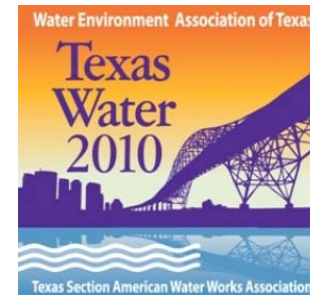


WATER REUSE AS A WATER MANAGEMENT STRATEGY FOR SMALL COMMUNITIES IN TEXAS



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Key Definitions



- **Water Reuse:** The use of surface water that has already been used once under a water right or the use of groundwater that has already been used.
- **Small Community:** A community which has less than 10,000 population and a total wastewater flow of less than 1 MGD.
- **Water Management:** Activities of planning, developing, distributing, and managing optimum use of water resources under defined water polices and regulations.



Why Water Reuse Is Needed in Texas?

- Urbanization and population growth are creating pressure on available water resources.
- Availability of fresh surface water is becoming limited.
- Groundwater in many areas is being depleted.
- Water reuse
 - augments water sources and provides an alternative source of supply.
 - protects aquatic ecosystems by reducing the quantity of nutrients entering waterways.
 - reduces the need for water control structures
 - manages water consumption and wastewater discharges.



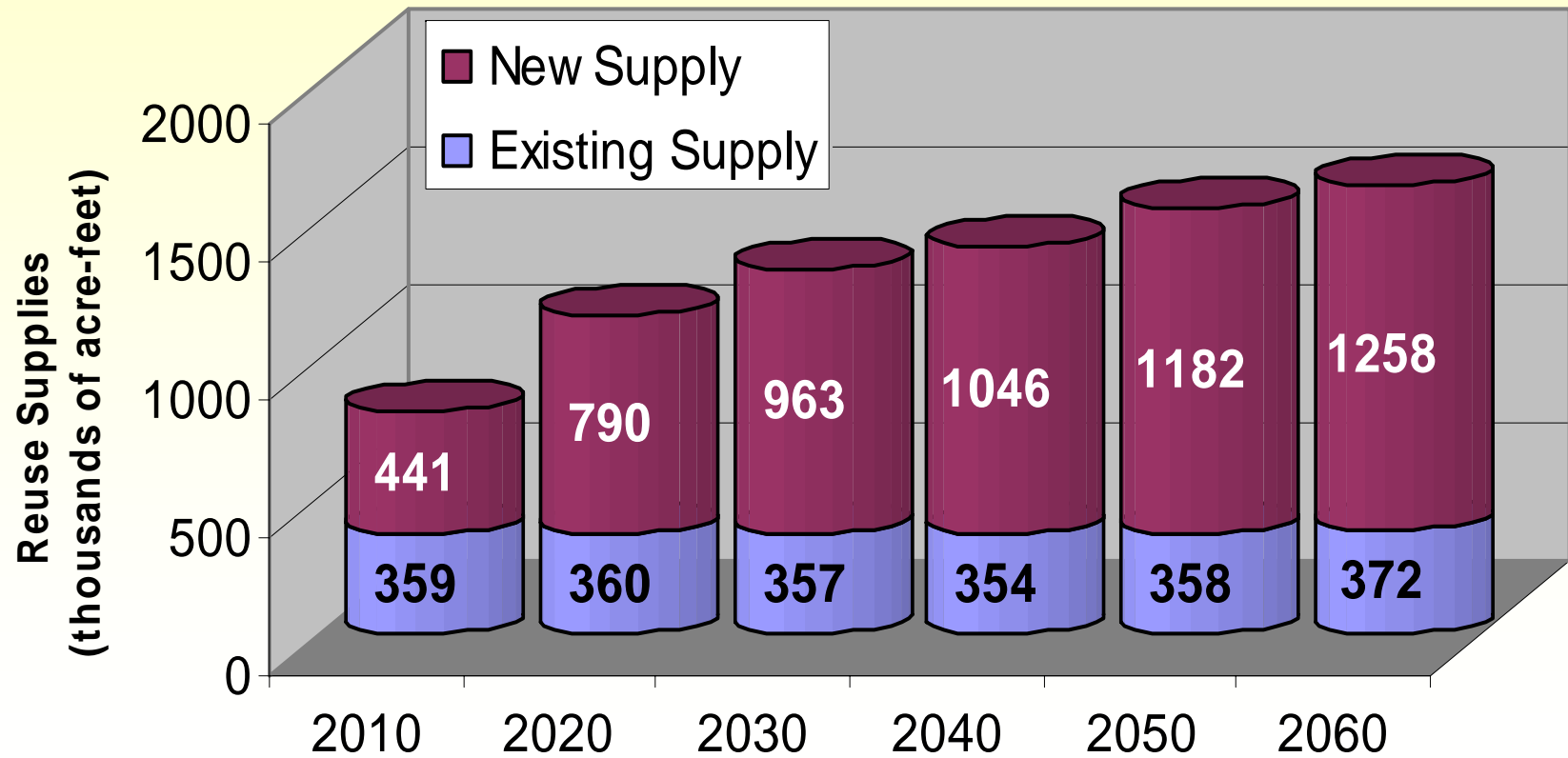
Reuse History in Texas

- In 1890, first recorded water reuse occurred in San Antonio, TX.
- In 1925, a continuing reuse project began in Lubbock, TX that provided effluent to the Frank Gray farm.
- In 1988, the City of Abilene initiated the *Use of Reclaimed Water for Lake Fort Phantom Hill* project to increase its water supply without detrimental effects on water quality.
- In 1989, Tarrant Regional Water District initiated a water reuse project (*Constructed Wetland Studies*) to increase its water supply.
- In 1992, US EPA and US Agency for International Development published *Guidelines for Water Reuse*.
- In 2004, US EPA and US Agency for International Development published *Guidelines for Water Reuse*.
- In 2008, a research study was conducted in Texas to analyze the inherent benefits and potential hazards associated with using reclaimed water to irrigate golf courses.



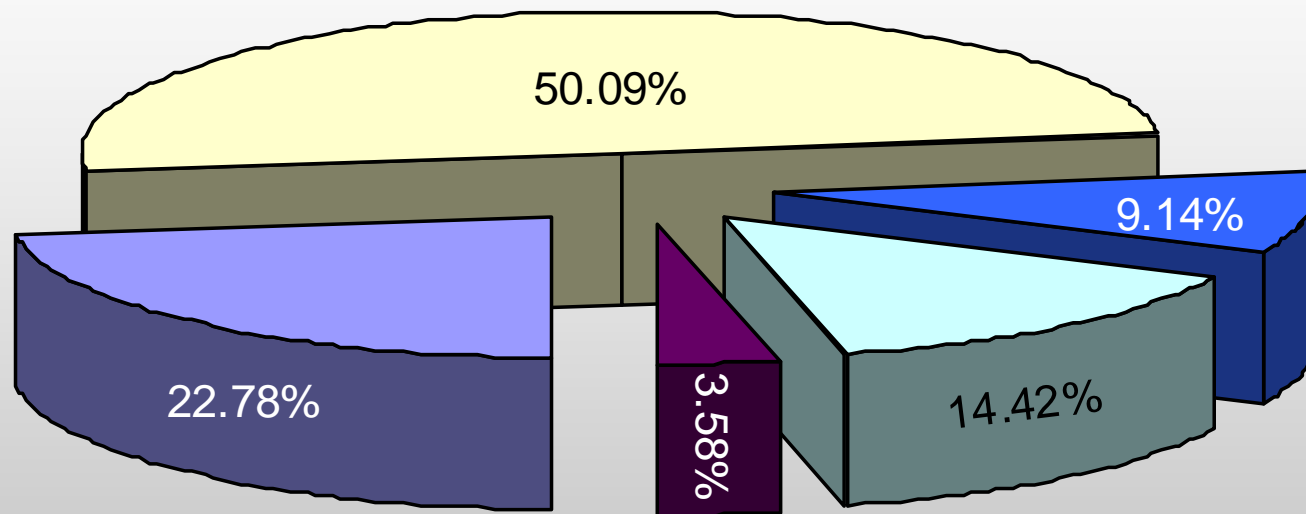
Water Reuse Status in Texas

Reuse Supplies with Implementation of Water Management Strategies



Water Reuse Status in Texas (Cont.)

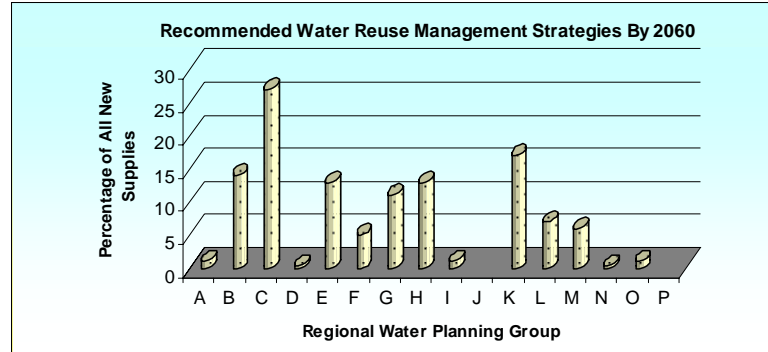
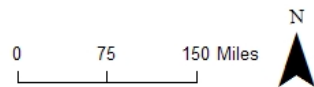
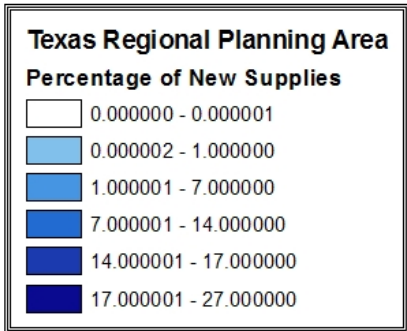
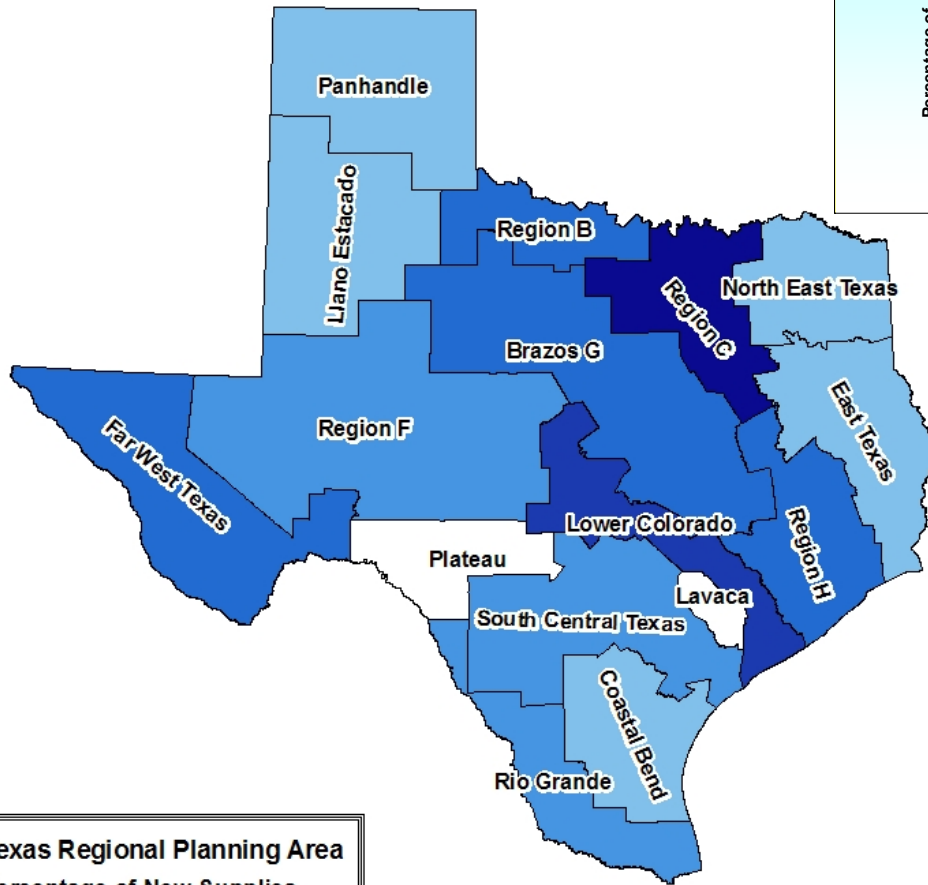
New Water Supplies by 2060 Using Different Water Management Strategies



- Conservation
- Groundwater Management Strategies
- Desalination
- Surface Water Management Strategies
- Water Reuse



Water Reuse Status in Texas (Cont.)



- A: Panhandle
- B: Region B
- C: Region C
- D: North East Texas
- E: Far West Texas
- F: Region F
- G: Brazos G
- H: Region H
- I: East Texas
- J: Plateau
- K: Lower Colorado
- L: South Central Texas
- M: Rio Grande
- N: Coastal Bend
- O: Llano Estacado
- P: Lavaca



Benefits of Water Reuse

- Reuse reduces demands on ground and/or surface water supplies.
- Reuse may postpone costly investment for the development of new water sources and supplies.
- Reuse helps reduce pollutant loading to surface waters.
- Reuse is a drought-proof technology.



Challenges for Implementing Water Reuse in Small Communities



- In many respects, small and large communities face same types of challenges for developing new water supply sources.
- The following factors have sharper impact on smaller communities considering water reuse than on larger communities
 - Availability of wastewater
 - Cost of infrastructures
 - Experienced personnel and operators
 - Financial resources
 - Cost of operation and production



Considerations for Implementing Water Reuse in Small Communities

- Improve communication with federal, state, local agencies, and other stakeholders.
- Develop adequate tools for operating and maintaining small systems appropriately.
- Apply effective policies, procedures, regulations, and standards for proper implementation of water reuse in small communities.



Implementing Water Reuse in Small Communities of Texas

- Regulations
- Water Rights
- Planning
- Treatment Technologies



Regulations and Water Rights

Regulations

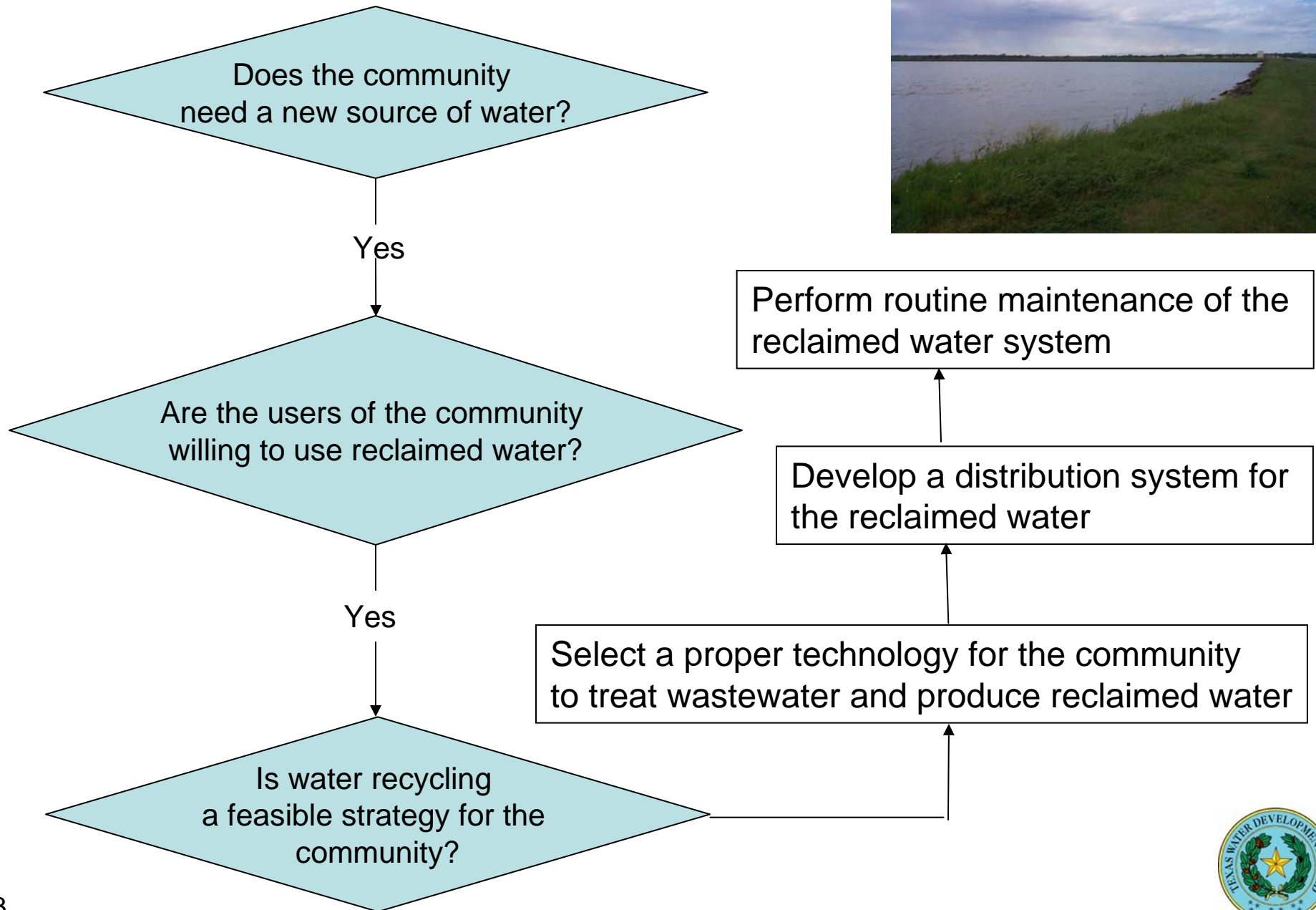
- Applications of reused water is regulated by TCEQ as prescribed in 30 TAC Chapter 210.
- Based on the likelihood that the water would come in contact with humans, Chapter 210 defines 2 types of reused water
 - ❖ Type I reused water - Incidental contact with humans is likely to occur
 - ❖ Type II reused water - Incidental contact with humans is not likely to occur

Water Rights

- A water right allows water to be diverted at one or more particular points and a portion of the water to be used for one or more particular purposes.



Planning



Treatment Technologies



Technology	Advantages	Limitations
Pretreatment technologies (racks, screens, grit chambers, oil/water separators)	Reduce downstream maintenance requirements	Cause potential odor problems and is not suitable for the removal of dissolved solids
Detention and retention basins	Recharge aquifer	Potential problems associated with litter scum, algal blooms, nuisance odors
Constructed wetlands	Reduce downstream scour and loss of aquatic habitat	Require dry-weather base flow to maintain the permanent pool
Sand filters	Applicable for treating runoff from highly impervious drainage areas	May get clogged
Bioretention systems	May contribute to groundwater recharge	May contaminate groundwater
Advanced technologies (air floatation, lime softening, UV, GAC, ion exchange, UF, RO, MBR etc.)	Require less land areas and produce better water quality	More expensive and more complex to operate

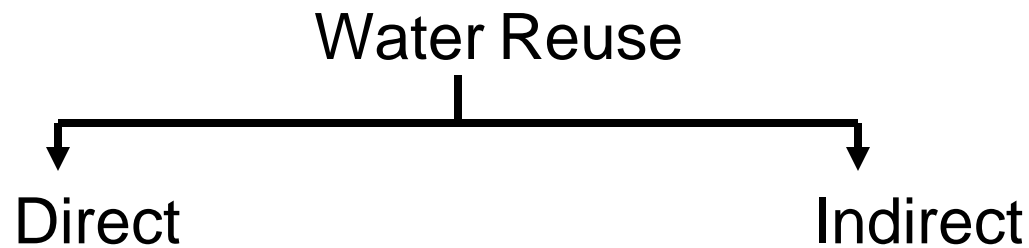


Resources for Implementing Water Reuse in Small Communities

- **Guidelines:**
 - US EPA guidelines for water reuse (2004)
 - Australian guidelines for water recycling: managing health and environmental risks (2009)
- **Manuals:**
 - Manual of practice, how to develop a water reuse program, published by the WaterReuse Association (2009)
 - Recycled water user manual, developed by Los Angeles county Recycled Water Advisory Committee (2005)
 - Reclaimed water for beneficial reuse, published by New Jersey Department of Environmental Protection's Division of Water Quality (2005)
- **Regulation:**
 - Title 30 Texas Administrative Code, Chapter 210
- **Funding:**
 - US Bureau of Reclamation
 - WaterReuse Foundation
 - Water Research Foundation
 - Federal, state, regional, and local grant and loan support



Water Reuse Applications



Direct Reuse is the use of effluent from a wastewater treatment plant that is piped directly from the plant to the place where it is used.

Indirect reuse (also called “bed and banks”) is the use of treated wastewater effluent that is discharged into a water body (lake, river, or stream) and then diverted further downstream to be used again.



Water Reuse Applications (Cont.)

Type	Use	Opportunities	Precautions
Direct Reuse	Irrigation	<ul style="list-style-type: none"> • Production of agricultural crops 	<ul style="list-style-type: none"> • Soil, plant, groundwater, and local environment should be protected from contamination. • The cross-connection between reused water and potable water should be avoided.
	Residential uses	<ul style="list-style-type: none"> • Garden irrigation • Toilet flushing • Home air conditioning • Car washing. 	<ul style="list-style-type: none"> • Quality of water should be ensured. • The cross-connection between reused water and potable water should be avoided.
	Urban and recreational use	<ul style="list-style-type: none"> • Street cleaning • Firefighting • Ornamental impoundments • Decorative fountains. 	<ul style="list-style-type: none"> • Reused water should be free from contamination.
	Aquaculture	<ul style="list-style-type: none"> • Cultivation of aquatic plants and animals. 	<ul style="list-style-type: none"> • Aquatic environment should be protected from adverse effects of toxic substances.
Indirect Reuse	Aquifer recharge	<ul style="list-style-type: none"> • Recharging aquifers 	<ul style="list-style-type: none"> • Indirect reuse reduces flow in the downstream watercourse.
	Surface water augmentation	<ul style="list-style-type: none"> • Augmenting surface water 	<ul style="list-style-type: none"> • Quality of water should be ensured.



Examples of Water Reuse Strategies for Small Communities in Texas

- **City of Bowie** County: Montague

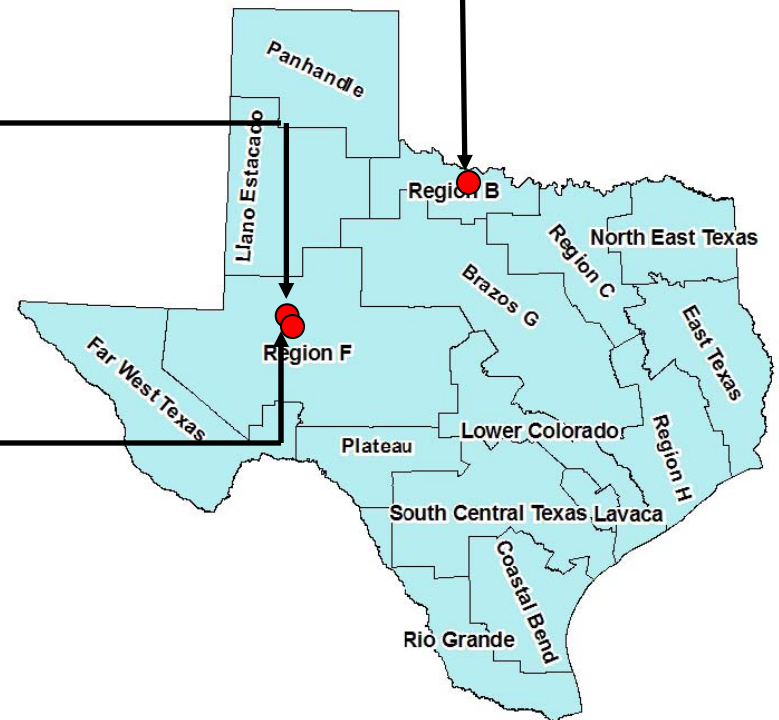
Population in July 2008: 5,580
Wastewater Discharge (2006): 0.6 MGD

- **City of Ballinger** County: Runnels

Population in July 2008: 3,724
Wastewater Discharge (2006): 0.5 MGD

- **City of Winters** County: Runnels

Population in July 2008: 2,569
Wastewater Discharge (2006): 0.5 MGD



Examples of Water Reuse Strategies for Small Communities in Texas (Cont.)

Year	City of Bowie			City of Ballinger			City of Winters		
	Demand (Ac-ft/Yr)	Supply from Water Reuse (Ac-ft/Yr)	Demand Met by Water Reuse (%)	Demand (Ac-ft/Yr)	Supply from Water Reuse (Ac-ft/Yr)	Demand Met by Water Reuse (%)	Demand* (Ac-ft/Yr)	Supply from Water Reuse (Ac-ft/Yr)	Demand Met by Water Reuse (%)
2010	-	-	-	1,142	-	-	720	-	-
2020	-	-	-	1,185	-	-	710	-	-
2030	-	-	-	1,216	-	-	700	-	-
2040	31	31	100	1,249	220	17.6	690	110	15.9
2050	73	73	100	1,285	220	17.1	680	110	16.1
2060	134	134	100	1,329	220	16.6	670	110	16.4

* Although demand for the city is expected to grow over time, outside sales are expected to diminish as rural residents are annexed into the city, sales to Runnels County WSC are shifted to the City of Ballinger, and water conservation reduces per capita demand.



Examples of Water Reuse Strategies for Small Communities in Texas (Cont.)

Cities

City of Bowie

- Recommended water reuse in 2060: 134 Ac-ft/Yr
- Projected capital cost: \$895,000
- Projected annual cost: \$122,000
- Unit cost (\$/Ac-ft): \$911 (before amortization)
\$328 (after amortization)

City of Ballinger

- Recommended water reuse in 2060: 220 Ac-ft/Yr
- Projected capital cost: \$1,980,000
- Projected annual cost: \$219,845
- Unit cost (\$/Ac-ft): \$999 (before amortization)
\$345 (after amortization)

City of Winters

- Recommended water reuse in 2060: 110 Ac-ft/Yr
- Projected capital cost: \$1,660,000
- Projected annual cost: \$198,000
- Unit cost (\$/Ac-ft): \$1800 (before amortization)
\$482 (after amortization)

Strategies Considered & Recommended

- Develop groundwater supplies
- [Water reuse](#)
- [Subordination of downstream Water rights](#)
- [Redistribution from Ivie reservoir](#)
- Redistribution from Lake Brownwood
- Redistribution from CRMWDS
- Desalination
- [Water reuse](#)
- [Water conservation](#)
- Water rights
- Redistribution from Lake Brownwood
- Desalination
- [Water reuse](#)
- [Water conservation](#)
- Drought management



Potential Impacts on the Community and Environment Due to Water Reuse



- Reuse will divert part of the treated effluent currently used for irrigation, which may make less water available for irrigation.
- Water reuse would have a low-to-moderate impact on the receiving stream because of the diversion of a portion of the effluent.
- Cost of reuse may have an adverse impact on the communities' limited financial resources.
- There could be an issue with public acceptance of a water reuse program because of perceived health and safety concerns.



Conclusions

- Water reuse is a proven technology for meeting the increasing water demands.
- Many small communities' wastewater utilities struggle to achieve financial stability, managerial excellence, and technical proficiency.
- Improving communication with state, and local agencies, developing useful tools for management, and implementing effective policies will assist small utilities to develop successful water reuse programs.



Acknowledgements

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Thank You

