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# Everything Is Bigger in Texas, including the Need to Incentivize and Implement Innovative Decentralized Wastewater Treatment Systems as a Method of Water Reuse

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# EVERYTHING IS BIGGER IN TEXAS, INCLUDING THE NEED TO INCENTIVIZE AND IMPLEMENT INNOVATIVE DECENTRALIZED WASTEWATER TREATMENT SYSTEMS AS A METHOD OF WATER REUSE

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*Abstract*

*Texas will need to adapt to a drier climate and reduced water supply in the 21st century as the negative hydrological effects of climate change continue. Rising temperatures will accelerate evaporation of surface water resources, which in turn both increases reliance on depletable groundwater resources and decreases the amount of surface water available for aquifer recharge. As a result, Texans who rely on either groundwater or surface water to meet their domestic water needs—particularly those in rural arid regions—may suffer as both quantities decrease in the coming decades. The practice of domestic water reuse presents one solution to a decreasing water supply by safely treating wastewater and creating a sustainable source of water to irrigate a household's garden or landscape without placing additional demand on existing water supplies. The practice of water reuse is by no means a new development; however, the primary focus has been city-level reuse and not household practices. This Article seeks to bridge the information gap by highlighting and discussing the authorities relevant to domestic water reuse in Texas, including title 30, chapter 210 of the Texas Administrative Code and the water allocation doctrines of prior appropriation and rule of capture. This Article finds those authorities to be favorable to individual water reuse, however, this Article argues for regulatory and statutory amendments that will encourage and incentivize domestic water reuse. Amendments are essential if Texas wishes to make domestic water reuse—and drought-hardy sources of water—accessible to households in rural arid regions of Texas, where water reuse will undoubtedly be of great importance in the coming decades.*

## I. INTRODUCTION

In 2012, the town of Spicewood Beach made headlines as "the first Texas town to run out of water."[1] The headline came shortly after the Texas Commission on Environmental Quality ("TCEQ") projected that Spicewood and twelve other public water systems would run out of the resource necessary to sustain life within the near future.[2] In February of 2013, the groundwater well serving the entire town of Barnhart ran dry.[3] By May 2014, TCEQ listed thirty-

1. Saskia de Melker, *Two Texas Towns Run Out of Water*, PBS NEWS HOUR (Mar. 20, 2012), https://www.pbs.org/newshour/science/science-jan-june12-texaswater_03-20#:~:text=This%20January%2C%20Spicewood%20Beach%20became,day%20to%20supply%20the%20homes [https://perma.cc/52UW-W8CT].

2. Manny Fernandez, *Texas Drought Forces a Town to Sip From a Truck*, N.Y. TIMES (Feb. 3, 2012), https://www.nytimes.com/2012/02/04/us/texas-drought-forces-town-to-haul-in-water-by-truck.html [https://perma.cc/EXG3-D6PN].

3. Kate Galbraith, *West Texas Oilfield Town Runs Out of Water*, THE TEX. TRIBUNE

two public water systems—a total that represented nearly twenty towns—as systems that could run dry within three months.[4] These shortages came in the wake of Texas's drought of record, which began in 2011 and endured through 2015.[5] As the state's temperature and water demand increase in the coming decades, shortages akin to those that started in 2011 may become the new normal across arid regions of the state.[6] It is true that everything is bigger in Texas, particularly the need to permit, incentivize, and implement innovative methods of sustainable water treatment and use to prepare for climate change's worsening effects on Texas's dwindling water supply. A predicted decrease in Texas's supply of water due to an increase in temperature, a decrease in precipitation, and an increased reliance on non-replenishable groundwater withdrawals calls for flexible and practicable solutions to address existing and worsening water scarcity in Texas.[7] The practice of water reuse presents a solution that will become necessary due to impending water shortages in Texas. Water reuse produces beneficially usable water without placing additional demand on the water supply, and is an efficient method of producing water even in times of drought.[8] However, there is a significant lack of published practical guidance on domestic water reuse in Texas.[9] This Article seeks to fill that gap by urging the critical necessity of permitting, incentivizing, and implementing decentralized wastewater treatment systems that produce recycled water so that households in arid and rural regions may have an efficient source of water for irrigation of personal gardens and domestic agriculture without placing additional demands on a dwindling water supply, even in times of drought.

This Article finds Texas's controlling regulations, including title 30 chapter 210 of the Texas Administrative Code and the water allocation doctrines of prior appropriation and rule of capture, to be largely supportive of the practice of water reuse. However, there is always room for improvement. Texas can and should amend portions of each controlling authority so that decentralized wastewater treatment systems and irrigation by means of the recycled water they provide is available to all Texans interested in obtaining a drought-hardy water

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(June 6, 2013), https://www.texastribune.org/2013/06/06/west-texas-oilfield-town-runs-out-water/#:~:text=Barnhart%2C%20a%20small%20community%20about,oil%20drilling%20are%20a%20factor.&text=Barnhart%2C%20a%20small%20community%20in,has%20run%20out%20of%20water [https://perma.cc/X4XS-8VT8].

4. Carrie Taylor, *Nearly 20 Texas Towns Could Run Out of Water in 90 Days*, HOUS. CHRONICLE (May 20, 2014), https://www.chron.com/news/houston-texas/article/Nearly-20-Texas-towns-could-run-out-of-water-in-5492619.php [https://perma.cc/SH3U-QHQA].

5. *Everything You Need to Know About the Texas Drought*, NPR: STATE IMPACT, https://stateimpact.npr.org/texas/tag/drought/#:~:text=2011%20was%20the%20driest%20year,lowering%20river%20and%20lake%20levels [https://perma.cc/7XU7-8UC9].

6. Carlos Rubinstein & Robert E. Mace, *Understanding Texas Weather and Climate and How Climate Change Might Impact Water Resources*, *in* ESSENTIALS OF TEXAS WATER RESOURCES 2.6:1-2 (Mary K. Sahs, ed., 6th ed. 2020).

7. *Id.*

8. Nathan E. Vassar, *Meeting Water Supply Needs: Planning, Permitting, and Implementation*, *in* ESSENTIALS OF TEXAS WATER RESOURCES, *supra* note 6, § 3.14:1.

9. Seth Boettcher, Courtney Gately, Alexandra Lizano, Alexis Long & Alexis Yelvington, WATER RECYCLING TECHNICAL REPORT FOR DIRECT NON-POTABLE USE 1-13, at 6 (Tex. A&M Univ. Sch. of Law Program in Nat. Res. Sys., 2020) https://scholarship.law.tamu.edu/cgi/viewcontent.cgi?article=1008&context=nrs-publications [https://perma.cc/G8H6-G5YC].

supply for irrigation. Part II urges the necessity of decentralized wastewater treatment and water reuse projects by highlighting a predicted decrease in both surface and groundwater supplies as a result of climate change's higher temperatures and increased evaporation. It also calls for the collection of more data on the related issue of wastewater treatment inaccessibility because a lack of wastewater treatment poses both public health and water scarcity concerns, as no one can beneficially reuse untreated wastewater. Part III advocates for water reuse as *the* renewable solution to Texas's water shortages because water reuse provides households with a drought-proof supply of irrigation water and reduces demand on existing water supplies.[10] To illustrate the possibilities of innovative decentralized wastewater treatment systems, Part III examines two decentralized systems for potential use in Texas: a freestanding, solar-powered wastewater treatment system and a gradual hydroponic wastewater treatment system, both designed for producing recycled water suitable for irrigation of domestic agriculture intended for personal use. Part IV introduces the Texas authorities that govern the use of recycled water for irrigation, followed by Part V's analysis of the authorities' compatibility with domestic water reuse for irrigation. While the controlling authorities are largely favorable to domestic water reuse for irrigation, Part V calls for regulatory changes to title 30, chapter 210 of the Texas Administrative Code and to the doctrine of prior appropriation so that domestic water reuse projects may be more accessible. It also urges that information on domestic reuse to be more widely available so as to increase its popularity, demonstrates that interest in funding innovative water reuse projects exists in Texas and should be adapted to decentralized wastewater treatment projects.

## II. TEXAS'S TWIN NEEDS

### A. WHERE IS THE WATER GOING? CLIMATIC EFFECTS ON TEXAS'S WATER SUPPLY

Texas is very familiar with droughts. The state's most recent significant drought occurred between 2011-2015 and caused approximately $8 billion of damage to ranchers and farmers,[11] making it the state's costliest drought.[12] 2011 experienced Texas's worst single year drought in recorded history[13] as it impacted the entire state,[14] caused nearly ninety percent of the state to experience an exceptional drought, and required two years to pass before water supplies returned to pre-drought conditions.[15] The drought particularly affected the rice, corn, and peanut industries.[16]

Almost every region in Texas may face water shortages within the next fifty

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10. Vassar, *supra* note 8.
11. *Everything You Need to Know About the Texas Drought*, *supra* note 5.
12. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 35 (2021).
13. *Id.* at 36.
14. *Id.* at 35.
15. *Id.*; Kartik Venkataraman et al., *21st Century Drought Outlook for Major Climate Divisions of Texas Based on CMIP5 Multimodel Ensemble: Implications for Water Resource Management*, 534 J. Hydrology 300, 300 (2016).
16. *Everything You Need to Know About the Texas Drought*, *supra* note 5.

years, and the shortages will be more severe in arid regions.[17] Climate change, defined as "long-term changes in regional and global climate caused by human activity," has had and will continue to have a significant negative impact on the availability of water.[18] Texans are well-acclimated to dry weather and its *temporary* hydrological shortcomings,[19] but climate change will undoubtedly have significant and damaging effects on available water sources in the state that are unlike those associated with seasonal dry weather and the occasional drought.[20] As the Texas Water Development Board's ("TWDB") newly-released 2022 State Water Plan explains, "[w]armer temperatures, increased evaporation, and increasingly variable precipitation, as experienced in recent years, enhance the risk of extreme drought in Texas" and cast a foreboding shadow upon the availability of water in the state.[21] Doing nothing is not an option; without implementation of critical water management strategies, eighty percent of Texans may see a ten percent water shortage by 2070, and approximately twenty-five percent of Texans may have less than half of the water they need to live and work.[22] Further, TWDB estimates that without the development of additional municipal water supplies, approximately twenty-six percent of Texans will have less than half of the water supply they need by 2070.[23]

With higher temperatures comes increased evaporation, a problem for Texas's surface water sources.[24] One model predicts reservoirs in Central Texas will see an increase of nineteen inches in evaporative loss in the year 2100 as compared to today's evaporative losses.[25] These impacts will particularly affect those in the arid and rural regions of the Rio Grande Basin, lower Rio Grande Valley, and West Texas.[26] For example, climate projections indicate that the Rio Grande Basin may see temperature increases of five-to-six degrees Fahrenheit in this century, which could greatly increase evaporation from surface water sources.[27] Heightened evaporation rates also require the use of more irrigation water to offset evaporative losses in irrigation, placing an increased demand on

17. TEX. WATER DEV. BD., 2017 STATE WATER PLAN 78 (2016).

18. Rubinstein & Mace, *supra* note 6, § 2.1.

19. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 36 (2021) ("[h]istory demonstrates that extended droughts are natural phenomena in Texas.").

20. *See id.* at 43.

21. *Id.*; *see also* Venkataraman et al., *supra* note 15, at 301 (explaining different climate models that predict no increase in precipitation in Texas's 21st century and an increase across the board in temperature); Katherine Hayhoe, *Climate Change Projections for the City of Austin*, ATMOS RESEARCH & CONSUL. 82 (Apr. 2014), https://austintexas.gov/sites/default/files/files/Katherine_Hayhoe_Report_-_April_2014.pdf [https://perma.cc/DN7V-9A47] (showcasing an increase in consecutive dry days per year in Austin, despite predicting no change in aggregate precipitation).

22. *See* TEX. WATER DEV. BD., 2022 STATE WATER PLAN 13 (2021).

23. *Id.* at 86.

24. Rubinstein & Mace, *supra* note 6, § 2.6:2; TEX. WATER DEV. BD., 2017 STATE WATER PLAN 43 (2016).

25. Rubinstein & Mace, *supra* note 6, § 2.6:2.

26. *Id.* § 2.6:1.

27. U.S. DEP'T OF THE INTERIOR & U.S. BUREAU OF RECLAM., BASIN REPORT: RIO GRANDE 1 (2003), https://www.usbr.gov/climate/secure/docs/2016secure/factsheet/RioGrande BasinFactSheet.pdf [hereinafter BASIN REPORT: RIO GRANDE].

an already limited supply of water.[28] As Texas climate scientist Katherine Hayhoe explained in response to the 2011 drought, increased temperatures and evaporation require the application of "more water to provide the same amount of irrigation for crops."[29] Evaporative losses play a crucial role in decreasing water availability, particularly for households in arid regions, and innovative ideas and projects are necessary to combat increased evaporative losses.

In addition to increased evaporative loss in the coming decades, TWDB predicts its demand for water will dramatically increase as the state's population continues to swell.[30] As it stands, municipal use constitutes forty-four percent of surface water use in Texas.[31] TWDB defines "municipal use" broadly to include "water used by . . . single and multi-family residences [and] nonresidential establishments (commercial, institutional, and light industrial)."[32] Under this broad definition, it is difficult to imagine any individual who would not be at least somewhat affected by shortages in the municipal water supply. With predicted population growth, TWDB estimates municipal water demand will see an increase of sixty-three percent by 2070, an alarming figure for Texans aware of a decreasing water supply.[33] Indeed, predictions indicate that demand for municipal water will surpass the demand for irrigation water (currently the category of highest demand) by 2060.[34]

While declines in surface water will be visible to all, long-term droughts brought on by a warming climate will also negatively impact groundwater quantities in a way largely unseen to those without groundwater wells. Groundwater wells withdrawing from thirty-one aquifers located across the state are sources of fresh groundwater in Texas.[35] Aquifers are "geologic formation[s] that contain[] sufficient saturated permeable material to yield significant quantities of water to wells and springs."[36] Simply put, aquifers act as an intricate matrix of rocks, gaps, and sediment that store and move water underground. Recharging aquifers rely on surface water that seeps through permeable geographical structures in the ground and replenishes groundwater quantities.[37] Therefore, reductions in precipitation and surface water reduce a recharging aquifer's ability to

28. de Melker, *supra* note 1.

29. *Id.*

30. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 47 (2021).

31. Keith Phillips & Judy Teng, *Groundwater Markets Slowly Evolve in Ever-Thirstier Texas*, FED. RESERVE BANK OF DALL. (2020), https://www.dallasfed.org/research/swe/2020/swe2001/swe2001c.aspx (2020).

32. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 57 (2021).

33. *Id.* at 53.

34. *See id.*

35. *Texas Aquifers*, TEX. WATER DEV. BD., https://www.twdb.texas.gov/groundwater/aquifer/index.asp.

36. ROBERTO ANAYA ET AL., TEX. WATER DEV. BD., TEXAS AQUIFERS STUDY: GROUNDWATER QUANTITY, QUALITY, FLOW, AND CONTRIBUTIONS TO SURFACE WATER 4 (2016) https://www.twdb.texas.gov/groundwater/docs/studies/TexasAquifersStudy_2016.pdf.

37. Alvar Escriva-Bou et al., *Groundwater Recharge in California*, PUB. POL'Y INST. OF CAL. (Aug. 2021), https://www.ppic.org/publication/groundwater-recharge/#:~:text=Recharge%20occurs%20when%20water%20seeps,of%20crops%20and%20urban%20landscapes.&text=In%20some%20agricultural%20areas%20flood%20irrigation%20is%20the%20primary%20method%20of%20recharge.

maintain the quantities of water necessary for groundwater withdrawal, especially if groundwater withdrawals increase.[38] Due to their dependence on surface water, recharging aquifers—such as the Edwards Aquifer—are particularly susceptible to climate change.[39]

Non-recharging aquifers do not benefit from surface water recharge as they are either occluded by impermeable material or are located in a region that does not see precipitation and, therefore, do not have the opportunity to recharge.[40] As a result, the groundwater found in non-recharging aquifers may be millions of years old.[41] Because non-recharging aquifers do not recharge, some consider them as nonrenewable resources, which makes their conservation all the more important.[42] Indeed, TWDB predicts a thirty-two percent decrease in Texas's groundwater supplies over the next fifty years, due in large part to reduced groundwater availability from the non-recharging Ogallala Aquifer.[43] TWDB also predicts that aquifer depletion will cause an eighteen percent decline in Texas's existing water supplies (identified as those that can be relied upon in drought conditions) by 2070.[44]

As non-recharging aquifers do not rely on surface water to maintain quantity, they are much less hydrologically sensitive to droughts than their recharging counterparts, but that does not mean they are a drought-proof supply of water.[45] As a warming climate reduces the annual precipitation and surface water levels in Texas, many Texans have and will continue to turn to groundwater to compensate for the loss.[46] The 2011 drought's effect on the state's groundwater provides a pertinent example of what may happen as the climate continues to warm, precipitation does not increase, and Texans turn to rely on groundwater.[47] As the drought continued into 2012, homeowners flocked to hire private drill-

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38. Rubinstein & Mace, *supra* note 6, § 2.6:2.

39. *Id.*

40. Gabriel Eckstein & Amy Hardberger, *Scientific, Legal, and Ethical Foundations for Texas Water Law*, *in* ESSENTIALS OF TEXAS WATER RESOURCES, *supra* note 6, § 1.11:1.

41. *Id.*

42. Jean Margat et al., *Concept and Importance of Non-Renewable Resources*, *in* NON-RENEWABLE GROUNDWATER RESOURCES: A GUIDE TO SOCIALLY SUSTAINABLE MANAGEMENT FOR WATER POLICY MAKERS 13, 13 (Stephen Foster & Daniel P. Loucks eds., 2008); Gabriel Eckstein & Yoram Eckstein, *Nonrenewable Aquifers and International Law: Considerations for Managing a Critical Depleting Resource*, NAT'L GROUNDWATER ASS'N (Oct. 14, 2008, 11:00 AM), https://ngwa.confex.com/ngwa/renew08/techprogram/P5506.HTM; Emily Chung, *Most Groundwater is Effectively a Non-Renewable Resource*, CBC NEWS (Nov. 18, 2015), https://www.cbc.ca/news/technology/groundwater-study-1.3318137; *but see* William M. Alley et al., *Sustainability of Ground-Water Resources*, U.S. GEO. SURV., https://pubs.usgs.gov/circ/circ1186/html/intro.html (explaining that groundwater is not a nonrenewable resource, unlike minerals or oil). There is some debate over application of the term "nonrenewable" to non-recharging aquifers because most are indeed capable of recharging, but recharge at a rate that requires many lifetimes to see any measurable increase in quantity. *See* Margat et al., *supra* note 42, at 13. The overwhelming consensus, important for the purpose of this Article, is that sustainable groundwater management and conservation practices are necessary to avoid depletion of both renewable and nonrenewable aquifers.

43. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 7 (2021).

44. *Id.* at 3.

45. Rubinstein & Mace, *supra* note 6, § 2.6:2.

46. BASIN REPORT: RIO GRANDE, *supra* note 27.

47. ANAYA ET AL., *supra* note 36, at 16.

ing companies to install groundwater wells on their properties in hopes of securing their own water source separate from municipal supply.[48] Homeowners in Austin, for example, entered the groundwater frenzy after the city discussed banning the use of municipally-supplied water for lawn watering.[49] As an unsurprising result, every Texas aquifer experienced significant declines in quantity during the years 2010-2015, the years in which the state felt the effects of 2011's drought the most.[50] The potential effects of a warming climate on water supplies in rural, arid regions of Texas can be summarized and demonstrated using the Department of the Interior and the Bureau of Reclamation's Basin Report for the Rio Grande.[51] The agencies suggest that the increased temperatures predicted in the Rio Grande Basin—an area that is already heavily reliant on groundwater for municipal use—may result in a decrease in surface water supply due to evaporation, which may present a dual problem for the Basin's groundwater supply: less groundwater recharge due to declining surface water, and an increase in groundwater pumping to compensate for surface water shortages.[52]

Planning groups for TWDB's 2017 State Water Plan recommended the development of at least some new groundwater wells in order to meet Texas's growing water supply needs.[53] Specifically, the groups found that "[n]ew wells were often the only feasible strategy to meet the water needs of rural municipal water users."[54] The groups also found that in the case of drought, the most feasible emergency response options for small, rural municipalities—those "with a population of 7,500 or less that rely on a sole source of water supply"—include curtailing water rights, obtaining water from other locales, and relying on local groundwater wells.[55] TWDB's 2022 State Water Plan reiterates the feasibility of trucking in water from other locales, relying on local groundwater wells, and curtailment of water rights.[56] Larger communities may be able to front the cost of drilling a new well or improving existing wells to provide water to their residents, as San Angelo and Las Cruces (just across the border in New Mexico) did in response to 2011's drought, but small communities may not be able to afford that investment.[57] It is similarly unlikely that every Texan possesses the means to drill their own groundwater well like the thousands of Austinites did in 2012. A residential well is not cheap, as installation costs range between

48. Kate Galbraith, *A Rush for Water Wells as Texas Drought Drags On*, TEX. TRIBUNE (Feb. 17, 2012, 06:00 AM), https://www.texastribune.org/2012/02/17/texas-drought-sparks-water-well-drilling-frenzy/ [https://perma.cc/V77M-WPT5]; Saskia de Melker, *In Drought-Stricken Texas, Hunt for Water Heads Deeper Underground*, PBS NEWS HOUR (Mar. 20, 2012, 01:47 PM), https://www.pbs.org/newshour/science/in-drought-stricken-texas-hunt-for-water-heads-deeper-underground [https://perma.cc/F8QP-J55D].

49. Galbraith, *supra* note 48.

50. ANAYA ET AL., *supra* note 36 at 16.

51. *See* BASIN REPORT: RIO GRANDE, *supra* note 27.

52. *Id.*

53. TEX. WATER DEV. BD., 2017 STATE WATER PLAN 96 (2016).

54. *Id.*

55. *Id.* at 36.

56. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 40 (2021).

57. Suzanne Goldenberg, *A Texan Tragedy: Ample Oil, No Water*, GUARDIAN (Aug. 11, 2013), https://www.theguardian.com/environment/2013/aug/11/texas-tragedy-ample-oil-no-water [https://perma.cc/6RZX-5J4Y]. As one official from the aforementioned town of Barnhart remarked in response to the town running dry in 2013, "[w]e barely make enough money to pay our light bill and we're supposed to find $300,000 to drill a water well?" *Id.*

$12,000-$30,000.[58] Even if a municipality or homeowner is able to afford the cost of drilling a well, there is no guarantee that the well will continually supply water. As mentioned above, every groundwater well within the vicinity of Spicewood Beach ran completely dry in 2012, leaving its population without water.[59] As a result, the drought forced the Lower Colorado River Authority (the public utility charged with managing Spicewood Beach's groundwater supply)[60] to rely on another emergency response suggested in the 2022 State Water Plan: trucking in water from other locales.[61] However, that backup method cost the Authority up to $800 a day, a formidable daily cost for a community of just over a thousand people.[62]

Between the cost of developing a groundwater well, the uncertainty of whether that well will produce water, and the cost of relying on backup methods, Texans need innovative solutions to ensure they maintain access to an adequate water supply, especially as climate change's hydrological effects become even more severe. This is particularly true in rural areas. For the state of Texas to adequately address a growing future demand for a resource predicted to become even scarcer,[63] it is necessary to promote the planning, permitting, and implementation of innovative water supply projects designed to stretch water quantities as far as possible.

### B. A Related Issue: Accessible Wastewater Treatment

#### 1. Plumbing Poverty & the Need for More Information

The problems and potential solutions discussed in this Article center around a decreasing supply of water for Texans, however, one would be remiss to ignore a related problem: a lack of adequate wastewater treatment. We can view these problems interdependently, as the former describes a lack of water, and the latter describes water that cannot be beneficially reused. After all, "[t]here is no such thing as wastewater . . . just water that is wasted!"[64] This Article suggests innovative systems of water recycling as a potential solution for mitigating water shortages in rural, arid regions of Texas, and that the practice of water recycling converts unusable wastewater into beneficially usable water, which protects both human health and the environment by preventing the

58. Galbraith, *supra* note 48.

59. Terrence Henry, *When Wells Run Dry: Spicewood Beach, Texas is Out of Water*, NPR: StateImpact (Jan. 31, 2012, 06:00 AM), https://stateimpact.npr.org/texas/2012 /01/31/when-wells-run-dry-spicewood-beach-is-out-of-water/ [https://perma.cc/SC56-7HWG].

60. *Enhancing the Lives of Texans*, Lower Colo. River Auth., https://www.lcra.org/about/overview/ [https://perma.cc/T32L-EGWT].

61. Henry, *supra* note 59; Tex. Water Dev. Bd., 2022 State Water Plan 40 (2021).

62. Henry, *supra* note 59. In the year just prior to the town running out of water, water haulers—like those later contracted to bring water to the dry town at a price of $200 per 4,000 gallons—purchased over a million gallons of Spicewood Beach's water at a price of just $32 per 4,000 gallons. Terrence Henry, *Where Did Spicewood Beach's Water Go?*, NPR: StateImpact (Feb. 2, 2012, 04:00 PM), https://stateimpact.npr.org/texas/2012/02/02/where-did-spicewood-beachs-water-go/ [https://perma.cc/9FND-9EFF].

63. Vassar, *supra* note 8, § 3.1.

64. G. Tracy Mehan III, *Coping with Water Scarcity, Risk & Uncertainty: Resilience & Hope*, 1 Tex. A&M J. Prop. L. 1, 5 (2013).

spread of disease and excessive pollution.[65] Given the crucial role wastewater treatment plays in protecting human health and the environment, it is surprising that very little state-wide data is available on how many Texans lack access to wastewater treatment systems at home.[66] The best state-wide data comes from the U.S. Census Bureau and shows that approximately 40,000 Texas households reported a lack of plumbing in 2019.[67] While that number may seem small in a state with a population of almost thirty million people,[68] it shows that there are more people in Texas lacking residential plumbing than people living in the cities of Nacogdoches or Hurst.[69] However, the Census Bureau data is not well-suited for determining wastewater treatment accessibility because it asks whether residents have "complete plumbing facilities," as defined by the Bureau to include "hot and cold running water and [] a bathtub or shower."[70] While the 2019 data is certainly a helpful starting point, its broad questioning on plumbing facilities does not provide specific information on wastewater treatment accessibility.[71]

Given the comprehensive data on the demand, shortages, and forecasts of Texas's water supply provided by TWDB's 2022 State Water Plan, it is interesting–from a water reuse perspective–to note that no similar data compilation exists relating to wastewater treatment. This Section explains how the traditional systems of wastewater treatment-centralized systems in particular-can be inaccessible to many users largely due to cost. Given the cost-prohibitive nature of access to wastewater treatment for users in rural areas unable to achieve economies-of-scale,[72] this Article suggests that a lack of wastewater treatment may exist

65. Andrea G. Capodaglio, *Integrated, Decentralized Wastewater Management for Resource Recovery in Rural and Peri-Urban Areas*, 6 RES. 3 (June 15, 2017), https://doi.org/10.3390/resources6020022.

66. Even on a national scale, household sanitation data has not been gathered in over thirty years. The U.S. Census Bureau spearheaded the last national data collection on household sanitation in 1990. ERIN RIGGS ET AL., UNIV. OF N.C. ENV'T FIN. CTR., AN OVERVIEW OF CLEAN WATER ACCESS CHALLENGES IN THE UNITED STATES 10-11 (Oct. 2017), https://www.urbanwaterslearningnetwork.org/wp-content/uploads/2019/05/UNC-Clean-Water-Access-Challenges2017.pdf [https://perma.cc/3PLJ-MAZ4]. One 2016 study estimated that 600,000 households (representing 1.5 million people) live without complete plumbing facilities and that number is largely comprised of migrant or economically distressed populations. Wendy Jepson & Emily Vandewalle, *Household Water Insecurity in the Global North: A Study of Rural and Periurban Settlements on the Texas-Mexico Border*, 68 PROF. GEO. 66, 66 (2016).

67. U.S. CENSUS BUREAU, 2019: ACS 5-YEAR ESTIMATES DATA PROFILES, https://data.census.gov/cedsci/table?g=0400000US48&tid=ACSDP5Y2019.DP04&hidePreview=true [https://perma.cc/NK7L-8PBB].

68. *Quick Facts, Texas*, U.S. CENSUS BUREAU (Jul. 1, 2021), https://www.census.gov/quickfacts/TX [https://perma.cc/9GX8-79ES].

69. *Quick Facts, Hurst city, Texas; Nacogdoches city, Texas*, U.S. CENSUS BUREAU (Jul. 19, 2019), https://www.census.gov/quickfacts/fact/table/hurstcitytexas,nacogdochescitytexas/PST045219 [https://perma.cc/L5AC-H7AK].

70. AMERICAN COMMUNITY SURVEY AND PUERTO RICO COMMUNITY SURVEY 2019 SUBJECT DEFINITIONS, 28 U.S. CENSUS BUREAU (2019), https://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2019_ACSSubjectDefinitions.pdf [https://perma.cc/P4YM-SMMK].

71. *See id.*

72. ENV'T PROT. AGENCY, RESPONSE TO CONGRESS ON DECENTRALIZED WASTEWATER TREATMENT SYSTEMS 6 (Apr. 1997), https://www.epa.gov/sites/production/files/2015-06/documents/septic_rtc_all.pdf [https://perma.cc/N27F-GA6F] [hereinafter EPA RESPONSE]; "Economies of scale" is defined as "a reduction in the cost of producing something . . . brought about

to some measurable extent across Texas and calls for more data on the subject. More data is necessary to paint a robust picture of how many households across Texas—particularly those in rural arid region—lack adequate wastewater treatment.[73] If state-wide data were made available, Texas would be better prepared to identify wastewater treatment inaccessibility and devote resources to innovative solutions.[74]

While the Census Bureau data remains the only state-wide data and is not specific to wastewater treatment, sizable literature exists on two specific communities in Texas that face systemic infrastructural inequities, including a lack of wastewater treatment: Sandbranch and *Las Colonias*.[75] Sandbranch, an unincorporated and predominantly Black community located just fourteen miles from Dallas,[76] lacks both wastewater treatment and running water.[77] Ironically, the City of Dallas operates a wastewater treatment plant just fifty feet from Sandbranch.[78] Despite its proximity to the plant, the community's location within a floodplain severely limits it from developing its own infrastructure.[79] FEMA regulations for floodplains severely limit what can be built and greatly increase the cost of planning and developing infrastructure, leaving the residents of Sandbranch without access to wastewater treatment.[80]

*Las Colonias* is a collection of rural communities located mostly along the Texas-Mexico border plagued by a combination of infrastructural inequities such as a lack of potable water, electricity, paved roads, and adequate septic or

especially by increased size of production facilities" and is primarily used in plural form. *Economy of scale*, MERRIAM-WEBSTER ONLINE, https://www.merriam-webster.com/dictionary/economy%20of%20scale [https://perma.cc/9VPL-U2CT]; *see infra* Section II.B.2.

73. The Author recognizes the possibility that the requested data, if available, would show that a lack of wastewater treatment is not a problem across Texas. Until such data is made available, a precautionary approach to the issue should be employed given the extreme public health risks associated with untreated wastewater.

74. For those without access, some useful data points may include how many households currently lack wastewater treatment, the location of those households, how and where households lacking treatment dispose of wastewater, and the factors (cost, access, location, etc.) contributing to why a household lacks treatment, among others. Useful data points for households with decentralized systems may include type of decentralized system in use, cost of system installation and upkeep, satisfaction with the system's operation, upkeep, and cost requirements, and frequency and severity of system failures (if any), among others. For households connected to a centralized system, the points could include cost of connection and satisfaction with service and cost, among others.

75. ALA. CTR. FOR RURAL ENTER., COLUM. L. SCH. HUM. RTS. CLINIC, & INST. FOR THE STUD. OF HUM. RTS., FLUSHED AND FORGOTTEN: SANITATION AND WASTEWATER IN RURAL COMMUNITIES IN THE UNITED STATES 24 (May 2019), http://www.humanrightscolumbia.org/sites/default/files/Flushed%20and%20Forgotten%20-%20FINAL%20(1).pdf [https://perma.cc/E5TL-S3VM] [hereinafter FLUSHED AND FORGOTTEN].

76. Kirsten West Savali, *Sandbranch, Texas: A Small Community Denied Water for Over 30 Years Fights Back*, THE ROOT (Dec. 14, 2016, 11:49 AM), https://www.theroot.com/sandbranch-texas-a-small-community-denied-water-for-o-1790858153 [https://perma.cc/ZJ7K-7ZGS].

77. FLUSHED AND FORGOTTEN, *supra* note 75. Sandbranch had access to usable groundwater until severe groundwater contamination made it unusable in the 1980s. *Id.*

78. West Savali, *supra* note 76.

79. Naomi Martin, *Sandbranch Doesn't Need Dallas County to Fund Water Lines, Lawyer Says, But Obstacles Remain*, DALL. MORNING NEWS (Apr. 27, 2016, 02:18 PM), https://www.dallasnews.com/news/2016/04/27/sandbranch-doesn-t-need-dallas-county-to-fund-water-lines-lawyer-says-but-obstacles-remain/ [https://perma.cc/R8E2-BMKW].

80. *Id.*

sewer systems.[81] A 2014 study by the Federal Reserve Bank of Dallas found that 337 *Colonias* lacked access to wastewater treatment.[82] On an individual scale, the Rural Community Assistance Partnership estimates that approximately 106,000 people within the border region lacked access to adequate wastewater treatment in 2015.[83] A lack of adequate wastewater treatment combined with the area's topographical exposure to flooding has caused communicable diseases including tuberculosis, hepatitis, and cholera to flourish as untreated sewage contaminates the supply of drinking water.[84]

Infrastructural shortcomings within both Sandbranch and *Las Colonias* have left residents in "plumbing poverty," a term recently developed to "examine the intersectional nature of infrastructure, space, and social inequality" in water security analyses.[85] The authors of the term recognized a significant problem associated with current data regarding plumbing insecurity: aggregate numbers, such as those put forth by the Census Bureau,[86] fail to identify the location and identities of the "plumbing poor."[87] The authors note that without proper in-depth data, plumbing poverty will continue to be invisible simply because it is not identified.[88] More data is necessary to adequately gauge the breadth of plumbing poverty in Texas.[89] Adequate data on plumbing poverty is crucial to address and remove barriers to wastewater treatment and should be a priority given the important sanitary function wastewater treatment serves in society. Such data is important to preventing water shortages in Texas, as it would identify areas that may stand the most to gain from implementing innovative reuse projects by converting otherwise unusable wastewater into beneficially usable recycled water.

### 2. Decentralized Wastewater Treatment: The Way to Go

There are two primary systems of wastewater treatment: centralized and decentralized. This Article uses the terms "decentralized" and "individualized" interchangeably, as the two terms encompass the mutual theme of treating sewage closer to the source of wastewater production, namely, individual homes.[90]

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81. FED. RES. BANK OF DALL., LAS COLONIAS IN THE 21ST CENTURY: PROGRESS ALONG THE TEXAS-MEXICO BORDER 1 (Apr. 2014), https://www.dallasfed.org/~ /media/documents/cd/pubs/lascolonias.pdf [https://perma.cc/9WN3-HEG2].

82. *Id.* at 4.

83. RURAL CMTY. ASSISTANCE P'SHIP, U.S.-MEXICO BORDER NEEDS ASSESSMENT AND SUPPORT PROJECT: PHASE II ASSESSMENT REPORT 17 (Jul. 30, 2015), https://www.rcap.org/wp-content/uploads/2016/03/RCAP_Colonias-Phase-II-Assessment-Report_FINAL_web.pdf [https://perma.cc/YDG4-BVLT].

84. Tom I. Romero, II, *Bridging the Confluence of Water and Immigration Law*, 48 TEX. TECH. L. REV. 799, 811-12 (2016).

85. Shiloh Deitz & Katie Meehan, *Plumbing Poverty: Mapping Hot Spots of Racial and Geographic Inequality in U.S. Household Water Insecurity*, 109 ANNALS OF THE AM. ASS'N OF GEOG. 1092, 1094 (2019).

86. U.S. CENSUS BUREAU, 2019: ACS 5-YEAR ESTIMATES DATA PROFILES, https://data.census.gov/cedsci/table?g=0400000US48&tid=ACSDP5Y2019.DP04&hidePreview=true [https://perma.cc/NK7L-8PBB].

87. *See* Dietz & Meehan, *supra* note 85, at 1093.

88. *See id.*

89. *See id.* at 1094.

90. *Learn About Small Wastewater Systems*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/small-and-rural-wastewater-systems/learn-about-small-wastewater-systems

In contrast, centralized systems collect and treat wastewater from homes, businesses, and industries within a certain proximity in one single treatment plant.[91] Centralized plants treat approximately seventy-five percent of America's wastewater.[92]

Decentralized systems can be more practical for households not in proximity to a centralized system.[93] From an economic standpoint, decentralized systems may be more cost effective because they do not require the vast infrastructure of centralized systems and a homeowner can install them directly.[94] Engineers estimate that decentralized systems can reduce the cost of collecting and treating wastewater by as much as sixty percent.[95] The EPA has recognized that decentralized systems may be the most cost-effective option for rural areas, hilly terrain where homes are spread out, and other areas with low population densities.[96] This is because the significant costs associated with constructing centralized systems are often not feasible in areas with low population densities because there are few users to support infrastructural costs.[97] Centralized systems require numerous pipes and energy to carry wastewater from a household to a centralized treatment plant,[98] which can be cost-prohibitive in areas with low population densities as scattered populations likely cannot achieve cost discounts through economies of scale.[99] Indeed, the remote location of communities within *Las Colonias* "greatly increase[s] the per capita cost to extend water lines and build water treatment plants, making these basic necessities prohibitively expensive."[100] As discussed above, more data would illustrate how many communities in Texas face similar problems. In addition to the cost savings of decentralized systems, the systems are also less vulnerable to disruptions caused by inclement weather or system-wide mechanical problems because disruptions to decentralized systems are limited to the systems in a particular area, as compared to a disruption in a centralized system which could temporarily eliminate wastewater treatment for an entire municipality.[101]

Decentralized wastewater treatment systems are relatively common in

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[https://perma.cc/BC4B-MUP6].

91. *Id.*

92. *Id.*

93. *See id.*

94. Susan Parten, *Preferred Wastewater Systems for the Texas Hill Country and Over the Edwards Aquifer*, MEADOWS CTR. FOR WATER & THE ENV'T 9 (March 2019), https://gato-docs.its.txstate.edu/jcr:7cd99555-9be7-43cf-9e41-d522245a4325 [https://perma.cc/FUP4-QRCQ]; *Basics for Septic Systems*, TEX. COMM'N ON ENV'T QUALITY (May 5, 2021), https://www.tceq.texas.gov/assistance/water/fyiossfs.html.

95. Andrea G. Capodaglio, *Integrated, Decentralized Wastewater Management for Resource Recovery in Rural and Peri-Urban Areas*, 6 RES. 15-16 (June 15, 2017), https://doi.org/10.3390/resources6020022.

96. EPA RESPONSE, *supra* note 72, at 6.

97. *See id.*

98. Capodaglio, *supra* note 95, at 4.

99. EPA RESPONSE, *supra* note 72, at 6.

100. HOUSING ASSISTANCE COUNCIL, HOUSING IN THE BORDER COLONIAS: RURAL RESEARCH REPORT 8 (Aug. 2013), http://www.ruralhome.org/storage /documents/rpts_pubs/ts10_border_colonias.pdf [https://perma.cc/ZBP9-CNJM].

101. *Id.*

Texas, as twenty percent of new homes built within the state utilize decentralized systems.[102] This is largely due to an increase in housing development in suburban and rural regions of Texas, where municipal sewage systems are not accessible.[103] The most common decentralized systems feature a septic tank and use gravity to disperse septic effluent into the ground.[104] Once the effluent has been clarified (a process that removes solid matter), as many as fourteen methods exist for final dispersal into the environment.[105] With so many variables involved in determining the most appropriate decentralized system for a home, it's clear that there is no "one size fits all" system within existing wastewater treatment systems in Texas.

While decentralized systems are already in use in many Texas homes, the characteristics of standard decentralized systems present challenges that limit their feasibility for some Texans. The systems may be cost-prohibitive to install, not suited to the particular region and/or soil condition, or require too much in maintenance labor and cost to be a plausible option.[106] These barriers to wastewater treatment pose major public health problems because a lack of wastewater treatment infrastructure can cause harmful contact between humans and septic waste.[107] Septic wastewater can contain nitrates, phosphorus compounds, bacteria, and viruses, all of which are damaging to human health at certain quantities, which makes the need for adequate wastewater treatment a public health issue.[108] Because the effects of inadequate wastewater treatment are severe, data collection on wastewater treatment inaccessibility is necessary so as to shed light on the problem and create a pathway for innovative solutions.

## III. DOMESTIC WATER REUSE: THE SUSTAINABLE SOLUTION

Texas will need innovative water sources as climate change's ecological effects continue, water scarcity continues to grow, and wastewater treatment inaccessibility persists. These problems will require the state to adapt and implement creative and sustainable solutions to provide an adequate supply of beneficially usable domestic effluent. A worthwhile solution can be found in the practice of water reuse, which produces reclaimed water. The Texas Administrative Code defines reclaimed water as "[d]omestic or municipal

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102. *Basics for Septic Systems,* TEX. COMM'N ON ENV'T QUALITY, https://www.tceq.texas.gov/assistance/water/fyiossfs.html [https://perma.cc/G2EV-6RAV].

103. *See id.*

104. *Onsite Wastewater Treatment Systems (OWTS),* TEX. A&M AGRILIFE EXTENSION, https://ossf.tamu.edu/onsite-wastewater-treatment-systems-owts/ [https://perma.cc/MP9E-NCAX].

105. *Final Treatment and Dispersal,* TEX. A&M AGRILIFE EXTENSION, https://ossf.tamu.edu/final-treatment-and-disposal [https://perma.cc/8LUG-SXNY].

106. For example, most treatment units must be specifically designed by a professional engineer and installed by a professional installer. *Choosing a Septic System,* TEX. COMM'N ON ENV'T QUALITY (Aug. 2, 2021), https://www.tceq.texas.gov/permitting/ossf/ossfsystems.html [https://perma.cc/B6S8-PCA4].

107. *See Wastewater Treatment Water Use,* U.S. GEO. SURVEY (June 18, 2018), https://www.usgs.gov/special-topic/water-science-school/science/wastewater-treatment-water-use?qt-science_center_objects=0#qt-science_center_objects [https://perma.cc/WV8P-58B6].

108. *See* ENV'T PROT. AGENCY, ONSITE WASTEWATER TREATMENT SYSTEMS MANUAL 1-1 (Feb. 2002), https://www.epa.gov/sites/production/files/2015-06/documents/2004_07_07_septics_septic_2002_osdm_all.pdf.

wastewater which has been treated to a quality suitable for a beneficial use."[109] Water reuse is viewed as "a drought-proof supply"[110] because it places no additional demand on water sources. Therefore, implementing a system which takes untreated wastewater and produces reclaimed water could assist a household facing water scarcity by providing water for domestic agricultural use without placing additional demand on a dwindling water supply. As it stands, water reuse for agricultural purposes accounts for thirty-two percent of the worldwide use of reused water.[111] Further, solid waste produced by domestic households can be used for liquid or dry fertilizer, soil improvement, and even biogas.[112] It is no surprise, then, that the United Nations sees wastewater reuse as an "untapped resource" full of possibility and creative solutions to existing problems around the world.[113] Now is the perfect time to make that resource available to Texas households.

### A. WATER REUSE: NOTHING NEW

Reuse for irrigation is not new to Texas. The practice of planned water reuse began in Texas in the late 1800s.[114] Areas around San Antonio, Amarillo, Lubbock, Odessa, and Abilene reused water to irrigate farms and ranches.[115] In fact, San Antonio currently possesses the "largest urban direct reuse distribution system" in the country.[116] In 2020, water reuse in Texas provided 620,000 acre-feet of water per year (four percent of total supplies) and is expected to increase by fifteen percent over the next fifty years.[117] San Antonio utilizes treated wastewater for the irrigation of golf courses and parks as a cost-effective and environmentally conscious solution to water scarcity in the region.[118] The city's system has the capability to provide 25,000 acre-feet of treated wastewater per year, decreasing demand for that quantity from the Edwards Aquifer and preserves the Aquifer's water for potable uses.[119] Similarly, El Paso utilizes up to six million gallons a day (roughly 6,700 acre-feet per year) of treated wastewater for irrigation of crops, landscapes, and golf courses, thereby preserving aquifer and river water.[120] El Paso also treats its wastewater to potable standards so the

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109. 30 TEX. ADMIN. CODE § 210.3(24) (1997) (Tex. Comm'n on Env't Quality, Definitions).

110. Vassar, *supra* note 8.

111. U.N. WATER, *World Water Development Report 2017, Wastewater: The Untapped Resource* 126 (2017), https://reliefweb.int/sites/reliefweb.int/files/resources/247153e.pdf.

112. *Id.* at 22, 129–30.

113. *Id.*

114. TEX. WATER DEV. BD., DIRECT POTABLE REUSE RESOURCE DOCUMENT 1-1 (Apr. 2015), https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1248321508_Vol1.pdf.

115. Tom Gooch et al., *Water Reuse, in* ESSENTIALS OF TEXAS WATER RESOURCES, *supra* note 6, § 24.5.

116. *Id.* § 24.28.

117. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 77–78, 151 (2021) (an acre-foot is a volumetric unit of measurement representing the quantity of water necessary to fill an acre of land one foot deep with water).

118. *Irrigational & Industrial Recycled Water: An Environmentally Responsible, Cost-Effective Solution*, SAN ANTONIO WATER SYSTEM, https://www.saws.org/your-water/new-water-sources/current-water-supply-projects/recycled-water/ [https://perma.cc/8ZEX-6P4L].

119. *Id.*

120. *Wastewater*, EL PASO WATER, https://www.epwater.org/our_water/wastewater [https://perma.cc/8D3V-ENAN].

city can use it for aquifer recharge, further protecting its naturally-occurring resources.[121] Going even further, some Texas cities treat wastewater for direct potable reuse, an option that became a necessity following the state's worst recorded drought in 2011.[122] These examples demonstrate that municipal wastewater recycling has become popular in Texas as water scarcity increases and the need to preserve existing water sources becomes more apparent.

Water reuse in Texas is becoming more and more important as water quantities decline and water scarcity increases. First, wastewater reuse can be more economical; it can be implemented close to a consumer, which eliminates the need for water transfers of distant supplies.[123] Further, reclaimed water sources have been shown to withstand significant droughts because additional water is not necessary, making them "less variable than other surface water sources."[124] Additionally, wastewater treatment standards have become more stringent in the last fifty years.[125] Most importantly, reclaimed water use lowers demand on Texas's traditional water sources—surface water and groundwater—thereby conserving them for future use.[126]

The benefits of wastewater recycling on resource conservation are not limited to municipalities; on an individual level, the practice of recycling wastewater is a strategy that could decrease the increasing water scarcity for households in Texas.[127] By reusing water, households could stretch their existing water supply, which could reduce household allocation choices such as choosing between drinking water and irrigation or irrigation and domestic uses. This Article focuses on water reuse for small scale domestic agriculture use and not domestic or potable uses, though all three uses can benefit from water reuse by potentially decreasing difficult water allocation decisions.[128] This is because potable water may not have to be rationed as harshly to allocate agricultural water if an existing supply of small-scale agricultural water is made available as a result of water reuse.[129] Further, water reuse for domestic agriculture makes logical sense for water scarce regions considering irrigation water need not meet the more stringent regulatory standards of potable water, and crops may benefit from compounds commonly removed from potable water.[130]

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121. *Id.*

122. Mike Lee, *Parched Texas Town Turns to Treated Sewage as Emergency Drinking Water Source*, CLIMATEWIRE (July 11, 2014), https://www.scientificamerican.com /article/parched-texas-town-turns-to-treated-sewage-as-emergency-drinking-water-source/ [https://perma.cc/B72S-KXBH]; Kristen Cabrera, *From Toilet to Tap: How Big Spring Fights the Effects of Drought*, TEXAS STANDARD (Dec. 11, 2018), https://www.texasstandard.org/stories/how-big-spring-fights-the-effects-of-drought-with-its-toilet-to-tap-water-system/ [https://perma.cc/YC5U-JNJE].

123. *See* Gooch et al., *supra* note 115, § 24.4.

124. *Id.*

125. *Id.*

126. *Reuse Frequently Asked Questions*, TEX. WATER DEV. BD., https://www.twdb.texas.gov/innovativewater/reuse/faq.asp [https://perma.cc/Q9C8-TDXD].

127. *Id.*

128. *Id.*

129. *See* 30 TEX. ADMIN. CODE ANN. § 210.3(1) (1997) (Tex. Comm'n on Env't Quality, Definitions) (beneficial uses of reclaimed water includes those uses "which take[] the place of potable and/or raw water that could otherwise be needed from another source").

130. Othman A. Al-Mashaqbeh et al., *Grey Water Reuse for Agricultural Purposes in the Jordan Valley: Household Survey Results in Deir Alla*, 4 WATER 580, 587 (2012).

### B. PROPOSED SYSTEMS

Decentralized wastewater treatment systems can provide a sustainable method of securing irrigation water for Texas households in the coming decades.[131] The concept of sustainability "aims at maintaining economic wellbeing, protection of the environment, prudent use of natural resources, and equitable social progress."[132] It follows that the determination of whether a given system is sustainable has traditionally been a consideration of economic feasibility, environmental protection, social acceptance, and consistency.[133] Decentralized systems increase sustainability and reduce waste by emphasizing water reuse.[134] A variety of sustainable, individualized wastewater treatment systems designed for providing reuse water for agricultural purposes exist in the world today. This Article proposes two decentralized systems for potential use in Texas: a solar powered, self-operating wastewater treatment system and a gravity-flow hydroponic system. This Section gives an overview of these systems and explains why they are particularly well-suited for use in rural arid regions of Texas. This Section and the regulatory analysis that follows opens the door to discussing, analyzing, and implementing innovative reuse systems in Texas and encourages further discovery and development of individual wastewater treatment systems for agricultural reuse.

#### 1. Solar Powered, Self-Operating Wastewater Treatment System

Clive Lipchin, of the Arava Institute for Environmental Studies in Israel, set out on a mission to reduce the rate at which raw sewage kills individuals and communities who lack access to adequate wastewater treatment.[135] According to the United Nations Programme on the Environment, untreated water kills 1.7 million people globally each year, largely due to fecal contamination.[136] In an effort to reduce this number, Lipchin developed a freestanding, solar powered, remotely operated wastewater treatment system designed for use by individual households.[137] The system is remotely monitored by engineers via a cell phone app.[138] The system receives wastewater, primarily sewage, from the house and moves it through the system as microorganisms remove contaminants and pollutants.[139] The end result is reuse water that has been treated to a quality suitable for agricultural use.[140] Lipchin and the Arava Institute recently implemented a pilot system in Umm Batin, a Beduoin village in Israel that lacks infrastructure for treating wastewater and faces chronic water shortages due to an

131. *See* Capodaglio, *supra* note 95, at 2.

132. *Id.* at 6.

133. *Id.* at 3.

134. *See id.* at 15.

135. Sue Surkes, *First Off-Grid Wastewater Treatment Unit in Bedouin Village Piloted,* TIMES OF ISRAEL (June 1 2020, 10:24 AM), https://www.timesofisrael.com/first-off-grid-wastewater-treatment-unit-in-bedouin-village-piloted/ [https://perma.cc/QRB3-KZSV].

136. *Better Sewage Treatment Critical for Human Health and Ecosystems,* UNEP, (Apr. 5, 2019), https://www.unenvironment.org/news-and-stories/story/better-sewage-treatment-critical-human-health-and-ecosystems [https://perma.cc/N49V-N778].

137. Surkes, *supra* note 135.

138. *Id.*

139. *Id.*

140. *Id.*

arid climate.[141] Lipchin's goal is to implement the system in small, arid communities worldwide, considering up to seventy percent of the world does not treat their wastewater and lack of wastewater treatment infrastructure is not a problem unique to the Middle East.[142]

Lipchin's system could prove very useful to Texas's rural arid regions. While the hot, sunny climate is a major contributor to Texas's water scarcity, the intense sun exposure could be put to good use by powering Lipchin's solar-powered system. Further, this system would be of great value for rural locales, as one can monitor the system via a cell-phone app and, therefore, does not require maintenance personnel to live in the immediate area. Most importantly, the system would provide a source of agricultural water without placing additional demand on a waning water supply.

### 2. Gradual Hydroponic Wastewater Treatment System

Researchers from An-Najah National University in Nablus, Palestine performed an evaluative study of a "gradual vertical flow" hydroponic wastewater treatment system, ultimately determining whether such systems would provide an effective method of wastewater treatment for use in Palestine's rural areas.[143] Their system consists of an elevated wastewater tank that supplies untreated wastewater to a descending line of five separate holding barrels "used as a growth cell[s] for the different plants used in the treatment."[144] Each barrel contains three layers of sediment: a base layer of large gravel, an intermediate layer of course aggregates, and a top layer of aggregates mixed with sand.[145] The system is designed to maximize porosity in the barrels, as porosity increases aeration and enhances quality.[146] Porosity also prevents clogging and safely increases the quantity of wastewater each barrel can hold.[147] Each line of growth cells contains a specific plant type so scientists can monitor plant growth as the system treats the water by sending it down the row of barrels.[148] The plants chosen were corn brooms, barley, alfalfa, sweet corn, and sunflower.[149] Wastewater in this system flows through each barrel and produces recycled water in just six days.[150]

This system is advantageous for many reasons. First, its gravitational design

141. Brian Blum, *Bedouin Village Tests New Solar-Powered Wastewater Treatment System*, ISRAEL 21C (July 28, 2020, 8:03 AM), https://www.israel21c.org/bedouin-village-tests-new-solar-powered-wastewater-treatment-system/ [https://perma.cc/W6FC-WMFA].

142. *Id.*

143. Marwan Haddad et al., *Evaluation of Gradual Hydroponic System for Decentralized Wastewater Treatment and Reuse in Rural Areas of Palestine*, 5 INT. J. AGRC. & BIOL. ENG. 47, 48 (2012), https://ijabe.org/index.php/ijabe/article/view/682/530.

144. *Id.*

145. *Id.* at 49.

146. *Id.*

147. *Id.*

148. *Id.* at 48.

149. Haddad et al., *supra* note 143, at 50.

150. *Id.* at 50. The recycled water contains between 94.0-96.9% less biological oxygen demand ("BOD") than upon entrance, with BOD levels ranging from 8 mg/l (sunflowers) to 12 mg/l (barley). *Id.* at 51. In this study, BOD removal was not dependent on the type of plants grown because plant roots do not produce oxygen, *supra*, but removal of other effluents such as total suspended solids ("TSS"), total nitrogen ("TN") and chloride may be dependent on plant growth and root size. *Id.*

does not require outside energy to pump water through the system, which reduces energy costs and increases energy efficiency.[151] Its gravitational design also makes it an ideal candidate for decentralized wastewater treatment in hilly areas.[152] Lastly, the system requires minimal investment, as it utilizes barrels, gravel, sand, substrate and crops as equipment.[153] A pump is only required to carry untreated wastewater from the home to the first level of treatment, elevated to fifteen meters.[154]

As demonstrated by the existence of these two systems, innovative systems of wastewater treatment that produce recycled water exist. These teams designed these systems to address water shortages in rural and arid regions like Texas. Texans should consider these systems as innovative pathways to the future of water security and wastewater treatment in Texas.

## IV. CONTROLLING REGULATIONS

TCEQ is charged with regulating water quality and reuse in Texas,[155] and does not require permits for individual reuse operations.[156] There are no national regulations on the reuse of water.[157] Chapters 210 and 297 within title 30 of the Texas Administrative Code govern the use of reclaimed water for irrigation[158] and water rights,[159] respectively. The Texas Administrative Code "is a compilation of all state agency rules in Texas,"[160] and its chapters 210 and 297 contain rules promulgated by TCEQ.[161] In contrast, the Texas Water Code is statutorily promulgated by the Texas Legislature and its relevant portions include chapter 11, which governs water rights, and chapter 26, which governs water quality.[162] As explained in this Section and the regulatory analysis that follows, all four sources of law contain regulations that apply to the use of the

151. *Id.* at 48-49.

152. *Id.* at 52.

153. Haddad et al., *supra* note 143, at 48-49.

154. *Id.* at 48.

155. Nathan S. Bracken, *Water Reuse in the West: State Programs and Institutional Issues: A Report Compiled by the Western States Water Council*, 18 HASTINGS W.N.W.J. ENV'T L. & POL'Y 451, 509 (2012). The exception to TCEQ's authority on water reuse is reuse in the oil and gas industry, but that is not relevant here.

156. TEX. WATER CODE § 26.0271(a). The Water Code makes a distinction between municipal and individual reuse projects; municipal wastewater treatment facilities serving over one million people must obtain a permit from TCEQ prior to producing reclaimed water. *Id.*

157. Karlene Martorana, *The Price of Reclaimed Water–Too Much to Stomach?*, 26 NAT. RESOURCES & ENV'T 37, 37 (2012). The Clean Water Act does regulate direct reuse (explained *infra*) because direct reuse discharges recycled water directly into watercourses. *Id.*

158. 30 TEX. ADMIN. CODE § 210.2(a) (1997) (Tex. Comm'n on Env't Quality, Purpose and Scope). Chapter 285 of the same title provides the regulatory requirements of decentralized wastewater treatment systems and is an important addition to determining whether a household can implement a system proposed in this Article. *Supra* § 285.1(a-b) (2001) (Tex. Comm'n on Env't Quality, Purpose and Applicability). Chapter 285 is comprised mostly of scientific and technical requirements that are beyond the scope of this paper.

159. *See generally id.* § 297 (titled "Water Rights, Substantive").

160. *Welcome to the Texas Administrative Code*, TEX. SEC. OF STATE, https://www.sos.state.tx.us/tac/index.shtml [https://perma.cc/L7RA-T72R].

161. *See* 30 TEX. ADMIN CODE §§ 210.2, 297.1 (2021).

162. *See* TEX. WATER CODE §§ 11.002 (West 2017), 26.003 (West 2001).

proposed systems.[163]

### A. DEFINITIONS AND DISTINCTIONS IN TEXAS WATER REUSE

Texas defines domestic wastewater as "[w]aste and wastewater from humans or household operations that are discharged to a wastewater collection system or otherwise enters a treatment works."[164] Texas defines reclaimed water as "[d]omestic or municipal wastewater which has been treated to a quality suitable for a beneficial use, pursuant to the provisions of this chapter and other applicable rules and permits."[165] The terms "reclaimed water," "recycled water," and "water reuse" are all used interchangeably by Texas's applicable authorities and regulations.[166] As such, this Article will utilize the nomenclature used by the referenced statutory authority.

There are two types of reuse. Direct reuse describes wastewater that is treated and subsequently flows from the treatment system to another use.[167] Indirect reuse refers to treated wastewater that is discharged to a water course and diverted downstream for use.[168] Because indirect reuse is discharged to watercourses within the state, it must meet more stringent quality standards than direct reuse.[169] Further, the state makes a distinction between potable reuse and nonpotable reuse.[170] This creates four types of reuse classifications: (1) indirect nonpotable reuse, where treated wastewater is discharged to a watercourse for later diversion;[171] (2) indirect potable reuse, in which treated wastewater is discharged to a watercourse that is then diverted for treatment to meet drinking water standards;[172] (3) direct nonpotable reuse, which is treated wastewater that is directly applied to an approved nonpotable use;[173] and (4) direct potable reuse, where wastewater is treated to meet drinking water standards and then used for drinking water without diversion into a watercourse.[174] Because water used for irrigation is not directly consumed by humans, irrigation water is often nonpotable.[175] The treatment systems described in this Article use treated wastewater for direct irrigation of crops without entry into a watercourse, and therefore fall under the umbrella of direct nonpotable reuse.[176]

Direct nonpotable reuse is classified as either Type I or Type II. Type I uses include those "where contact between humans and the reclaimed water is likely."[177] Uses under this classification include irrigation of food crops that may

163. *See* 30 TEX. ADMIN. CODE §§ 210.2, 297.1 (2021); *see* TEX. WATER CODE §§ 11.002 (West 2017), 26.003 (West 2001).
164. 30 TEX. ADMIN. CODE § 210.3(5) (2022) (Definitions).
165. *Id.* § 210.3(24).
166. Boettcher et al., *supra* note 9, at 2.
167. Gooch et al., *supra* note 115, § 24.3.
168. *Id.*
169. *Id.*
170. *Id.*
171. *Id.*
172. *Id.*
173. *Id.*
174. *Id.*
175. *Id.*
176. *Id.*
177. 30 TEX. ADMIN. CODE § 210.3(31) (2021) (Tex. Comm'n on Env't Quality, Definitions).

occur while persons are present, or where an edible part of the crop has direct contact with reclaimed water.[178] Type II, in contrast, includes uses where direct "contact between humans and the reclaimed water is unlikely."[179] Because Type I uses may involve human contact, Type I reclaimed water must meet more stringent conditions than Type II reclaimed water.[180] For example, Type I reclaimed water cannot contain more than twenty colony forming units ("CFU") of fecal coliform (*E. Coli*) per one-hundred milliliters in a thirty day average, whereas Type II may, in a thirty day average, contain up to 200 CFU.[181] Because Type I imposes more stringent requirements contains less contaminants than Type II, it can also be used for any Type II use.[182] Regardless of classification of use, the TCEQ recommends that users conduct fecal coliform sampling periodically, though TCEQ approval of the user's fecal coliform testing plan is not required.[183]

This Article focuses on Type I uses because they are more likely to be implemented by households with the suggested treatment systems. Households that meet Type I standards will have full flexibility to choose what kind of produce to grow, instead of being limited to produce whose edible parts have not been in direct contact with reclaimed water. Furthermore, meeting more stringent Type I qualifications will benefit households by affording them the full flexibility to implement uses available under both Type I and Type II.

### B. TYPE I DIRECT NONPOTABLE REUSE REGULATORY REQUIREMENTS UNDER CHAPTER 210

Chapter 210 of Title 30 of the Texas Administrative Code regulates direct reuse and sets criteria intended to "allow the safe utilization of reclaimed water . . . to ensure the protection of public health[,] to protect ground and surface waters[,] and to help ensure an adequate supply of water resources for present and future needs."[184] Chapter 210 sets the minimum requirements for "design, operation, monitoring, reporting, and management of reclaimed water systems for direct nonpotable reuse."[185] Chapter 210 is applicable to the proposed decentralized wastewater treatment systems discussed in this Article because they produce water for direct nonpotable reuse.[186] This is distinct from on-site sewage facilities that use surface irrigation as a method of effluent disposal, which are subject to Chapter 285 of the same Title.[187] Chapter 210 does not apply "to

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178. *Id.* §§ 210.32(1)(A), (D) (Specific Uses of Reclaimed Water).

179. *Id.* § 210.3(32).

180. *See id.* §§ 210.33(1), (2)(A) (Quality Standards for Using Reclaimed Water).

181. *Id.*

182. *Id.* § 210.32(3).

183. *Id.* § 210.35 (Guidelines for Certain Distribution Systems).

184. *Id.* § 210.2(a) (Purpose and Scope); *see also Frequently Asked Questions*, TEX. WATER DEV. BD., https://www.twdb.texas.gov/innovativewater/reuse/faq.asp#title-05 [perma.cc/JS4N-6MLX] ("What major laws regulate the treatment and use of reclaimed water in Texas? The Texas Administrative Code Chapter 210 . . . provides guidelines for the quality, design, and operational requirements for the beneficial use of reclaimed water.").

185. Gooch et. al., *supra* note 116, § 24.17.

186. *See* 30 TEX. ADMIN. CODE § 210.1 (2021) (Tex. Comm'n on Env't Quality, Applicability).

187. *Id.*; *see* 30 TEX. ADMIN. CODE § 285.1 (2021) (Tex. Comm'n on Env't Quality, Purpose and Applicability).

those systems authorized under Chapter 285 . . . which utilizes surface irrigation as an approved disposal method."[188] The regulatory distinction between reuse and disposal means that Chapter 210 applies to water reuse for irrigation, whereas Chapter 285 applies to effluent disposal, which may take the form of surface irrigation.[189]

The TCEQ does not require users who both produce and use reclaimed water (as opposed to users who produce reclaimed water for use by other users) to obtain prior approval.[190] Regardless of system location, structure, and operation, one overarching regulation applies to all steps of the reuse process: nuisance conditions are prohibited.[191] Chapter 210 defines nuisance as "distribution, storage, or use of reclaimed water . . . which adversely affects human health or welfare, animal life, vegetation, or property, or which interferes with the normal use and enjoyment of animal life, vegetation, or property."[192] Essentially, the user must ensure that the use of reclaimed water does not "pose[] potential or actual adverse impacts upon human health, soil and groundwater resources, or aquatic life."[193]

In addition to the general prohibition on nuisance conditions, Chapter 210's specific requirements for agricultural use of reclaimed water that the proposed devices produce can be divided into three categories: infrastructural,[194] technical,[195] and storage.[196] Chapter 210 also provides qualitative requirements for recycled water.[197] However, the scientific nature of these requirements is beyond the legal scope of this Article. This Section discusses the specific requirements of each step in the reuse process, which includes constructional (infrastructural), technical, and storage. This Section does not discuss every applicable regulatory requirement. Instead, it provides an overview that potential users may find helpful in determining whether a reuse system is appropriate for use on their property, and Section V analyzes the regulations and suggests potential amendments that would make implementation of reuse projects more popular and accessible among homeowners in rural, arid regions of Texas.

### 1. Infrastructural Requirements

Chapter 210 provides infrastructural design requirements applicable to the proposed wastewater treatment systems.[198] One such requirement is that hoses

188. 30 TEX. ADMIN. CODE § 210.1.

189. *See id.*; 30 TEX. ADMIN. CODE § 285.1.

190. 30 TEX. ADMIN. CODE § 210.4(c) (2021) (Notification). Though TCEQ approval is not required, municipal and county permitting requirements may vary; users should take note of locally-applicable requirements. *See* Boettcher et al., *supra* note 9, at 6.

191. 30 TEX. ADMIN. CODE § 210.22(c) (2021) (Gen. Requirements).

192. *Id.* § 210.3(18) (Definitions).

193. *Id.* § 210.5(b) (Authorization for the Use of Reclaimed Water).

194. *See id.* § 210.25 (Special Design Criteria for Reclaimed Water Sys.).

195. *See id.* § 210.24 (Irrigation Using Reclaimed Water).

196. *See id.* § 210.23 (Storage Requirements for Reclaimed Water).

197. *See id.* § 210.33 (Quality Standards for Using Reclaimed Water). For example, Type I use must contain 5 mg/l or less BOD, less than 20 colony forming units/100mL of fecal coliform, and have a turbidity of 3 NTU or less over a thirty-day average. *Id.* § 210.33(1). "NTU" is defined as "[n]ephelometric turbidity units." *Id.* § 210.3(17) (Definitions).

198. *See id.* § 210.25 (1997).

and faucets used for reclaimed water must be painted purple to distinguish reclaimed water hoses from standard water hoses.[199] Hose bibs must be located in locked vaults and include clear labeling indicating the water is non-potable.[200] Further, reclaimed water piping must be separated a minimum distance of nine feet from standard piping.[201] Reclaimed water storage areas must also either include visible warning signs reading "Reclaimed Water, Do Not Drink" or be secured from public access.[202]

### 2. Technical Requirements in Irrigation

The ability to produce and use reclaimed water with the systems proposed in this Article comes with many ongoing responsibilities, primarily preventing reclaimed water overflow and soil contamination through accurate recordkeeping and proper irrigation practices.[203] The user must keep accurate records of the water balance, including anticipated precipitation and the crops' consumptive use requirements, to ensure the user is aware of and able to respond to soil contamination and overflow before either occurs.[204] Further, the irrigation site must either have a "vegetative cover or be under cultivation" when reclaimed water is used.[205] Chapter 210 prohibits standing reclaimed water and application of that water to saturated ground, but incidental pooling caused by irrigation methods or local conditions is permissible.[206]

While Type I reuse grants flexibility in irrigation methods and crop selection, there are varying requirements for irrigating certain types of crops.[207] Chapter 210 prohibits direct contact between reclaimed water and edible crops that will not be "peeled, skinned, cooked, or thermally processed" prior to consumption.[208] Therefore, those crops must be irrigated by indirect methods.[209] Such indirect methods may include drip irrigation for above ground crops, but drip irrigation would not avoid direct contact with root vegetables such as carrots.[210] Chapter 210 expressly prohibits spray irrigation, a method of direct application, from use with crops that will be consumed raw.[211] Conversely, citrus fruits and crops that will be "peeled, skinned, cooked, or thermally processed"

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199. *Id.* § 210.25(a), (g).
200. *Id.* § 210.25(a).
201. *Id.* § 210.25(c).
202. *Id.* § 210.25(b).
203. *Id.* § 210.24(d)(1) (Irrigation Using Reclaimed Water).
204. *Id.* § 210.24(d)(1)(A)-(B).
205. *Id.* § 210.24(d)(2). This requirement ensures that reclaimed water is not improperly disposed by simply dumping the water onto bare ground.
206. *Id.* § 210.24(d)(3), (6). This Section is not an exhaustive list of applicable requirements located in § 210.24. It highlights those that warrant an explanation and analysis for use with the proposed systems. Other requirements, including that the systems "be designed to prevent operation by unauthorized personnel," *id.* § 210.24(d)(7), and "be designed so that the irrigation spray does not reach any privately-owned premises" other than the user's irrigated property, *id.* § 210.24(d)(5), do not materially contribute to the discussion herein.
207. *Id.* § 210.24(b).
208. *Id.* § 210.24(c)(1)(D).
209. *Id.* § 210.24(c)(1)(C).
210. *Id.*
211. *Id.* § 210.22(b) (General Requirements).

prior to consumption may have direct contact with reclaimed water.[212]

3. Storage Requirements

Adequate storage of reclaimed water ensures that the reclaimed water does not contaminate groundwater resources.[213] A user cannot store reclaimed water in a floodplain.[214] The most cost-effective method of ensuring compliance with storage requirements for an individualized wastewater treatment system is utilizing constructed storage tanks.[215] To comply, the storage tanks must be constructed of "leak-proof" material.[216]

## V. PRACTICABILITY & SUGGESTED AMENDMENTS TO CONTROLLING AUTHORITIES

Implementation of the wastewater treatment systems producing reuse water for agricultural use by individual households may seem to be one practical solution to worsening water scarcity and extreme droughts predicted in Texas in the 21st century. Given that water reuse is already a relatively common practice in Texas, regulatory requirements will also likely not pose any practical issues for implementation. As explained in this Section, some changes to chapter 210, water allocation doctrines and an increase in literature and information on domestic water reuse would make systems like those proposed in this Article an implementable solution to arid Texas's water scarcity in the 21st century.

### A. CHAPTER 210 IS SUPPORTIVE OF DOMESTIC WATER REUSE, UNLESS . . .

Chapter 210 largely supports individualized wastewater treatment systems, assuming the potential user undertakes proper planning, unless the user lives in a floodplain. After all, chapter 210 serves the purpose of "ensur[ing] an adequate supply of water resources for present and future needs," and the use of water reuse systems proposed in this Article can greatly assist users in doing so.[217] While some of chapter 210's requirements may seem tedious, adequate planning and monitoring remains key to successful implementation of the proposed systems. Because the proposed systems produce recycled water for irrigation on the same property, users are not required to obtain permission from the TCEQ for the reclaimed water use.[218] In order to ensure TCEQ permission

212. *Id.* § 210.24(c)(1)(A)-(B).

213. *Id.* § 210.23(c)(1), (d)(1) (Storage Requirements for Reclaimed Water).

214. *Id.* § 210.23(a).

215. *See* Gooch et al., *supra* note 115, § 24.17. Alternatively, a user could construct a storage pond. However, storage ponds are both expensive to construct and subject to a litany of additional regulations to prevent contamination of surrounding water resources, particularly for users within the Edwards Aquifer recharge zone. Storage ponds are frequently used by recycled water producers dealing in a high quantity of recycled water; a producer dealing exclusively with quantities produced by a household is unlikely to have a need for storing quantities larger than what could be stored in a storage container. For these reasons, this article focuses on chapter 210's requirements as they pertain to the use of storage containers. *Id.*

216. 30 TEX. ADMIN. CODE § 210.23(e).

217. *Id.* § 210.2(a) (Purpose and Scope).

218. *Id.* § 210.4(c) (Notification). Users will still have to obtain TCEQ permission for the actual use of one of the proposed wastewater treatment systems in accordance with § 285, and

is not required, the user should not distribute reclaimed water produced by these systems to other properties or users.[219] However, if the use of reclaimed water has the potential to adversely impact human health, soil, or groundwater, the user must obtain permission.[220]

In determining whether one of the proposed systems is appropriate for use, the user needs to determine whether their property is in a floodplain. This is because the most restrictive barrier to implementation of one of the proposed systems is that storage facilities for recycled water cannot exist in floodplains.[221] Interestingly, there are no floodplain-related prohibitions on the actual use of reclaimed water in irrigation,[222] making the storage prohibition the only regulation (applicable to these systems) that pertains to households in floodplains. While this regulation ensures that reclaimed water does not contaminate existing water sources in the event of heavy precipitation, it presents an unavoidable barrier for individuals who live in floodplains and as a result does not encourage the necessary use of innovative water reuse projects.

Individuals in floodplains who wish to utilize the proposed systems should take special caution to avoid the necessity of storing their recycled water. While doing so would require a fair amount of planning and calculation of both the amount of recycled water produced by the home and demanded by crops, it would eliminate the need for storage. Even then, however, this method would not be foolproof as unexpected hydrological conditions (heavy rains that reduce the need for irrigation, saturated soil, frozen soil, etc.) may impair the user's ability to irrigate. Users of these systems cannot transfer recycled water to other properties in the event that more recycled water is produced than can be used for irrigation (that transfer would require a permit from TCEQ).[223] Thus, users in floodplains have very limited (if any) options in the event that the recycled water cannot be used for irrigation since recycled water cannot be stored in floodplains.[224] This prohibition continues the ever-present cycle of restricting access to wastewater treatment for those in floodplains as demonstrated by *Las Colonias* and Sandbranch. As discussed *infra* Section II.B.1, Sandbranch is located in a floodplain and many *Colonias* are susceptible to flooding, while both locales systemically lack access to adequate wastewater treatment.[225]

Instead of forcing individuals in floodplains who seek to implement water reuse projects to bear the (seemingly impossible) burden of ensuring that storage is not required, a regulatory amendment to chapter 210 to allow storage in floodplains would be greatly beneficial for implementation. Because chapter 210 already requires the use of leak-proof storage containers for the storage of reclaimed water,[226] there seems to be little to no risk of contamination in the event of a flood if such containers are properly secured and not at risk of being

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permission to use the reclaimed water on the user's property is not required. *Id.*

219. *See id.* § 210.4(a).

220. *Id.* § 210.5(b) (Authorization for Use of Reclaimed Water).

221. *Id.* § 210.23(a).

222. *See id.* § 210.24(d) (Irrigation Using Reclaimed Water) (prohibits use of reclaimed water when ground is frozen, saturated, or when application would contribute to standing water).

223. *See id.* § 210.4(a)-(b).

224. *Id.* § 210.23(a).

225. Romero, *supra* note 84, at 811 (*Las Colonias*); West Savali, *supra* note 76 (Sandbranch).

226. 30 TEX. ADMIN. CODE § 210.23(e).

carried away in floodwater. Under this rationale, the main roadblock to implementation for those in floodplains has an easy fix. TCEQ should undertake this fix if it wishes to permit innovative solutions to water scarcity in the coming decades and address plumbing poverty in communities in floodplains and those disadvantaged by other geographic or socio-economic factors. Considering leak-proof containers are already required for storage, and assuming that such containers can be secured, an amendment to allow storage in floodplains is possible without imposing additional risk on surrounding water quality. Such an amendment would encourage the use of reuse water projects like those proposed in this Article by removing a significant barrier to implementation for systemically neglected communities including Sandbranch and *Las Colonias*.

Aside from the outright prohibition on storage in floodplains currently in place in chapter 210, there are few regulatory barriers to implementation. The infrastructural requirements discussed above are readily achievable with proper foresight. For example, the requirements that pipes containing reclaimed water be a minimum distance of nine feet from standard piping[227] and that hose valves be in locked vaults[228] are easily achievable with proper planning. Similarly, the requirements that pipes carrying reclaimed water be purple and possess adequate signage—both relatively cosmetic requirements—are easily achievable.[229]

Before a user implements a system proposed in this Article, the user should determine what irrigation methods are feasible for use. This is important in determining what crops the user will be permitted to grow under chapter 210's irrigation requirements. A user who has means to implement a drip irrigation system or another indirect method will have more flexibility in above-ground crop choice, as the user would not be limited to crops that will be peeled or cooked prior to use.[230] However, if a user cannot implement indirect methods of irrigation, making direct contact unavoidable, the user still has a wide range of possible crops. Because chapter 210 permits direct contact with crops that will be cooked or peeled prior to consumption, the user need only ensure that directly irrigated crops are cooked or peeled prior to consumption.[231] Regardless of irrigation method, subsurface crops such as potatoes or carrots will need to be peeled or cooked prior to consumption due to direct contact with reclaimed water in the soil.[232]

Users of the proposed hydroponic system will need to take special note that crops grown in the hydroponic system cannot be used or consumed because the reuse of untreated wastewater is prohibited.[233] The treatment cells and associated plants act as a wastewater treatment system that produces recycled water and should be viewed as such. The product of this system is the recycled water it produces, which can then be used for irrigation. The product is not the crops grown during treatment, as those crops have been irrigated using untreated

227. *Id.* § 210.25(c) (Special Design Criteria for Reclaimed Water Systems).
228. *Id.* § 210.25(a).
229. *Id.* § 210.25(a)-(b), (g).
230. *Id.* § 210.24(c)(1)(D) (Irrigation Using Reclaimed Water).
231. *Id.* § 210.24(c)(1)(A).
232. *See id.* § 210.24(c)(1)(C) ("indirect application method[s] . . . would not be suitable for crops such as carrots or radishes" because they do not "preclude the direct contact with the reclaimed water.").
233. *Id.* § 210.22(a) (General Requirements).

wastewater.

Chapter 210's storage requirements "can be significant limitations to direct nonpotable reuse" because there must exist some synchronicity in timing between the production of domestic wastewater and its eventual application to domestic agriculture.[234] Chapter 210's storage requirements "can be significant limitations to direct nonpotable reuse" because there must exist some synchronicity in timing between the production of domestic wastewater and its eventual application to domestic agriculture.[235] For example, a homeowner may irrigate a garden at only one time during the day, but the household continues to produce wastewater throughout the day and will need to safely store both the untreated wastewater and the recycled water.[236] Users must ensure adequate storage exists for these daily variations in wastewater production and treatment so as to avoid improper storage or disposal of recycled wastewater.[237] Users will also need to consider seasonal variations in their own demand for recycled irrigation water.[238] For example, a user's demand for recycled water will likely be higher in the spring and summer months as plants require more water for growth and when evaporation levels are high, whereas the demand may lower in the fall and winter months when plants may go dormant or require less water.[239] Assuming the household's wastewater production is kept constant, the need for adequate water storage is crucially important in the cooler months.[240] This is particularly true given that chapter 210 prohibits the application of effluent when the ground is frozen.[241]

To avoid improper storage and disposal of recycled water produced by one of the proposed systems, users should plan accordingly for the possibility of reduced demand, particularly in cooler months. One method of ensuring that adequate storage is in place for the cooler months is implementing one of the proposed systems early in the summer and subsequently tracking the amount of recycled water produced. Tracking the quantity of recycled water produced when storage is a lesser concern can inform users of the maximum amount of storage that may become necessary when demand for recycled water decreases. This method is an optional, yet helpful addition to chapter 210's various recordkeeping requirements, discussed *infra* Section IV.B.2, including that the user "determine and document typical irrigation demands" for the irrigated crops.[242]

Further, it is optimal for a user to keep recycled water demands as constant as possible by planting crops year-round. Luckily, Texas's mild fall and winter

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234. Gooch et al., *supra* note 115, § 24.17.

235. *Id.*

236. *See id.* (explaining that facilities providing reclaimed water for landscape irrigation must construct adequate short-term storage for daily variations caused by the continual receiving of untreated wastewater while demand for water for landscape irrigation occurs at night, where evaporation and potential for human exposure is minimal).

237. *Id.*

238. *Id.*

239. *Id.*

240. *Id.*

241. 30 TEX. ADMIN. CODE § 210.24(d)(6) (2021) (Texas Comm'n on Env't Quality, Irrigation Using Reclaimed Water).

242. *Id.* § 210.24(b).

months provide perfect weather conditions for dozens of crops, including carrots, beets, swiss chard, collards, mustard, onions, radishes, and turnips.[243] The user should research winter crops' water demands and plan accordingly. Finally, Type I reuse can be used for residential irrigation, which could provide a use for recycled water when crop demands are not high.[244] While the intended scope of this Article and the proposed systems is domestic agriculture, no additional regulatory requirements must be met for residential irrigation.[245] This makes landscape irrigation a realistic use of recycled water when agricultural demand decreases. Regardless of how a user chooses to monitor and store recycled water quantities, it is important to anticipate a decreased demand of recycled water and plan accordingly.

Chapter 210 imposes many requirements on users of this Article's proposed systems, including structural, technical, and monitoring requirements. Chapter 210 contains three subchapters of pertinent requirements, amounting to thirty-six different sections of rules, each of which contain multiple requirements.[246] In practice, most of these numerous requirements do not appear to impose significant economic or infrastructural barriers to use of the proposed systems or do not apply to the proposed systems. They do, however, require an intensive monitoring and recordkeeping approach, which could intimidate households who wish to implement a system to conserve and reuse water.[247] Even if most requirements do not require significant time or financial investments, the sheer quantity of requirements may discourage interested households from the systems proposed in this Article.

A simplified method of explaining the regulations that are applicable to users of the proposed systems may reduce hesitation and permit households to make a more informed and confident decision as to whether reclaimed water for irrigation is a practical option. A guidance document, checklist, and/or resource guide for individual domestic users of reclaimed water could explain the requirements in common terms in a user-friendly format. Students at Texas A&M University School of Law recently published a technical report that gives an overview of indirect nonpotable reuse's regulatory requirements and noted that an in-depth and "updated 'one-stop-shop' resource" for such requirements does not exist.[248] Notably, the city of Austin has published a "how-to" document for using residential graywater (defined as residential wastewater from sinks, showers, and washers that has not had contact with hazardous material or human waste) that includes guidance on collection and use of graywater, as well as pertinent regulations.[249] However, Austin's document advises only on graywater

243. Larry Stein & Joe Masabni, *Fall Vegetable Gardening Guide for Texas*, TEX. A&M AGRILIFE EXTENSION, https://agrilifeextension.tamu.edu/browse/featured-solutions/gardening-landscaping/fall-vegetable-gardening-guide-for-texas/#:~:text=Plant%20long%2Dterm%2C%20frost%2D,%2C%20parsley%2C%20spinach%20and%20turnip [https://perma.cc/M83D-KF4L].

244. 30 TEX. ADMIN. CODE § 210.32(1)(A) (Specific Uses of Reclaimed Water).

245. Because residential irrigation is a Type I use, it must meet the same requirements under chapter 210 as domestic irrigation. *See id.* § 210.3(31) (Definitions).

246. *Id.* § 210.1-36.

247. *See, e.g., id.* § 210.24(b).

248. Boettcher et al., *supra* note 9, at 1.

249. *Residential Gray Water Frequently Asked Questions*, AUSTIN WATER (Sep. 16, 2016), https://www.austintexas.gov/sites/default/files/files/Water/Conservation/GrayWater-FAQ.pdf [https://perma.cc/FL9P-G7UK].

(not all wastewater produced by a house) and its Type II uses.[250] Guidance documents for reclaimed water producers (such as municipal treatment plants) are common, but the same documents are seemingly nonexistent on an individual scale.[251] University of Maryland Extension has published a guidance document for farmers who use reclaimed water for irrigation, though the guide is intended for farmers who obtain that water from municipal treatment facilities.[252] Nonetheless, it provides easily understandable guidance on the applicable water quality standards, technical requirements, and risks and benefits of irrigating with reclaimed water.[253] A similar document describing Texas's regulatory requirements for individuals producing and using reclaimed water may entice potential users who would otherwise be discouraged by chapter 210's numerous regulations and use of legalese. A document of this type could be prepared by the TCEQ, TWDB, or Texas A&M AgriLife Extension, among others. Given the need for creative water conservation techniques in Texas, information on regulatory requirements for water reuse projects should be widely accessible so that potential users are not discouraged from use.

### B. TEXAS'S WATER ALLOCATION DOCTRINES PRESENT NO IMPEDIMENTS TO DIRECT REUSE

Neither of Texas's water allocation doctrines of prior appropriation nor the rule of capture present an impediment to the treatment and use of recycled water. Indeed, "approval . . . of a reclaimed water use project under [chapter 210] does not affect any existing water rights."[254] This Section applies to users who possess and intend to utilize a water right in Texas with a system proposed in this Article, whether it be a surface water appropriative right or a groundwater right.

#### 1. Utilizing Surface Water for Direct Reuse

Texas's surface water allocation doctrine of prior appropriation is complementary to direct water reuse suggested in this Article because domestic use of surface water generally does not require a prior appropriation right.[255] This

250. *Id.* ("Gray water cannot . . . be used to water vegetable gardens that have root crops or crops where the edible part of the plant touches the ground. . .").

251. *See generally Requirements for Reclaimed Water*, TEX. COMM'N ON ENV'T QUALITY, https://www.tceq.texas.gov/assistance/water/reclaimed_water.html [https://perma.cc/4HH8-RWNA] (giving an overview of regulatory requirements for producers of reclaimed water who distribute to users); *Reclaimed Water for Beneficial Reuse,* N.J. DEP'T OF ENV'T PROT. (Jan. 2005), https://www.state.nj.us/dep/dwq/techmans/reuseman.pdf [https://perma.cc/Q9T6-XJYZ]; *General Criteria for Preparing a Reclaimed Water Management Plan*, NEV. DIV. OF ENV'T PROT., https://ndep.nv.gov/uploads/water-wpc-resources-publications-docs/wts1b-rev-10-2017.pdf [https://perma.cc/4JCC-3C4G].

252. Mayhah Suri et al., *How Do I Use Reclaimed Water on My Farm? A Review of Maryland Class IV Reclaimed Water Guidelines,* UNIVERSITY OF MARYLAND EXTENSION 3-5, https://extension.umd.edu/sites/extension.umd.edu/files/_docs/publications/3.23%20Use%20Reclaimed%20Water%20%282%29.pdf [https://perma.cc/L7TY-Q68A].

253. *Id.* at 2.

254. 30 TEX. ADMIN. CODE § 210.2(c) (2022) (Tex. Comm'n on Env't Quality, Purpose and Scope).

255. Douglas G. Caroom & Susan M. Maxwell, *Surface Water Rights Permitting, in* ESSENTIALS OF TEXAS WATER RESOURCES, *supra* note 6, § 9.14; TEX. WATER CODE ANN. § 11.303(l) (2021).

statement applies both to potential users of the suggested systems who already beneficially use surface water from an adjacent watercourse for domestic purposes or those who seek to do so. Prior appropriation controls the allocation of surface water in the state that has not previously been appropriated.[256] In order to obtain a prior appropriation right to surface water, the user must possess intent to divert the water, actually divert the water, and apply that water to a beneficial use.[257] Pursuant to the statutory definition, domestic use is the "[u]se of water by an individual or household to support domestic activity," which may include "water for . . . irrigation of lawns or of a family garden and/or orchard."[258] The proposed systems produce recycled water that is used for domestic agriculture, which falls under the definition of domestic use and its exemption;[259] thus, the TCEQ does not require users to seek a prior appropriation right.[260]

While prior appropriation is the controlling doctrine for surface water allocation in Texas, the allocation doctrine for domestic users typically follows the doctrine of riparian rights in that persons may directly divert and beneficially use waters from watercourses adjacent to their property without obtaining a surface water right.[261] A homeowner's right to divert water from a watercourse adjacent to the property, and beneficially use that water for domestic purposes, "is a vested right that predates the prior appropriation system in Texas and is superior to appropriative rights."[262] The Texas Water Code permits "a person [to] construct on the person's own property a dam or reservoir with normal storage of not more than 200 acre-feet . . . for domestic and livestock purposes" without obtaining a prior appropriation right.[263] Even though this statutory exemption pertains solely to storage of water, instead of the actual use, the "exemption for domestic and livestock *use* is the established existing law and practice."[264]

The only restriction on domestic use of this type is that the use may not

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256. *See* TEX. WATER CODE ANN. § 11.121 (West 2021) (unless a statutory exemption is met (such as domestic use), "no person may appropriate any state water . . . without first obtaining a permit from [TCEQ] to make the appropriation."); *id.* § 11.022 ("the right to use state water may be acquired by appropriation in the manner and for the purposes provided in this chapter. When the right to use state water is lawfully acquired, it may be taken or diverted from its natural channel."). In this context, state water includes "the water of the ordinary flow, underflow, and tides of every flowing river, natural streams, and lake . . . the storm water, floodwater, and rainwater of every river, natural stream . . . and watershed in the state." *Id.* § 11.021.

257. TEX. WATER CODE ANN. § 11.026 (West 2021).

258. 30 TEX. ADMIN. CODE § 297.1(19) (2020) (Tex. Comm'n on Env't Quality, Definitions).

259. *See id.*

260. TEX. WATER CODE ANN. § 11.142(a) (West 2021).

261. 30 TEX. ADMIN. CODE § 297.21(a) (2020) (Domestic and Livestock and Wildlife Permit Exemptions); *see* TEX. WATER CODE ANN. § 11.303(l) (West 2021). A riparian right is "the right to the use of water adjacent to one's lots, as it flowed in its natural channel" and in the early days of Texas water law, "was a right inherent and inseparably connected with the land itself." Glenn Jarvis, *Historical Development of Texas Surface Water Law: Background of the Appropriation and Permitting System and Management of Surface Water Resources*, *in* ESSENTIALS OF TEXAS WATER RESOURCES, *supra* note 6, § 4.4:2.

262. David Klein & Robin Smith, *Exploring the Scope of Landowner Water Rights for Domestic and Livestock Purposes*, 7 TEX. TECH. ADMIN. L. J. 119, 132 (2006) (quoting 30 TEX. ADMIN. CODE § 297.21(a)).

263. TEX. WATER CODE ANN. § 11.142(a).

264. Caroom & Maxwell, *supra* note 255, § 9.14 (emphasis in original).

unreasonably interfere with another person's reasonable domestic use.[265] Under Texas's practice of prior appropriation and its associated domestic exemption, the use of the systems proposed in this Article will not require a prior appropriation right from TCEQ, assuming that the potential user is adjacent to a watercourse[266] and does not unreasonably interfere with another person's reasonable use.[267] Therefore, potential users who already divert and use or seek to divert and use water from an adjacent watercourse will not be required to obtain a prior appropriation right to use the proposed systems because the recycled water produced by these systems will still be used for domestic purposes.[268]

Texas's system of prior appropriation permits water reuse without imposing additional requirements on the user, but there is one adjustment to prior appropriation that would incentivize the use of individual reuse systems. As evidenced by this Article's focus on meeting Type I regulations, which allow the user to use reused water for both Type I and Type II uses, the ideal regulatory and appropriative system would allow the domestic user to have a full range of possibilities in reusing wastewater. With that in mind, the expansion of the term "domestic use" to include small-scale agriculture operations, which can be sustained with the amount of reclaimed water produced only by an individual user's household, would grant households the opportunity to offer crops for sale at a local farmers' market that were irrigated with reused water. Currently, the Texas Administrative Code specifically excludes "water used to support activities . . . for which the product of the activity is sold" from the definition of domestic use, regardless of production size.[269] Under this definition of domestic use, if a user wishes to sell any produce irrigated with reclaimed water from their domestic appropriative right, he or she is required to seek a permit because the use would no longer be domestic.[270]

If TCEQ were to alter the definition of "domestic use" to permit small-scale water reuse, users could market crops without having to amend their water rights. Thus, users of these reuse systems would have an opportunity to market their produce at farmers' markets or other small, local venues, and see a financial reward, no matter how small, for reusing water.[271] Currently, domestic users who wish to sell any produce grown using reclaimed water have to obtain a per-

265. *See* 30 TEX. ADMIN. CODE § 297.21(c) (2020). This restriction also requires the use to allow sufficient inflows in the watercourse so as to leave enough water for beneficial use by downstream users. *Id.*

266. 30 TEX. ADMIN. CODE § 297.21(a) (2020); *see* TEX. WATER CODE ANN. § 11.303(l) (West 2021).

267. *See* 30 TEX. ADMIN. CODE § 297.21(c) (2021).

268. TEX. WATER CODE ANN. § 11.023(a)(1) (West 2021).

269. 30 TEX. ADMIN. CODE § 297.1(19) (2022) (Definitions).

270. *See id.*; *see* TEX. WATER CODE ANN. § 11.122(a) (West 2021) (requiring an amendment to an existing water permit if user wishes to change purpose of use).

271. This Article in no way calls for the expansion of the term "domestic use" in a way that would include agriculture operations larger than what is capably produced by a single home. Though conservation incentives are necessary in the "big-ag" market as well, that discussion is entirely beyond the scope of this Article. While there may be concern that an amendment to include some for-profit agriculture in "domestic use" would be abused, it is highly unlikely that the quantity of recycled water produced by the suggested systems would be enough to support any big operation.

mit to transition their use from exempt, domestic use to commercial, agricultural use.[272] An amendment to the definition of "domestic use" would incentivize implementation of small-scale water reuse projects and would reduce the administrative burden of seeking an amendment to an appropriation right. The legislature would rightfully hesitate at such an amendment out of fear that permitting users to sell produce grown with domestic water would obliterate the distinction between domestic and commercial water use and the rights and privileges associated with each. However, the legislature also has the power to set restrictions on domestic water use to curb such fears. The legislature could set size and production quantity limits on gardens that produce crops for sale to ensure that the exemption from permitting for domestic use of water is not exploited.

According to EPA data, the average household uses approximately 41.3 gallons of water that is eligible for conversion to Type I reuse per person, per day.[273] The amount of recycled water that a household can eventually use to irrigate a garden depends on the efficiency of the household's treatment and irrigation systems; however, estimates could be made to allow for legislation that expands domestic use to include recycled water used to irrigate crops that a household may sell at a small market. The expansion would use the estimated amount of recycled water an average household produces and the amount of produce that quantity of water can irrigate. This amendment should be viewed as an incentive for households to implement sustainable wastewater treatment systems, not as an upheaval of the domestic exemption. Even without an amendment, households would still reap the obvious benefits of using reclaimed water to water their gardens, including a lower water bill and a more consistent source of irrigation water. Nonetheless, if Texas wishes to encourage sustainable water practices in this century, it must incentivize such projects accordingly.

### 2. Utilizing Groundwater for Direct Reuse

In *Houston & Texas Central Railway Company v. W. A. East*, the Supreme Court of Texas adopted the rule of capture as Texas's controlling groundwater allocation doctrine over 115 years ago.[274] Under *East*, "the use of [ground]water . . . is within the right of the owner of the soil, whatever may be its effect upon his neighbor's wells and springs."[275] The rule of capture grants a landowner the "absolute right to pump as much [ground]water [from his property] as he pleases, and do with it what he chooses, even if doing so deprives his

272. *See* TEX. WATER CODE ANN. § 11.122(a) (West 2021) (requiring an amendment to an existing water permit if user wishes to change the purpose of use).

273. OFF. OF WATER & OFF. OF RES. & DEV., EPA, ONSITE WASTEWATER TREATMENT SYSTEMS MANUAL 3-6 (2002).

274. Susana E. Canseco, *Groundwater Law and Regulation*, *in* ESSENTIALS OF TEXAS WATER RESOURCES, *supra* note 6, § 5.1.

275. Houston & Tex. Cent. R.R. Co. v. W.A. East, 98 Tex. 146, 149–50 (1904).

neighbors of its use."[276] The only exceptions to the rule of capture are prohibitions on malicious withdrawals,[277] wasteful withdrawals,[278] and negligent withdrawals that result in subsidence.[279] The broad, seemingly unfettered permission to withdrawal groundwater as one pleases presents no impediment to implementation of the suggested systems.

However, groundwater withdrawals may be managed by groundwater conservation districts ("GCDs"), which are "the state's preferred method of groundwater management."[280] GCDs are permitted to "make and enforce rules, including rules limiting groundwater production . . . to provide for conserving, preserving, protecting, and recharging of the groundwater"[281] and may require permits for the withdrawal of groundwater.[282] GCDs may not impose permitting requirements on landowners who withdraw water for domestic use on a property over ten acres in size and whose wells are equipped to produce no more than 25,000 gallons a day.[283] Therefore, potential users of the proposed systems who meet these exemption criteria will face no obstacle utilizing groundwater. Those who do not qualify for the exemption will need to ensure that their groundwater usage with the proposed systems is in accordance with the regulations set forth by their respective GCDs and with their own groundwater withdrawal permit.

If a potential user already possesses a groundwater withdrawal permit from a GCD, it is unlikely that implementing one of the proposed systems will require a permit amendment.[284] This is because the use of these proposed systems—wastewater treatment—by nature does not increase demand on the water supply because they utilize groundwater that has already been withdrawn and used. However, a user is required to obtain a permit amendment if the quantity of groundwater withdrawn increases.[285] Yet these proposed systems do not require additional groundwater to be withdrawn, and may in fact result in lesser withdrawals because users may use recycled water for irrigation instead of relying on groundwater for irrigation.[286] For this reason, the proposed systems are well-adapted for use under both the rule of capture and GCDs' groundwater management program.

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276. Leah D. Pinkard, *You Can't Squeeze Water from a Stone, But Soon We May Have to Try: A Scratch at the Surface of Texas Groundwater Law and How Antiquated Common Law Could Leave Us All High and Dry*, 41 T. MARSHALL L. REV. 138, 144 (2016).

277. Canseco, *supra* note 274, § 5.8:1. Interestingly, "there are no Texas cases addressing liability for malicious production, despite courts' continued references to the malice exception to the rule of capture." *Id.*

278. *Id.* Just as with malicious production, case law regarding the waste exception is slim to none. There has been just one Texas case involving wasteful withdrawal: *City of Corpus Christi v. City of Pleasanton. See* 154 Tex. 289 (1955).

279. Canseco, *supra* note 274, § 5.8:2.

280. TEX. WATER CODE ANN. § 36.0015(b) (West 2021).

281. *Id.* § 36.101(a).

282. *Id.* § 36.113(a).

283. *Id.* § 36.117(b)(1).

284. *Id.* § 36.113(a). Best practice, of course, is for a potential user to check with the rules set forth by the applicable GCD.

285. *Id.* § 36.113(a).

286. *See supra* section III.B.

### C. INTEREST EXISTS IN FUNDING INNOVATIVE WATER PROJECTS

Any wastewater treatment system has its financial costs, but to adequately plan for a drier 21st century, Texas should fund or otherwise incentivize sustainable water management projects such as those proposed in this Article. A variety of grant programs, revolving loan programs, and financial incentives exist for the development of sustainable water management and the discussion of programs in this Section is by no means exhaustive.[287] Due to the relatively new emergence of individual wastewater treatment systems like those proposed in this Article, it is unclear what funding would be available for implementation of these systems. It is clear, however, that a plethora of sources exist that fund water conservation and treatment projects.[288] The existence of such programs shows that interest in funding sustainable water management, conservation, and quality control projects exists in Texas. As individualized projects become more popular (and necessary), it is very possible that existing funding programs may become more accepting of individualized systems or that funding programs for individual systems may develop. Given that a significant amount of funding sources already in existence pertain specifically to rural water projects, it is possible that funding for individual reuse projects in rural regions may increase within the coming decades.

One such funding program is the Clean Water State Revolving Fund ("CWSRF") from TWDB which provides financial assistance for planning and construction of reuse water infrastructure.[289] CWSRF provides funding to government entities, including counties, districts, river authorities, and intermunicipal or state agencies for projects that "create or improve wastewater treatment facilities, reuse/recycle facilities, and collection systems," and "re-use or recycle wastewater."[290] While this program does not provide direct assistance to individual property owners,[291] a governmental entity representing a group of rural property owners who seek to implement the proposed systems could theoretically obtain funding for group implementation.

Similarly, TWDB's Rural Water Assistance Fund ("RWAF") can provide small, rural water utilities with funding for wastewater planning and construction.[292] RWAF includes funding for onsite wastewater treatment facilities.[293] Importantly, RWAF also offers assistance for regional projects that may be made more affordable through economies of scale.[294] This is particularly helpful for the suggested systems if the installation of multiple units occurs, bringing the

287. *See* TEX. WATER DEV. BD, 2022 STATE WATER PLAN 137 (2021).

288. *See id.*

289. *Clean Water State Revolving Fund (CWSRF) Loan Program,* TEX. WATER DEV. BD., https://www.twdb.texas.gov/financial/programs/CWSRF/index.asp (last visited Feb. 28, 2022).

290. TEX. WATER DEV. BD., INTENDED USE PLAN: CLEAN WATER STATE REVOLVING FUND, 6-7 (Dec. 16, 2020) https://www.twdb.texas.gov/financial/programs/CWSRF/doc/SFY2020/SFY2020_CWSRF_IUP.pdf.

291. *See id.* (providing a list of eligible applicants to CWSRF that does not include individual property owners).

292. TEX. WATER DEV. BD, 2022 STATE WATER PLAN 138 (2021).

293. Jeffrey A. Leuschel, *Financing Water Projects, in* ESSENTIAL OF TEXAS WATER RESOURCES, *supra* note 6, § 37.2:3.

294. TEX. WATER DEV. BD, 2017 STATE WATER PLAN 46 (2016).

price per unit down. Because of its emphasis on economies of scale and projects designed for rural regions,[295] this fund could assist in implementing individualized wastewater treatment systems discussed in this Article, an attainable goal for a drought-heavy rural region in the state.

For areas lacking existing municipal water and wastewater treatment systems or whose systems do not currently meet state standards, the Economically Distressed Areas Program provides both grants and loans to fund the development of water services.[296] This program aims to "meet immediate health and safety concerns and stop[] the proliferation of sub-standard water and wastewater services."[297] It funds water and wastewater infrastructure in areas deemed economically distressed,[298] or where wastewater service is unavailable.[299] Due to its focus on immediate health and safety concerns,[300] this fund may prove valuable to those seeking to install an individualized system, particularly those without existing wastewater services. Through the existence of these programs and additional programs not described in this Section,[301] it is clear that interest exists in financing and incentivizing sustainable water conservation and reuse projects. To further incentivize these projects and reduce financial barriers to implementation, TWDB should expand funding to include grants, loans, or subsidies of such projects so that potential users have the possibility to implement innovative water reuse projects in the coming decades.

### D. SOCIAL CONSIDERATIONS

Environmental advocates may oppose water reuse due to concerns about the reused water's quality, including a fear that the reused water's quality may negatively impact natural watercourses.[302] This concern, while valid, is not applicable to the proposed systems because the recycled water produced is utilized for direct reuse. The systems do not discharge directly into watercourses, as an indirect reuse would,[303] and will therefore have a lesser impact on water in the state. Further, the public health concerns associated with water reuse are lessened by the stringent qualitative standards in place for water reuse as well as the proposed systems' direct application. One such public health concern is the growing incidence of pharmaceuticals in Texas's potable water, through both improper disposal (disposal "down the drain") and bodily excretions containing remnants of consumed pharmaceuticals.[304] Perhaps the largest concern of pharmaceutical-tainted water is the prevalence of prescribed antibiotics, which could

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295. *Id.*

296. TEX. WATER DEV. BD, 2022 STATE WATER PLAN 139 (2021).

297. TEX. WATER DEV. BD, 2017 STATE WATER PLAN 47 (2016).

298. TEX. WATER DEV. BD., QUARTERLY REPORT, ECONOMICALLY DISTRESSED AREAS PROGRAM 2 (Sep. 30, 2019), https://www.twdb.texas.gov/publications/reports/edap_reports/doc/Status.pdf [https://perma.cc/GQ7Z-8HW6].

299. TEX. WATER DEV. BD, 2022 STATE WATER PLAN 139 (2021).

300. TEX. WATER DEV. BD, 2017 STATE WATER PLAN 47 (2016).

301. *See id.* at 137–39 (additional funding sources include the Water Infrastructure Fund, the Agricultural Water Conservation Program, and loans provided by TWDB for water conservation and quality enhancement projects).

302. Gooch et al., *supra* note 115, § 24.21.

303. *Id.* § 24.3.

304. Joseph Behnke, *Pharmaceuticals in the Water: The Albatross Around Texas's Neck*, 13

contribute to antibiotic-resistant waterborne bacteria.[305] However, the most effective method for preventing the disposal of unused medication into a water system is prevention.[306] As such, users of the proposed system should be aware of appropriate methods of pharmaceutical disposal, including mail back programs and drug take back days.[307] Again, however, direct reuse does not present a risk of contamination because of its direct application and qualitative controls,[308] and the risk of contamination is further lowered by proper disposal of pharmaceuticals.

Decentralized reuse projects must also overcome the "yuck" factor associated with reuse of wastewater. Reused water is regulated with health and safety in mind, though those regulations may not assuage fears of using water that has traveled from "toilet to tap."[309] Among the top concerns with reused water today are aesthetic qualities such as taste and odor.[310] However, those concerns may not be applicable to nonpotable agricultural use discussed here because the consumer will not directly consume the reused water and will instead use it for irrigation.

Traditionally, public health and regulatory concerns occupied the main opposition to reused water.[311] However, consumer behavior and cultural norms are considered to be the greatest influence on whether reused water will face public resistance.[312] Studies have indicated that the prevalence of water scarcity may be the leading determinant of public acceptance for the use of reused water.[313] This seems to reflect the cultural norms of a water-scarce region whose population seeks innovative water sources and consequently may possess a greater acceptance of water reuse projects.[314] Further, studies suggest that public acceptance varies just slightly across socioeconomic classes in regions facing water scarcity, which suggests that income, formal education, and other socioeconomic factors may not be as much of a determinative factor as previously thought.[315] In any case, public education and branding are the keys to assuaging fears of reused water.[316] One way of overcoming the "yuck" factor and increasing popularity of reuse projects lies in clearly illustrating both the objectives and

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TEX. TECH. ADMIN. L.J. 325, 327 (2012).

305. *Id.* at 330.

306. *Id.* at 344.

307. *How and Where to Dispose of Unwanted Prescription Painkillers and Other Drugs*, OFFICE OF THE ATT'Y GEN., https://www.texasattorneygeneral.gov/sites/default/files/files/dor/DOR-Texas-DrugTakeBack-Flyer.pdf [https://perma.cc/7ZJJ-7WCF]. All Texans should be familiar with appropriate pharmaceutical disposal methods.

308. *See* 30 TEX. ADMIN. CODE § 210.33 (2021) (Tex. Comm'n on Env't Quality, Quality Standards for Using Reclaimed Water).

309. Cabrera, *supra* note 122.

310. UN WATER, WASTEWATER: THE UNTAPPED RESOURCE 136 (2017), https://reliefweb.int/sites/reliefweb.int/files/resources/247153e.pdf [https://perma.cc/6GG2-6R67].

311. *Id.*

312. *Id.*

313. Al-Mashaqbeh et al., *supra* note 130, at 588.

314. *Id.*

315. *Id.*

316. UN WATER, *supra* note 310, at 136.

advantages of reuse projects, which could be economic, ecological, and resource-focused, so that households are able to make an informed decision regarding implementation.[317]

One example of a project that did not take public acceptance into account is a regulation in Beijing, China, which required that large buildings recycle greywater for use as water for toilet flushing in an effort to mitigate the city's water deficit.[318] As of 2017, the regulation was not widely implemented due to public objection, save for some university buildings where student residents were amicable to the reuse regulation.[319] While the systems proposed in this Article treat water on an individualized scale and the choice to implement such systems is left to each individual household—as opposed to the city-wide regulation of Beijing—public education and outreach must be tailored and clearly explain the advantages of the proposed systems so that households are not dissuaded by the "yuck" factor of reuse water. For successful implementation, the education and outreach branding should be tailored to the individual circumstances of the community, based on local knowledge and needs, and respectful of the households' wishes.[320] In order to properly implement individual systems such as those proposed in this Article, proper education, outreach, and branding is necessary.

## VI. CONCLUSION

There are many beneficial reasons to implement decentralized water reuse systems in Texas. First, because the state is predicted to experience a warmer and drier 21st century that will see a dwindling water supply, implementation of reliable and sustainable water supply and conservation projects is critical.[321] Additionally, water reuse provides safe, usable water without placing additional demand on the dwindling water supply.[322] Decentralized wastewater treatment systems, such as those proposed in this Article, provide both a safe and efficient method of wastewater treatment and a source of domestic irrigation water.[323] However, more data is necessary to truly identify and address barriers to wastewater treatment in Texas.[324] The solar-powered individualized system or hydroponic system proposed in this Article could provide households with a renewable source of irrigation water. This renewable source would not require the rationing of water supplies by choosing between water for irrigation and water for household use, particularly as water supplies in Texas are predicted to become scarcer.[325] Sustainable and responsible water management practices are critically important for those in arid and rural Texas regions who are likely to be most affected by the water shortages brought on by a drier 21st century.[326]

317. Capodaglio, *supra* note 65, at 4.
318. *Id.* at 3.
319. *Id.*
320. Al-Mashaqbeh et al., *supra* note 130, at 585.
321. *See* Gooch et al., *supra* note 115, § 24.1.
322. Vassar, *supra* note 8.
323. PARTEN, *supra* note 94.
324. *See* discussion *supra* Section II.B.1.
325. TEX. WATER DEV. BD., 2022 STATE WATER PLAN 3 (2021); Vassar, *supra* note 8, § 3.1.
326. Rubenstein & Mace, *supra* note 6, § 2.6:1.

These shortages may come from decreased surface water reserves due to increased temperature and resulting increases in evaporation,[327] or a decrease in groundwater supplies either as due to inadequate groundwater recharge from decreased surface water supplies or as a result of increased reliance on groundwater supplies.[328]

The good news for the future of innovative water reuse projects in Texas is that Texas's controlling authorities are largely supportive of decentralized reuse projects such as those proposed in this Article. For example, both the rule of capture and groundwater management through GCDs are amicable to decentralized water reuse because the reuse of water does not increase demand on groundwater.[329] Further, the doctrine of prior appropriation is largely favorable to decentralized water reuse projects for domestic use given its exemptions to permitting for domestic use.[330] Finally, chapter 210 itself does not impose significant barriers to these projects considering most infrastructural and storage requirements are cosmetic or easily achievable with proper planning.

While these controlling authorities are amicable to the proposed projects, some amendments are necessary to properly encourage decentralized wastewater treatment for direct reuse in a drier 21st century. An individual wastewater treatment system can provide a safe and efficient wastewater treatment system for these individuals, but to increase popularity of these systems as they inevitably become more necessary, Texas will need to incentivize such projects accordingly. As suggested in this Article, these incentives could come in the form of regulatory amendments to chapter 210, specifically, removing the (arguably redundant) prohibition on reuse storage in floodplains even if leak-proof containers are used for storage.[331] Further, a slight change to the doctrine of prior appropriation could permit households to sell crops irrigated with water produced by these projects without triggering the necessity of obtaining a permit for agricultural use. This would allow households to see a financial reward for implementing innovative reuse projects such as those proposed in this Article, thereby incentivizing such projects. Additionally, publication and widespread availability of clear and thorough information on water reuse projects and the regulations that control them would popularize domestic water reuse projects and increase awareness of their availability. Finally, existing financial incentives through loan and grant programs should be further developed so that cost is not a prohibitive factor in securing a drought-proof supply of water.

As Texas enters a drier 21st century brought on by a warmer climate, the state will need to publicize and incentivize innovative water reuse projects so that households, particularly those in rural and arid regions, can have a sufficient supply of water for domestic irrigation that does not increase demand on conventional water supplies. This Article has recognized and laid a preliminary

327. *Id.* § 2.6:2.

328. BASIN REPORT: RIO GRANDE, *supra* note 27.

329. TEX. WATER CODE ANN. § 36.113(a) (West 2021).

330. *Id.* § 11.303(a); 30 TEX. ADMIN. CODE § 297.21(a) (2022) (Tex. Comm'n on Env't Quality, Domestic and Livestock and Wildlife Permit Exemptions).

331. 30 TEX. ADMIN. CODE § 210.23(e) (2022) (Tex. Comm'n on Env't Quality, Storage Requirements for Reclaimed Water).

framework for navigating existing controlling authorities, has highlighted favorable authorities, and has suggested changes to authorities so that decentralized projects such as a freestanding, solar-powered wastewater treatment system and a gravity-flow hydroponic system can be accessible to homeowners in arid and rural regions of Texas. Potential users should, of course, consult with controlling entities—including TWDB, TCEQ, or a corresponding GCD—to ensure that a water reuse project is appropriate for their property and use.