



Figure 2. Reclaimed water cannot be applied on slopes more than 5 percent, when the ground is frozen, when soil is saturated or during periods of precipitation.

areas must be controlled by the user and requires fencing and signage. These areas also are required to be separated a certain distance from wells, waterbodies and property lines. If sprinkler irrigation is being used, wind blowing droplets over property lines must be considered. These distances are illustrated in Figure 1. The type of crop that can be irrigated is also based on the reclaimed water category, but no food crop that may be eaten raw can be irrigated with reclaimed water. Also, irrigation should cease 30 days before harvest of processed food crops. Furthermore, any lagoon cell with raw sewage cannot be used as an irrigation source and other water quality conditions must be met.

Requirements of the Distribution System

Reclaimed water distribution systems have special requirements to protect public health from potential contact. Pipes carrying reclaimed water are required to be purple in color, as well as the connected valves and outlets. This piping is also required to be marked with the warning, "CAUTION: RECLAIMED WATER – DO NOT DRINK." Hose bib connections to the system are required to be in locked vaults below the ground surface. Pump stations within the distribution system are required to be secured from unauthorized access and to have



Figure 3. Reclaimed water is used for forage irrigation at the OSU South Central Research Station near Chickasha, OK.

back-up pumps or generators on hand. Distribution systems are required to have flow measuring devices to measure the amount of reclaimed water used. Finally, all components of the distribution system are required to be well maintained and in working order.

Distribution systems are required to be flushed periodically to prevent slime growth. The water used for flushing the system must be disposed of properly, such as in a sanitary sewer. Flushing plans for the system must be developed and included with the systems operation and maintenance manual. These plans also must be certified by DEQ.

Operation and Maintenance

Operation of a reclaimed water system requires periodic inspection and sampling, as well as reporting. Suppliers of reclaimed water are required to have certified personnel at all times, and are responsible for the sampling and recordkeeping. Any samples taken must be analyzed by an accredited lab.

The different reclaimed water categories have different sampling requirements, but each requires the supplier to submit and retain a Monthly Operating Report (MOR). MORs are forms containing information and data about the operations of a system for a given month. This information includes the volume of water reclaimed and how much is supplied to each user, the results of each sampling event, weather conditions, type of plants irrigated and the irrigation rates at each site.

Reclaimed water systems are required to be inspected annually. The DEQ can complete these inspections, or the supplier can become approved through an application. The inspections are performed annually and include the sites of each user. The inspections are to ensure adequate separation distances, protection against bypasses, evidence of ponding of water, the type of vegetation and irrigation rate, whether the site is secure, if the flushing plan is being followed and for disinfection if necessary. At any time, if there is an accidental discharge or bypass of reclaimed water, or any part of the system is out of compliance, it must be stopped and cleaned up. Any such incidents must also be reported to DEQ. This report should include reasons for the incident and actions taken to fix it.

References

- U.S. Environmental Protection Agency. (2012). 2012 Guidelines for Water Reuse. EPA/600/R-12/618. EPA. Washington, D.C.
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Agricultural Irrigation with Reclaimed Water: Oklahoma Regulation

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Introduction

The availability of water is an area of growing concern in the state of Oklahoma. Frequent droughts threaten typical surface water sources and put added strain on aquifers. Demand for water also increases along with the growing population. Furthermore, growing populations require increased food, which requires increased irrigation. These trends make it necessary to explore different and more reliable sources of water to meet future demands.

One potential source of reliable water is wastewater that has undergone treatment prior to reuse, known as reclaimed water. Typically, after water is flushed or drained, it is carried to a treatment facility to be treated, then dispersed back to the environment. Reusing this treated water for irrigation can meet some of the increasing demand for fresh water. It can also decrease the cost of treating the wastewater. The nutrient content of wastewater is one of the reasons it is treated before being returned to the environment. Some of these same nutrients can be utilized by irrigated crops (EPA, 2012), thus reuse for irrigation allows for a less comprehensive treatment and nutrient removal, which has cost saving advantages.

Wastewater irrigation is already being practiced in several areas in Oklahoma. The type of irrigation ranges from turf of golf courses to food crops and other forms of agriculture. Things to consider when planning to reuse water for irrigation include; source water quality, source water quantity, crop selection, soil conditions, method of irrigation, economics, potential health effects and existing regulations (EPA, 2012). This fact sheet focuses on Oklahoma regulations.

Definitions

Reclaimed Water – Wastewater that has gone through various treatment processes to meet specific water quality criteria with the intent of being used in a beneficial manner.

Reclaimed Water Category – The regulatory rating of reclaimed water based on levels of wastewater treatment dictating allowable uses.

Primary Treatment – A wastewater lagoon system for the removal of larger solids from wastewater.

Secondary Treatment – A suspended growth mechanical treatment process for the reduction of organic content in wastewater.

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Treatment, Category and End Use

Treatment levels, e.g. primary and secondary, are defined by the Department of Environmental Quality (DEQ). Primary treatment is obtained through a wastewater lagoon system for the removal of solids and secondary treatment is obtained through a suspended growth mechanical treatment process for the reduction of organic matter. Other treatments include nutrient removal (nitrogen and phosphorus) and disinfection. Some treatment requirements for nutrient removal can also be met by the uptake of irrigated plants.

Oklahoma's regulation for reclaimed water use is based on the wastewater's treated water quality and the corresponding reuse. Since contact with wastewater poses a public health risk, uses with higher likelihood of public contact require more treatment before reuse. For example, wastewater being reused for irrigating a park requires secondary level treatment and disinfection. This includes removing nutrients and solids from the wastewater, as well as killing any harmful pathogens that may remain. On the other hand, water for irrigating forage crops may only require primary treatment.

Reclaimed water is divided into categories based on the treatment it receives. There are six categories and the more advanced treatment wastewater receives, the lower its category number becomes and more uses become allowed (see Table 1). Disinfection of reclaimed water has different requirements between the categories. The requirements for storing reclaimed water also vary between categories.

Each category of reclaimed water has its allowable uses and monitoring requirements. The categories, their treatment levels and their uses are shown in Table 1. Also, each category has a variety of specific restrictions in the regulations. These restrictions become more stringent as the category number approaches 1, because these uses have a greater likelihood of public contact with the reclaimed water. It should be noted that more restrictive categories can be used for less restrictive uses.

Regulation

The Department of Environmental Quality (DEQ) enforces Oklahoma's reclaimed water regulations. These regulations are located in the Oklahoma Administrative Code, Title 252, Chapter 656 Subchapters 25 and 27 and Chapter 627, which can be found online through the DEQ website. These regulations pertain to the construction requirements, as well as

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Table 1. Reclaimed Water: Uses and Requirements.

| Abbreviations | | | |
|---|---|---|--|
| MOR: Monthly Operating Report | R/A: Restricted Access | DO: Dissolved Oxygen | |
| N/P: Nitrogen and Phosphorus | EOP: End of Pipe | POE: Point of Entry | |
| BOD/CBOD: (Carbonaceous) Biological Oxygen Demand | FC: Fecal Coliforms | | |
| Category | Treatment Level | Allowable Uses | Monitoring Requirements (frequency) |
| 6 | N/A | <ul style="list-style-type: none"> Only allowed for certain processes within Wastewater Treatment Plant | N/A |
| 5 | Primary (Lagoon) | <ul style="list-style-type: none"> R/A pasture irrigation for range cattle R/A fiber, seed, forage irrigation Silviculture Irrigation | MORs |
| 4 | Primary (Lagoon) Disinfection Storage | <ul style="list-style-type: none"> Soil compaction and similar construction activities Existing R/A golf course irrigation* | MORs DO (weekly) Chlorine (Daily) FC (weekly) |
| 3 | Secondary Nutrient Removal Disinfection | <ul style="list-style-type: none"> Subsurface irrigation of orchards or vineyards R/A landscape irrigation Irrigation of livestock pasture Concrete Mixing Dust control Aggregate washing /sieving New R/A golf course irrigation Industrial cooling/boiler systems Hydraulic fracturing | MORs BOD/CBOD (weekly) Chlorine (12 hrs) FC (3 per week) N/P (monthly) |
| 2 | Secondary Nutrient Removal Coagulation Filtration Turbidimeters Disinfection** | <ul style="list-style-type: none"> Drip irrigation on orchards and vineyards Spray or drip irrigation on sod farms and public access landscapes Toilet and urinal flushing Fire protection Commercial closed-loop AC systems Vehicle and equipment washing Range cattle watering Make-up water for oil and gas production | MORs CBOD5 (weekly) Chlorine @ EOP (Daily) Chlorine @ POE (Cont.) Turbidity (Cont.) FC (Daily) N/P (monthly) |
| 1 | N/A | <ul style="list-style-type: none"> Reserved for future indirect/direct potable reuse | N/A |

* Category 4 water may not be used for new golf course irrigation pending further research by DEQ.
 ** Disinfection for Category 2 water has additional kill/inactivation requirements for certain pathogens.

operating and maintaining a water reuse system. Prior to any construction of a water reuse system, the DEQ must approve an engineering report, as well as plans and specifications before they will issue a "Permit to Construct."

The regulations categorize those who use reclaimed water as "users," and those who supply reclaimed water as "suppliers." If a supplier and user are the same entity, then the regulations treat them as a supplier. Suppliers, or wastewater treatment plants, bear the bulk of the responsibility for compliance.

A Permit to Supply is required before any reclaimed water can be supplied for reuse. Obtaining a Permit to Supply requires an application, a copy of a Permit to Construct, a binding agreement between the supplier and any users and a fee. The binding agreement lays out the terms of how the supplier will supply the water to the user. This could include fees, quantity and quality of reclaimed water, etc. Permits to

Supply for reclaimed water of categories 2 through 4 require an additional set of statements in the binding agreement that include the user will comply with DEQ regulations, allow access to the supplier to all sites of reuse and documentation of a user's legal interest in reuse locations (typically a deed). Permits to Supply last for five years and can be renewed with an application to DEQ.

Land Application of Reclaimed Water

Although the reuse of reclaimed water for irrigation can save on water supply and fertilizer cost, it does pose potential risks to human and environmental health. Human contact with wastewater can cause sickness, and if released into the environment, wastewater can harm the health of plants and animals and is very difficult to clean up. To mitigate these risks, certain restrictions are placed on land applications of reclaimed water.

The goal of reclaimed water use is to irrigate without overloading the soil and vegetation's capacity to accept nutrients and water. This requires the amount of water, nutrients and suspended solids be considered when designing the irrigation system. The irrigated area should be large and the application rate small enough so no water ponds on the surface or flows overland. The type of crop selected for receiving the irrigation water is also important.

There are other restrictions on land applications to ensure reclaimed water doesn't leave the site. No irrigation can take

place when it is raining or snowing, the soil is saturated or the ground is frozen. No irrigation can occur on slopes more than 5 percent. Finally, the irrigated area can have no berms or barriers that can cause ponding of irrigated water or stop rainwater from flowing. These restrictions necessitate storage for reclaimed water, such as a lagoon, when irrigation demands are low, but wastewater supplies are high.

The types of irrigation allowed are based on the category of reclaimed water, and the sites where this irrigation takes place have to be safe for potential public interaction. Irrigated

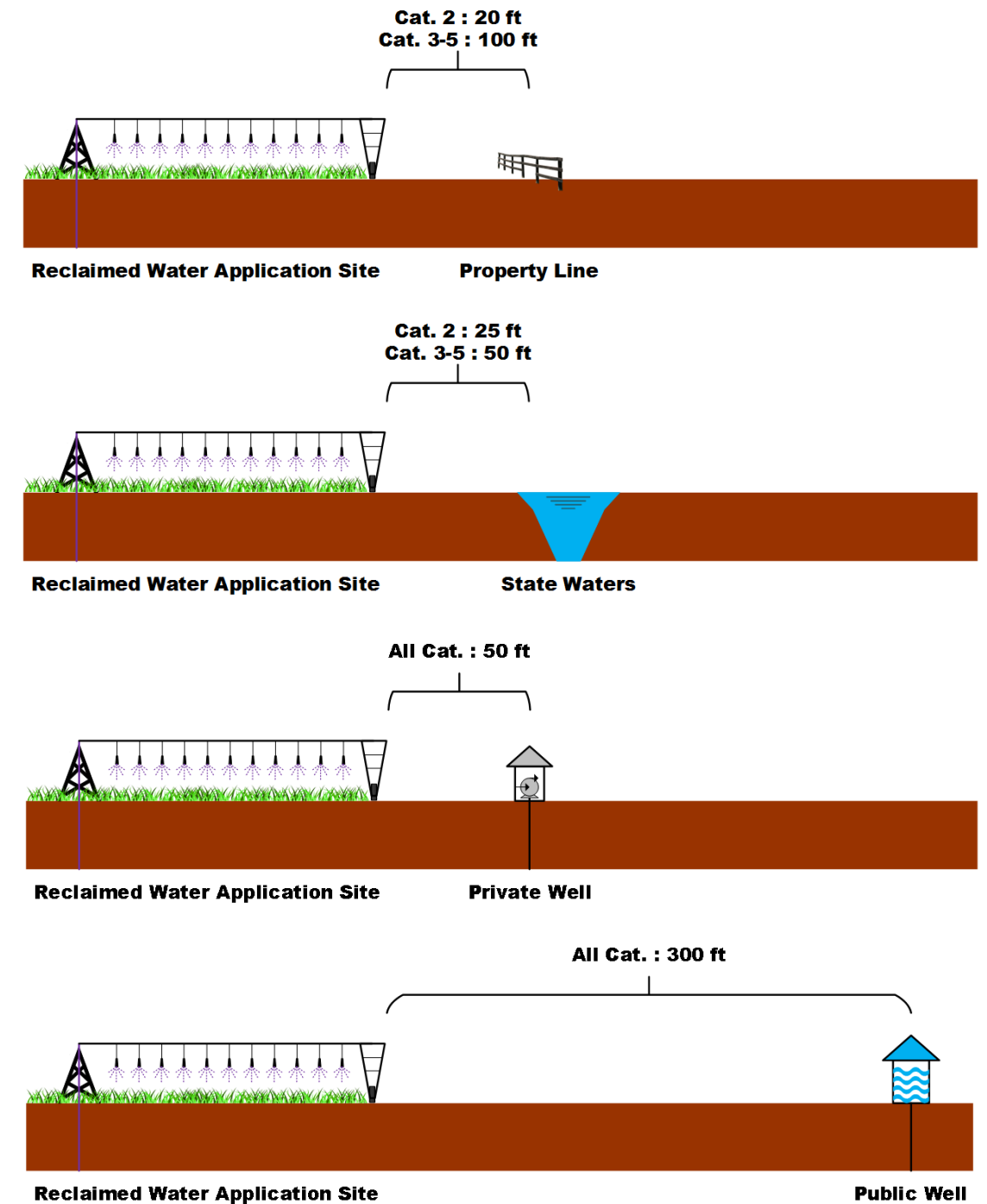


Figure 1. Required separation distances for land application. If using sprinkler irrigation, the distance of wind drift must be considered too.