WATER QUALITY CONTROL DIVISION

SAFE DRINKING WATER PROGRAM POLICY

POLICY TITLE: **Direct Potable Reuse Policy**	
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1.0 Purpose and Background

The Water Quality Control Commission's XXXXX edition of the Direct Potable Reuse (DPR) Rule to the Colorado Primary Drinking Water Regulations, 5 CCR 1002-11 (Regulation 11) was intended to protect public health by requiring additional activities to be performed by suppliers of water both in planning and seeking department approval of DPR and in ongoing monitoring and operations of DPR. In order to achieve this, section 11.14 (Direct Potable Reuse Rule or DPR Rule) requires that suppliers develop multiple plans and perform monitoring prior to installing a DPR facility. Planning includes topics such as: communications, enhanced source control, treated wastewater characterization, and operations. Monitoring efforts will include monitoring of water feeding the wastewater treatment plan and monitoring of treated wastewater to characterize additional treatment steps needed to produce finished drinking water. Also the direct potable reuse rule requires department approval at the pre-planning stages as well as approval of the treatment scheme. This policy specifies the requirements and components of specific plans and activities suppliers of water must undertake both during the planning stages and while operating DPR.

The Colorado Department of Public Health and Environment (the department) reserves the right to deviate from this policy as specified in Water Quality Control Division (WQCD) Policy 1: Implementation Policy Framework.

2.0 Applicability

This policy applies to all suppliers of water that are subject to section 11.14 of Regulation 11.

3.0 Definitions

The following definitions exist in Regulation 11, section 11.14 and will be used throughout this policy:

“ACTION LIMIT” means a limit at a critical control point that, when exceeded, triggers a response to prevent a potential human health hazard.

“ADVANCED OXIDATION PROCESS” means a set of chemical treatment processes whereby oxidation of organic contaminants occurs on a molecular level through reactions with hydroxyl radicals or similarly aggressive radical oxidant species. The process breaks down recalcitrant organic molecules into smaller oxidized organic fragments.

“ALERT LIMIT” means a limit at a critical control point that, when exceeded, alerts an operator that a potential problem may require a response.

“BYPASS” means, for the purposes of direct potable reuse, the intentional diversion of waste streams from any portion of a non-domestic source’s treatment facility.

“CONSTITUENT(S) OF CONCERN” means potentially harmful or difficult to treat substances that could cause treatment interference, pass through, or a violation either of a treatment technique requirement or of an MCL specified in 11.45 in finished drinking water. Constituents of concern include target chemicals.

“CRITICAL CONTROL POINT” means a treatment process or a portion of a treatment process designed to reduce, prevent, or eliminate a human health hazard.

“CRITICAL CONTROL POINT MONITORING” means the approved parameters and methods used to monitor the effectiveness and status of treatment at each critical control point. Critical control point monitoring indicates whether the performance of the critical control point is achieving treatment goals. Action and alert limits must be associated with critical control point monitoring.

“CRITICAL CONTROL POINT MONITORING LOCATION” means an approved location where effectiveness and status of each critical control point is monitored. Each critical control point must have at least one approved critical control point monitoring location.

“DIRECT POTABLE REUSE” means using a series of processes that produce finished drinking water utilizing a source containing treated wastewater that has not passed through an environmental buffer.

“ENVIRONMENTAL BUFFER” means either a surface water or groundwater aquifer that causes adequate dilution or natural attenuation of pathogenic and chemical contaminants. Wastewater effluent from a permitted (e.g. Colorado Discharge Permit System) wastewater treatment plant that has been discharged to a surface water body is considered to have passed through an environmental buffer. For new waterworks, the Department shall determine if a source containing wastewater effluent passes through an environmental buffer during review of plans and specifications in 11.4.

“INDICATOR COMPOUND” means a chemical compound that has chemical properties that make it removable by some treatment processes but that may be recalcitrant to others. Indicator compounds are indicative of other compounds in that family of compounds and can be used to monitor the efficacy of removal of that group of compounds by a critical control point.

“INTERFERENCE” means a discharge from a non-domestic source which alone or in conjunction with a discharge or discharges from other sources that inhibits or disrupts the supplier’s treatment processes or operations that has a significant potential to have serious adverse effects on public health or to cause a violation either of a treatment technique requirement or of an MCL specified in 11.45 in finished drinking water.

“METROPOLITAN SEWAGE DISPOSAL DISTRICT” means a district organized under Part 5,, Article 4 of Title 32,Colorado Revised Statutes. A Metropolitan Sewage Disposal District is a

type of wastewater entity.

“NON-DOMESTIC SOURCE” means all industrial or commercial sources of wastewater to a wastewater treatment plant that are subject to National Pretreatment Standards and any other source that may adversely affect the waterwork’s operation or has a significant potential to have serious adverse effects on public health or to cause a violation either of a treatment technique requirement or of an MCL specified in 11.45 in finished drinking water. Non-domestic source(s) that are determined to be Non-Significant pursuant to the criteria and procedures developed under 11.14(4)(a)(i)(B)(II) are exempt from individual permitting or other individual control mechanisms under the Enhanced Source Water Control Program.

“OXIDIZED WASTEWATER” means wastewater in which the organic matter has been stabilized, is non-putrescible, and contains dissolved oxygen.

“PASS THROUGH” means a condition where a constituent of concern enters the waterworks in quantities or concentrations that have a significant potential to have serious adverse effects on public health or to cause a violation either of a treatment technique requirement or of an MCL in finished drinking water as specified in 11.45.

“RECALCITRANT TOTAL ORGANIC CARBON (rTOC)” means the total organic carbon (TOC) present in finished water that ultimately becomes treated wastewater. The recalcitrant TOC differs from anthropogenic TOC present in wastewater in that it may not be efficiently removed by the wastewater treatment plant and will be a component of the TOC in the treated wastewater.

“TARGET CHEMICAL” means any unregulated chemical causing a potential human health concern that may be present in the treated wastewater.

“TREATED WASTEWATER” means any water source from a wastewater treatment plant that has undergone a treated wastewater characterization for either enhanced wastewater treatment or secondary wastewater treatment as defined in the Direct Potable Reuse Policy and originates from a wastewater treatment plant that has liquid stream treatment processes that, at a minimum, are designed and operated to produce oxidized wastewater to achieve a defined source water quality for additional treatment by a supplier utilizing direct potable reuse.

“WASTEWATER TREATMENT PLANT” means an arrangement of devices and structures for collecting, treating, neutralizing, stabilizing, or disposing of domestic wastewater, industrial wastes, and biosolids. For purposes of direct potable reuse, a wastewater treatment plant does not include industrial wastewater treatment plants or complexes whose primary function is the treatment of industrial wastes, notwithstanding the fact that human wastes generated incidentally to the industrial process are treated therein.

4.0 Policy Statements

The following sections discuss different aspects of the Direct Potable Reuse Rule and how Regulation 11.14 will be interpreted and implemented by the department. Each DPR installation is expected to produce drinking water that maintains steady state water quality in the finished water and distribution system. While deviations from the policy can be granted in writing from the department, the department expects suppliers of water to follow the principles and intent of both the Direct Potable Reuse Rule as well as this policy. The purpose of this policy is to expound on the regulation, giving further definition and examples of how certain requirements must be met.

For example, the regulation requires characterization for treated wastewater (treated wastewater characterization). This policy specifies the minimum parameters and frequencies that must be sampled to accomplish the treated wastewater characterization. There could be extenuating circumstances that arise whereby a supplier of water would ask for a deviation around a specific timeframe or a specific parameter. The department will review and make a decision to grant those deviations on a case-by-case basis. However, in most cases suppliers of water should plan on collecting the information specified. Also, the required elements within this policy are to be considered minimum requirements. The department recommends suppliers consider going above and beyond these requirements in order to provide as much information as possible about DPR to interested stakeholders and to assist with the regulatory approval process.

4.1 Communications and Public Outreach

4.1.1 Acceptable Methods of Communication

The Communications and Public Outreach Program Section 11.14(3)(b)(D) requires that suppliers deliver information specified in 11.14(3)(a) by at least one additional method as approved by the Department. Displaying information and educating the public through the following methods are acceptable by the Department.

1. Coverage through a local news outlet (e.g. television, newspaper, social media)
2. Community event(s) (e.g. setting up table/booth)
3. Local school(s) and school events
4. Providing opt in email/text notifications to customers
5. Neighborhood association meeting(s)
6. Bulletins and other publicly accessible areas
7. Online forums (e.g. Nextdoor)
8. Social media
9. Civic organizations
10. Commercial/business partners
11. Elected officials/thought leaders
12. Advocacy organizations and local non-profits
13. Other methods to be pre approved by the Department

4.1.2 Communicating with Local Governmental Entities and Other Key Audiences

Regulation 11, Section 11.14(3)(b) requires the following for delivery of information about DPR:

(i) The supplier must deliver the information specified in 11.14(3)(a)(i) in all of the following methods:

(A) A local, publicly accessible repository that contains information including but not limited to the information required in 11.14(3)(a)(i) with a means for the public to submit questions and comments, obtain responses from the supplier and engage with the supplier. This repository must be active when the supplier complies with 11.14(3)(b)(i)(B).

(B) At least one notification by mail or by another Department-approved method to all of its consumers prior to the public meeting required by 11.14(3)(b)(i)(C).

(C) At least one public meeting must be held at least six months prior to serving finished water from direct potable reuse.

(D) At least one additional method as approved by the Department.

(E) For systems supplying a large proportion of non-English speaking consumers, as determined by the Department, for the information in 11.14(3)(a)(i)(A-G) that is distributed per 11.14(3)(b)(i)(A-D), the supplier must include either:

(I) Information in the appropriate language(s).

(II) A telephone number, email address or address where the consumer may contact the supplier to obtain a translated copy of written communication or request assistance in the appropriate language for written and oral communications.

When the supplier distributes public notice and holds the public meeting portion of the outreach effort, the department expects the supplier to involve local government in the process. While each local jurisdiction will have different oversight, involvement of local officials and decision makers in the outreach and communications process is critical for public acceptance. The supplier must include a list of all pertinent stakeholders they intend to communicate with. The supplier should notify and educate local health authorities and medical professionals when possible.The department will also involve local health departments when reviewing applications for direct potable reuse in order to keep transparency and coordination of communications possible. It may also be pertinent to involve local governmental representatives, local health authorities, planning departments, and neighboring communities as appropriate, depending on the size and scope of any individual DPR effort.

The department also recommends that the supplier involve other key audiences. Suppliers may conduct outreach to city/town councils and boards, local elected officials, community organizations that represent disproportionately impacted communities, environmental groups, industry groups (such as food and beverage), schools/school boards and medical professionals. These groups can have a high impact on other members of the community and therefore should be aware and informed of the supplier's DPR effort.

It is also highly recommended, when resources permit, to assess community members' opinions about DPR prior to conducting communications and outreach. This can be conducted through surveys, focus groups and other means to collect and assimilate data on attributes of individuals and groups and their perceptions and opinions of DPR. Consequently, this information can be used to target communications and outreach efforts to address concerns and leverage support based on the supplier's local community's perceptions and preferences.

4.1.3 Suppliers Notifications to All of Its Consumers

Sections 11.14(3)(a)(ii) and 11.14(3)(b)(i)(B) require that suppliers notify all of its consumers of its intention to apply for and implement DPR, and to send at least one notification by mail or another Department-approved method to all of its consumers, respectively. A significant portion of a supplier's customers do not directly receive water bills or have service connection addresses (e.g. house renters, apartment dwellers, university students, nursing home patients, prison inmates, etc.) Suppliers may use any other method designed to reach all other consumers

regularly supplied by the system through a Department-approved method. Other methods may include publication in a local newspaper, delivery of multiple copies for distribution by customers that provide their drinking water to others (e.g., apartment building owners or large private employers), posting in public places supplied by the system or on the Internet, or delivery to community organizations. This method may be concurrent with the requirements in Section 11.14(3)(b)(i)(D). The Department will work with suppliers on these requirements during the approval process of the Communications and Public Outreach Plan.

4.1.4 Communications and Public Outreach Timeline

	Step	Timing	Regulation 11 Citation
1	Send notification to public of intent to apply for DPR	At least 60 days prior to submitting application to Department	11.14(2)(b)(i)(A)
2	Submit Communications and Outreach Plan to Department with DPR application	Prior to submitting plans for construction of waterworks	11.14(2)(b)(i)
3	Prepare and enact local, publicly accessible repository	Prior to delivery of notice to be sent out before public meeting	11.14(3)(b)(i)(A)
4	Conduct public meeting	At least 6 months prior to serving finished water to customers	11.14(3)(b)(C)
5	Submit reporting requirements for Communications and Public Outreach	No later than 30 days before production of finished water	11.14(3)(c)(i)

4.2 Enhanced Source Control

The Enhanced Source Control Policy has been developed separately both due to the length of the policy and because many of the requirements already exist within the wastewater National Pretreatment Program, although for slightly different goals and results measures. Please refer to the Enhanced Source Control Policy located here.

4.3 Wastewater Treatment

The Direct Potable Reuse Rule includes a number of definitions specific to the source water that are integral to potential applicants' understanding of the minimum expectations for characterizing the wastewater based on the designed or planned level of treatment at domestic wastewater treatment works. At the risk of altering or detracting from the meaning of each term, this section first repeats the exact definition from Regulation 11 and then clarifies the definitions to establish expectations and interpretations for specific implementation.

A list of key source water (i.e., wastewater) related definitions for DPR are listed as follows:

> *"OXIDIZED WASTEWATER" means wastewater in which the organic matter has been stabilized, is non-putrescible, and contains dissolved oxygen.*
>
> *"TREATED WASTEWATER" means any water source from a wastewater treatment plant that has undergone a treated wastewater characterization for either enhanced wastewater treatment or secondary wastewater treatment as defined in the Direct Potable Reuse Policy and originates from a wastewater treatment plant that has liquid stream treatment processes that, at a minimum, are designed and operated to produce oxidized wastewater to achieve a defined source water quality for additional treatment by a supplier utilizing direct potable reuse.*
>
> *"WASTEWATER TREATMENT PLANT" means an arrangement of devices and structures for collecting, treating, neutralizing, stabilizing, or disposing of domestic wastewater, industrial wastes, and biosolids. For purposes of direct potable reuse, a wastewater treatment plant does not include industrial wastewater treatment plants or complexes whose primary function is the treatment of industrial wastes, notwithstanding the fact that human wastes generated incidentally to the industrial process are treated therein.*

Note, the above list is not inclusive of all the definitions provided in Regulation 11. Applicants are strongly encouraged to review the definitions provided in Section 11.14 and above in the definitions section of this policy prior to submitting a DPR application. For additional information regarding the Commission's intent for the definitions, please refer to the associated Statement of Basis and Purpose language included at the end of Regulation 11.

<u>Oxidized Wastewater</u>

The term "oxidized wastewater" describes the basic wastewater treatment level beyond simple removal of floating and suspended solids and is generally described as secondary treatment. Secondary treatment is expected to employ biological methods to reduce chemical and biological loadings to the environment. This level of treatment has the ability to meet the technology-based limits of Biochemical Oxygen Demand or Carbonaceous Biological Oxygen Demand, Total Suspended Solids, and pH established by the Water Quality Control Commission in Regulation 62 Regulations for Effluent Limitations.

Wastewater Treatment Plant

A "wastewater treatment plant" is a domestic wastewater treatment works that consists of the appurtenances and unit processes required to collect and treat the domestic wastewater to achieve a consistent source water quality for additional processing by the specific advanced water treatment facility for direct potable reuse. The level of treatment and source water characterization of the treated wastewater is specific to the wastewater treatment process and the associated advanced water treatment facility.

The "wastewater treatment plant" for the direct potable reuse rule must qualify as a domestic wastewater treatment works under *Regulation 22 Site Location Application and Design Review Requirements for Domestic Wastewater Treatment Works* (Regulation 22) to produce and transfer treated wastewater to an advanced water treatment plant. Domestic wastewater treatment works may process single source wastewater from domestic sources or mixed wastewater from a combination of domestic and non-domestic sources when the non-domestic wastewater is incidental to the domestic wastewater.

For clarity, domestic wastewater can generally be characterized as discharges from plumbing facilities in residential or domestic dwellings or commercial establishments and include sanitary, bath, laundry, dishwashing, garbage disposal and cleaning wastewaters. Examples of commercial establishments that generate domestic wastewater include restaurants, country clubs, mobile home parks, office buildings, motels, and hotels. Alternately, non-domestic wastewater typically includes wastewater from other non-domestic sources, such as industrial processes, food processing operations, kennels, car washes, vehicle service facilities, vehicle storage facilities, landfill leachate, and hauled waste.

While domestic wastewater treatment works may process some non-domestic wastewater, the non-domestic sources must be incidental to the domestic wastewater sources in quantity and pollutant load for the treatment plant to be considered a "wastewater treatment plant" fit for direct potable reuse. The phrase "incidental to" applies to mixed wastewater when the non-domestic wastewater portion has minor consequences on the typical characteristics of the domestic wastewater in quantity and quality. The Department will decide when non-domestic wastewater, when mixed with domestic wastewater, is no longer incidental. Applicants are encouraged to consult with the division early in the process to determine whether a mixed wastewater qualifies as domestic or non-domestic wastewater.

While the advanced water treatment facility (AWTF) accepts treated domestic wastewater as its source water, the AWTF is not a domestic wastewater treatment works and is not subject to Regulation 22. The AWTF would be separately subject to CDPS permitting under Regulation 61 if it generates and discharges process wastewater.

Treated Wastewater

The term "treated wastewater" for the direct potable reuse rule defines the minimum wastewater treatment and source water characterization necessary for a consistent source water that supplies and is followed by the advanced drinking water treatment facility to generate

potable water through direct potable reuse (e.g., the WWTP is the first critical control point for the DPR project). The definition establishes the minimum wastewater treatment and wastewater characteristics required to transfer the wastewater to an advanced water treatment facility. The key words and phrases of the definition include:

- "has liquid stream treatment processes that, at a minimum, are designed and operated to produce oxidized wastewater to achieve a consistent source water quality"
- "any water source from a Wastewater Treatment Plant that has undergone a source water characterization"

The first phrase sets a minimum treatment level to qualify wastewater as a potential source water for DPR. The minimum treatment achieves 'oxidized wastewater' through aerobic, biological liquid stream treatment processes. For this minimum level of treatment, the treated wastewater must undergo pathogen characterization while performing Treated Wastewater Characterization as explained in Section 4.4 of this policy.

The applicant has the option of demonstrating that the liquid stream treatment process exceeds this minimum liquid stream treatment to justify a reduction of the wastewater characterization requirements. If the treatment processes include unit processes in addition to basic aerobic, biological treatment used primarily for removal of organic material, which may also achieve ammonia removal, the applicant may request the Department to not require a complete pathogen characterization while characterizing the treated wastewater in accordance with Section 4.4. An example of a liquid stream treatment process that would meet this criterion includes a treatment train that includes a combination of aerobic and anaerobic and/or anoxic unit treatment processes with a solids retention time exceeding 10 days. This type of treatment process improves the consistency of the wastewater effluent, improves pathogen reduction, and improves the mitigation of target chemicals (See Section 4.5 below) compared to treatment trains only meeting the minimum treatment level.

In order for DPR to be successful, the treated wastewater must have undergone a minimum level of treatment that results in reliable, treated wastewater characteristics which will subsequently be established as alert and action limits in the operating plan. The minimum wastewater treatment processes may be negotiated with the advanced water treatment facility but may not be less than the minimum criteria outlined in the definition of "treated wastewater".

Secondary and enhanced liquid stream wastewater treatments are described as follows:

<u>Secondary Wastewater Treatment</u>

Minimum wastewater treatment requires that the treated wastewater come from a wastewater treatment plant designed and operated to provide liquid stream unit treatment processes that primarily achieve 'oxidized wastewater' through aerobic, biological treatment processes. Treatment plants that meet this requirement are expected to have fewer liquid stream treatment processes with shorter solids retention times (e.g., <10 days) than enhanced wastewater treatment or are based on hydraulic retention times. Treated wastewater from wastewater

treatment plants meeting the minimum criteria is expected to exhibit more variability, less pathogen removal, and less mitigation of target chemicals (see Section 4.5 below) than treated wastewater from enhanced wastewater treatment. To compensate for these shortcomings, the Department expects that the advanced water treatment facility's design will adjust for the treated wastewater's variability and characteristics. This option requires a more robust treated wastewater characterization that meets Section 4.4 including characterization of pathogens.

Enhanced Wastewater Treatment

Enhanced Wastewater Treatment requires that the treated wastewater come from a wastewater treatment plant that has liquid stream treatment processes designed and operated to produce consistent effluent that reduces pollutants in addition to those targeted by oxidized wastewater. For enhanced wastewater treatment, the Department expects that the liquid wastewater treatment train will include unit processes in addition to basic aerobic, biological treatment used for removal of organic material and ammonia reduction. An example of a liquid stream treatment process that would meet this criterion includes a treatment train that has a combination of aerobic and anaerobic and/or anoxic unit treatment processes with a solids retention time exceeding 10 days. This type of treatment process improves the consistency of the wastewater effluent, improves pathogen reduction, and improves the mitigation of target chemicals (See Section 4.5 below) compared to treatment trains only meeting minimum treatment requirements. When a design includes enhanced wastewater treatment, the applicant may make a request to the Department to not complete pathogen characterization.

While the Department has provided flexibility by not defining a particular treatment train or set of numeric effluent limits, the Department will not accept an application asserting that systems such as a typical waste stabilization pond with an anaerobic cell meet this option. In particular, waste stabilization pond technologies are excluded from this option. The Department expects treatment trains meeting this option will include multiple process treatment environments (e.g., anoxic, anaerobic) and operator controls for process kinetics in addition to the amount or frequency of air delivered. These controls may be in the form of chemicals, filtration, mixed liquor concentration, or other demonstrated and Department accepted methods. The anticipated targets for these additional processes are pollutants like nitrate and total phosphorus, but will be identified as part of the application.

The wastewater treatment plant acts as the first critical control point for the DPR project. The application will describe how the wastewater treatment plant and the advanced water treatment facility work in concert to produce finished water (potable water). For the wastewater treatment plant, specific parameters must be selected and approved as critical control point monitoring. Specifically, the application must identify the treatment goals (e.g., acute, average, averaging period, and numeric value) that define the critical control point (wastewater treatment process) and establish both alert limits and action limits from these goals. At a minimum, the requirements of oxidized wastewater must be included. These treatment goals support the argument that the liquid stream process produces treated wastewater that meets the intent of this option.

Please note that this definition only considers the liquid stream treatment processes. While the solids or side stream processes may be important to achieve effluent limits for environmental discharges and plant operations, the direct potable reuse definition of treated wastewater only considers the unit processes that 100 percent of the liquid stream flows through prior to transfer and delivery to the advanced water treatment facility. These unit processes will be used to determine the applicability of this option to domestic wastewater treatment works.

In addition to the liquid stream processes of the domestic wastewater treatment plant, treated wastewater meeting this criteria will have undergone a source water characterization process that meets all the requirements of section 4.4 including the pathogen concentration requirements unless the Department accepts the request to not complete pathogen characterization for enhanced wastewater treatment.

Overall, to qualify for reduced wastewater characterization, each applicant must justify how the treatment train and treated wastewater meets the intent of the enhanced wastewater treatment option.

4.4 Treated Wastewater Characterization

4.4.1 Treated Wastewater Operational Data

When gathering WWTP effluent data for DPR consideration, utilities are required to collect the following water quality data to help establish the 'baseline' conditions or an operating envelope which characterize and also capture conditions under which pathogens were characterized (if Item 4.4.2 below is performed). The data will be used by the department to better define the critical control point monitoring around the wastewater treatment to establish alert limits and action limits for both pathogens and for chemicals. The methods used must be approved by the department. If the requirement is to maintain online monitoring, the expectation is that data will be collected every 5-15 minutes. However, while an online analyzer is broken or being serviced, grab samples can be taken every 4 hours.

For reporting to the department, the department expects the supplier to provide all the data and also provide summaries for the reporting period. If the ammonia is analyzed via an online monitor, then the summary of operational ammonia data should include graphs of the data, median and mean values, 25th, 75th percentile values to characterize the ranges of operational variation in the data.

Required Parameters	Analysis Type and Method	Notes
Ammonia	Online	Primary control parameter to show WW plant is functioning properly
Turbidity	Online	The department will allow TSS instead of requiring turbidity in each case depending on whether turbidity can be properly monitored without equipment fouling.
Total Organic Carbon (TOC) or Online UV254 Absorbance	Online or grab.	TOC is not a key wastewater parameter but will be a key Drinking water parameter and regulated under Section 14.7 UV Absorbance can be used as a surrogate if approved by the department (demonstrated correlation with TOC).
Flowrate	Online	Both the influent and effluent flow of the wastewater treatment plant.
pH	Online	
Conductivity	Online	

Nitrate	Online or Grab	
Target Chemicals	Grab	See section 4.4.3 below
Recommended Parameters	**Analysis Type**	**Notes**
Phosphorus	Online or Grab	For DPR systems that may concentrate phosphorus by recycling water, monitoring for phosphorus for a year would be helpful to understand and baseline the data. Discharge limits on nutrients will be implemented in the 2020s and 2030s and the department does not want DPR to cause effluent violations.
Total Dissolved Solids	Grab	For longer term mass balances
Alkalinity	Grab	
Nitrite	Online or Grab	
Additional Parameters within the Wastewater Treatment Plant		Notes
Solids Retention Time (SRT)	Online Calculate weekly	For specific wastewater treatment processes such as activated sludge.
Total Suspended Solids	Online or Grab	See turbidity comment above

4.4.2 Target chemical monitoring

Section 4.5 of this policy discusses the need to identify and reduce or remove target chemicals from the finished water both for the protection of public health but also for the perception of risk in DPR. To arrive at an acceptable list of target chemicals, characterization of the wastewater will need to occur. Frequency of monitoring may be negotiated case-by-case but the monitoring must continue for at least one year. The department recommends that the supplier propose a list of likely target chemicals for approval prior to the one-year of monitoring. The list of target chemicals should be developed using the principles discussed in Section 4.5. Also, the sampling performed for target chemicals should be similar to the sampling for pathogens discussed in the next section, 4.4.3.3.

4.4.3 Requirements for Determination of Log Removal Targets (LRTs)

4.4.3.1 Background Information

Quantitative microbial risk assessment (QMRA) is a process used to evaluate exposure risks and adverse health outcomes in various applications. The QMRA methodology is complex and fortunately for the drinking water community, the bulk of the analysis has already been

completed by the US EPA and others in establishing dose-response relationships for the key pathogens of concern in potable reuse. These efforts have established acceptable microbial target concentrations in drinking water that would result in less than 1 in 10,000 illnesses associated with each organism on an annual basis, as shown below:

Giardia =	6.8 x 10^-6 cysts/L (Source: Regli et al, 1991)
Cryptosporidium =	3.0 x 10^-5 oocysts/L (Messner et al, 2001)
Viruses =	2.2 x 10^-7 MPN/L (Source: Regli et al, 1991)

Given that the risk assessment has been completed with associated pathogen targets, the remaining task for water utilities is to assess the concentration and variability of pathogens in the treated wastewater to determine the amount of additional treatment required for finished water production. The target virus concentration is based on the rotavirus dose-response model, which is used to represent enteric virus infectivity. Adenovirus shall be used as the representative enteric virus for baseline virus enumeration based on recommendations from the NWRI report. Either quantitative polymerase chain reaction (qPCR) or culture methods may be used for analysis provided recovery-corrected data and results with appropriate quality assurance and quality control (QA/QC) are provided.

Once samples are collected per the timeframe below, the entire data set should be evaluated and the 95th percentile highest concentration should be used to calculate the required log removal targets (LRTs) per the following formula:

Once samples are collected per the timeframe below, the entire data set should be evaluated and the 95th percentile highest concentration should be used to calculate the required log removal targets (LRTs) per the following formula:

Minimum LRT = log(95th Percentile Concentration) - log(Pathogen Target)

Example: The 95th percentile measured adenovirus over the year of sampling was 1.5 x 10^4 gene copies per liter. The required LRT for virus would be log(1.5x10^4) - log (2.2x10^-7) = 4.2 - (-6.7) = 10.9 log removal.

4.4.3.2 Log Removal Target Requirements

Based on the recommendations from the NWRI panel, a utility may opt for one of two approaches to determining the minimum LRT for viruses, *Giardia*, and *Cryptosporidium*. (1) Lacking any data on pathogen concentration in the treated wastewater effluent, the DPR processes shall be required to meet 12-log virus, 10-log *Giardia*, and 10-log *Cryptosporidium* removal; or (2) Through a dedicated sampling program, the supplier may demonstrate the expected pathogen concentration in wastewater to determine an alternate minimum LRT, as demonstrated on the previous page, though the minimum LRT may not be less than 8-log virus, 6-log *Giardia*, and 5.5-log *Cryptosporidium* removal.

4.4.3.3 Minimum Time Frame and Sampling Frequency

To evaluate the concentration and variability of pathogens (adenovirus, *cryptosporidium*, and *giardia*) in the source water, either qPCR or culture methods with standard QA/QC procedures and recovery correction may be utilized. Samples must be collected weekly for one year, on the same day of the week and at the same time throughout the period of sampling to avoid having staff skip or reschedule samples for optimal treatment plant performance (e.g., 3 pm every Tuesday). Based on recent research, process upsets are more likely to be captured by following a set schedule than if sampling staff are allowed to adjust the date and time of sample collection. Samples of treated wastewater effluent must be collected at the point where treated wastewater will be transferred to the advanced drinking water facility. The sampling must be before any treatment process that will be used for a treatment credit in future direct potable reuse (e.g. aeration column, ozonation, etc). Note, if the point where treated wastewater will be transferred to the advanced drinking water facility is ahead of additional wastewater treatment processes like disinfection, then sampling must also occur at that location and not post-disinfection.

To determine the appropriate sample collection time, the following schema for sampling is recommended:

- During the first month capture nighttime and daytime samples for four weeks to evaluate diurnal variability (2 samples per week).
- When results are returned, select the period of time with higher pathogen concentration and set the sample collection schedule to coincide with that timeframe.
- Using the selected time of day, select a given day of the week (Tues, Wed, or Thurs) to collect samples and continue to collect 1 sample per week for an additional 48 weeks.
- If a week is missed or a schedule is missed, simply extend sampling by another week rather than replacing a sample with a different day/time combination.

For sample data that are returned as below the method reporting limit (MRL), for the sake of calculation the value used in the cumulative data set shall be the MRL. For example, if the MRL is 0.1 oocysts/L and a value is returned from sample analysis as "<MRL", then the data shall be input as 0.1 oocysts/L and be flagged as <MRL for the record.

4.5 Chemical Reduction and Monitoring

A cornerstone of successful DPR is chemical reduction. To confidently provide water that is equally or more safe than existing supplies, suppliers must demonstrate high removal of a wide variety of chemicals, not just known toxins. This section in combination with section 4.11 concerning drinking water treatment processes will be used by the department and suppliers of water to ascertain a list of both target chemicals and indicator compounds for use in establishing alert and action limits for the critical control points focusing on chemical reduction. This section expounds on how to select appropriate indicator compounds and target chemicals.

The supplier must identify two levels of chemical compounds to be regularly monitored to verify critical control point integrity. Prior to the design, a year of treated wastewater sampling is required - see prior section 4.4. The department recommends twice per month sampling for target chemicals and at least once per month sampling is required. Refer to the previous section for chemical monitoring prior to initiating DPR. At startup, monitoring must be monthly for one year and then monitoring frequency may be changed to quarterly, or more or less frequently, at the department's discretion in the approved operating plan. The two types of chemical compounds are listed below and described in detail in the following sections:

1. **Target Chemicals** are any unregulated chemical causing a potential human health concern that may be present in the treated wastewater. For example: 1,4-dioxane, per and poly fluorinated alkyl substances (PFAS), N-nitrosodimethylamine (NDMA) would be considered target chemicals. Target chemicals must be targeted by one or more chemical critical control points if present in the treated wastewater.
2. **Indicator Compounds.** are chemical indicators chosen to monitor treatment performance in the treated wastewater and finished water.

4.5.1 Target Chemicals

Chemicals in this category are not regulated under Regulation 11. However, they are known to occur in treated wastewater at concentrations that could potentially approach or exceed safe levels if not controlled appropriately. Because the presence of these chemicals above certain levels could represent a health risk, plans need to be developed as to how to respond to exceedances of targets including operating changes and public notification. The department expects the supplier to set alert and action limits well below any documented health advisory levels for target chemicals. Alert and action limits must be approved by the department in the operations plan.

While there are thousands of chemicals in treated wastewater and the environment, specific chemicals may fall into the category of target chemicals for either or both of the following reasons:

1. The compound or its toxicity was recently determined or re-assessed. The EPA has had insufficient time or has insufficient data to conclude whether nationwide regulation is justifiable. Nevertheless, toxicity studies on this compound, or toxicity studies on similar compounds, provide cause for concern about this compound.
2. The compound is common in treated wastewater but not surface water or groundwater. Certain wastewater-associated potentially toxic compounds are diluted or naturally remediated in the environment to below detection limits or are far below plausible hazardous concentrations at most conventional drinking water intakes. The prevalence of these compounds in natural water may not justify a nationwide drinking water standard. Nevertheless, these compounds may pose a chronic health risk in the context of DPR if they are not monitored and removed. Compounds that are recalcitrant to multiple treatment barriers (such as 1,4-dioxane or PFAS) or known disinfection byproducts with wastewater-associated precursors that may form after or during early treatment steps (such as NDMA) merit greatest vigilance. Target Chemicals may be selected in consultation with CDPHE based on any or all of the following justifications (listed approximately in order of priority).
    a. Contaminants with EPA health advisory levels (HALs) but not MCLs, such as PFOA and PFOS or perchlorate.
    b. Contaminants with MCLs or equivalent by other states or countries, but not the US EPA, such as methyl-tert-butyl ether, which has an MCL in California (California State Water Resources Control Board 2018).
    c. Contaminants with notification levels or HALs or equivalent by other states or countries, but not the US EPA, such as 1,4-dioxane and NDMA.
    d. Contaminants with domestic water supply standards in 5 CCR 1002-31 or 5 CCR 1002-41.
    e. Contaminants that are present in treated wastewater at potentially hazardous or unpalatable concentrations in recent technical reports (such as reports by NWRI or The Water Research Foundation) or peer-reviewed journals, but with toxicity and prevalence not yet widely corroborated (Marron, et al. 2019, Khan, Fisher and Roser 2019).
    f. Any additional chemicals that have been identified in the wastewater collection system or have the potential to enter the wastewater stream, such as PFAS at a fire training area, petroleum hydrocarbons near a leaking underground fuel storage tank, metal plating, or solvents at dry cleaners.

4.5.2 Indicator Compounds

The DPR train should be designed, built and operated to remove at least 75 percent of each indicator compound as measured from the treated wastewater to the finished water. This goal is important for:

• Public acceptance. The idea that some compounds have entered the drinking water supply from human waste prevents people from accepting DPR. Public

resistance may take hold even if the compounds are proven to be nontoxic. Public acceptance is crucial for DPR projects as explained in Section 4.2.

• Uncertain toxicity. Many compounds that occur in treated wastewater but are thought to be safe or have not yet been thoroughly tested for toxicity. Future scientific studies may reveal toxicity for some of these compounds.

• Unidentified compounds. Hundreds of manmade chemicals have been detected in treated wastewater, including at least 70 pharmaceuticals (Petrie, Barden and Kasprzyk-Hordern 2015) and over 20 per- and polyfluoroalkyl substances (Scott, et al. 2010, Glover, Quinones and Dickenson 2018, Subedi, Codru, et al. 2015, Pisarenko, et al. 2015, Sinclair and Kannan 2006, Sedlak, et al. 2017). Thousands more are likely present at some level based on industrial registries, and new chemicals are invented every day. Furthermore, over 600 DBPs have been discovered after chlorine or chloramine water disinfection (Stanford, et al. 2018). Advances in analytical chemistry are accelerating the rate at which new compounds are detected in water (Strynar, et al. 2015).

• Synergistic toxicity. Certain compounds interact in such a way that their combined toxicity is greater than their individual toxicity (Chen, et al. 2015). It is impossible to assess the toxicity of all possible combinations of chemicals in surface waters, groundwaters, or treated wastewater. Routinely monitoring all chemicals in treated wastewater is impossible. However, strategically selecting indicator compounds can demonstrate that all reuse treatment processes are properly functioning and are collectively removing virtually any chemical compound.

Indicator compounds are not necessarily toxic. Rather, indicator compounds have chemical properties that make them removable by some treatment processes but recalcitrant to others. For example, several artificial sweeteners that are approved for human consumption are useful indicators because of their recalcitrance to biological treatment (Jmaiff Blackstock, et al. 2019).

The indicator selection process must be thorough and strategic; it must follow established steps and criteria, and should be conducted in partnership and consultation with the department.

Indicator compound selection is site specific and based on a number of factors that allow regular and accurate measurement of the selected chemicals to confirm treatment process removal. Pilot studies of the chemical critical control points are critical to aid in establishing indicator compound selection.

4.5.2.1 Indicator Chemical Selection:

Compounds prevalent in one community's treated wastewater might not be prevalent in another's. The initial candidate list for indicator screening should take into account expected chemical emissions from local industry and other efforts and

research characterizing treated wastewater. Furthermore, indicators should target the treatment processes used at the specific DPR facility.

Note: it may be challenging to meet the specificity, sensitivity, and diversity criteria below with indicator compounds that are prevalent in treated wastewater at relevant concentrations. While the criteria below represent the ideal, site-specific pilot study data will be used case by case by the supplier and the department to select the appropriate number and types of indicator compounds. Each supplier must submit a recommendation for indicator compound monitoring which includes the following:

1. **Concentration**. The indicator should have a median concentration at least five times greater than its Method Reporting Limit (MRL). Otherwise, a high percentage of removal cannot be demonstrated.
2. **Prevalence.** The indicator should have a detection frequency greater than 80 percent in the site-specific treated wastewater. Otherwise, its absence may be random or seasonal and may not reflect treatment efficacy. For example, sunscreen UV blockers or allergy medications follow a seasonal occurrence pattern in treated wastewater (Petrie, Barden and Kasprzyk-Hordern 2015).
3. **Measurability**. Sufficiently precise and sensitive analytical methods for the compound are necessary to meet the above two criteria. Analytical methods should be well established in the scientific literature. While some methods may be approved by the EPA, the department can allow other methods that are well-established but not yet EPA approved.
4. **Specificity.** The indicator compound should be removable by the process(es) it is intended to monitor. It should be sufficiently recalcitrant to any upstream processes—or at such high concentration in the treated wastewater—that it meets the concentration and prevalence criteria at the influent of the targeted treatment process. Ideally, the indicator compound should be recalcitrant to downstream processes as well, however that may not always be the case. If all indicators meet this criterion, then all indicators could be monitored at just two sampling locations (WPF influent and final effluent). This criterion is based on convenience and operational efficiency, however in practice the department expects that some indicator compounds will be monitoring within the process as well.
5. **Sensitivity**. The indicator should be moderately removable by the targeted process, such that 75 percent removal is feasible only when the process is functioning as designed.
   - For example, ozone doses in reuse systems are typically around CT10 = 4-11 mg*min/L to balance chemical and pathogen removal against bromate formation (Dickenson, et al. 2009). Some compounds such as hydrocodone are so sensitive to oxidation that they are more than 90 percent removed even when the operationally defined ozone exposure is 0 mg*min/L (Dickenson, et al. 2009) Hydrocodone would be a poor indicator for ozonation, since it can be removed below its MRL even if an ozone generator is malfunctioning and

dosing less ozone than intended.

- On the other hand, ozonation removes chemicals such as chloroform and tris(2-chloroethyl) phosphate by less than 25 percent under typical conditions (Dickenson, et al. 2009). Removing more than 75 percent of these compounds with ozone would be cost prohibitive or physically impossible, and would likely cause the bromate concentration to exceed regulation.
- Moderately oxidizable compounds such as DEET or iopromide would serve as better ozonation indicators because they are more than 75 percent removed under typical conditions but mostly pass through at lower ozone exposure (Dickenson, et al. 2009).

6. **Diversity.** There should be at least one indicator that specifically monitors each chemical treatment barrier. Furthermore, there should be at least one indicator that is partially removed by each treatment barrier, but only removed to a target of at least 75 percent if all treatment barriers are functioning as intended—a system indicator.

To determine which compounds meet criteria 3 through 5, chemicals can be organized into groups based on their expected removal by each treatment process. Preliminary screening and organization of proposed indicators can be conducted using chemical properties that correlate with removal (for example, molecular weight, logD), bench scale experiments under controlled, standardized conditions (for example, Rapid Small Scale Column Test), or published pilot-scale data. However, water treatment efficacy depends on site-specific factors such as pH and competition for adsorption sites.

Therefore, the final indicator selection must consider the above and also use site-specific pilot study data to verify assumptions. By following these criteria, the ability of a treatment plant to remove virtually any chemical can be demonstrated with as few as four indicators: three for individual chemical contaminants removed by each of the required three chemical treatment barriers and one for the system as a whole.

Also, the number of indicator compounds required for monitoring could be fewer than four, if certain target chemicals are selected as indicators. However, in this case, the selection of a target chemical as an indicator compound should be clearly and specifically communicated to the department and well documented in the approved operations plan. Such a compound should be monitored with the sampling frequency and locations assigned for target chemicals and indicator compounds. Furthermore, in cases where there are significant health concerns like PFAS, prevention of the target chemical from entering the collection system through enhanced source control or upgrades to the wastewater treatment facility should be prioritized over maintaining the target chemical as an indicator compound.

4.6 Engineered Storage

Engineered storage after DPR treatment must be considered to confirm treatment process operation and finished water quality before releasing the DPR water. The use of engineered storage and the appropriate volume of water to store will vary between DPR projects depending on many factors, including the level and redundancy of online instrumentation, the sophistication and speed of automated alarm responses, and the availability of operators and their response time. Generally, the design must consider that if a pathogen log reduction target is not met, the water should be diverted and not sent to the finished water distribution system. Therefore, the engineered storage should be able to accommodate the delay time between water passing through a pathogen critical control point and the monitoring providing necessary data to operators to determine if an action limit is exceeded. Then the additional time must be considered for the response time to adequately and safely shut down the process.

The basis of design report must state if engineered storage is being provided and the rationale for the specified volume. As discussed above, an appropriate criteria for specifying volume is the amount of water needed to contain finished water flow while diverting or shutting down the DPR operations during an action limit exceedance for pathogen reduction. Alternatives to engineered storage can be justified based on finished water blending, storage and other factors.

For other critical control points, the supplier must provide a justification of whether the engineered storage buffer is needed and will be used as a response action (wastewater treatment, chemical critical control point) considering there may not be acute health threats with all of those critical control points. The department recommends that any water that could be perceived as unsafe by the public be diverted to ensure public confidence.

4.7 Treated Total Organic Carbon

Regulation 11.14(8)(b)(iv) requires the supplier to achieve a specific TOC goal in the finished water as critical control point monitoring for chemical reduction. The 2019 National Water Research institute's document, "Guidelines for Direct Potable Reuse in Colorado" states the following about finished water TOC:

> *TOC is an important bulk surrogate for DPR. When considering WPFs as a whole, TOC removal correlates with trace organic contaminant (TOrC) removal (Schimmoller and Lozier, 2019). TOrCs refers to an array of natural and manufactured substances including industrial chemicals, household chemicals, metabolites excreted by people, and by-products formed during water treatment processes (Hai, et al. 2014). Some TOrCs have high toxicity, such as NDMA and PFOA, while others are considered nontoxic, for example, sucralose. TOC removal also correlates with regulated DBP precursor removal (Hill, et al. 2018). Perhaps, and even more importantly, an increase in TOC breakthrough could indicate process failure, process exhaustion, or breakthrough of a recalcitrant industrial contaminant (Marron, et al. 2019).*
>
> *When the TOC in the purified water is lower than TOC in the original drinking water source, the TOrC concentrations have been found to be lower as well (Schimmoller and Lozier, How to Regulate and Control Organics in Potable Reuse Plans that Don't Use Reverse Osmosis 2019). If the TOC is greater in the purified water than in the original drinking water source, it creates uncertainty about DBP formation and bacterial regrowth in the distribution system and presents a challenge for public acceptance.*

In the process of characterizing the treated wastewater in the application for DPR, the supplier must determine the recalcitrant TOC concentration that was contributed by the original drinking water than ultimately becomes treated wastewater. Once done, the finished water TOC goal is established and the TOC critical monitoring for the chemical reduction critical control points can be established.

The NWRI report displays the TOC concentrations graphically in Figure 9 (NWRI Report page 55). The 'orange' portion of TOC is combined or added to the original TOC (blue portion) to form the total TOC entering the wastewater treatment facility. The wastewater plant is expected to reduce the TOC by some degree, but the treatment processes which further purifies the treated wastewater must then further reduce the TOC back to original levels thus ensuring the chemical removal critical control points are operating appropriately and disinfection byproducts (DBPs) are being minimized.

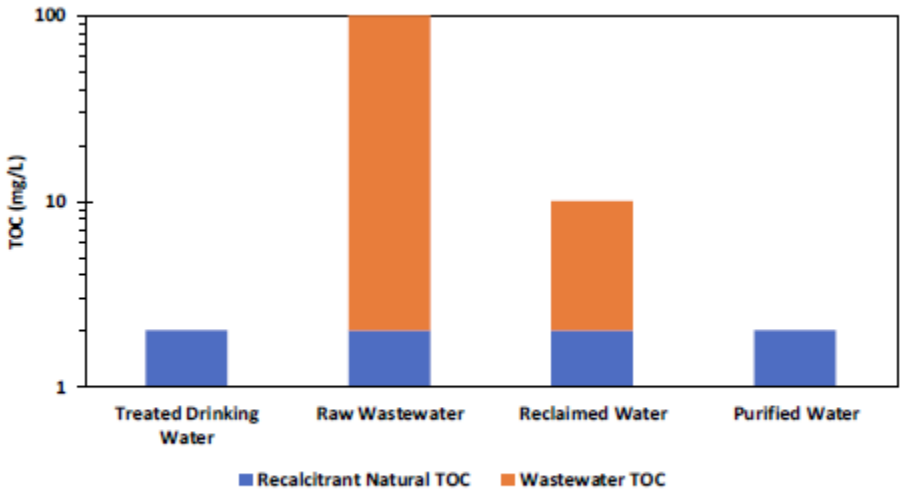

Figure 9. Hypothetical comparison of the a) sample locations and b) total organic carbon levels for the purified and original drinking water.

Each system must submit a plan to characterize the TOC of the drinking water that feeds the wastewater collection system. In some cases, characterization of the drinking water TOC (recalcitrant natural TOC in Figure 9 above) may be as simple as reporting the median TOC at the finished water entry points. In other cases, samples from portions of the drinking water distribution system may need to be collected and analyzed for TOC if a specific portion feeds the DPR process and has different water quality than the entry points. For example, if a distribution system is partially fed by a master meter to another system and a groundwater source, but the portion of the distribution system system feeding the DPR process is disproportionately influenced by the purchased water, then the entry point TOC values from the groundwater source would not represent the recalcitrant natural TOC that feeds the wastewater plant.

At a minimum, the following must be collected and analyzed:

(i) One year of TOC sampling (at least 1 sample per week) of the TOC (specified from above depending on system configuration) feeding the wastewater collection system.
   a. Location of TOC monitoring must be approved by the department
   b. Median, 75th percentile, and 95th percentile must be calculated.
   c. Action limit will be set at 1.5X 95th percentile of recalcitrant natural TOC.
   d. Alert limit will be set at the 75th percentile.

(ii) The treated water TOC (after DPR treatment) must be measured at least every 4 hours.

(iii) Per Section 11.14(8)(b)(iv), exceedance of the action limit (1.5X95%) - within 72 hours of becoming aware:

a. either stop producing finished water and investigate, identify, and correct issue, or
b. correct the issue with confirmation that treated water TOC is acceptable, identify issue

(iv) Exceedance of the alert limit (75%) - develop an action plan, report to the state

4.8 Mass Balance - Total Dissolved Solids including Sodium

Each supplier of water practicing DPR must submit a total water system mass balance projecting whether the introduction of DPR will result in an increase in total dissolved solids (TDS) in the water. There exists a secondary maximum contaminant level from the USEPA of 500 mg/L TDS. Also, increasing TDS concentrations over time could lead to concerns about water corrosivity. As part of the application for review and approval, the department will be considering long-term sustainability of the DPR project. A project that concentrates salts with no ability to achieve steady state may not be approved.

If the water system is proposing to use more than 50% of their water as DPR, or if the water system mass balance shows that the overall TDS will increase over time and not achieve a steady state, then the department will require the system to present a plan to mitigate the accumulation of ions in the system. This plan may include periodic flushing, side stream RO to remove salts, or other solutions.

Each DPR installation is expected to produce drinking water that maintains steady state water quality in the finished water and distribution system.

Within Regulation 11, specifically section 11.20, sodium is required to be monitored and sodium concentrations must be reported annually to the local health department. EPA Health Advisory Guidance recommends that sodium levels be between 30-60 mg/L in the drinking water for the general population and 20 mg/L or less for sodium restricted diet members of the population (who are limited to a total of 500 mg of sodium per day). If a DPR facility adds an appreciable amount of sodium to the existing drinking water, they must report that to the local public health agency who in turn may provide some public outreach about health concerns for those impacted. All of this outreach and attention may lead the public to perceive a risk from drinking water originating at a DPR facility.

4.9 Operations Program

Regulation 11, Section 11.14(5)(a)(i) establishes the minimum requirements of the DPR Operations Program. The DPR Operations Program, which will be synonymous with the term DPR Operations Plan, must be submitted to the department as part of the application for approval to use DPR. The department views the operations plan as a critical component of the DPR application process and is the supplier's opportunity to demonstrate to the department that it has the technical, managerial, and financial capacity (TMF Capacity) to properly operate DPR safely and sustainably. While only new community or non-transient, non-community public water systems must submit a TMF review per Regulation 11, 11.4(1)(a), the operations plan is the opportunity for all systems that are proposing DPR to demonstrate that adequate TMF Capacity exists to successfully implement DPR. The elements listed in the regulation for inclusion in the operations plan should be considered by applicants as minimum standards of care and not a comprehensive list for successful implementation of DPR. The regulation requires the following elements to be included in the operations plan:

Certification that the water and wastewater systems are operated by certified operators at the appropriate certification levels for each facility.

(B) A communications plan describing the schedule and method for communications between water and wastewater operators.

(C) A preliminary operations manual that details standard operating protocols at the wastewater system, water treatment system, and water distribution system.

(D) A characterization of the treated wastewater based on monitoring under 11.14(6)(b) to identify alert and action limits prior to the water treatment plant.

(E) Identification of each critical control point for pathogen reduction to comply with 11.14(7).

(F) Identification of critical control point monitoring and critical control point monitoring locations to be monitored to evaluate the effectiveness of critical control points for pathogen reduction.

(G) Identification of each critical control point for chemical reduction to comply with 11.14(8).

(H) The identification of indicator compounds, critical control point monitoring, and critical control point monitoring locations that indicate whether treatment goals at each critical control point for chemical reduction are being met.

(I) Identification of target chemicals that are present in treated wastewater and targeted for removal or reduction. The supplier must specify targeted removal rates to be removed at each critical control point.

(J) Identification of critical control point monitoring and critical control point monitoring locations to be monitored to evaluate the effectiveness of critical control points for chemical reduction.

(K) Identification of alert limits and action limits at each critical control point with an associated action plan with deadlines for addressing alert limit and action limit exceedances. For action limit exceedances, procedures must include but not be limited to provisions for process

shutdown or diversion, including provisions for an automated response, and must specify the fate of any water sent to waste.

(L) A direct potable reuse process schematic that identifies each critical control point for pathogen and chemical reduction and the critical control point for treated wastewater within the wastewater treatment plant.

(M) Identification of a critical control point dashboard that allows for online monitoring for display to the supplier's wastewater and water treatment operator(s).

(N) A communications plan describing how the supplier will maintain the following forms of communication with the public:

(I) The local, publicly accessible repository of information required in 11.14(3)(b)(i)(A).

(II) The methods and frequency for continued communications with the public about direct potable reuse operations, status, and water quality, including situations requiring public notice under 11.33.

The the following sections explain more about what are considered minimum requirements for approval of sections of the operations plan:

4.9.1 Operator certification:

A class "A" water operator is required for the pathogen and chemical critical control points portion of the treatment scheme.

A class "A" wastewater operator is required for the wastewater treatment plant that provides the treated wastewater.

4.9.2 Communications plan for operations

The plan must include the schedule and method for regular communications between water and wastewater operators. This will include shared responsibility in the accuracy of information on the critical control point dashboard (see 4.1(vi)).

The department expects the supplier to outline operational scenarios where the treatment operators will need to communicate and coordinate. For each communications plan, the supplier must provide a description of normal operations, upset conditions, emergency response protocols including but not limited to: power outage, natural disaster, staffing issues, loss of communications, action limit exceedances, alert limit exceedances, evidence of pollution entering the collections system, and water and wastewater plant unexplained excursions. The department intends to review the supplier's plan and determine if sufficient coordination between wastewater and water operators has been demonstrated.

4.9.3 Standard Operating Protocols

The plan must include at a minimum a preliminary operations manual defining roles and responsibilities as well as key concepts in operating the wastewater system (including

collections and source controls such as pretreatment), water treatment system, and water distribution system. The plan will identify communication pathways and response to operational upset events, alert limits, and action limits.

While standard operating procedures do not need to include specific equipment SOPs, they should include key procedures for all critical control points identified. Also, the department expects suppliers of water to continue to train and keep operations staff, both new and existing, apprised of industry advancements as well as in connection with the latest DPR training.

4.9.4 Critical control points**

The operations plan must utilize the proposed process flow diagrams to establish and identify critical control points for key barriers and water quality. Critical control points must include, but are not limited to:

- Wastewater treatment - Regulation 11, Section 11.14(6) – proper treatment based on site-specific wastewater treatment requirements must occur. Based on treated wastewater characterization and monitoring, alert limits and action limits must be defined for identified variables to verify the critical control point is functioning properly.
- Pathogen barriers – minimum of 3 required per Regulation 11, Section 11.14(7). Note: each barrier is a critical control point regardless of the number installed.
- Chemical barriers - minimum of advanced oxidation and at least one other required per Regulation 11, Section 11.14(8). Note: each barrier is a critical control point regardless of the number installed.
- Additional critical control points that affect water quality must be identified (e.g. blending for TDS or nitrate control)

** For detailed discussion of critical control point methodology - see WERF Final Report "Development of an Operation and Maintenance Plan and Training and Certification for Direct Potable Reuse (DPR) Systems" (2016)

4.9.5 Critical control point monitoring locations

For each critical control point, monitoring location(s) must be identified clearly in the operations plan. Once a monitoring location has been identified, operational parameters must be identified and clearly summarized in the operations plan. For each operational parameter at each location, the supplier must include the following for department review and approval:

- Type of monitoring – online, continuous, grab sample
    - Continuous monitoring means at least every 15 minutes
- Frequency of monitoring – 15 min, daily, weekly
- Instantaneous flowrate and flow totalizing capability – for calculating residence times and responses

- Operational parameters must confirm the treatment barriers are intact to ensure the process is meeting the water quality and pathogen/chemical removal goals
- Action limits and alert limits with required response actions must be identified.

4.9.6 Critical control point dashboard:

The plan must identify a critical control point dashboard that is available to both water and wastewater operators that clearly identifies each critical control point, monitoring information including frequency of updates, process status, and residence times between critical control points. If the utility in question has a shared SCADA system for water and wastewater, the dashboard can be included in their existing system but must summarize the performance of the critical control points. While the department is not requiring a specific dashboard, the department will audit and review the status of each critical control point dashboard at a frequency it deems appropriate. It may be necessary to allow view access to the status of all critical control points of a DPR facility to department personnel, but the department is sensitive to infrastructure security concerns and will approve each dashboard on a case-by-case basis.

4.9.7 Action and alert limit triggers:

Each action and alert limit must have a corresponding action or actions identified to ensure the process is recovered properly and public health is not jeopardized. These detailed response actions must be included in the operational plan and be specific to the facility and the type of operation controls that exist at that facility. Specific delay times from sampling time, instrument analysis time, and operator response time must be included as well as anticipated time to respond.

The department expects each DPR facility to have automated shutdown based on pathogen critical control point failure. Typically, each process must be shut down in a specific order to avoid further problems at a facility. This detailed procedure and timing of shutdown must also be included for review and approval.The automated shutdown must be as soon as practical for each advanced water treatment facility. Since each DPR facility is anticipated to use engineered storage to some degree, the timing of the automated shutdown should consider the engineered storage volume and short circuiting within the engineered storage.

4.9.7.1 Examples of Action Limits and Alert Limits

Action limits can be associated with process control or operations:

- Loss of coagulant feed (for direct or conventional filtration)
- UV lamps loss of power
- Loss of oxidant feed (for log inactivation - chlorine, ozone, chlorine dioxide)

Action limits can be associated with monitoring operational parameters. Exceeding an action limit would necessitate taking immediate steps which could include shutting down the production of finished water within a documented timeframe until a cause of the event can be identified and eliminated or taking that specific

unit offline (if redundant units exist, e.g. multiple filters):

- Combine filter effluent turbidity above action limit.
- Oxidant residual out of desired range (e.g. improper Ozone to TOC ratio)
- Wastewater treatment producing ammonia beyond operating envelope as approved by the department based on treated wastewater characterization.

Alert limits can be associated with monitoring operational parameters and surrogates. Exceeding an alert limit would necessitate further action and follow up monitoring, but may involve more investigation rather than just shutting down the production of finished water. For example, if the finished water TOC is above the 75th percentile of the median distribution TOC, then it is appropriate to investigate the cause of the alert limit being triggered.

4.9.7.1 Sending water to waste

At times, the supplier of water may be compelled to send water to waste as a result of an action limit exceedance or deviation. Since this water originates at a domestic wastewater treatment facility typically and has not been discharged to the environment, a detailed plan on the fate of any wastewater from the treatment process must be provided. This plan must include:

- Points of diversion or waste streams from the treatment process including the following:
    - Treated wastewater that has exceeded an action limit.
        - If the treated wastewater is not accepted, it may be discharged via the wastewater treatment plant's permitted outfall provided the water meets permit requirements.
        - If the water is accepted, the plan must include where the water will be disposed of. Note: it is possible the water quality will be such that it is not allowed to be discharged at the existing outfall per the permit.
    - Pathogen and chemical barrier waste streams – including standard treatment waste (e.g. backwash, sedimentation blow down).
    - Process upset water, exceedance of an action limit (e.g. sedimentation basin needs to be wasted, ozone contactor needs to be drained, uv reactors down). Upset water may be disposed in a variety of ways if the proper approvals exist:
        - discharged via permit,
        - recycled back to the head of the facility (i.e. backwash pond with decant), or

- sent to a wastewater collection system.

Water system must show evidence that disposal or recycle of process upset water will be accepted and is appropriate for type of waste -see Chapter 9 of Policy 5 - Design criteria for potable water systems.

4.10 Groundwater Environmental Buffer

Regulation 11 defines direct potable reuse and environmental buffer as follows:

> *"DIRECT POTABLE REUSE" means using a series of processes that produce finished drinking water utilizing a source containing treated wastewater that has not passed through an environmental buffer*
>
> *"ENVIRONMENTAL BUFFER" means either a surface water or groundwater aquifer that causes adequate dilution or natural attenuation of pathogenic and chemical contaminants. Wastewater effluent from a permitted (e.g. Colorado Discharge Permit System) wastewater treatment plant that has been discharged to a surface water body is considered to have passed through an environmental buffer. For new waterworks, the Department shall determine if a source containing wastewater effluent passes through an environmental buffer during review of plans and specifications in 11.4.*

The intent of the above definitions is to clarify that the DPR rule will apply to systems that pipe treated wastewater directly from the wastewater treatment plant to the advanced drinking water treatment (DPR process). When a wastewater effluent stream is discharged to a surface water body, the DPR Rule will not apply. The department utilizes the Colorado Water Quality Control Act to permit and set limits on the wastewater effluent given the receiving stream's attributes and downstream uses. The permit limits protect the intended uses. Therefore, the department believes the surface water treatment rules (Regulation 11, Sections 11.8 - 11.10) are protective of public health and able to provide finished water based on the monitoring and multiple barriers of treatment for streams, rivers, lakes and other surface water.

When treated wastewater is not discharged to a surface water body, then the department reserves the right to evaluate the situation in a case-by-case manner. There are two cases contemplated in the definition above:

1. If treated wastewater is piped directly to a DPR treatment facility, then Regulation 11.14 Direct Potable Reuse Rule will apply.

2. If the treated wastewater is applied to the surface of the ground or to injection wells, and a supplier of water wishes to extract drinking water from drinking water wells nearby then the portion of the environmental buffer definition applies that states, "groundwater aquifer that causes adequate dilution or natural attenuation of pathogenic and chemical contaminants".

"Adequate dilution or natural attenuation of pathogenic and chemical contaminants" will be evaluated by requiring the supplier to collect typical wastewater indicators (see "Source Water Characterization" Section of this policy) both in the treated wastewater and in the proposed groundwater well with a focus primarily on pathogenic contamination. Upon comparing the two data sets, the department will make a 'weight of evidence' determination if sufficient dilution and attenuation of pathogenic contaminants are occurring based on the water quality in the proposed groundwater well. If adequate dilution or natural attenuation of pathogenic contaminants are not occurring, the supplier will be required to comply with the Direct Potable Reuse Rule.

When groundwater wells that are located within a few days travel time of a treated wastewater discharge to groundwater, the department anticipates that the groundwater well will contain significant wastewater indicators in water quality sampling. Conversely, when groundwater wells in an aquifer are located greater than 50 dayswith several years of travel time in the aquifer, the department anticipates that the groundwater well will not have appreciable concentrations of wastewater indicators of concern for groundwater. To protect public health, it is important for the department to have the authority to require that such analyses take place. This is particularly important considering the rapid growth of the front range area and the possibility of groundwater wells being located near treated wastewater discharge locations.

4.11 Drinking Water Treatment for Direct Potable Reuse

Drinking water treatment processes are required by Regulation 11 and further clarified and specified by the department's Policy 5, Design Criteria for Potable Water Systems. When it comes to DPR, Regulation 11 specifies critical control points for both pathogen and chemical reduction. In the case of pathogens, at least three barriers must be utilized, although more may be approved and may be appropriate for a given treatment scenario. For example, certain chemical reduction critical control points require specific water quality supplied to the process in order to properly operate sustainably. This water quality requirement may mean the supplier must install 4 pathogen critical control points to sufficiently achieve that minimum water quality.

For chemical reduction, all systems must perform advanced oxidation. Beyond advanced oxidation, systems may choose to either use reverse osmosis filtration, or they may choose to use adsorption technologies combined with at least one other chemical reduction technology. While the design criteria (Policy 5) specify design parameters for any given critical control points, the following two sections further clarify and specify which types of treatment are accepted and the general requirements for justifying a given treatment train. As part of the operations plan for direct potable reuse, each supplier will have to propose and justify a given treatment train - see Regulation 11, Section 11.14(5)(a)(i)(L). The department will require piloting to justify treatment trains.

4.11.1 Minimum Requirements for Piloting

Pilot plants must be constructed and operated for a minimum of 3 months for each proposed DPR treatment train. Piloting may occur during the year of wastewater characterization, but it may be pertinent to perform piloting after the year of characterization due to the fact that appropriate treatment processes may vary depending on the treated wastewater quality. The department expects the supplier to submit the pilot testing plan for comment prior to initiating a pilot.

The supplier must pilot each pathogen and chemical critical control point to generate empirical data in order to demonstrate that the barrier can reliably and consistently comply with the DPR rule.

4.11.2 Acceptable Treatment for Pathogen Reduction

Regulation 11 mandates the 3 pathogen barriers. The regulatory language is as follows:

(i) The supplier must utilize a minimum of three separate critical control points for pathogen reduction. Two of the critical control points for pathogen reduction must consist of one disinfection critical control point and one filtration critical control point from the following:

(A) A disinfection critical control point consisting of UV or ozone.

(B) A filtration critical control point consisting of one of the following:

(I) Reverse osmosis.

(II) Conventional or direct filtration in accordance with criteria specified in the *Direct Potable Reuse Policy* and Policy DW-005. Ozone/biofiltration is considered direct or conventional filtration.

(III) A Department-approved alternative filtration in accordance with criteria specified in the *Direct Potable Reuse Policy,* Policy DW-004, DW-005 and 11.10(5).

Based on the regulatory requirements, a supplier must propose **at least three** barriers for pathogen reduction. The choices of which types of filtration and disinfection are permitted extend from the surface water treatment rules (Sections 11.8 and 11.10 of Regulation 11). The tables below summarize the accepted filtration and disinfection treatment techniques. Alternative treatment techniques must be proposed and accepted by the department based on meeting pathogen reductions and can be applied for in accordance with Policy 5 - Design Criteria for Potable Water Systems.

Accepted Filtration Treatment Techniques for Pathogen Reduction

Filtration Technology	Cited Log Reduction Credits (*Cryptosporidium, Giardia,* viruses)	Regulatory/Policy Reference
Slow sand	2.0, 2.0, 3.0	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(5)(a)
Conventional filtration	2.5, 2.5, 2 (additional credit available based on filter turbidity performance)	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(5)(a)
Direct filtration	2.0, 2.0, 1.0 (additional credit available based on filter turbidity performance)	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(5)(a)
Low pressure membranes (micro or ultra filtration)	Dependent on acceptance and integrity test sensitivity - general acceptance allows 3.0, 3.0, 0 (additional credit available based on pressure decay testing performance)	Alternative filtration acceptance (Policy 5) and Regulation 11, Section 11.10(5)(j)
Reverse osmosis	Dependent on acceptance and integrity test sensitivity - general acceptance 3.0, 3.0, 0	Alternative filtration acceptance (Policy 5) and Regulation 11, Section 11.10(5)(j)
Nanofiltration	Dependent on acceptance and integrity test sensitivity - general acceptance 3.0, 3.0, 0	Alternative filtration acceptance (Policy 5) and Regulation 11, Section 11.10(5)(j)

Accepted Disinfection Treatment Techniques for Pathogen Reduction

Disinfection Technology	Pathogen targets	Regulatory/Policy Reference
Free Chlorine	*Giardia,* viruses	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(3)(b)
Monochloramine	*Giardia,* viruses	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(3)(b)
Chlorine dioxide	*Giardia, cryptosporidium,* viruses	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(5)(m)
Ozone	*Giardia, cryptosporidium,* viruses	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(5)(m)
Ultraviolet light (UV)	*Giardia, cryptosporidium* viruses (186 mJ/cm2 for 4 log), or 276 mg/cm2 for 6 log)	Safe Drinking Water Program Policy 4 and Regulation 11, Section 11.10(5)(n) and USEPA 2020 "Innovative Approaches for Validation of Ultraviolet Disinfection Reactors for Drinking Water Systems"

4.11.3 Acceptable Treatment for Chemical Reduction

Per Regulation 11.14(7), Advanced Oxidation is required as a critical control point for chemicals for each approved DPR treatment facility. Additional barriers will be chosen on a system specific basis. If a system elects to use reverse osmosis filtration as a barrier, then they do not need a third barrier. If a system elects to use carbon adsorption, then they must choose a third barrier.

The third barrier can be chosen for system-specific needs and may be taken from the following table, however performance must be verified through pilot testing:

Mechanism	Example	Types of chemicals removed
Adsorption	*Granular or powder activated carbon*	Hydrophobic (Westerhoff, et al. 2005)
High Pressure	Reverse Osmosis - Minimum	High molecular weight (>200

Membrane Treatment	salt rejection percentage required.	Da), charged (Bellona, et al. 2004)
Photolysis	Direct UV photolysis	Nitrosamines (Aqeel, Kim and Lim 2017), iodinated compounds (Yu, et al. 2015), nitro compounds (Dong, et al. 2017)
Ion Exchange	Cation and Anion exchange resins Must show through piloting that they remove a variety of Target Chemicals.	Positively or negatively charged
Coagulation and biofiltration	Enhanced coagulation, electrocoagulation Biofiltration	Assimilable organic carbon for biofiltration and High molecular weight (>1000 Da) (Wert, et al. 2011), high specific ultraviolet absorbance (Korak, Rosario-Ortiz and Scott Summers 2015, Korak, Rosario-Ortiz and Scott Summers 2015), certain heavy metals and radionuclides (WHO 2011)
Absorption	Air Stripping	Volatile, semivolatile

Each chemical reduction process must be piloted on the treated wastewater that has been characterized. Target chemicals and indicator compounds must be chosen for the pilot test plan based on the treated wastewater characterization. The pilot effort will then quantify the anticipated reduction percentages and help establish alert and action limits for indicator compounds. Certain processes in the table above may not achieve meaningful reductions of chemicals alone, but certain processes may be combined to form a chemical critical control point based on pilot testing results.

Advanced Oxidation.

Advanced oxidation processes include ozone with hydrogen peroxide, ultraviolet light with hydrogen peroxide, or ultraviolet light with hypochlorite. Alternative processes such as ozone alone must be justified on a case-by-case basis through pilot testing.

- The process must be shown through pilot testing to substantially reduce (>50%) an indicator compound.

    - Indicator compounds must be approved by the department and resistant to removal by other treatment processes, such as biological degradation, adsorption processes, RO/NF, and traditional oxidation processes such as hypochlorite, chloramines, permanganate, or chlorine dioxide (e.g. 1,4 Dioxane). See section 4.5 for discussion of indicator compounds.
    - Each pilot must spike and measure indicator compound removal.
    - Reference compound comparison: The department also expects 1,4 Dioxane to be spiked and removal percentages calculated in order to compare to other industry-accepted advanced oxidation.
    - In pilot testing, the final concentration of any indicator compound must be above the minimum reporting limit following AOP treatment.
- The Department will set operating conditions and verify critical monitoring parameter ranges from pilot work.
- If ozone is used without hydrogen peroxide, piloting must be performed. Ozone to TOC ratio set points, adjusted for nitrite, must be justified based on pilot data for the given treated wastewater supply.
- If adequate piloting is not performed (e.g. shorter time or limited scope), the advanced oxidation process must achieve 69% removal of 1,4 Dioxane
    - Other similar applications of the advanced oxidation process must be cited when applying for this option.

High Pressure Membrane Treatment: Reverse Osmosis minimum salt rejection.
When reverse osmosis is employed for pathogen reduction - the department's alternative filtration technology acceptance of nanofiltration and reverse osmosis shall apply. This acceptance allows for surface water treatment rule credits but utilizes an alternative integrity testing mechanism (rather than pressure decay testing) to establish a rejection percentage of a larger ion (like sulfate). However, when a supplier wishes to utilize reverse osmosis as a critical control point for chemical reduction, then the department will ensure that the reverse osmosis unit is capable of a minimum salt rejection.

In general, the following criteria will apply for reverse osmosis as a chemical critical control point (taken from California state regulations § 60320.201):

(1) each membrane element used in the project has achieved a minimum rejection of sodium chloride of no less than 99.0 percent (99.0%) and an average (nominal) rejection of sodium chloride of no less than 99.2 percent (99.2%), as demonstrated through Method A of ASTM International's method D4194-03 (2008) using the following substitute test conditions:

(A) tests are operated at a recovery of no less than 15 percent (15%);

(B) sodium chloride rejection is based on three or more successive measurements, after flushing and following at least 30 minutes of operation having demonstrated that rejection has stabilized;

(C) an influent pH no less than 6.5 and no greater than 8.0; and

(D) an influent sodium chloride concentration of no greater than 2,000 mg/L, to be verified prior to the start of testing;

APPENDIX A - Planning for Direct Potable Reuse

Ensuring a Consistent, Complete, and Adequate Application

Requirements for a Complete and Adequate Submittal include the following:

- Include completed versions of all of the necessary forms and checklists.
- Ensure that all of the requirements of Regulation 11 and this policy are adequately addressed for applications. Identify critical and unique challenges and document how each are addressed by the Communications Plan, Enhanced Source Water Control Program, and Operations Plan.
- The review time(s) of other agencies may differ greatly from that of the Department, especially where agreements are involved. Be sure to contact these agencies as early as possible so that this time can be accounted for in the overall project planning work. An example may be where a wastewater treatment entity needs to review and agree to the written plan for DPR prior to submission to the Department.
- One (1) electronic copy (i.e., sealed and signed) must be submitted to the Department through the drinking water portal for review and a decision.
- If the project will involve an alternative technology (not currently included in the design criteria), submit the alternative technology application and receive Department acceptance of the technology prior to developing a design around this process or product, otherwise this review could result in delays during the design application processes.

If you have any questions about the application process, please contact the Engineering Section Unit Manager for the county in which the project is located. The contact information for these individuals can be found on the following Department web page under the *Additional information and contacts* heading: https://cdphe.colorado.gov/design.

General Timeline Related to Implementation of DPR

Per section 11.14 of Regulation 11, the supplier is required to develop and maintain a written plan for direct potable reuse that includes key elements; 1) Communications and Outreach; 2) Enhanced Source Water Control Program; 3) Direct Potable Reuse Operations Plan which includes the wastewater treatment process description and the advanced drinking water treatment process description with critical control points identified.

The early planning and development of these key elements is critical for the successful implementation of direct potable reuse and may take a number of years to fully develop. Due to the magnitude of this undertaking, suppliers should establish a long range plan that provides sufficient time to fully develop each of these elements. To help suppliers plan, the following list outlines a possible approach for complying with the direct potable reuse rule and should serve as a guide.

Conceptual Steps:

1. Verify that the system has the water rights portfolio that allows DPR

implementation. Work through any water rights challenges to enable the legal implementation of DPR.

2. Complete the following early actions to help guide the overall process and inform later steps: (5+ Years Prior to Implementation)

    a. Sample raw wastewater and treated wastewater at the location where the wastewater would be pulled for transfer to the advanced water treatment facility in accordance with the sampling schedule set forth in 11.14(5)(b). At least one year of monthly sampling is required. If a new facility, the supplier should seek out and sample from a similar wastewater service area and wastewater treatment system.

    b. Identify key participants and parties that are integral to executing the Enhanced Source Water Control Program and get initial buy-in and support of all parties for DPR. Begin developing the roles and responsibilities of each party.

    c. Develop a chemical mass balance and operations plan to avoid concentrating constituents of concern (e.g., TDS and phosphorus).

3. Conceptualize the proposed wastewater treatment and advanced water treatment trains based on initial sampling. Draft the Communications and Outreach and the Enhance Source Control Plan sections of the written plan for DPR and submit these sections to the Department for feedback and general agreement. If a new community or non-transient, non-community water system is being proposed, submit a capacity assessment (Technical, Managerial, and Financial) to the Department for review and a decision per section 11.4 of Regulation 11. This capacity assessment is in addition to the specific Technical, Managerial, and Financial requirements that are part of the direct potable reuse requirements discussed in this policy. (4+ Years Prior to Implementation)

4. With general agreement from the Department,

    a. develop legal agreements between all parties with responsibility for implementation of the written plan;

    b. initiate an education and communication plan to establish awareness, address concerns, and garner support of DPR; and

    c. establish any required local ordinances and begin to implement the Enhanced Source Water Control Program. Since this plan may take time to become fully established, especially if a phased approach is being proposed, implementing the Enhance Source Control Program at least 1 year before producing finished direct potable reuse water is expected in most cases. (3+ Years Prior to Implementation)

5. For the next step, the supplier will:

    a. design any required wastewater treatment plant and waterworks upgrades and submit the proposed domestic wastewater treatment works and waterworks upgrades to the Department for review and decision;

b. draft the Wastewater Treatment Process Description and Control Points; Advanced Water Treatment Process Description, Control Points, and Early Water Quality Monitoring; and Direct Potable Reuse Operations Plan of the written plan for DPR;

c. update the Enhanced Source Control plan based on the proposed treatment processes;

d. Submit the written plan for Direct Potable Reuse to the Department for review and a decision. Upon approval, continue with implementation of the written plan.

e. With Department approval, construct any necessary upgrades to domestic wastewater treatment works and waterworks. (2+ Years Prior to Implementation)

6. Prior to delivering finished water to customers, the system must undergo a commissioning and start-up procedure. (1+ Years Prior to Implementation)

7. Update drinking water monitoring plan, deliver finished water to customers, and implement written plan for DPR.