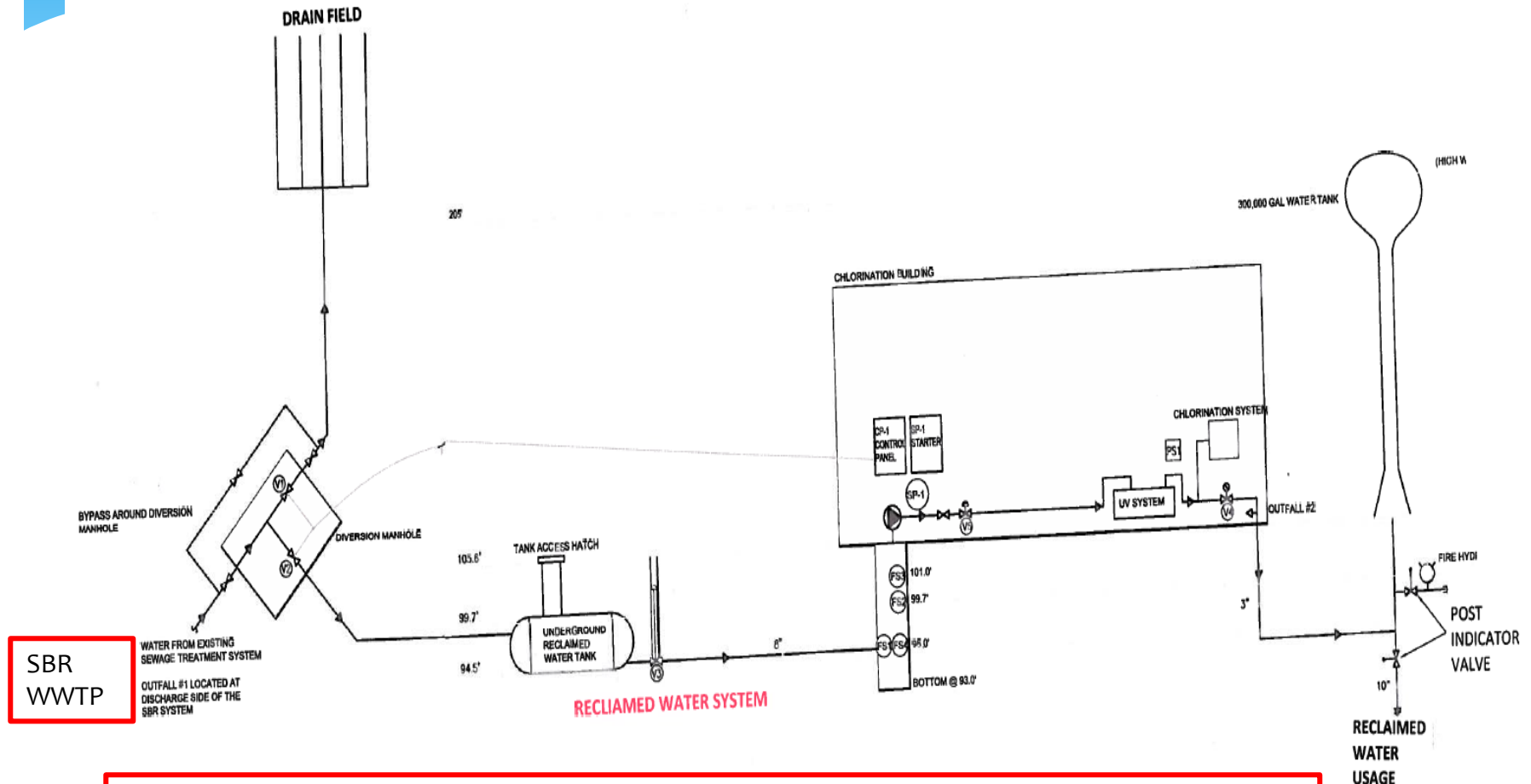
# SERC Reclaimed Water Quality Limitations (Excerpted from MDE discharge Permit)

2. Reclaimed water used for toilet flushing, outdoor irrigation and fire protection shall meet the following effluent quality measured at water reuse effluent line (except for total residual chlorine as noted below) with the sampling frequency indicated:

Parameter Code (STORET)	Parameter Description	Effluent limitations <sup>(3)</sup> (Class IV Reuse Standards)	Monitoring Frequency <sup>(5)</sup>	Sample Type
00310	BOD <sub>5</sub>	10 mg/l (monthly average)	Weekly	Grab <sup>(4)</sup>
00076	Turbidity	2NTU (daily average) Not to exceed 5 NTU at any time	Continuous	Recorded
51040	E. coli	1.0 (MPN per 100 ml monthly median) or meeting the Fecal coliform limit below	Weekly	Grab <sup>(4)</sup>
74055	Fecal coliform	2.2 (MPN per 100 ml monthly median)	Weekly	Grab <sup>(4)</sup>
00600	Total Nitrogen <sup>(1)</sup>	10 mg/l	Monthly	Grab <sup>(4)</sup>
00625	TKN	Report Value	Monthly	Grab <sup>(4)</sup>
00630	Nitrate + Nitrite (N+N)	Report Value	Monthly	Grab <sup>(4)</sup>
00400	pH	6.5-8.5 (all samples)	Daily	Grab <sup>(4)</sup>
50060	Total residual chlorine measured at system outlet	1.5-4.0 mg/l (all samples)	Daily	Grab <sup>(4)</sup>



# Reclaimed Water System Schematic Diagram Smithsonian Environmental Research Center (SERC)



Design water reuse rate: 20,000 gal/day used for fire fighting, lawn irrigation, toilet flushing and filling storm water ponds.

# Sequential Batch Reactor (SBR) Wastewater Treatment System at SERC

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# Micro-Filter and Online Turbidity Meter at SERC (Amiad's AMF 36K Model)

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# MEGATRON UV Unit and Chlorine Injection Systems at SERC





# **SERC Reclaimed Water Tower (300, 000 gallons Storage Capacity)\***



**\* Or 1,136 cubic meter  
Storage capacity**

# Reclaimed Water for Replenishing Storm Water Management Pond

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# **Reclaimed Water for Lawn Irrigation and Replenishing a Lined Ornamental Pond.**

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Thank You and Questions



