International Association for Food Protection WEBINAR

How Can We Effectively Reuse Water End-To-End: Creating Equitable Future

Organized by: IAFP's Beverages and Acid/Acidified Foods PDG

Moderator: Erdogan Ceylan

Sponsored By IAFP FOUNDATION

Webinar Housekeeping

- **It is important to note that all opinions and statements are those of the individual making the presentation and not necessarily the opinion or view of IAFP.**
- **All attendees are muted. Questions should be submitted to the presenters during the presentation via the Questions section at the right of the screen. Questions will be answered at the end of the presentations.**
- **This webinar is being recorded and will be available for access by IAFP members at within one week.**

Today's Panelists

Presenter
Anett Winkler

Presenter
Theresa Mazure

Presenter
Yuqian Lou

Presenter
Walter Brandl

Erdogan Ceylan
Moderator

Erdogan Ceylan

Dr. Ceylan currently serves as a Director-Scientific Affairs at Merieux NutriSciences in Chicago.

In this role, Dr. Ceylan supports the food industry globally on microbiological risk assessment, prevention strategies, process control, and regulatory requirements.

Dr. Ceylan holds a Ph.D. in Food Science from Kansas State University with a specialization in food microbiology.

Anett Winkler

Anett joined Kraft Jacobs Suchard in December 1998 to head up the research microbiology laboratory in Munich. Later on Anett concentrated on chocolate, biscuits and other low moisture foods including supplier developments and approvals. She also consolidated the scientific basis for microbiological process controls in low moisture foods by performing validation studies for nut & cocoa processing.

Following a regional role for Microbiology in the Eastern European, Middle East & African Region she was globally designing food safety programs, rolling out training modules related to food safety and further supporting supplier development.

Anett was also the global expert for thermal processing within Mondelez International. In October 2017 Anett moved to a new position as “EMEA Regional Food Microbiologist Lead” at Cargill, where she is supporting all Cargill businesses in that region (Europe / Middle East / Africa) for microbiological / food safety related topics.

Anett is also active in ILSI Europe (Chair of Microbiology Food Safety TF), and a consultant to ICMSF since 2022. Within Germany she is also co-editor of the Handbook on Food Hygiene.

Theresa Mazure

Theresa Mazure is a food safety scientist within PepsiCo R&D’s Food Safety Center of Excellence and leads their global food safety program for water reuse. She works with multinational cross-functional teams to implement a global food safety water reuse standard that enables fit-for-purpose water reuse. Additionally, she establishes food safety risk assessments for North America water reuse engineering projects.

Theresa has 20 years industry experience between analytical chemistry, quality, and food safety, holds a Bachelor of Science in chemistry from the University of Georgia, and is studying for a Master of Science in Food Safety Regulation from Johns Hopkins University.

Yuqian Lou

Yuqian Lou, Ph.D. PepsiCo R&D Fellow / Director of Food Safety, Sanitation & Sustainability

Yuqian Lou is currently a Director of Food Safety, Sanitation & Sustainability (FSSS) and a PepsiCo R&D Fellow. He is currently the Vice-Chair of the Beverages and Acid/Acidified Foods PDG. He joined PepsiCo Global R&D in 2013 as a Process Authority supporting R&D and supply chain beverage initiatives to ensure commercial sterility of PepsiCo products. He has excelled in applying engineering and microbiological principles in assessing various food safety or microbiological issues and then designing theoretically sound but practically feasible control measures to address these issues. Prior to joining PepsiCo, he spent sixteen years, as a R&D product and process developer, microbiologist, and thermal processing specialist in Sara Lee and Unilever R&D.

He holds a Ph.D. degree in Food Science (focusing on Food Microbiology) from The Ohio Statement University, and Master and Bachelor's degrees of Fermentation Engineering from Tianjin University of Science and Technology in China.

Walter Brandl

Walter Brandl has been involved in analytical chemistry for over 30 years involved in environmental chemistry, biotechnology and, most recently, food chemistry. During this time he has held positions in Quality Assurance, Operations and Training.

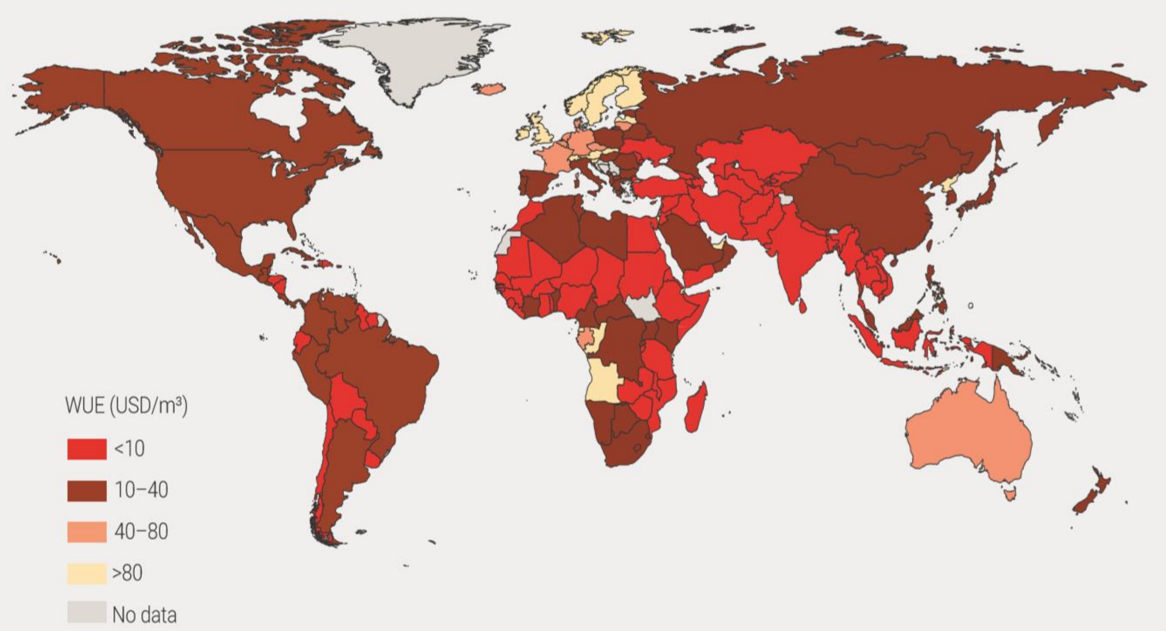
Walter’s technical expertise is mainly in the contaminant / food safety area such as toxic metals, pesticides, natural toxins and veterinary drug residues.

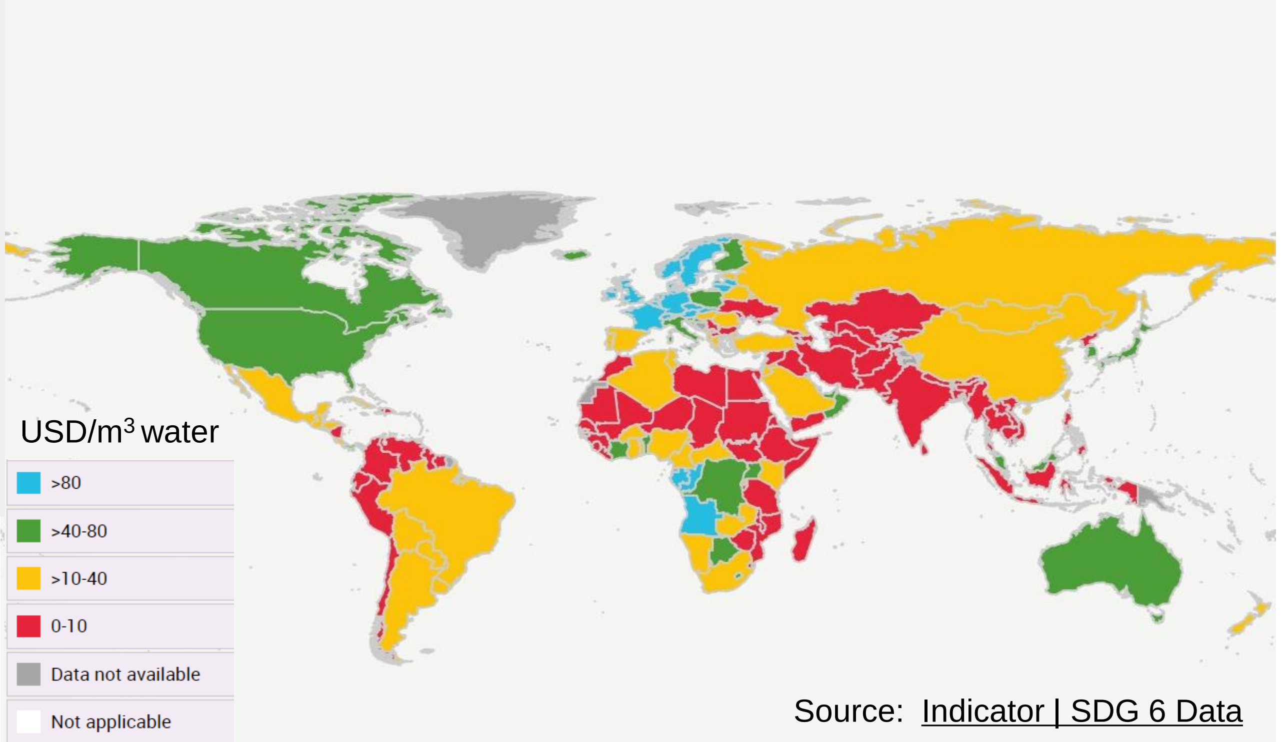
Previously, he held the position of Technical Director of Chemistry for Merieux NutriSciences in North America, responsible for the implementation of new methods, quality control in chemistry and providing technical support to both laboratories and clients.

Currently, he is the Regional Director of Chemistry in North America for Merieux NutriSciences and is primarily responsible for method development and deployment.

Water-use Efficiency in the World

2021

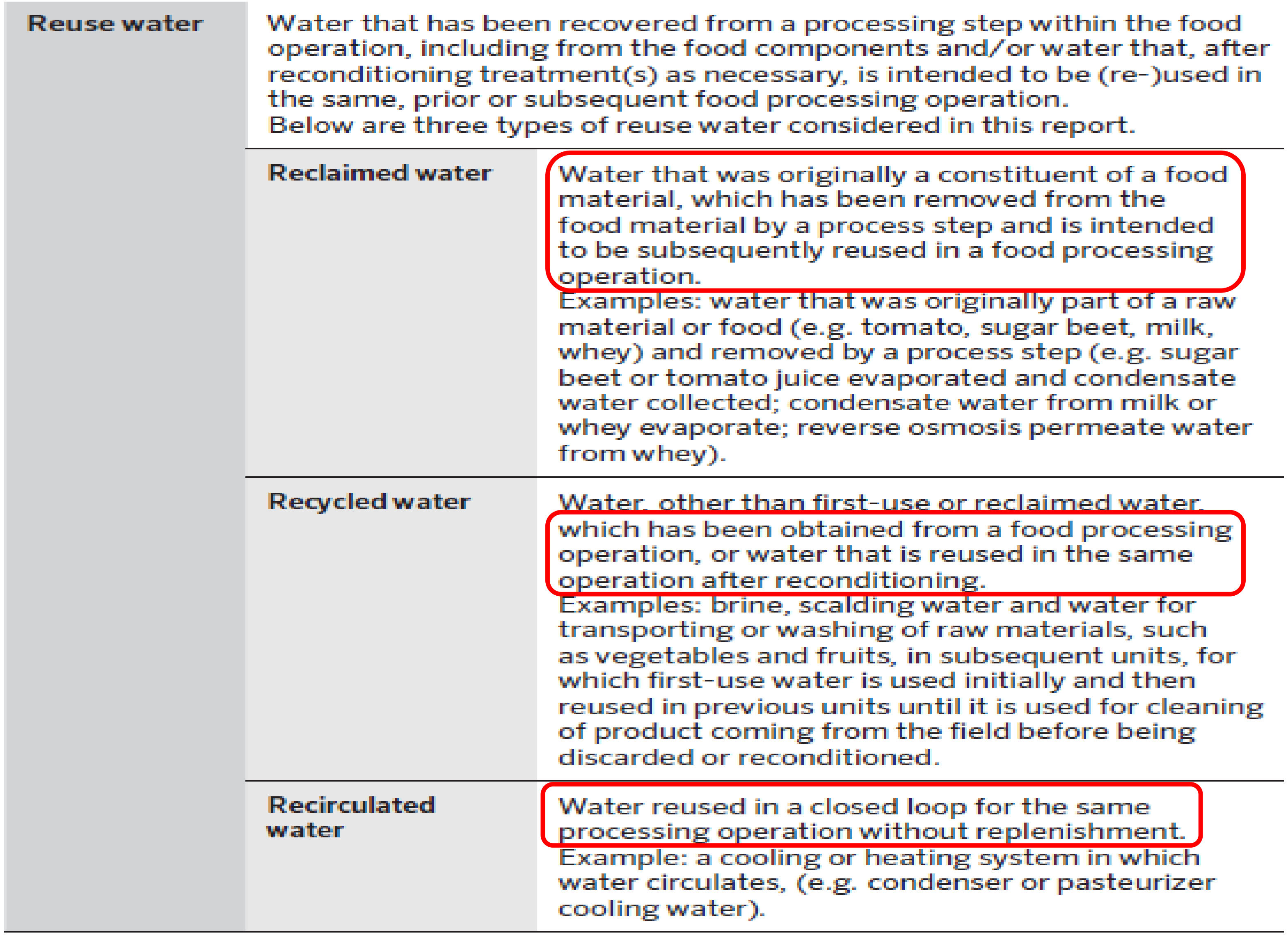




2015

Source: Indicator | SDG 6 Data

Definitions

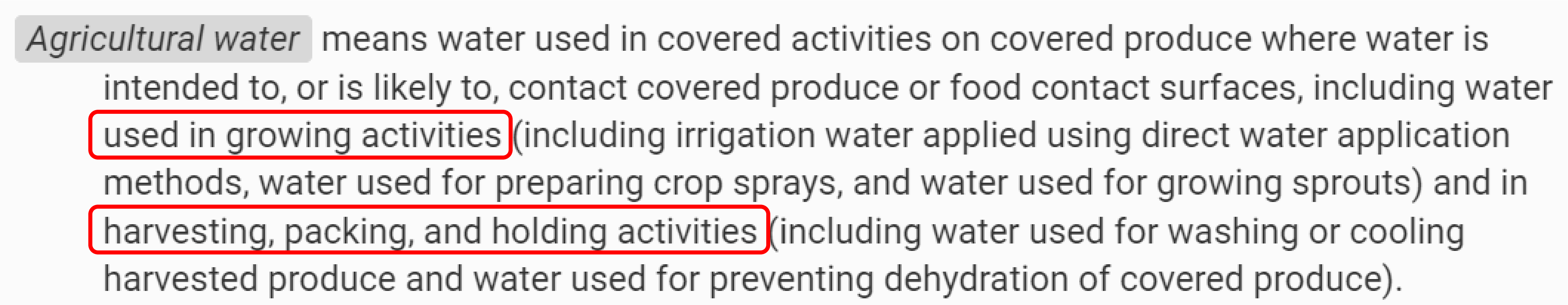


Reuse water	Water that has been recovered from a processing step within the food operation, including from the food components and/or water that, after reconditioning treatment(s) as necessary, is intended to be (re-)used in the same, prior or subsequent food processing operation. Below are three types of reuse water considered in this report.	
	Reclaimed water	Water that was originally a constituent of a food material, which has been removed from the food material by a process step and is intended to be subsequently reused in a food processing operation. Examples: water that was originally part of a raw material or food (e.g. tomato, sugar beet, milk, whey) and removed by a process step (e.g. sugar beet or tomato juice evaporated and condensate water collected; condensate water from milk or whey evaporate; reverse osmosis permeate water from whey).
	Recycled water	Water, other than first-use or reclaimed water, which has been obtained from a food processing operation, or water that is reused in the same operation after reconditioning. Examples: brine, scalding water and water for transporting or washing of raw materials, such as vegetables and fruits, in subsequent units, for which first-use water is used initially and then reused in previous units until it is used for cleaning of product coming from the field before being discarded or reconditioned.
	Recirculated water	Water reused in a closed loop for the same processing operation without replenishment. Example: a cooling or heating system in which water circulates, (e.g. condenser or pasteurizer cooling water).

Source:
Safety and Quality of Water Used in Food Production and Processing , FAO/WHO 2019

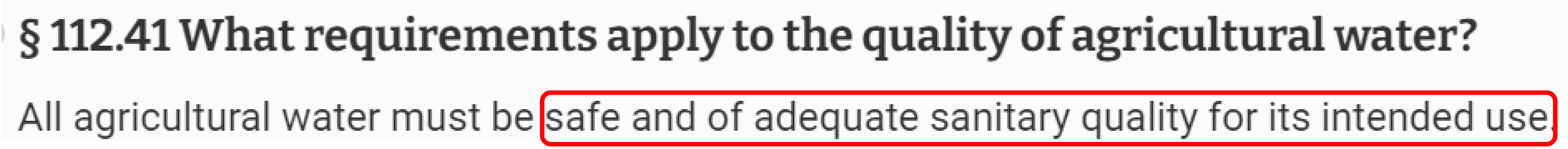
Definitions – FSMA „Agricultural Water“

21 CFR Part 112



Agricultural water means water used in covered activities on covered produce where water is intended to, or is likely to, contact covered produce or food contact surfaces, including water used in growing activities (including irrigation water applied using direct water application methods, water used for preparing crop sprays, and water used for growing sprouts) and in harvesting, packing, and holding activities (including water used for washing or cooling harvested produce and water used for preventing dehydration of covered produce).

Subpart E

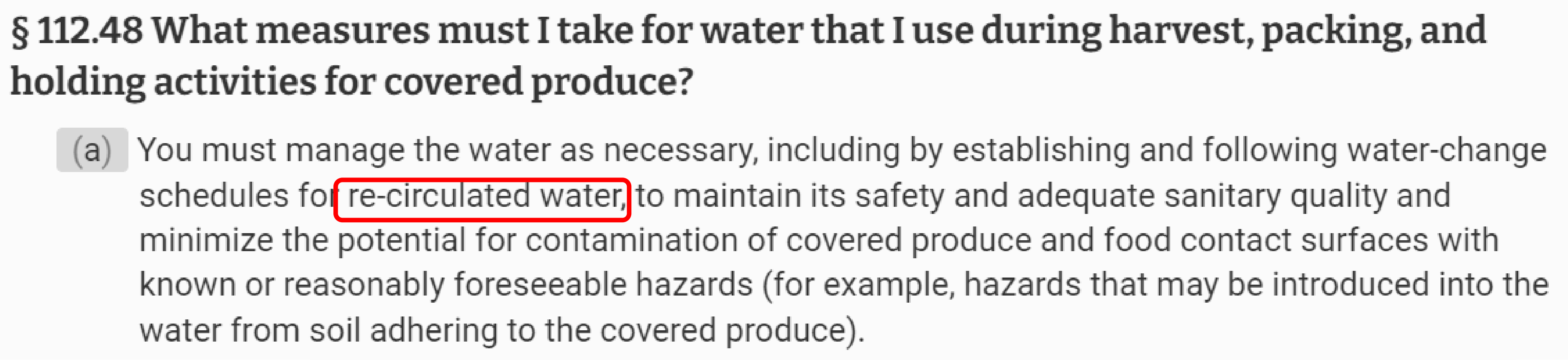


§ 112.41 What requirements apply to the quality of agricultural water?

All agricultural water must be safe and of adequate sanitary quality for its intended use.

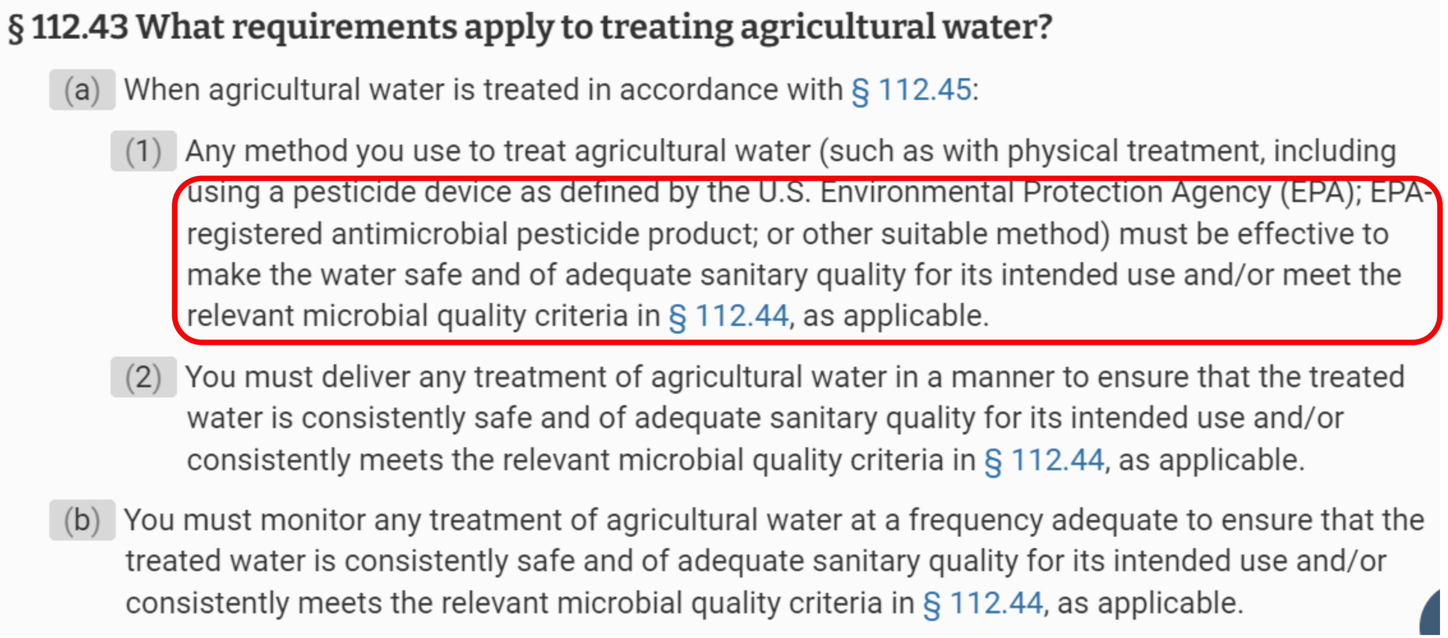
Definitions – FSMA „Agricultural Water“

Subpart E



§ 112.48 What measures must I take for water that I use during harvest, packing, and holding activities for covered produce?

(a) You must manage the water as necessary, including by establishing and following water-change schedules for re-circulated water, to maintain its safety and adequate sanitary quality and minimize the potential for contamination of covered produce and food contact surfaces with known or reasonably foreseeable hazards (for example, hazards that may be introduced into the water from soil adhering to the covered produce).



§ 112.43 What requirements apply to treating agricultural water?

(a) When agricultural water is treated in accordance with § 112.45:

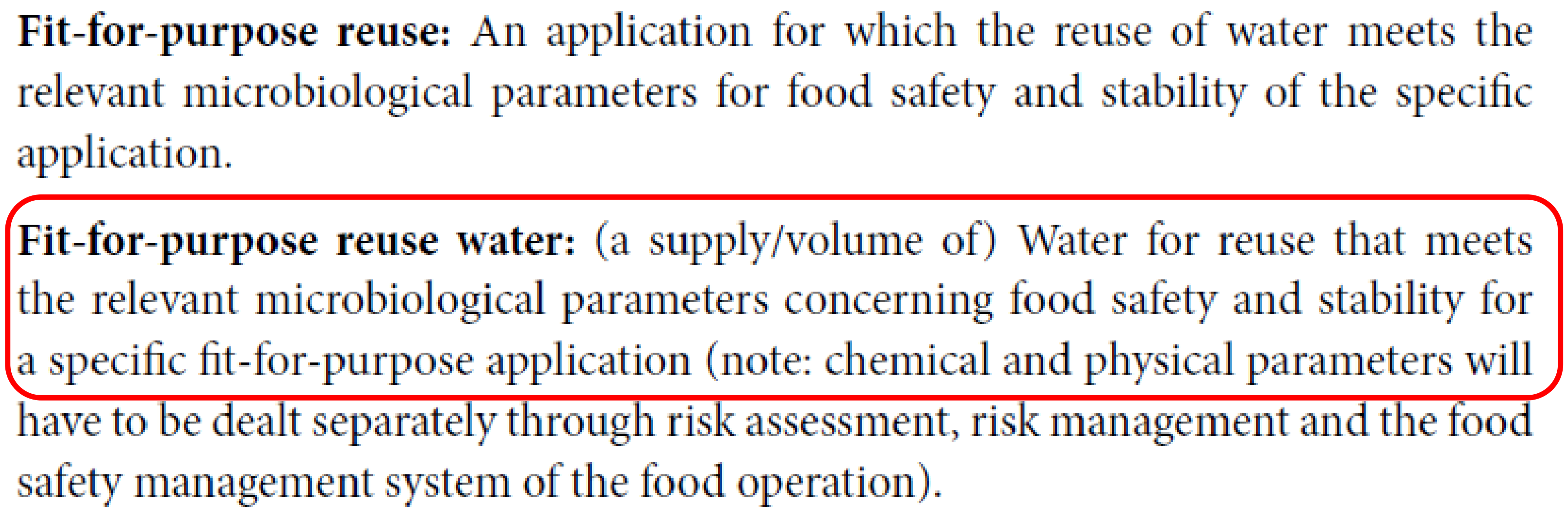
(1) Any method you use to treat agricultural water (such as with physical treatment, including using a pesticide device as defined by the U.S. Environmental Protection Agency (EPA); EPA-registered antimicrobial pesticide product; or other suitable method) must be effective to make the water safe and of adequate sanitary quality for its intended use and/or meet the relevant microbial quality criteria in § 112.44, as applicable.

(2) You must deliver any treatment of agricultural water in a manner to ensure that the treated water is consistently safe and of adequate sanitary quality for its intended use and/or consistently meets the relevant microbial quality criteria in § 112.44, as applicable.

(b) You must monitor any treatment of agricultural water at a frequency adequate to ensure that the treated water is consistently safe and of adequate sanitary quality for its intended use and/or consistently meets the relevant microbial quality criteria in § 112.44, as applicable.

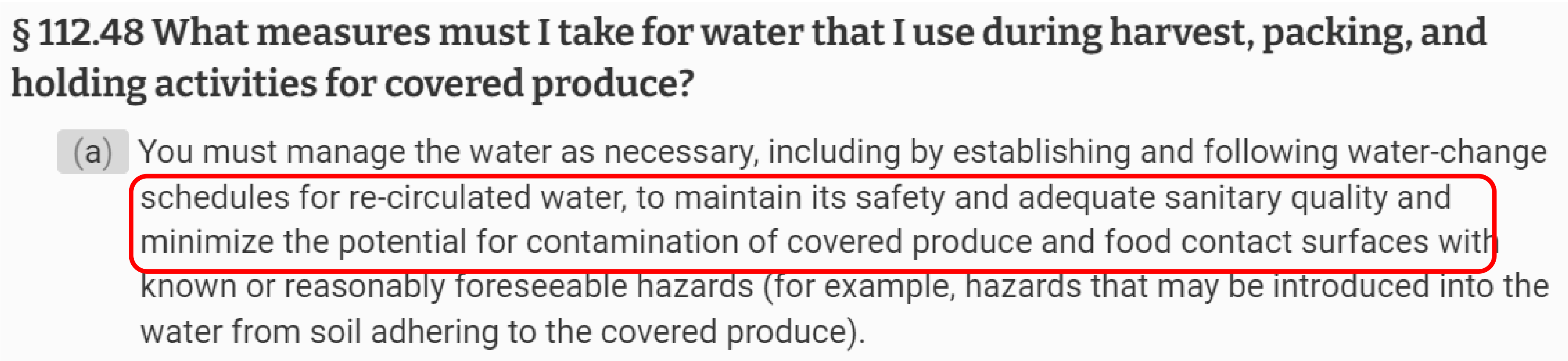
Definitions – „fit-for-purpose“ Water

FAO / WHO (2023) Safety and quality of water use and reuse in the production and processing of dairy products



Fit-for-purpose reuse: An application for which the reuse of water meets the relevant microbiological parameters for food safety and stability of the specific application.

Fit-for-purpose reuse water: (a supply/volume of) Water for reuse that meets the relevant microbiological parameters concerning food safety and stability for a specific fit-for-purpose application (note: chemical and physical parameters will have to be dealt separately through risk assessment, risk management and the food safety management system of the food operation).



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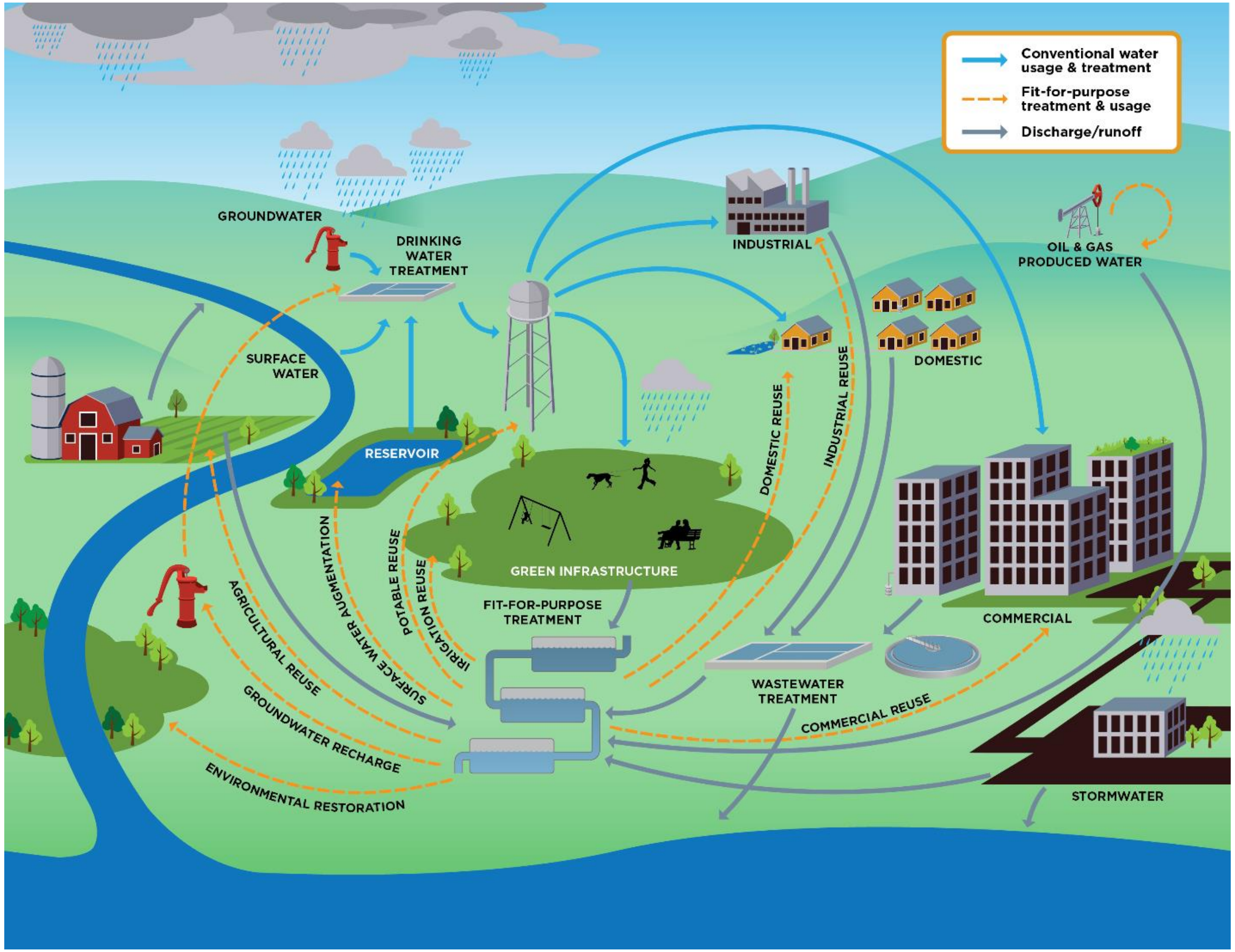
Definitions – „fit-for-purpose“ Water

- ➢ No single quality or treatment will fit all purposes
- ➢ Will depend on source - usage – re-use

**It is a risk-based approach –
Requiring Risk Assessments**

- ➢ No compromise on safety of the food it comes in contact with
- ➢ Food does not become more contaminated through contact with that water

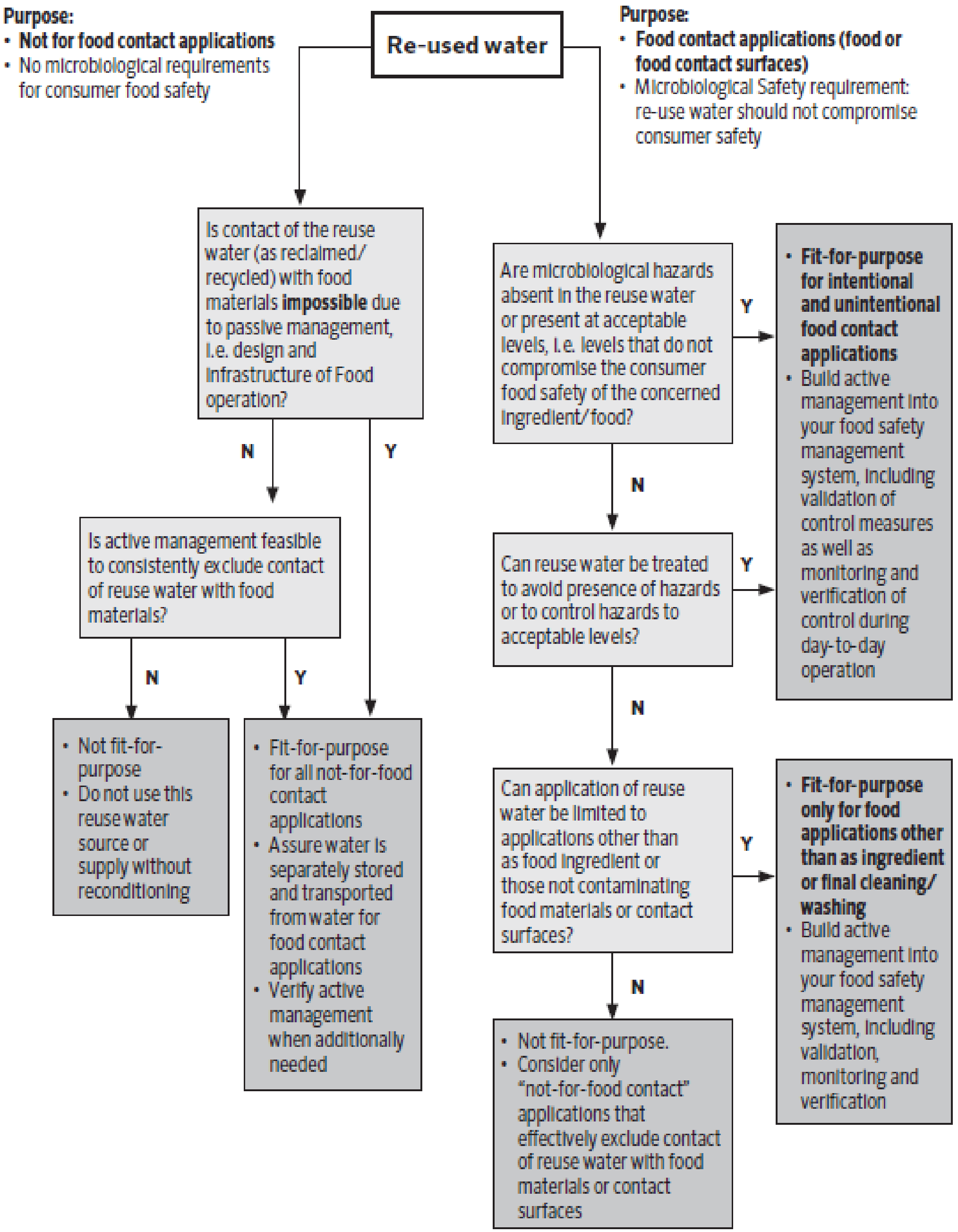
EPA „Water Reuse“ Potentials



Source: Basic Information about Water Reuse | US EPA

Potential Applications for Water Reuse in Food Production

Fresh Produce	Irrigation, Washing water, bin dumping,fluming (conveyance of products), hydrocooling, Cleaning
Fishery	Washing, Cleaning
Further Processing (e.g. dairy / meat)	Washing, Reclaim condensates for different purposes, Cleaning, Reciruclated cooling water



Purpose:
- **Not for food contact applications**
- No microbiological requirements for consumer food safety

Re-used water

Purpose:
- **Food contact applications (food or food contact surfaces)**
- Microbiological Safety requirement: re-use water should not compromise consumer safety

Is contact of the reuse water (as reclaimed/recycled) with food materials **impossible** due to passive management, i.e. design and infrastructure of Food operation?

Is active management feasible to consistently exclude contact of reuse water with food materials?

- Not fit-for-purpose
- Do not use this reuse water source or supply without reconditioning

- Fit-for-purpose for all not-for-food contact applications
- Assure water is separately stored and transported from water for food contact applications
- Verify active management when additionally needed

Are microbiological hazards absent in the reuse water or present at acceptable levels, i.e. levels that do not compromise the consumer food safety of the concerned ingredient/food?

Can reuse water be treated to avoid presence of hazards or to control hazards to acceptable levels?

Can application of reuse water be limited to applications other than as food ingredient or those not contaminating food materials or contact surfaces?

- Not fit-for-purpose.
- Consider only "not-for-food contact" applications that effectively exclude contact of reuse water with food materials or contact surfaces

- **Fit-for-purpose for intentional and unintentional food contact applications**
- Build active management into your food safety management system, including validation of control measures as well as monitoring and verification of control during day-to-day operation

- **Fit-for-purpose only for food applications other than as ingredient or final cleaning/washing**
- Build active management into your food safety management system, including validation, monitoring and verification

Risk-based framework on water reuse

Source:

Safety and Quality of Water Used in Food Production and Processing , FAO/WHO 2019

Potential Contaminants in water (reuse)

<u>Biological</u>

- bacteria, viruses, parasites
- toxins produced by Cyanobacteria (blue-green algae) and algae

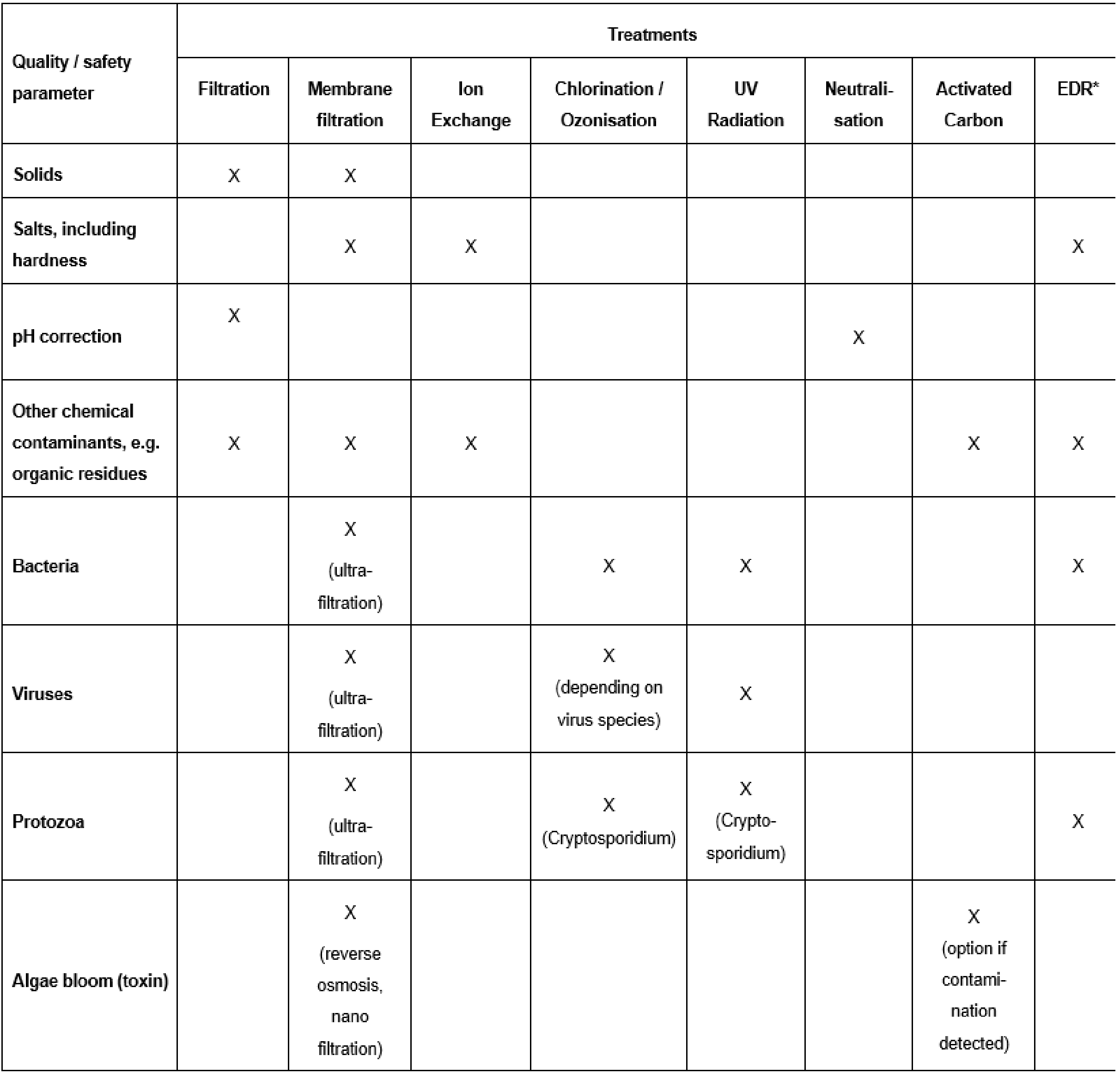
<u>Chemical</u>

- Minerals
- Chemicals from Industry waste streams
- Pesticides used in agriculture
- Organic residues
- Residues from human use (e.g. antibiotics)

<u>Physical</u>

- Solids and Foreign Matter

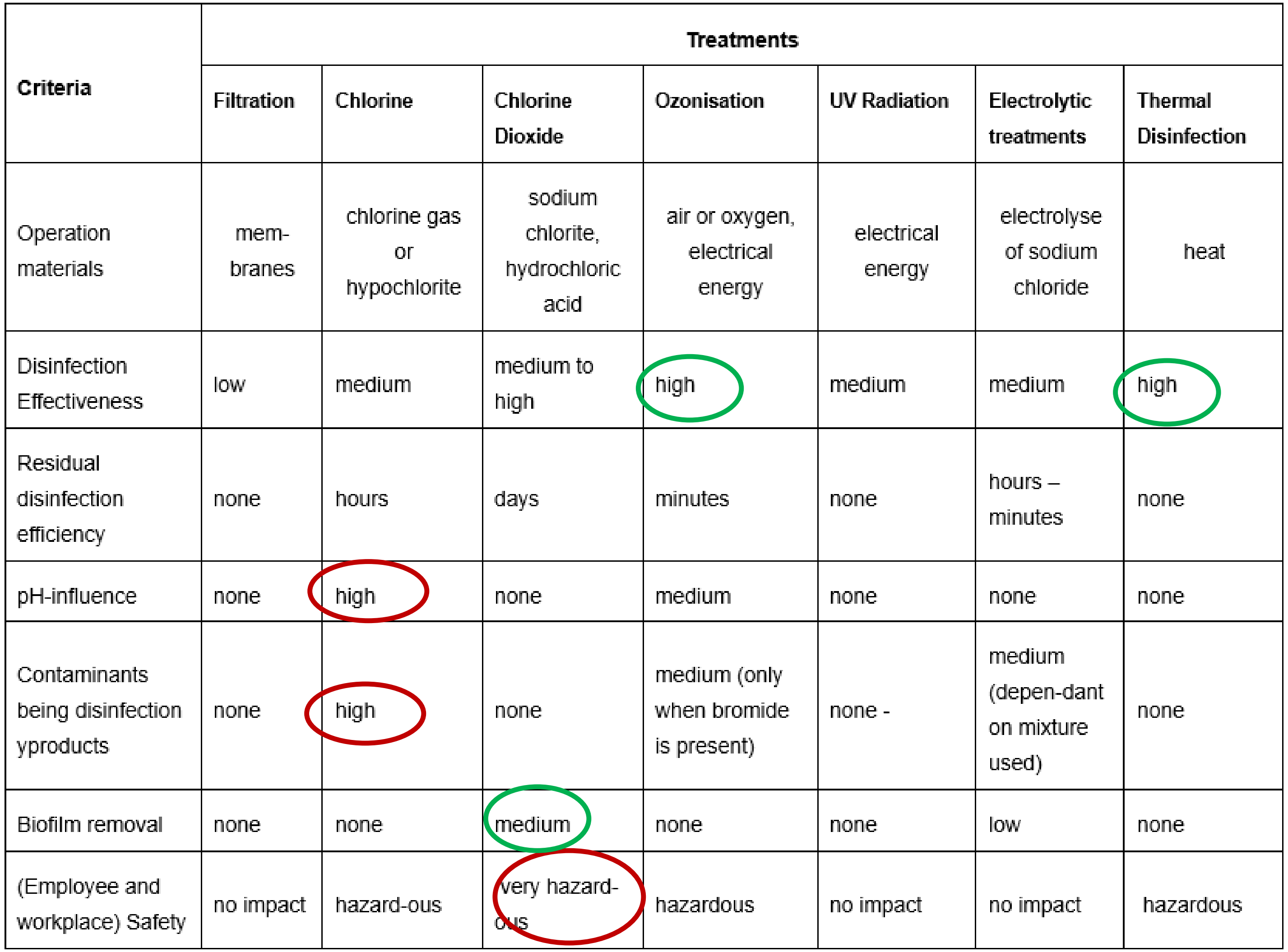
Water Treatments



Quality / safety parameter	Treatments							
	Filtration	Membrane filtration	Ion Exchange	Chlorination / Ozonisation	UV Radiation	Neutralisation	Activated Carbon	EDR*
Solids	X	X						
Salts, including hardness		X	X					X
pH correction	X					X		
Other chemical contaminants, e.g. organic residues	X	X	X				X	X
Bacteria		X (ultra-filtration)		X	X			X
Viruses		X (ultra-filtration)		X (depending on virus species)	X			
Protozoa		X (ultra-filtration)		X (Cryptosporidium)	X (Cryptosporidium)			X
Algae bloom (toxin)		X (reverse osmosis, nano filtration)					X (option if contamination detected)	

Source: EHEDG GL 28

Water Treatments

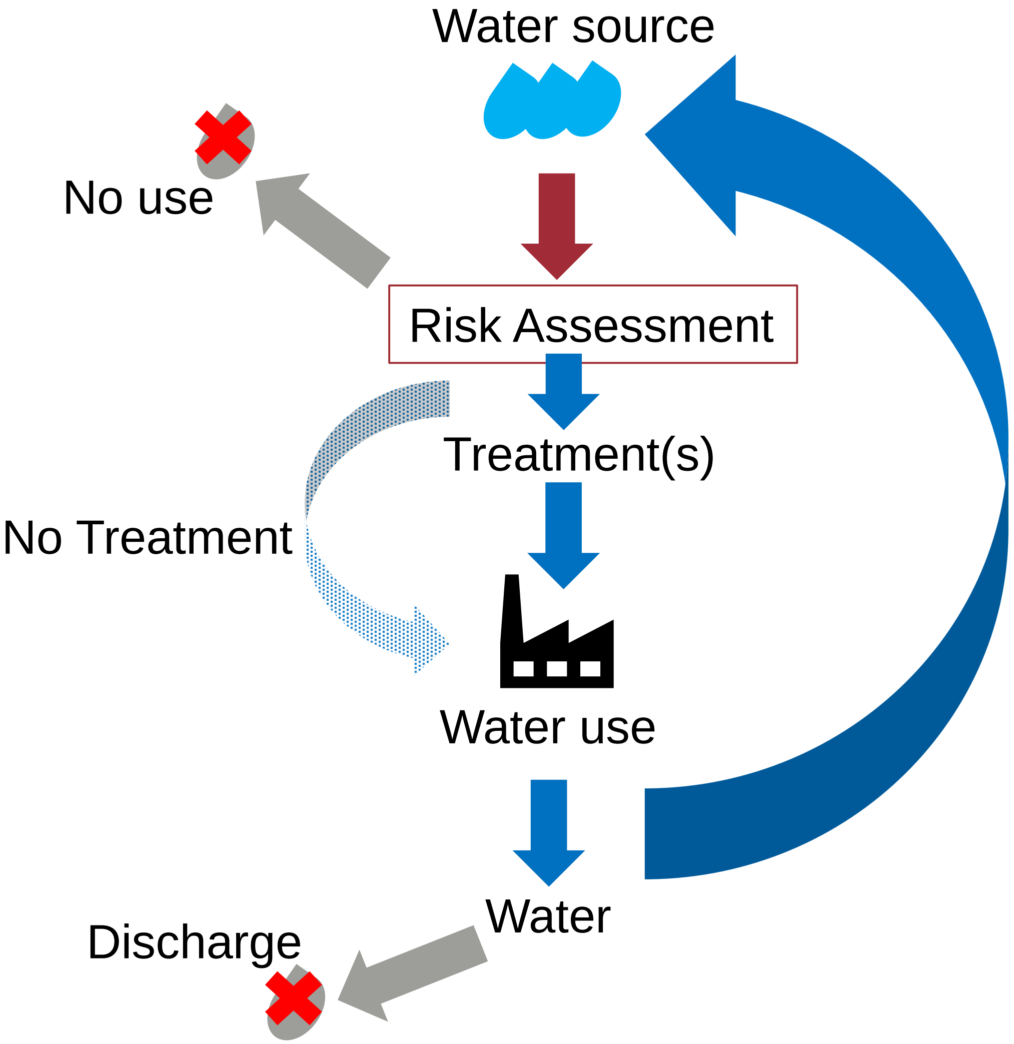


Criteria	Treatments						
	Filtration	Chlorine	Chlorine Dioxide	Ozonisation	UV Radiation	Electrolytic treatments	Thermal Disinfection
Operation materials	membranes	chlorine gas or hypochlorite	sodium chlorite, hydrochloric acid	air or oxygen, electrical energy	electrical energy	electrolyse of sodium chloride	heat
Disinfection Effectiveness	low	medium	medium to high	high	medium	medium	high
Residual disinfection efficiency	none	hours	days	minutes	none	hours – minutes	none
pH-influence	none	high	none	medium	none	none	none
Contaminants being disinfection yproducts	none	high	none	medium (only when bromide is present)	none -	medium (depen-dant on mixture used)	none
Biofilm removal	none	none	medium	none	none	low	none
(Employee and workplace) Safety	no impact	hazard-ous	very hazard-ous	hazardous	no impact	no impact	hazardous

Source: EHEDG GL 28

Water reuse requires knowledge /input from several areas:

- (first) Water sources and use
- Biological / Chemical / Physical risks
- Treatment technologies
- Water Distribution and Storage
- Product and its consumer use
- Process
- Validation, monitoring and verification
- Risk Assessment approaches
- Regulation



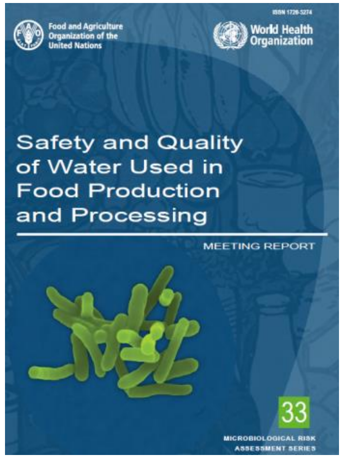
Useful Resources

FAO / WHO

MRA Series No. 33: Safety and Quality of Water Used in Food Production and Processing (2019)
MRA Series No. 37: Safety and quality of water used with fresh fruits and vegetables (2021)
MRA Series No. 40: Safety and quality of water use and reuse in the production and processing of dairy products
MRA Series No. 41: Safety and quality of water used in the production and processing of fish and fishery products

EHEDG

GL No. 28: Safe and Hygienic treatment and distribution of water in food and beverage factories (2018)



ISSN 1726-5274

Food and Agriculture Organization of the United Nations

World Health Organization

Safety and Quality of Water Used in Food Production and Processing

MEETING REPORT

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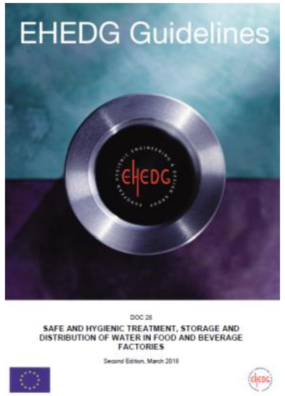
MICROBIOLOGICAL RISK ASSESSMENT SERIES



EHEDG Guidelines

DOC 28

SAFE AND HYGIENIC TREATMENT, STORAGE AND DISTRIBUTION OF WATER IN FOOD AND BEVERAGE FACTORIES

Second Edition, March 2018

Thank you for your Attention!

Water Reuse for Sustainability- Perspectives in Technological Advancement and Management Issues

IAFP Webinar
June 17, 2024

Theresa Mazure & Yuqian Lou
Food Safety Center of Excellence, PepsiCo Global R&D

Implementation of water reuse in food manufacturing involves

Legal

Understanding regulations

Safe

Thorough risk assessment

Control Strategies

Understanding technologies

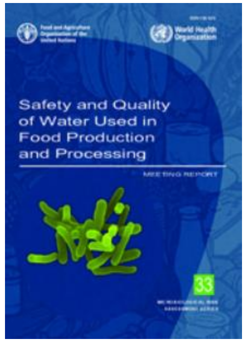
Ongoing management

Maintaining safe operations

Scan for information on PepsiCo water goals

WHO/FAO and Codex Alimentarius developed guidelines to assess and manage risk in water use and reuse

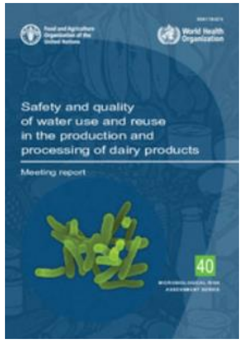
Microbiological Risk Assessment series



Safety and Quality of Water Used in Food Production and Processing

MEETING REPORT

33



Safety and quality of water use and reuse in the production and processing of dairy products

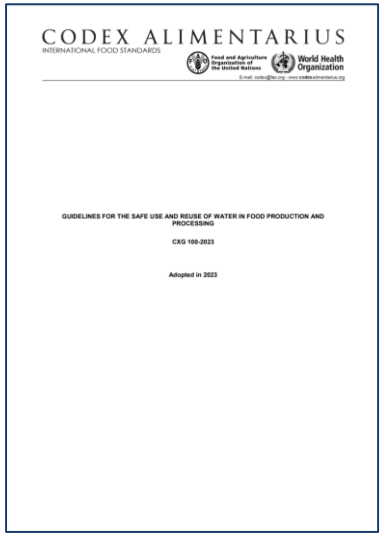
Meeting report

40

[Safety and Quality of Water Used in Food Production and Processing: meeting report](#)
Series 33, 2019

[Safety and quality of water use and reuse in the production and processing of dairy products: meeting report](#)
Series 40, 2023

CODEX Guidance



CODEX ALIMENTARIUS
INTERNATIONAL FOOD STANDARDS

Food and Agriculture Organization of the United Nations
World Health Organization
E-mail: codex@fao.org - www.codexalimentarius.org

GUIDELINES FOR THE SAFE USE AND REUSE OF WATER IN FOOD PRODUCTION AND PROCESSING

CXG 100-2023

Adopted in 2023

[Guidelines for the Safe Use and Reuse of Water in Food Production and Processing](#)
2023

World Health Organization & Food And Agriculture Organization of the United Nations

Water regulations span multiple government agencies

Water Regulations

EPA

Safe Drinking Water Act

40 CFR 141

Clean Water Act 33 USC 1251 et seq.

REUSExplorer tool

FDA

21 CFR 117 Subparts B, C, & G

(cGMPs, HACCP & PC, Supply-Chain Program)

State & Municipal

Source water

Discharge

Colorado & California approved regulations for Direct Potable Reuse

USDA

Meat and poultry, processed egg products, catfish

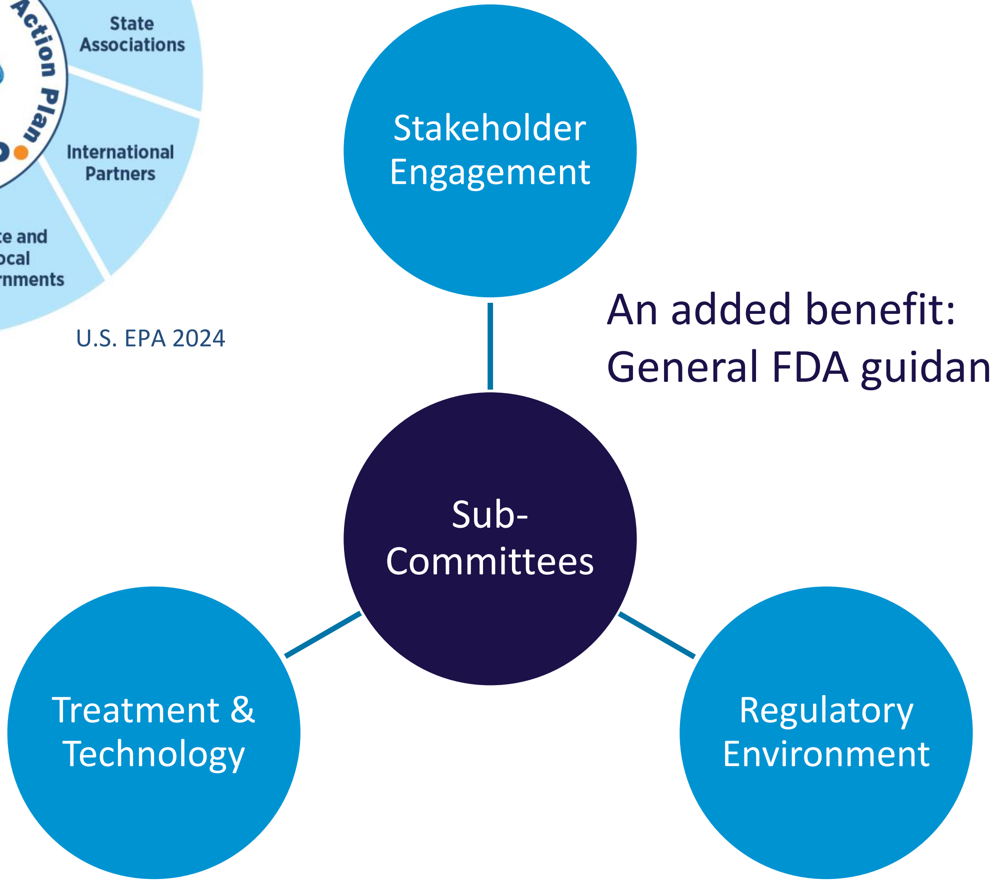
9 CFR 416.2(g)

EPA Water Reuse Action Plan
WRAP 5.7

U.S. EPA 2024

- Increase understanding
- Identify hurdles
  + near & long-term solutions

An added benefit:
General FDA guidance



Stakeholder Engagement

Sub-Committees

Treatment & Technology

Regulatory Environment

Advancing Water Reuse Within the Beverage Industry

Download the white paper

Disclaimer

The information in this document was developed under the National Water Reuse Action Plan, **Action 5.7**: Identify Opportunities to Implement Water Reuse Within the Beverage Industry. The Action Leaders and Partners provided their insights and contributions in kind. Mention of commercial products and the organizations offering such products do not constitute endorsement or recommendation for use. Furthermore, this document is a summary of the views of the individual convening participants; approval for publication does not signify that the contents reflect the views of the Action Partners' organizations, and no official endorsement should be inferred.

A Call to Action: Notes from the Action Leaders and Partners

Water is essential to the beverage industry as it is used in every facet of it. Water is used to irrigate and cultivate ingredients and is an ingredient in beverages. Water is a key process component in beverage manufacturing and is used to dispense and serve beverages to consumers. Without sufficient water, beverage companies cannot produce their products.

Water supply, quality, demand, and wastewater generation are meaningful in this sector. Water is a limited natural resource facing unprecedented local and global challenges. Water supply and disposal options are often constrained due to regulations governing discharge quality and environmental factors such as droughts. Across industry, and especially in regions where water scarcity is pronounced, these issues drive higher costs for beverage manufacturers to produce their products, not only to access source water, but also to dispose of wastewater. These complex water challenges have motivated corporate personnel, regulators, consulting engineers, equipment and technology providers (referred to herein as "water professionals"), and consumers to seek and develop solutions to help the beverage industry optimize water usage and operate sustainably.

Toward this end, water reuse offers a compelling opportunity for beverage manufacturers. By recycling water for non-ingredient (or non-product) purposes onsite, beverage manufacturers can minimize their demand for water from off-site sources, as well as the volume of wastewater taken off-site for disposal. Beverage manufacturers can also optimize water recovery and reuse onsite, elevating operational efficiencies, reducing costs, and achieving sustainability goals.

The United States Environmental Protection Agency (USEPA) coordinates the **National Water Reuse Action Plan (WRAP)** that promotes collaboration among the water sector to address barriers and drive opportunities for water reuse in the public and private sectors. As part of **WRAP Action 5.7**, a diverse group of action leaders and partners convened to assess barriers and opportunities for water reuse in the beverage industry. Based on feedback from the Action Partners and the public, the Action Leaders formed three subcommittees to investigate barriers to water reuse in the beverage industry based on three key topics: Stakeholder Engagement, Regulatory Environment, and Treatment and Technology. This paper is generally organized by these topics and is the primary output of WRAP Action 5.7.

Advancing Water Reuse Within the Beverage Industry | Water Reuse Action Plan Action 5.7 | 1

Two regulators with different approaches

EPA

- Drinking water standards
- Credits for treatment

Prescriptive: Meets a standard

FDA

- HACCP &
  Food Safety Plan
- Site & process specific

Guidance: Follows a process

General guidance from FDA for reusing process water

Though specific water reuse regulations do not exist, current FSMA regulations are valid for water reuse.

- **FSMA framework applies** to water reuse.
  HACCP principles & preventive controls
- Validate treatment technologies and qualify equipment.

21 CFR § 117

117.37(a) Water supply
Must be "safe and of adequate sanitary quality"

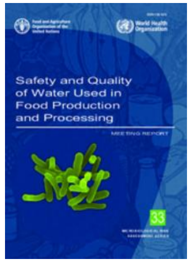
117.80(b)(1) Raw Materials and Other Ingredients

"Water used for washing, rinsing, or conveying food must be safe and of adequate sanitary quality. Water may be reused for washing, rinsing, or conveying food if it does not cause allergen cross-contact or increase the level of contamination of the food."

Subpart C Hazard Analysis and Risk-Based Preventive Controls

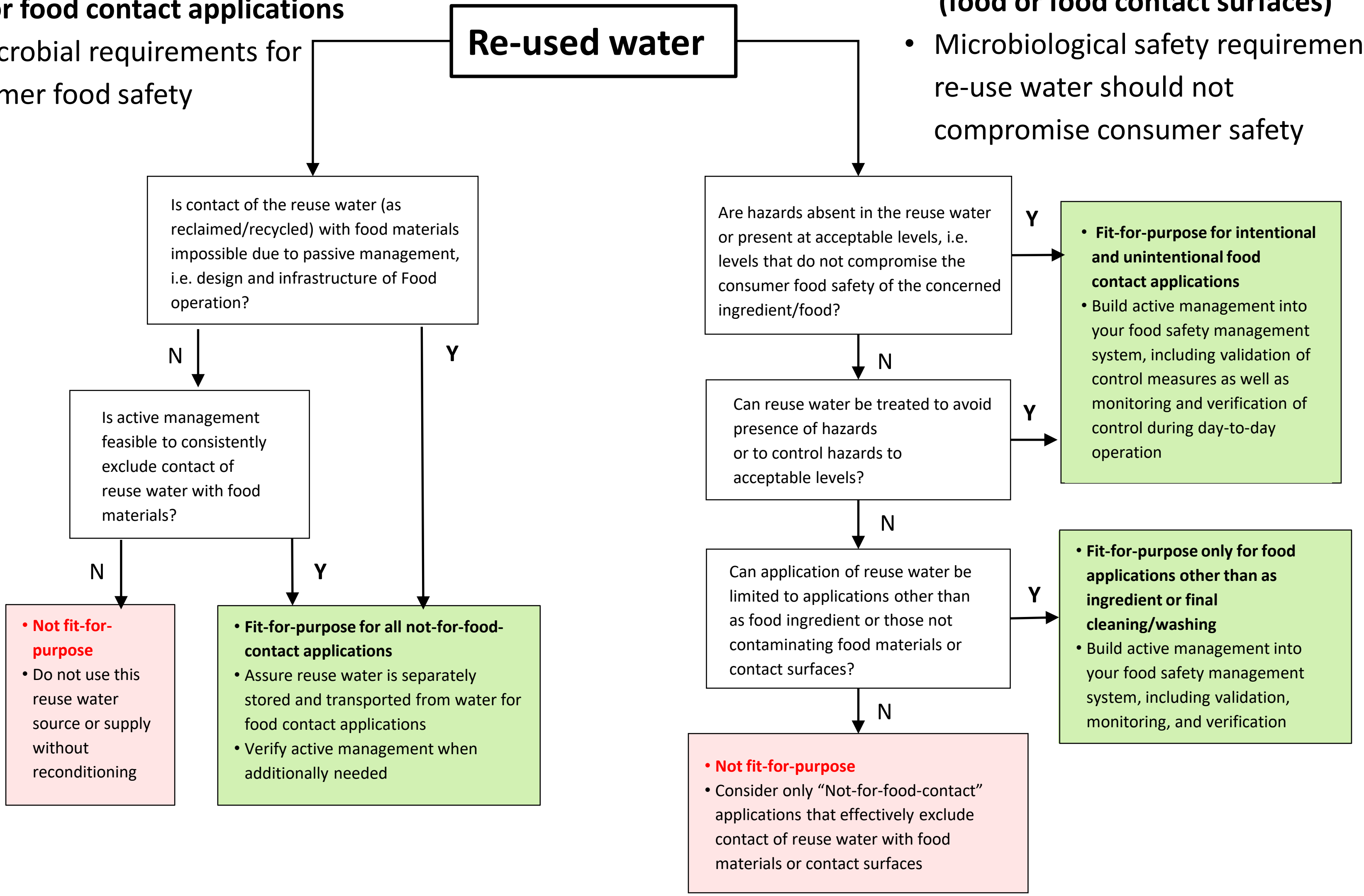
§ 117.126 Requires Food safety plan (FSP)
§ 117.130 Hazard analysis
§ 117.135 Preventive controls
§ 117.140 Preventive control management components
§ 117.145 Monitoring
§ 117.150 Corrective actions and corrections
§ 117.155 Verification
§ 117.160 Validation
§ 117.165 Verification of implementation and effectiveness
§ 117.170 Reanalysis
§ 117.190 Implementation records required for this

Example of a Fit-for-Purpose Framework



Safety and Quality of Water Used in Food Production and Processing: meeting report
Series 33, 2019
Section 6.3, p 61

Developed for biological hazards, but principles can be applied to other hazard types too.



Purpose:

- **Not for food contact applications**
- No microbial requirements for consumer food safety

Purpose:

- **Food contact applications (food or food contact surfaces)**
- Microbiological safety requirement: re-use water should not compromise consumer safety

Re-used water

Is contact of the reuse water (as reclaimed/recycled) with food materials impossible due to passive management, i.e. design and infrastructure of Food operation?

N: Is active management feasible to consistently exclude contact of reuse water with food materials?

N:
- **Not fit-for-purpose**
- Do not use this reuse water source or supply without reconditioning

Y:
- **Fit-for-purpose for all not-for-food-contact applications**
- Assure reuse water is separately stored and transported from water for food contact applications
- Verify active management when additionally needed

Are hazards absent in the reuse water or present at acceptable levels, i.e. levels that do not compromise the consumer food safety of the concerned ingredient/food?

N: Can reuse water be treated to avoid presence of hazards or to control hazards to acceptable levels?

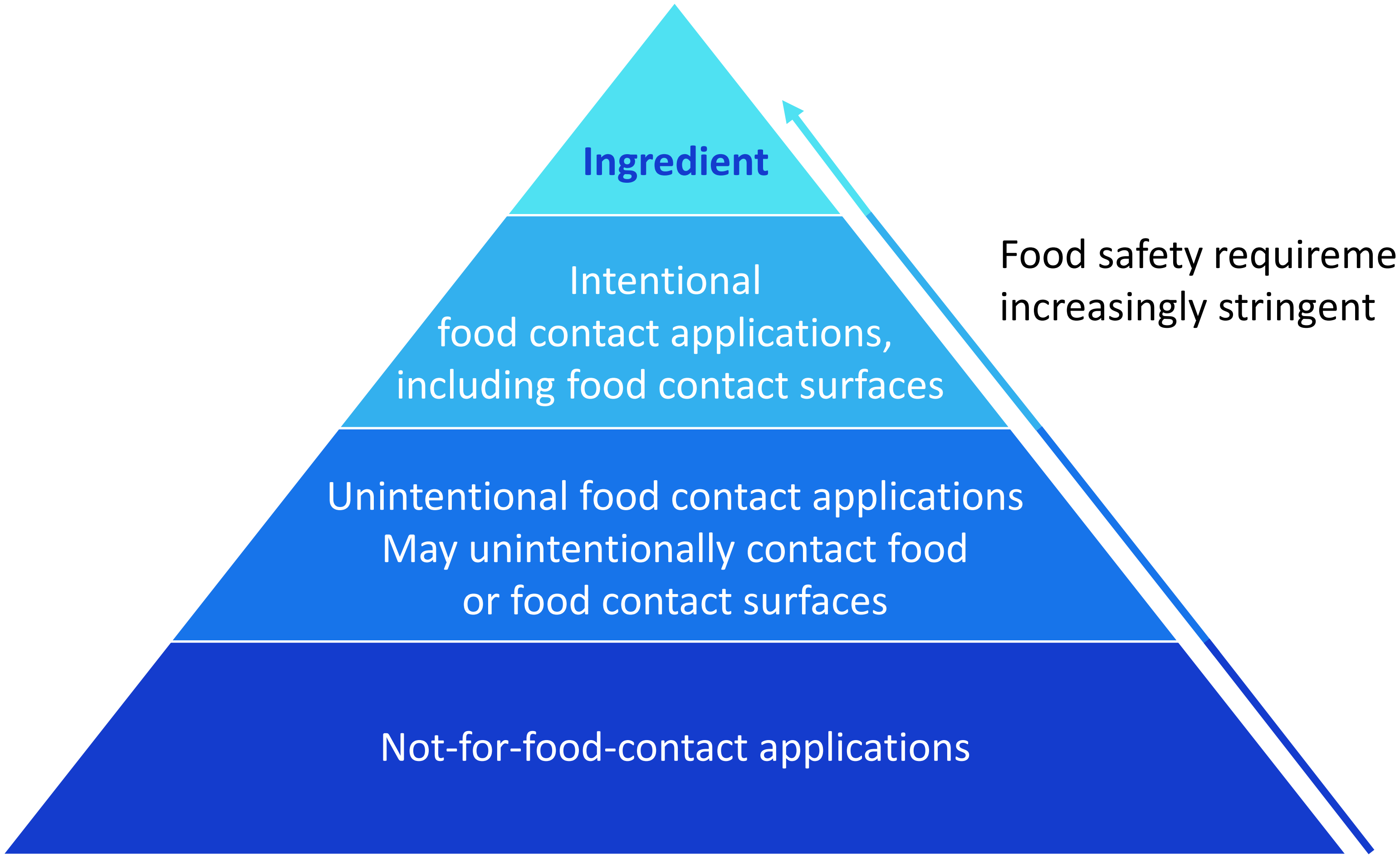
Y:
- **Fit-for-purpose for intentional and unintentional food contact applications**
- Build active management into your food safety management system, including validation of control measures as well as monitoring and verification of control during day-to-day operation

N: Can application of reuse water be limited to applications other than as food ingredient or those not contaminating food materials or contact surfaces?

Y:
- **Fit-for-purpose only for food applications other than as ingredient or final cleaning/washing**
- Build active management into your food safety management system, including validation, monitoring, and verification

N:
- **Not fit-for-purpose**
- Consider only "Not-for-food-contact" applications that effectively exclude contact of reuse water with food materials or contact surfaces

Types of water reuse applications



Ingredient

Intentional
food contact applications,
including food contact surfaces

Unintentional food contact applications
May unintentionally contact food
or food contact surfaces

Not-for-food-contact applications

Food safety requirements become increasingly stringent

US FDA Hazard Analysis differs from US EPA approach

Site specific

117.126 (a) Requires a written hazard analysis

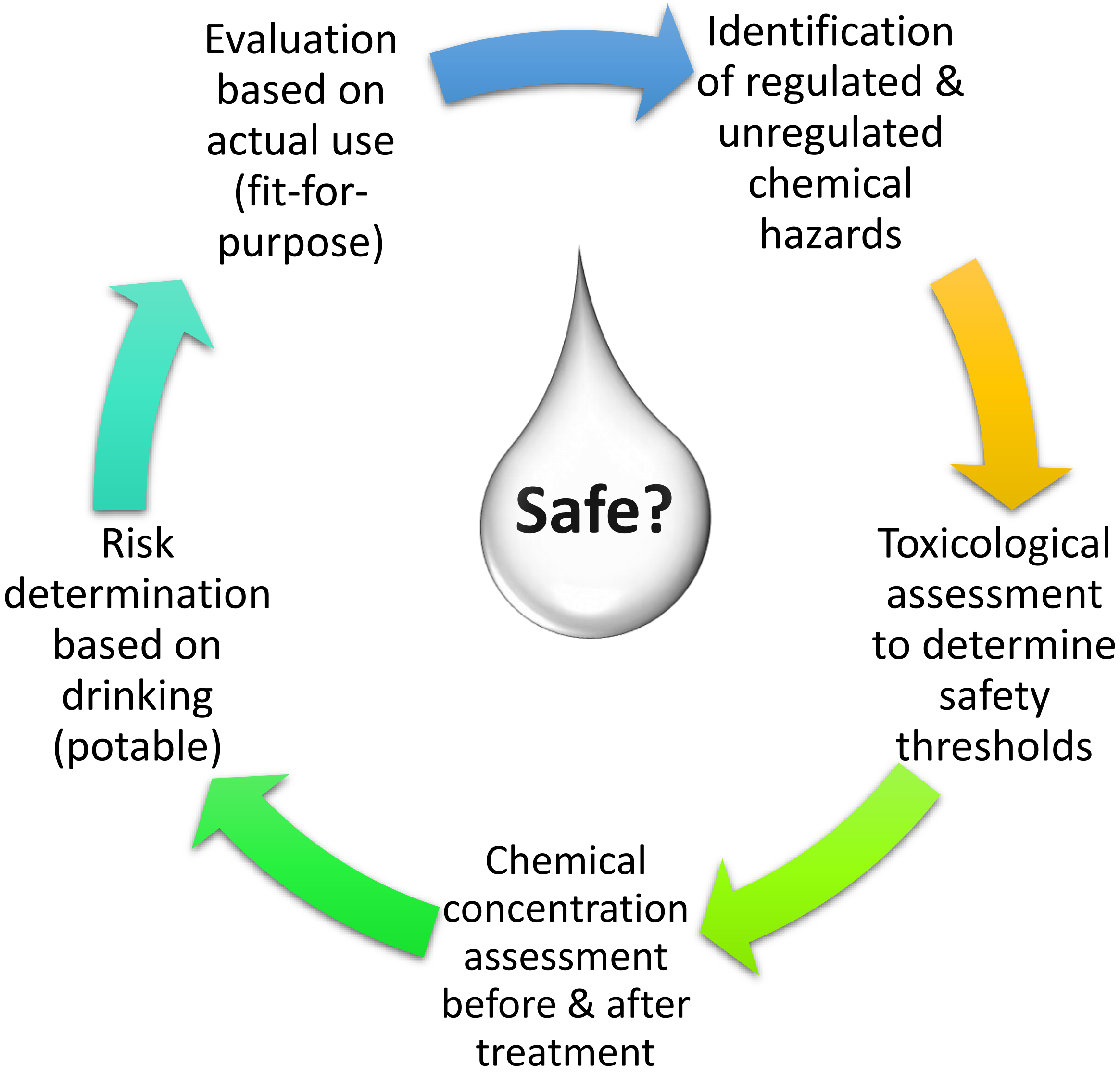
(b) ***Hazard identification.*** Must consider known or reasonably foreseeable hazards :

Biological Hazards	Chemical Hazards	Physical Hazards
• Parasites • Environmental pathogens • Other pathogens	• Pesticides residue • Natural toxins • Decomposition • Unapproved food or color additives • Food allergens	• Stones, glass, metal fragments

EPA - 40 CFR 141

• Regulated list based on source (Example: Enteric virus, Giardia, Cryptosporidium)	• Regulated list	

Chemical risk assessments pose unique challenges



Evaluation based on actual use (fit-for-purpose)

Identification of regulated & unregulated chemical hazards

Safe?

Toxicological assessment to determine safety thresholds

Chemical concentration assessment before & after treatment

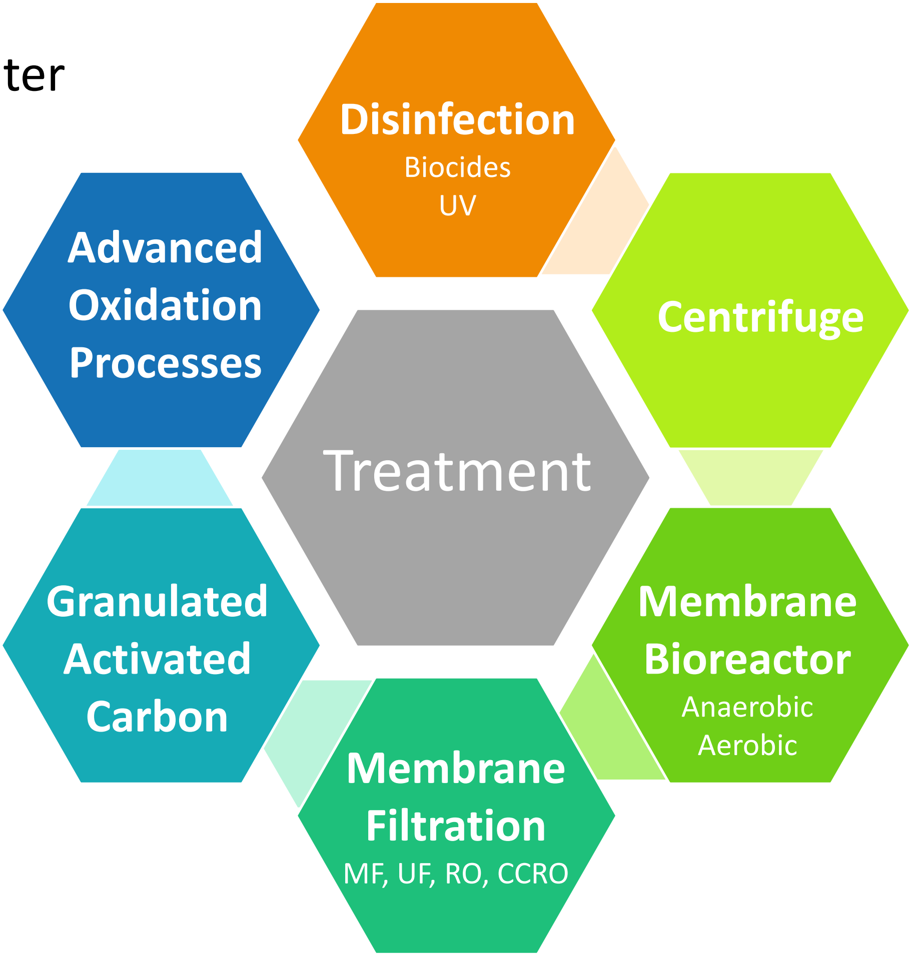
Risk determination based on drinking (potable)

Is meeting EPA or WHO drinking water standards always adequate?

Risk = Likelihood x Severity

Technological advancements enable safe reuse of water

Control strategies to treat water include proven technologies



Technology combinations enable simple and complex water reuse.

Goal: Reduce hazards in reuse water to safe levels & meet water quality appropriate for the application

Risk Analysis & Risk Management

HACCP

Hazard identification Hazard evaluation	Hazard control Treatment CCPs oPRPs PRPs	Demonstrate safety & System performance	Maintain safety: Monitoring Verification activities CAPA Training	Document all steps

Food Safety Plan

Building Food Safety Culture into Water Reuse

Training

- Understand roles & how actions impact water quality

Communication

- Visual and verbal
- Signs
- Instructions

Behaviors

- Set the example
- Choices made when no one is looking

Leadership Commitment

- Resource availability
- Policy & expectations
- Positive environment
- Recognition

No Dumping!

Water is recycled

Summary

- Regulations- Know which are relevant
- Fit-for-purpose- Possible to apply where allowed
- HACCP principles- Can be applied to establish safe & fit-for-purpose

Thank you!

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Material from “Water Reuse in the Beverage Industry EPA Water Reus Action Plan Action 5.7 Report-out” used with permission from Holly Churman.

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21 CFR 117.37(a) Subpart B Sanitary facilities and controls. Water Supply
21 CFR 117 Subpart C Hazard Analysis and Risk-Based Preventive Controls
21 CFR 117 Subpart G Supply Chain Program
40 CFR 141 National Primary Drinking Water Regulations
40 CFR 143 Subpart A National Secondary Drinking Water Regulations
33 USC 1251 et seq. Clean Water Act
42 USC 300f et seq. Safe Drinking Water Act

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Analytical Approaches to the Quality Monitoring of Reuse Water

Agenda

- Analytical Strategies for Reuse Water Monitoring
  - Background Information
  - Frequency
  - General Indicators vs Specific Targets
  - Screening vs Measuring

Background Information

Risk Management

- Look backwards and then forwards
- Consider the source and then the intended reuse
- These considerations will determine much of the monitoring strategy

Frequency

Frequency will be determined by the stability of the source and the remediation system

- A stable source will require less frequent monitoring
- A constantly changing source will require more frequent monitoring
- Changes in the system whether planned (maintenance) or unexpected (breakdown) will trigger increased monitoring.
- Frequency will also be different for various parameters

General Quality Parameters vs. Specific Hazards

- Non-specific indicators such as pH and conductivity and Total Organic Carbon will give a good indication of the state of your system
- These can be monitored online in real-time fairly inexpensively
- Frequency may be as high as all the time
- Specific hazards which create greater risk are typically monitored less frequently up to and including never

Screening vs Measuring

Your choice of analytical strategy will be dictated by your choice of Regulatory compliance (EPA) vs. Risk management approach (FDA)

- We will consider screening of contaminants to indicate a non-targeted approach focus more on identification than quantitation
- Spoiler alert – there is no such thing as a true non-targeted screen. As soon as a technique is selected we bias the results to a high degree.
    - Examples are GC, LC and ICP mass spectroscopy. These favor volatile and non-volatile organic molecules while ICPMS favor inorganics to the exclusion of virtually everything else.

Non-target Screening

ADVANTAGES

- Allows us to check for the presence of a large number of molecules without calibration or standards
- Allows us to elucidate the structure of molecules, even those not contained in databases or libraries
- Allows retrospective analysis of the data to look for molecules we did not look for initially

DISADVANTAGES

- As a rule NT screens are less sensitive
- As rule NT screens are not quantitative
- Greater expense

Targeted Measurements

Often uses the
same instrumentation as an NT screen but responses
are calibrated against standard of known concentration

ADVANTAGES

Often uses the same instrumentation as an NT screen but responses are calibrated against standard of known concentration

- Advantages
  - Allows for maximum sensitivity
  - Allows relaible comparison
    to regulatory limits or internal specifications

DISADVANTAGES

- Small changes in a compound can blind it to the instrument forcing us
  to measure multiple degradants
  to confirm concentration
- We can miss hazardous contaminants

Take aways

- Consider the source, the intended reuse and the purification system holistically
  - `   Will the intended reuse be the only use?
- Consider inline monitoring of basic quality parameters.
  - These are the vital signs of your system

- Link frequency of monitoring to stability of source and system and risk of detecting the contaminant

- Save NT analysis for infrequent baseline setting and detection of emerging contaminants

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Thank you

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Questions?

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