CONSERVE & PROTECT: NSF ONSITE WASTEWATER TREATMENT & REUSE STANDARDS

Derek DeLand, MPH, REHS/RS
Government Affairs Manager – EH Programs
NSF

Note: Materials presented represent the opinions of the presenter, not the opinions of NOWRA

Agenda

Introduction

- Who We Are

Standards Overview

- The How & The Why

A Deeper Look

- NSF 40: Residential Treatment Systems
- NSF 245: Nitrogen Reduction
- NSF 350: Wastewater Reuse

Our Foundation

In 1944,

NSF was founded as the National Sanitation Foundation in the University of Michigan's School of Public Health.

Today,

We are now *NSF International*, with corporate headquarters in Ann Arbor, MI, USA, and 75 office and partner locations worldwide.

We are an **independent**, not-for-profit organization dedicated to providing services to **improve human and planet health.**

NSF STANDARDS DEVELOPMENT
Joint Committees

Manufacturers

- Food equipment
- Chemicals
- Nonfood compounds
- Water distribution and treatment
- Recreational water equipment
- Onsite Wastewater Systems

Regulators

- EPA
- FDA
- USDA
- International (HC, etc.)
- State and local government agencies

End Users

- Industry QA/QC
- Equipment specifiers
- Test Labs
- Architects
- Academia/educators
- Consumer groups

NSF Wastewater Treatment Standards

NSF/ANSI 40 - Residential onsite systems

NSF/ANSI 41 - Non-liquid treatment systems

NSF/ANSI 46 - Components and devices

NSF/ANSI 245 - Nitrogen reduction

NSF/ANSI 350 - Onsite water reuse

Value of Standards & Certifications

Uniformity across the industry

Consistent methods and measures of analysis

Certifications → Independent confirmation the system works (BOD & N reduction, etc.)

Takes burden of testing/review of products off regulators

Can easily be referenced in codes

Fills a need

We Have a Nutrient Problem

Nutrient reduction in U.S. waterways is a concern across the country.

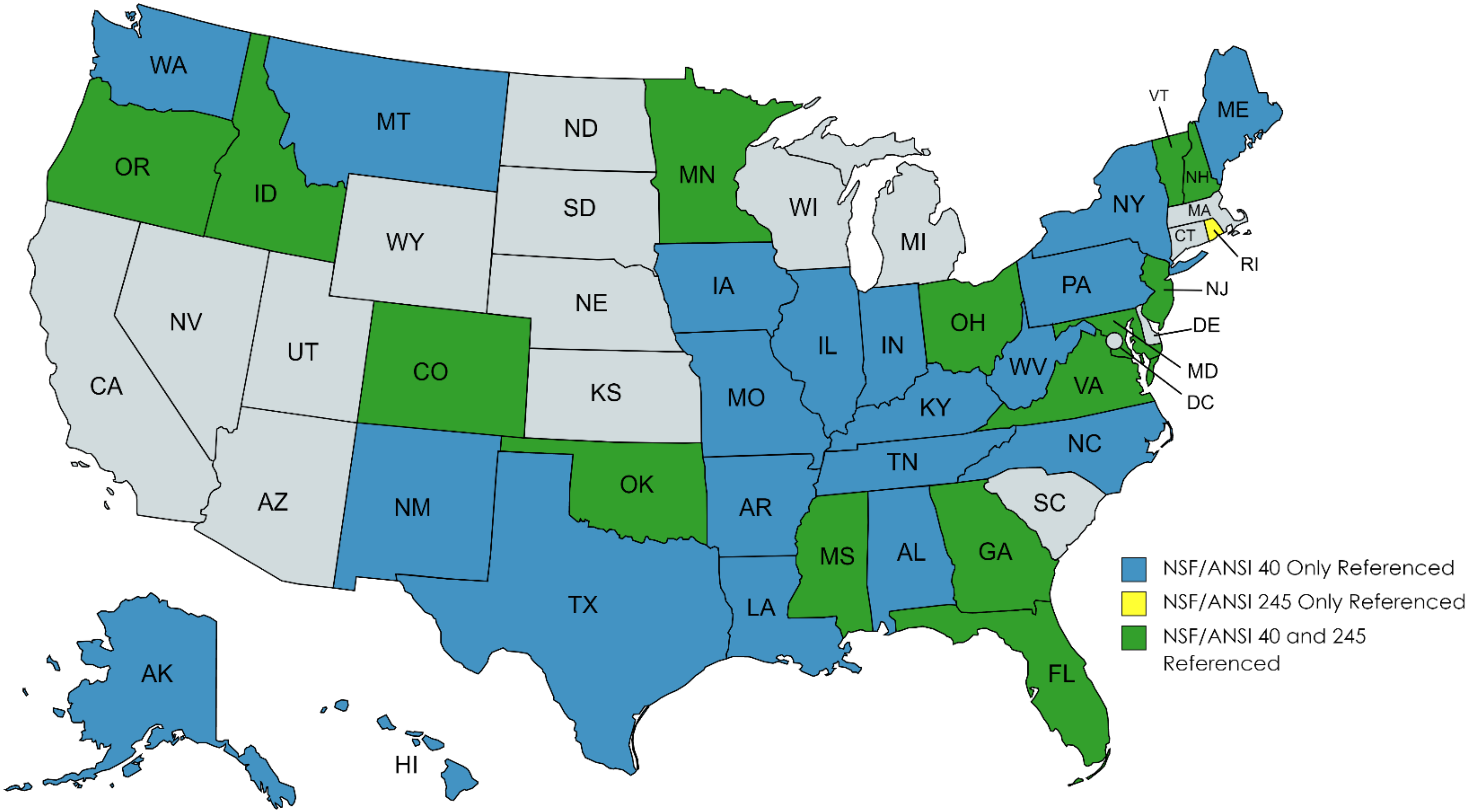
U.S. Environmental Protection Agency states, “Nutrient pollution is one of America’s most widespread, costly and challenging environmental problems impacting water quality.”

Onsite wastewater systems are one way that nutrients—nitrogen and phosphorus—are introduced into receiving waters.

Ground water elevation rise presents further risk of contamination

NSF/ANSI 40
Residential wastewater treatment systems
&
NSF/ANSI 245
Wastewater treatment systems – nitrogen reduction

States with NSF 40/245 References in Onsite Regulation/Codes



NSF/ANSI Standards 40 and 245

Any residential system with a treatment capacity of 400-1500 gal/day.

- NSF/ANSI 40: $CBOD_5$ and TSS reduction.
- NSF/ANSI 245: Nitrogen reduction (plus meet NSF/ANSI 40)
- No service or maintenance during entire six-month test
- All test data reported & no discard of any data except if test facility fails to provide an acceptable test.

NSF/ANSI Standard 40 and 245

26 Week Minimum Evaluation Period

- 16 weeks design loading
  - 6:00 am to 9:00 am; 35%
  - 11:00 am to 2:00 pm; 25%
  - 5:00 pm to 8:00 pm; 40%
- 7.5 weeks stress/design loading
  - wash-day
  - working-parent
  - power/equipment failure
  - Vacation
- 2.5 weeks design loading

Sampling

- 24-hour composite
- Standard 40: five days/week
- Standard 245: three days/week

NSF/ANSI Standards 40 and 245

Influent Wastewater Characteristics (NSF 40 & 245)

- BOD_5: 100 mg/L - 300 mg/L
- TSS: 100 mg/L - 350 mg/L
- Alkalinity: > 175 mg/L
- TKN: 35 mg/L – 70 mg/L (NSF 245 only)
- Temp: 10 C – 30 C (50 F- 86 F) (NSF 245 only)
- pH: 6.5 – 9 (NSF 245 only)

Effluent criteria (NSF 40 & 245)

- $CBOD_5$: 25 mg/L (30 day avg) = minimum 75% reduction
  $CBOD_5$: 40 mg/L (7 day avg)
- TSS: 30 mg/L (30 day avg) = minimum 70% reduction
  TSS: 45 mg/L (7 day avg)
- pH: 6.0 – 9.0
- Total Nitrogen (NSF 245 ONLY): minimum 50% reduction

→ EPA Secondary Treatment Levels

Continued Compliance & Service Agreements

Manufacturer's Must Provide:

- Two-year initial service policy w/ 4 site visits
- Extended policy available for a fee
- Stand by parts in stock

Manufacturer's Must Undergo:

- Production Facility Audits
- Field Audits of Authorized Reps (Installations & Service Visits)
- 5-year Product Reassessments

Wastewater Reuse System Standards (NSF/ANSI 350)

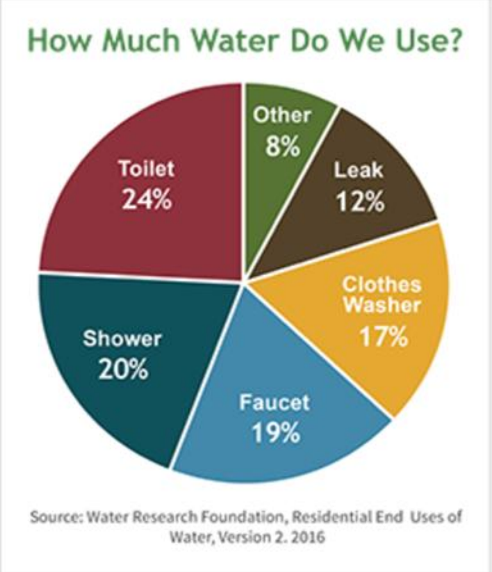
What are the Barriers/Benefits to Onsite Reuse?

BENEFITS

- Large percentage has modest level of contamination.
- Treated onsite to meet final application needs (fit-for-purpose).
- Water already available onsite; no more cost or energy needed to transport water.

BARRIERS

- Consumer perception with use of lower quality water.
- Inexpensive cost of potable water for many regions.
- Lack of residential plumbing infrastructure to accommodate partially treated water.
- Lack of enabling regulatory codes.

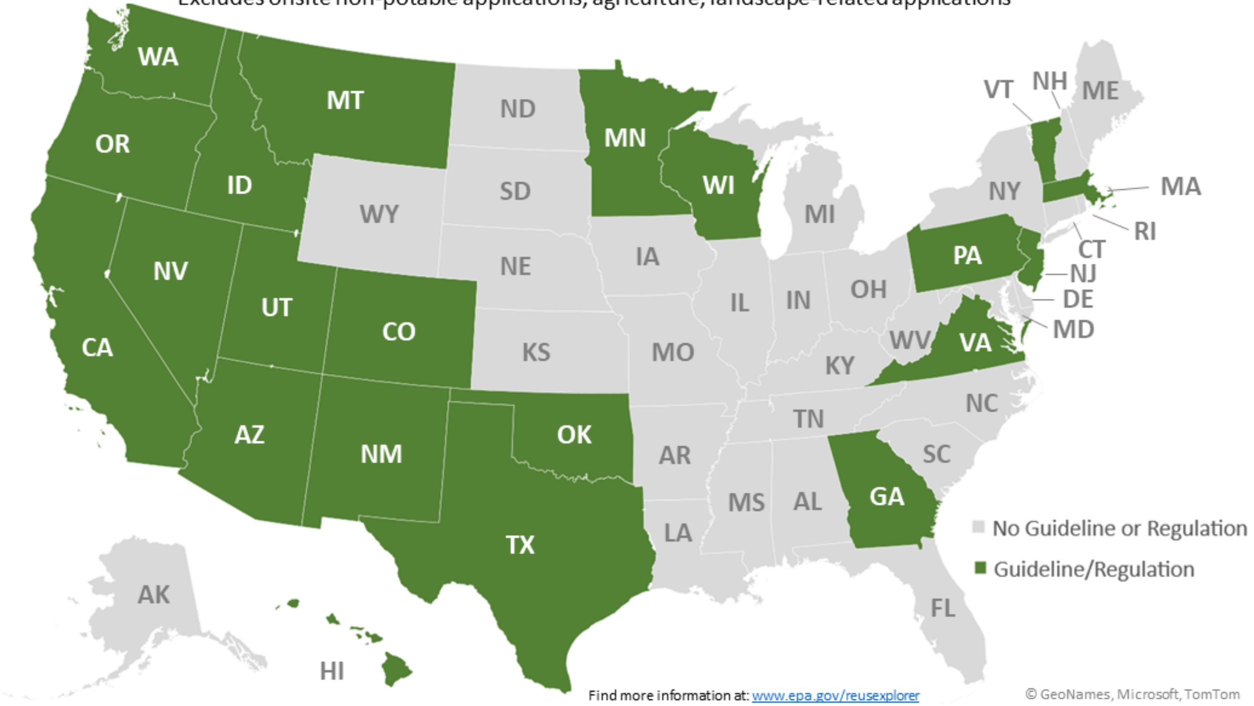


Reuse Is Rising In Popularity

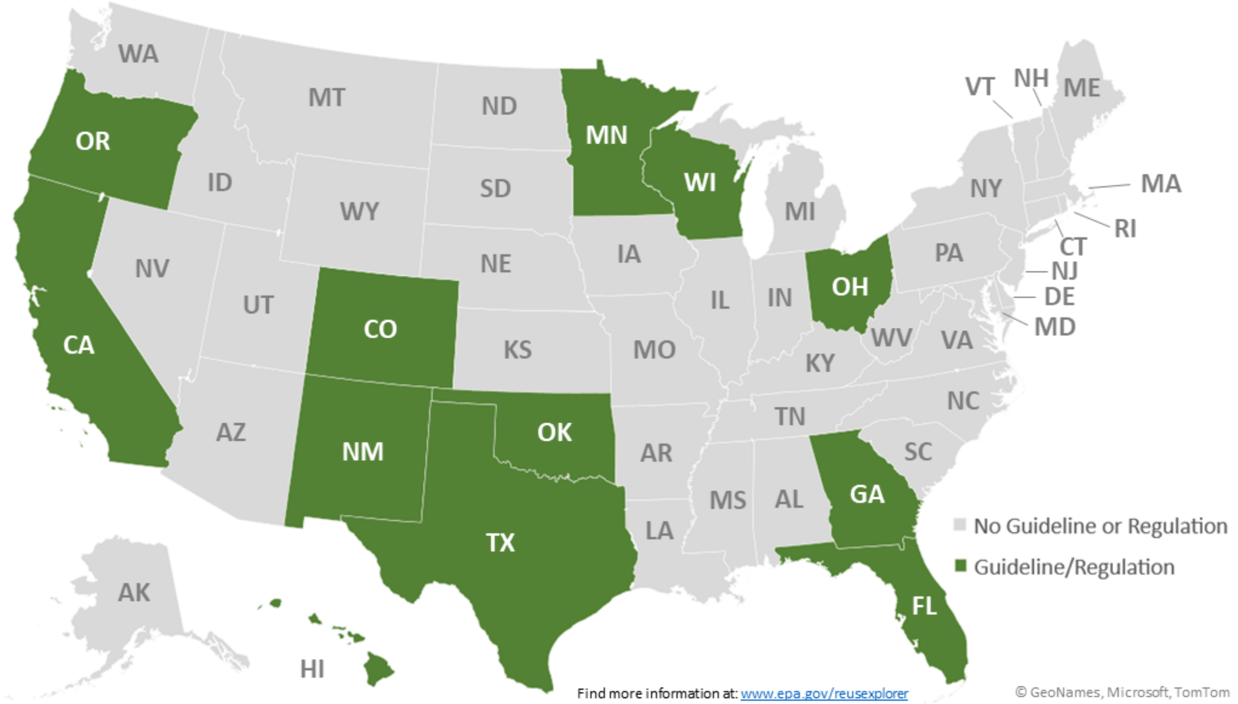
Decentralized/Onsite should gain in adoption as need continues to rise and centralized infrastructure isn’t available

States with Centralized Non-Potable Reuse Regulations or Guidelines

Excludes onsite non-potable applications, agriculture, landscape-related applications



States with Onsite Non-Potable Reuse Regulations or Guidelines



NSF/ANSI 350 in Codes and Policies

International Plumbing Code (IPC)

Uniform Plumbing Code (UPC)

International Residential Code (IRC)

International Green Construction Code (IgCC)

Several State Onsite Codes

General Services Administration (GSA) Facilities Standards for Federal Buildings (P100)

Broad Scope of Non-potable Reuse Applications

Uses For Treated Effluent:

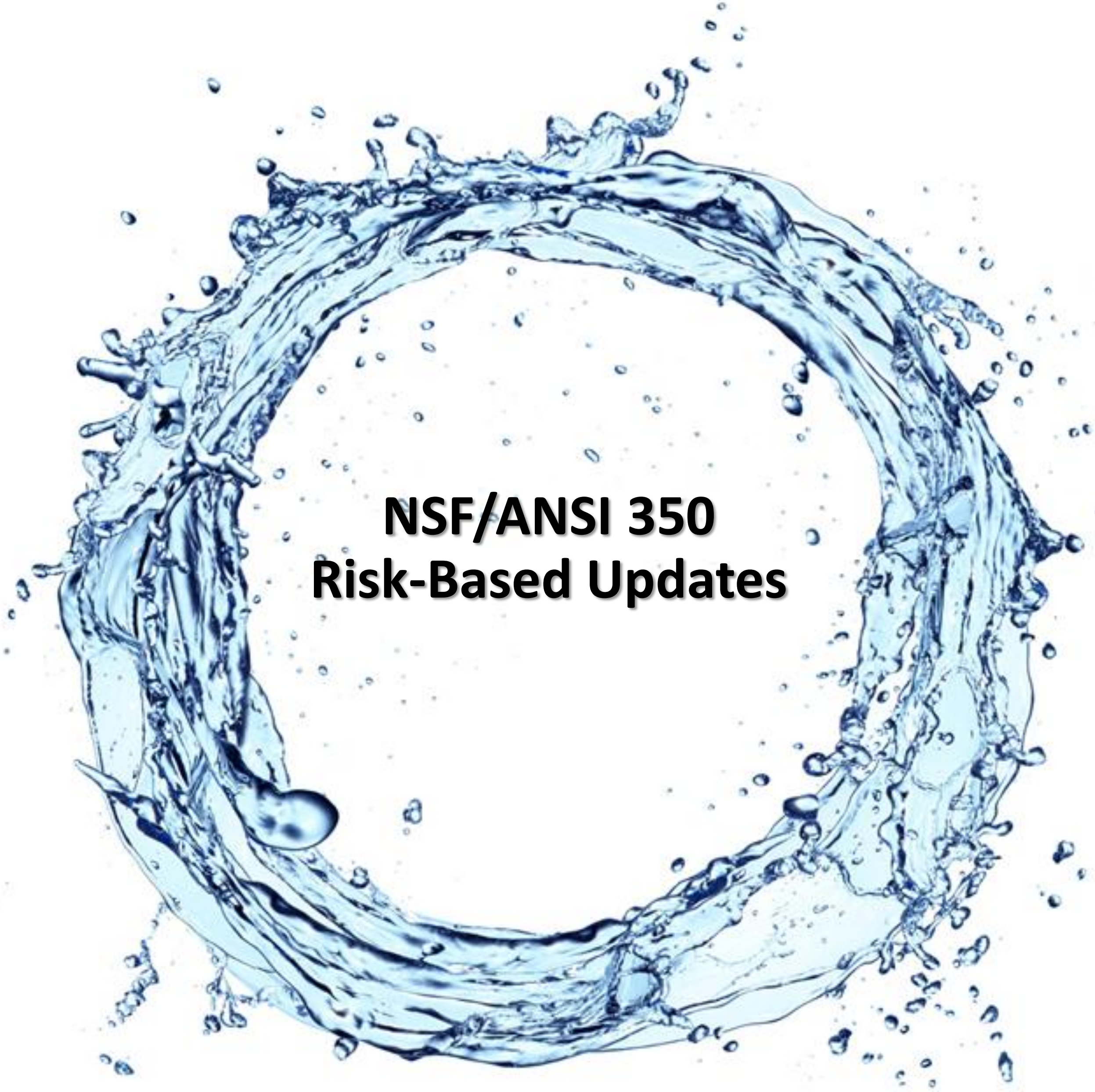
- Irrigation*
- Toilet/urinal flushing*
- Vehicle washing
- Fire protection
- Fountains
- Dust control
- Construction
- Laundry

*currently written into NSF 350 scope

NSF 350 Influent & Effluent Parameters (26 week test)

Parameter	Required Challenge Influent Range	Required Effluent Results (Class R)		Required Effluent Results (Class C)	
		Test Avg	Single Test Maximum	Test Avg	Single Test Maximum
TSS	GW: 50 – 160 mg/L WW: 100 – 350 mg/L	10 mg/L	30 mg/L	10 mg/L	30 mg/L
$BOD_5/CBOD_5$	GW: 130 – 210 mg/L WW: 100 – 300 mg/L	10 mg/L	25 mg/L	10 mg/L	25 mg/L
pH	6.0 – 8.5	6.0 – 9.0	NA	6.0 – 9.0	NA
Turbidity	30 - 100 NTU	5 NTU	10 NTU	2 NTU	5 NTU
E. Coli (per 100 mL)	$10^2 – 10^6$ cfu	14 MPN	240 MPN	2.2 MPN	200 MPN
Storage Vessel Disinfection	N/A	.5 - 2.5 mg/L	N/A	5 - 2.5 mg/L	N/A

NSF/ANSI 350 Risk-Based Updates



NSF/ANSI 350 – Risk-Based Framework

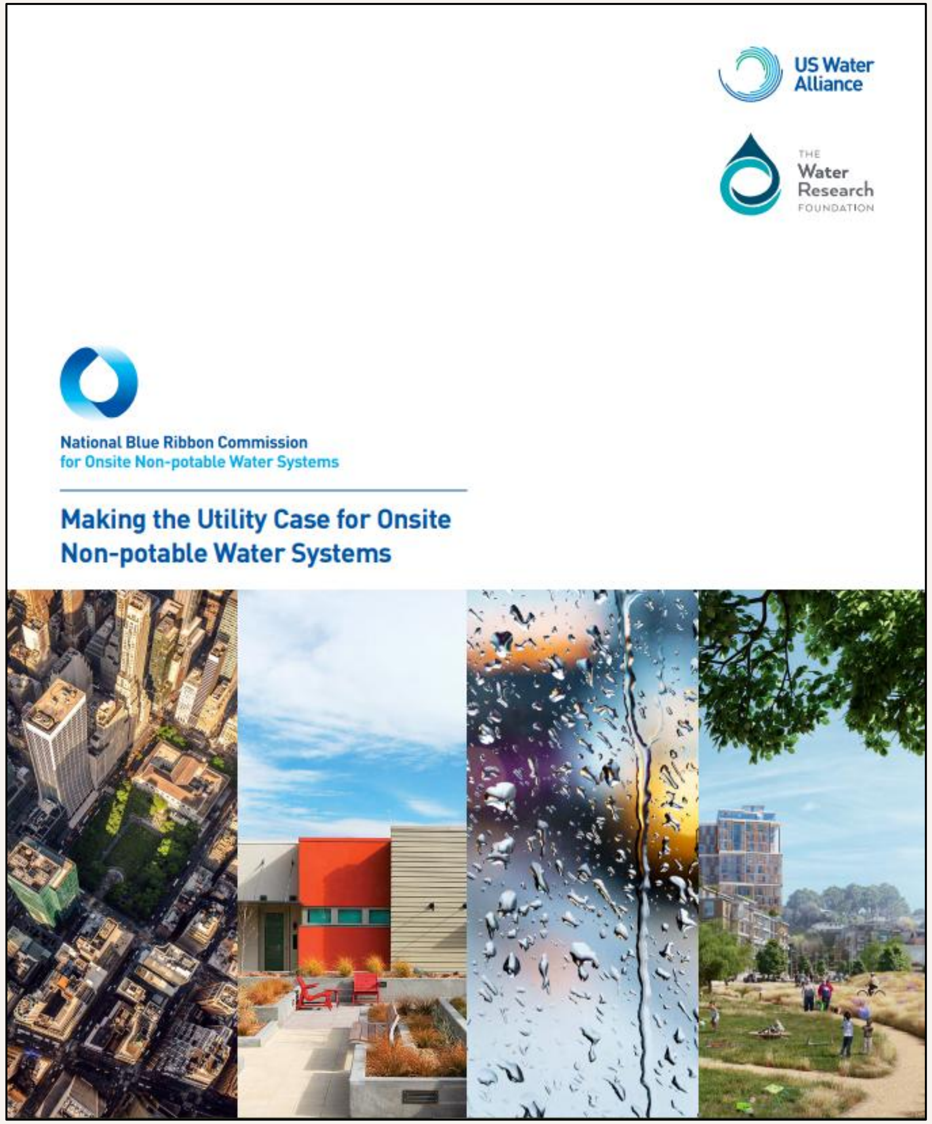
National Blue-Ribbon Commission (NBRC)

- Developed risk-based methodology using log-reduction targets (LRTs)
    - Example: 4 log reduction = %99.99
- Based on effectiveness of validated treatment components and continuous surrogate monitoring rather than end-point sampling
- Currently for non-single-family operations only

EPA Water Reuse Action Plan and several states have embraced the log-reduction target (LRT) approach

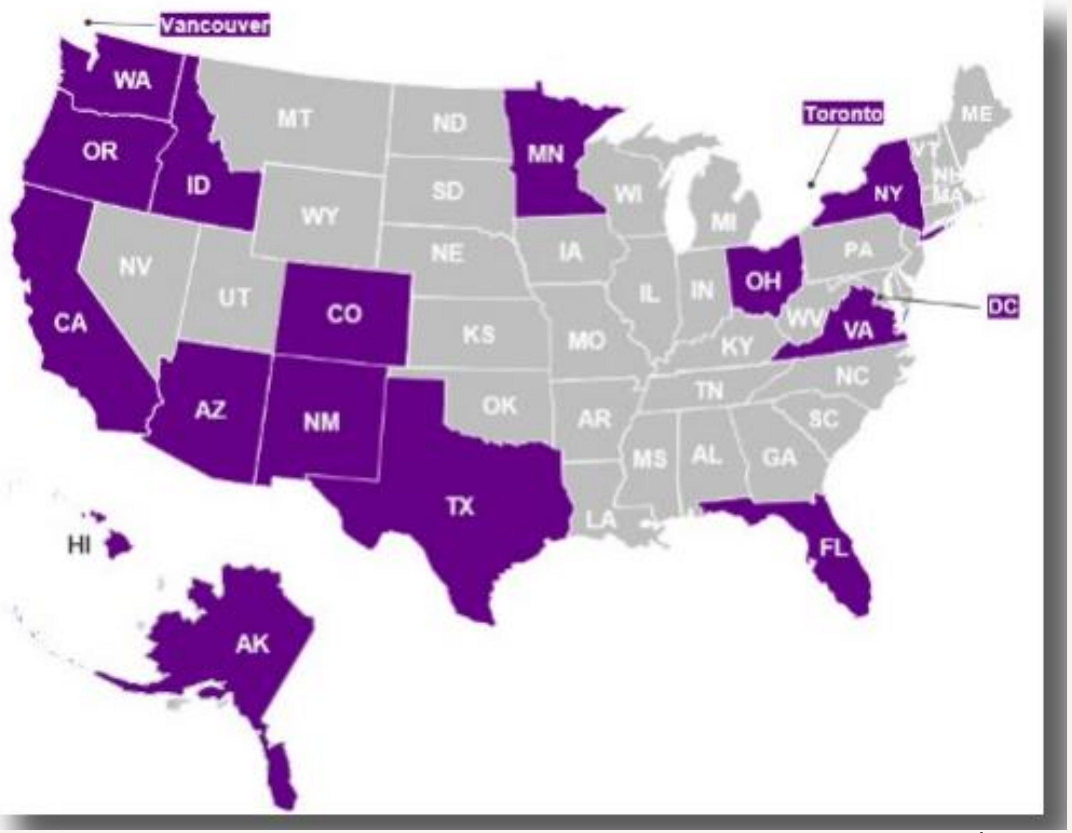
NSF/ANSI 350 Joint Committee passed language looking to do the same (Annex N-2)

- This adds needed viral and protozoan treatment criteria



NBRC Contributors

The commission is comprised of representatives from municipalities, water utilities and public health agencies from 15 states, the District of Columbia, the city of Toronto, the city of Vancouver, US EPA, and US Army Engineer Research and Development Center (see map below). See the full list of commissioners.



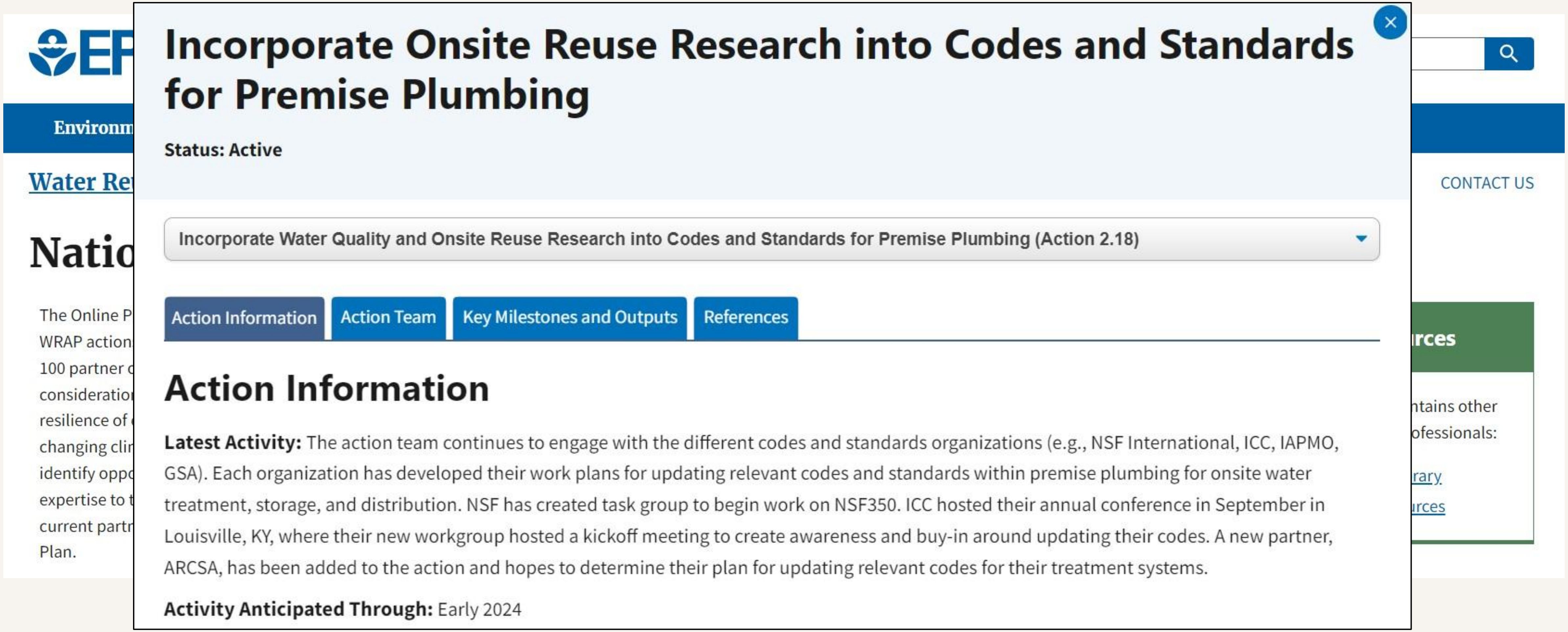
CO, CA, MN, WA, HI, have already passed legislation adopting risk-based (i.e. LRT) frameworks

TX, AK, OR, & NYC have expressed interest and/or are moving forward with plans to adopt

Source: National Blue Ribbon Commission Fact Sheet (April, 2024)

EPA WRAP Supports LRT Adoption
(NSF is an Action Partner – Item 2.18)

www.epa.gov/waterreuse/national-water-reuse-action-plan-online-platform



Incorporate Onsite Reuse Research into Codes and Standards for Premise Plumbing

Status: Active

Incorporate Water Quality and Onsite Reuse Research into Codes and Standards for Premise Plumbing (Action 2.18)

Action Information | Action Team | Key Milestones and Outputs | References

Action Information

Latest Activity: The action team continues to engage with the different codes and standards organizations (e.g., NSF International, ICC, IAPMO, GSA). Each organization has developed their work plans for updating relevant codes and standards within premise plumbing for onsite water treatment, storage, and distribution. NSF has created task group to begin work on NSF350. ICC hosted their annual conference in September in Louisville, KY, where their new workgroup hosted a kickoff meeting to create awareness and buy-in around updating their codes. A new partner, ARCSA, has been added to the action and hopes to determine their plan for updating relevant codes for their treatment systems.

Activity Anticipated Through: Early 2024

Risk-Based Approach Under NSF 350 Annex N-2

How Does It Work?

1. LRT assessment is an optional evaluation/certification.
2. Applicable to commercial and multi-family units only.
3. Maintains current NSF/ANSI 350 testing and conformance as a base requirement
4. Log-reduction credits (LRCs) are granted per individual validated treatment component
5. Sum of all LRCs must be greater than the log-reduction target (LRT) of a specific source water and end use (i.e. fit-for-purpose)
6. Requires continuously monitoring surrogate performance parameters to reduce the burden of expensive continuous sampling for viruses and protozoa by the end user.

Log Reduction Targets and Credits

Table N-2.1: Log Reduction Targets for specific indicators and intended use[1]

End Use	Enteric virus	Parasitic protozoan	Enteric bacteria
Onsite Wastewater – Irrigation	8.5	6.5	5.5
Onsite Wastewater for Indoor non-potable use	10	6.5	5.5
Graywater irrigation	6.5	4	3
Graywater for indoor non-potable use	7.5	4	3.5

[1] Log-Reduction Targets based on EPA-derived DALYS (NBRC 2023)

Table N-2.2: Log Reduction Credit Values for Specific Wastewater Treatment and Disinfection Processes[1]

Process	Virus	Protozoan	Bacteria
MBR [2]	1	2.5	4
Ultra and Micro Filter [3]	0	4	0
UV [4]	Up to 6	Up to 6	Up to 6
Cl [5]	Up to 5	0	Up to 5
Ozone [6]	Up to 4	Up to 3	Up to 4

Component Validation: UV example

Validation Methods:
- NSF/ANSI 55
- EPA UV Disinfection Guidance Manual
- NWRI UV Disinfection Guidelines for Water Reuse

Table N-2.3 Log Reduction Credits per Validated UV dose (applies for validation protocols using MS2)

Minimum total validated dose (mJ/cm^2)	Virus credit[1]	Protozoa credit[2]	Bacteria credit[3]
40	2	3	2
60	2.75	4.5	2.75
80	3.5	6	3.5
120	5	6	5
150 (and above)	6	6	6

This table was adapted from WRF/NBRC Onsite Non-Potable Water System Guidance Manual, 2020

[1]Virus credit based on standard MS2 dose-response curve (NWRI 2012)

[2]Protozoa credit based on recommendations from EPA (2006)

[3]Bacteria credit conservatively based on virus credit.

Continuous Monitoring Capability: UV example

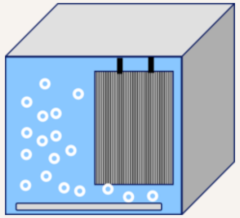
Since effluent is not being constantly sampled for all microbiological hazards, continuous monitoring of operational parameters ensures LRCs are achieved

N-2.4.3.5 Methods for continuous monitoring are required and shall include:

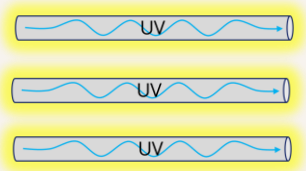
— UV Intensity (UVI). UVI shall remain within documented operating parameters of the UV device to retain log-reduction credits; and

— flow rate. Flow rate shall remain within documented operating parameters of the UV device to retain log-reduction credits.

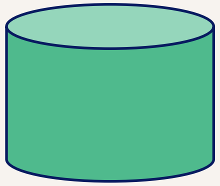
Example System: Greywater for Indoor Use (toilet flushing)



MBR
.5 NTU



UV
3 @ 40 mJ/cm2



Cl
(CT 7 mg-min/L)

Pathogens	LRC per component process			Total LRC Achieved	Total LRT Required
	MBR	UV	Cl		
Virus	1.0	5.0	2.0	8.0	7.5
Protozoa	2.5	6.0	0	8.5	4.0
Bacteria	4.0	5.0	2.0	11.0	3.5

Proposed system would pass for NSF 350 LRT certification since Total LRC ≥ LRT required*.

*Assumes system also has met all other requirements including having sensors for continuous monitoring of turbidity, UVI, flow rate, free chlorine residual

Looking Forward/Horizon Scan

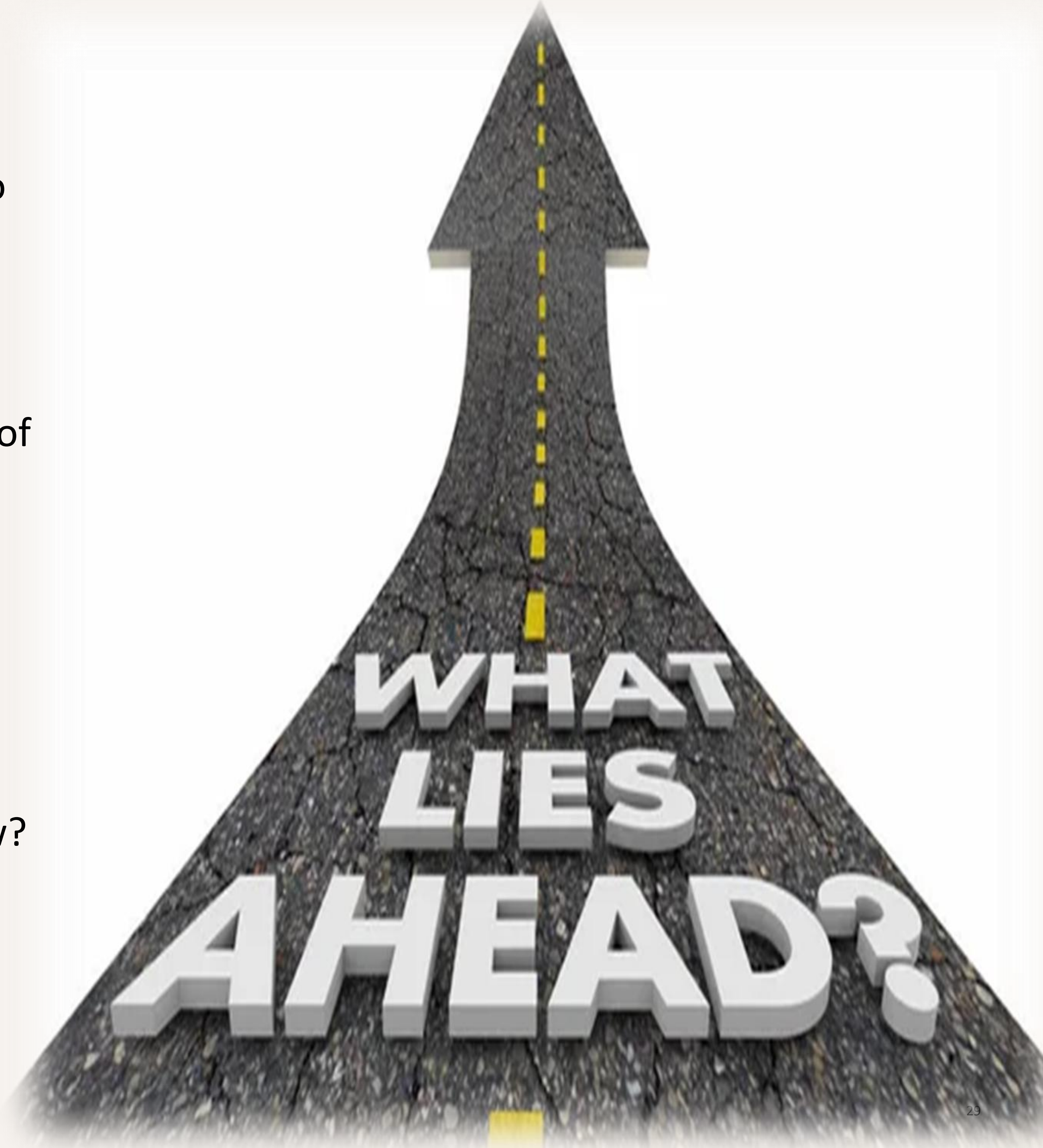
Crediting methodologies for other technologies that do not have current frameworks

Single-family residence reuse (NSF 350 covers this currently, but will it need updating?)

Do energy and nutrient recovery need to become part of the equation?

Onsite direct potable reuse (DPR) standard?

- Desirable to some, but there are obstacles
  - Will require a look beyond microbiologics for treatment
  - Who will monitor for safety/compliance and how?



Summary / Take Aways

1. NSF standards are the American National Standards (consensus driven) and are a free resource for regulators
2. Onsite wastewater treatment standards are valuable public health tools
   - protection of water quality & public health
   - conserving water resources
   - easy adoption into codes and streamlines approvals
3. Risk-Based methodology using LRTs is being implemented to better address microbiological hazards in water reuse - in a cost-effective manner

Questions ?

Derek DeLand, MPH, REHS/RS
Environmental Health Programs Manager,
Government Affairs
NSF International
e: ddeland@nsf.org
ph: 734-418-6683