Water Quality

What is Water Quality?

Water quality is the measure of the condition of water by examining the presence of certain contaminants (e.g., physical, chemical, biological, radiological).[1] Examining bodies of water will aid in determining where the water can be used, such as in the protection and reproduction of fish, shellfish, and wildlife, recreational and public drinking water supply, as well as agricultural and industrial purposes.[1] Ensuring water quality and regulating the entry of contaminants from entering water sources across the United States can protect human health and aquatic life.

In the United States, there are three sources of water supply for public water systems and private wells.[2] These sources include:

- Surface water (e.g., lakes, rivers, or reservoirs),
- Ground water (e.g., aquifers), and
- Recycled water (e.g., reused water).

Millions of people in the United States rely on public community water systems for tap water yearly. In the United States, 9 out of 10 people receive their water supply from one of the 148,000 public water systems.[2] The U.S. Environmental Protection Agency (EPA) sets standards and regulations that are required to be followed by all public water systems in the United States.[3]

Factors Affecting Water Quality

Contaminated water can lead to various health issues, including gastrointestinal illnesses, reproductive problems, chronic diseases, and neurological disorders.[4] Vulnerable populations (e.g., infants, young children, pregnant women, the elderly, and those with weakened immune systems) may have an increased risk of becoming sick after contact with contaminated water.[4]

Causes of water contamination[5]:

- Naturally Occurring Chemicals and Minerals (e.g., arsenic, radon, and uranium)
- Agricultural Practices and Operations
    - Agricultural runoff, caused by fertilizers, pesticides, livestock, and concentrated animal feeding operations.
- Sewer System Overflow
    - Untreated sewage from human and industrial waste and other stormwater pollutants into nearby water sources.
- Industrial Processes
    - Industrial waste can threaten bodies of water, as it can potentially transform into toxic or corrosive substances. Examples include cleaning fluids, paints, and pesticides.
- Storm Water
    - Storm water pollution happens when materials and chemicals are collected into the storm drain and into waterways.
- Wildlife

- Distribution System Issues
    - Particles can accumulate in pipes and tanks, leading to the deterioration of water pipes over time.

Water contamination may lead to waterborne illnesses, including legionella, giardia, norovirus, shigella, and campylobacter within human health.[5] Poor water quality can also harm aquatic life, leading to concerns within the ecosystem.

Measuring Water Quality

A series of assessments are conducted to determine an area's water quality. Measurements that are included in determining the quality of the water[6,7]:

- Temperature,
- Acidity (pH),
- Dissolved solids (specific conductance),
- Turbidity (cloudiness of the water),
- Dissolved oxygen (the level of oxygen that is dissolved in the water),
- Hardness, and suspended sediments of the water,
- Monitoring for contaminants (e.g., arsenic, nitrite, nitrate, uranium), and
- Physical characteristics of water (e.g., water absence/presence, water level, and discharge).

Public water systems that fail to meet water quality standards must alert the public of potential health risks.[8] Local water companies release annual Consumer Confidence Reports (CCR), also known as Water Quality Reports, providing more information on water quality.[8] The report shares information on the local areas drinking water quality, including the water source, contaminants found, and drinking water protection.

The EPA and the state of California set limits on substances that could impact community health or the appearance of water. The Maximum Contaminant Level (MCL) is a critical measure of water quality.[6] It represents the highest level of contaminants that can be present in drinking water without violating any regulations. Primary MCLs address health concerns and secondary MCLs determine esthetic levels such as taste and odor.[9] The Public Health Goal (PHG) and Maximum Contaminant Level Goal (MCLG) strive to determine a contaminant level in drinking water that is safe and does not pose any known or expected health hazards.[9] These measurements assist with keeping bodies of water healthy and assessable to the public.

National Statistics and Disparities

Although there have been many improvements in water quality practices in the United States over the years, such as the addition of fluoride to drinking water to prevent dental caries, further efforts are still needed to improve water quality systems to reduce the impact of waterborne illnesses reported nationally.[4,10]

- *Drinking Water*
  - In 2021, in the United States, there were 15 outbreaks (214 cases) of waterborne illnesses from public drinking water. These illnesses were mostly reported in July and August.[11]
  - Out of the 214 cases, 56 hospitalizations and 7 deaths occurred from drinking water contamination.[11]
- *Recreational Water – Treated*
  - In 2021, in the United States, there were 23 outbreaks (223 cases) of waterborne illnesses from treated recreational water.[11]
  - Out of 223 cases, 34 cases resulted in a hospitalization and 1 death occurred from treated recreational water contamination.[11]
- *Recreational Water – Untreated*
  - In 2021, in the United States, there were 10 outbreaks (65 cases) of waterborne illnesses from untreated recreational water.[11]
  - Out of 65 cases, 4 cases were hospitalized from untreated recreational water contamination.[11]
- *Waterborne Outbreaks*
  - Between 1971 and 2021, Legionella pneumophila, a type of bacteria, has been found to be the leading cause of waterborne outbreaks resulting from contamination of drinking water.[11,12]
  - Between 1971 and 2020, Cryptosporidium, a parasitic disease that causes diarrheal illness, has been the primary cause of waterborne outbreaks caused by recreational water contamination.[13]

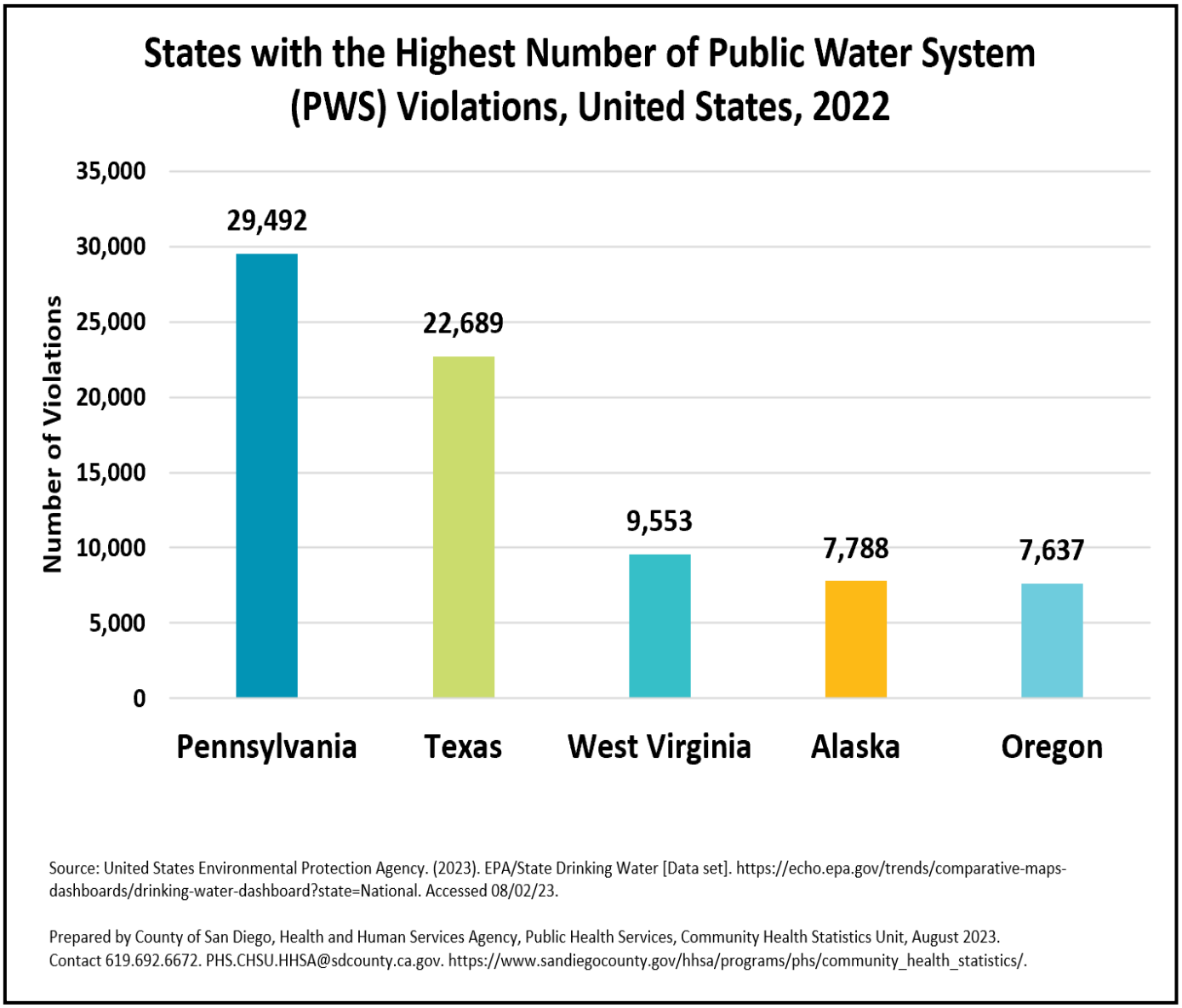


Figure 1: States with the highest number of public water system (PWS) violations, United States, 2022

- In the United States, Pennsylvania had the highest number of public water system violations (29,492), followed by Texas (22,689) in 2022.[14]
- The most common violation for Pennsylvania, Texas, West Virginia, Alaska, and Oregon was the failure to regularly monitor and submit reports on drinking water quality, as required by the Safe Drinking Water Act.[14]
- In 2022, the states with the fewest public water system violations were North Dakota (250), South Dakota (225), Nebraska (148), Delaware (133), and Hawaii (5).[14]

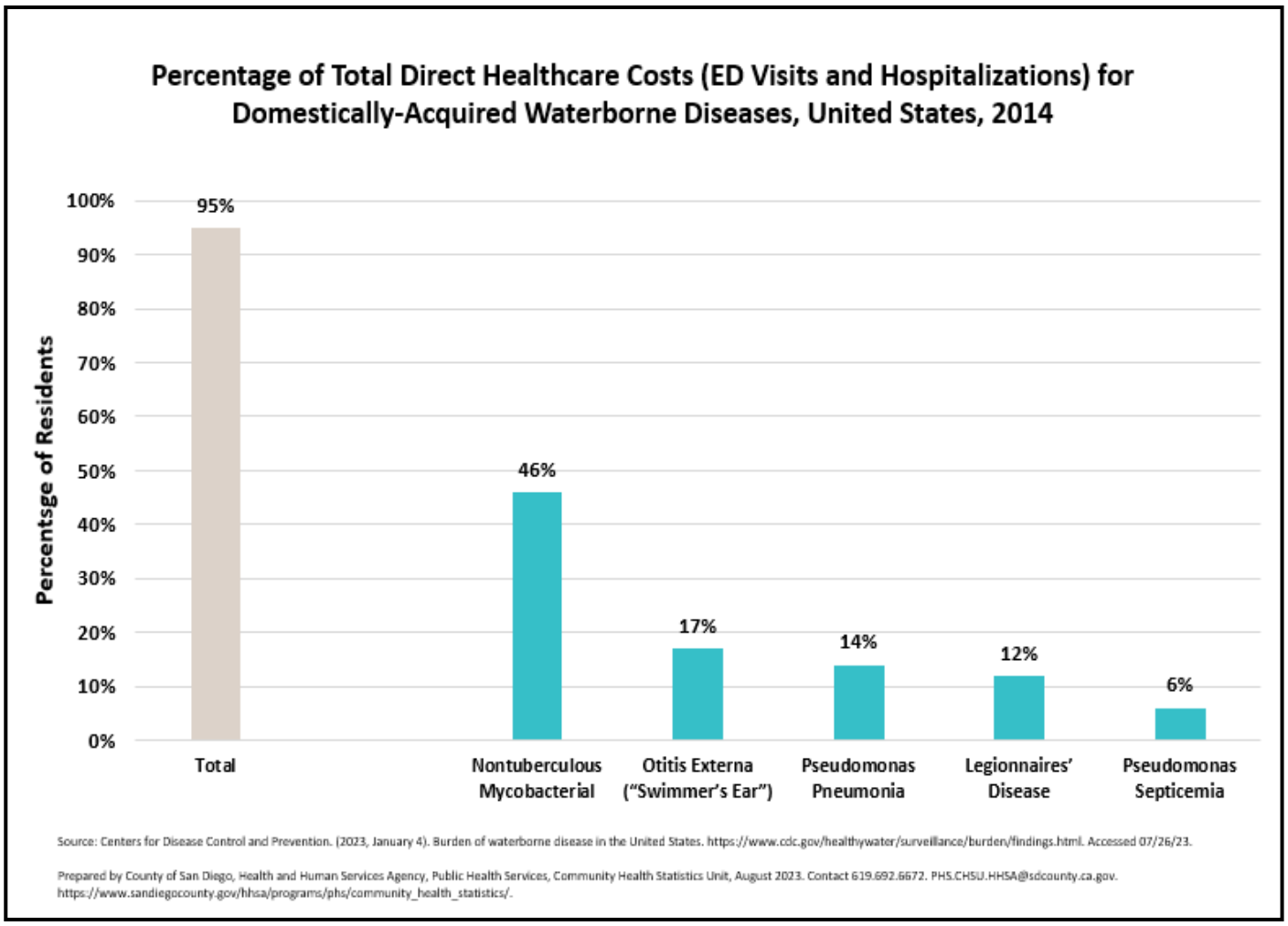


Figure 2: Percentage of total direct healthcare costs (ED visits and hospitalizations) for domestically-acquired waterborne diseases, United States, 2014

Cost

Waterborne illnesses place a significant financial strain on the healthcare system.

- The total estimated direct healthcare costs for hospitalizations and emergency department visits due to waterborne illnesses totaled $3.1 billion in 2014.[15]
- In 2014, nontuberculous mycobacterial (NTM) - a type of bacteria - was found to be the mostly costly waterborne illness of combined costs for emergency department visits and hospitalizations.[15] This illness accounted for 46% of the total direct healthcare costs for waterborne illnesses, amounting to $1.5 billion.[15]

State Statistics and Disparities

California has two primary sources of water: the Colorado River and the State Water Project.[16,17] These sources supply water to various communities, agricultural areas, and recreational spots throughout the state.

- In 2013, approximately 98% of Californians received water from public water system sources, while the remaining 2% obtained water from unregulated small water systems or privately operated groundwater wells with little or no treatment.[8]
- California has 2,933 public water systems, including 90 state small water systems, spread across its 58 counties.[8]

Contamination of drinking water has the potential to impact a significant number of individuals as it is distributed to many people from a single source.[8] The EPA monitors violations related to drinking water according to the Safe Drinking Water Act; violations are classified into different categories.

Health-Based Violations

- Violations that occur when the maximum contaminant levels (MCLs), maximum residual disinfectant levels (MRDLs), or treatment technique rules (TT) exceed or are not followed as required.[18]

Acute Health-Based Violations

- Health-based violations that may pose an immediate health risk to the general public and could result in illness.[18]

Monitoring and Reporting Violations

- Occurs when reports on drinking water quality are not submitted regularly or when monitoring is not done as required.[18]

Public Notification Violations

- The failure to immediately notify the public if there is a significant issue with the drinking water that could pose a risk to the communities' health.[18]

Other Violations

- Violations that do not fall into the above categories but represent other Safe Drinking Water Act requirements, including issuing annual consumer confidence reports or administering periodic sanitary surveys.[18]

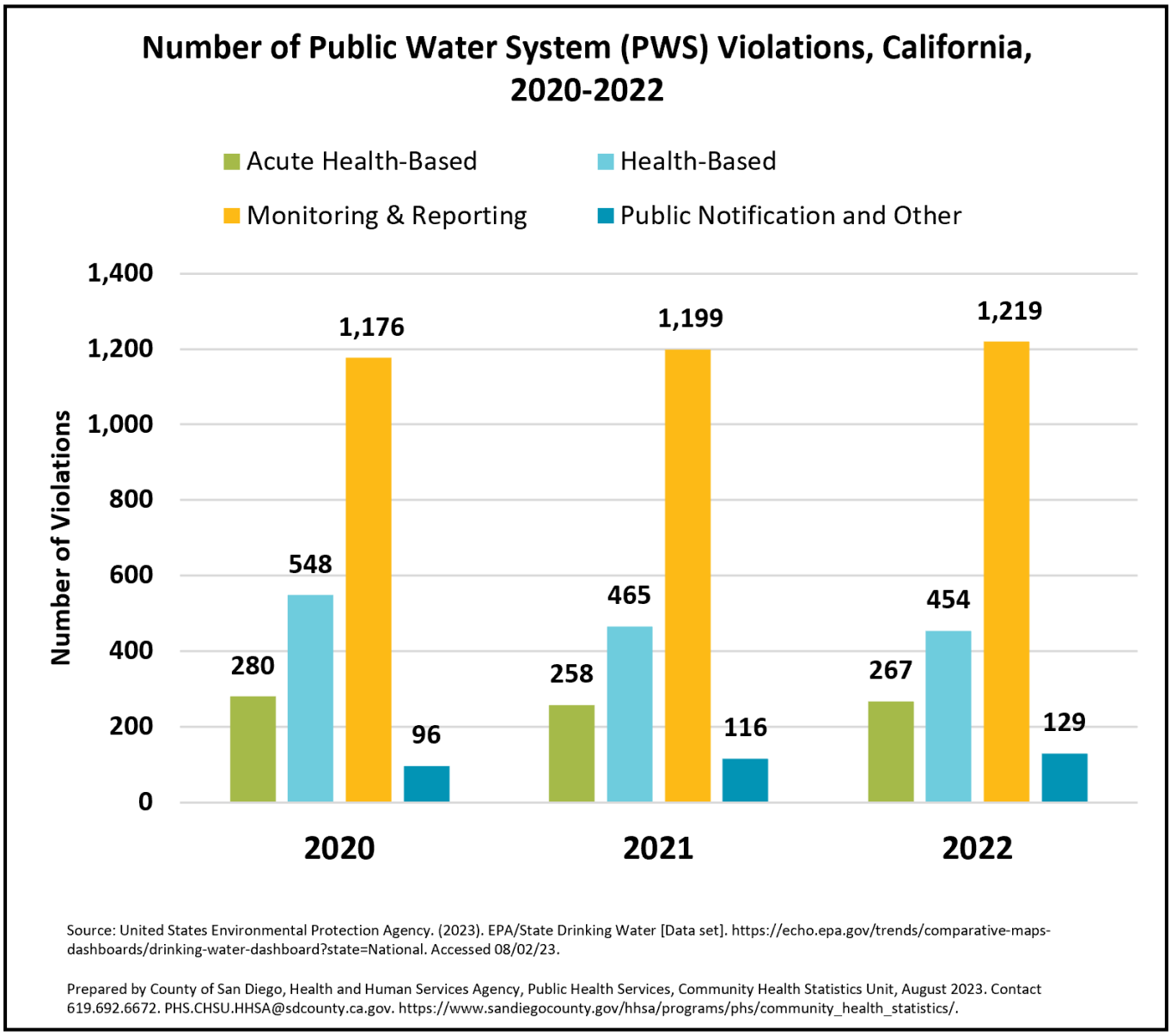


Figure 3: Number of public water system (PWS) violations, California, 2020-2022

- The most common violation was related to monitoring and reporting, with approximately 1,200 violations annually.[14]
- The total number of violations in California's public water systems has decreased from 2,100 in 2020 to 2,069 in 2022.[14]
- Among the states in the US, California was ranked 28th for the number of violation issued to public water systems in 2022.[14]

Local Statistics and Disparities

San Diego County receives water from multiple sources. The Metropolitan Water District of Southern California (MWD) is a major supplier of water, and sells a portion of water from the Colorado River and the State Water Project to the San Diego County Water Authority (SDCWA).[19]

There are 236 public water systems in San Diego County.[20,21] The San Diego County Water Authority buys treated and raw water and resells it to its two dozen local water agencies within the county. Treated water purchased through MWD is treated and processed at the Metropolitans Skinner Treatment Plant located in Temecula, CA.[22] The Twin Oaks Valley Treatment Plant in San Marcos processes some of the raw water that belongs to SDCWA. SDCWA resells the remaining raw water to local water agencies. Some of those local agencies, including the city of San Diego, have their own treatment plants to treat water. The SDCWA also receives desalinated water from the Claude "Bud" Lewis Carlsbad Desalination Plant in Carlsbad to blend within the public drinking water supply.[22]

In 2022, SDCWA's water supply consisted of[19]

- Conserved water from the Imperial Irrigation District (43%),
- Conserved water from the All American Canal (16%),
- Metropolitan Water District of Southern California (MWD) (13%),
- Seawater Desalination (10%),
- Local Surface Water (4%),
- Recycled Water (5%),
- Groundwater (6%), and
- San Luis Rey Water Transfer (3%)

The Colorado River is over 50% of the County of San Diego's water source. To sustain future water demand throughout the county, SDCWA has proposed to decrease water supply through the Colorado River and increase potable reuse water by 18% by 2045.[19] The County of San Diego is actively exploring new and innovative ways to improve water sources within the county to serve its San Diego residents.

There has been much progress in keeping the water safe and clean throughout San Diego County. Despite efforts to maintain water quality, numerous challenges still threaten it. These include drinking water containment levels, potential threats to groundwater, and impaired water bodies within the county.

Water Quality

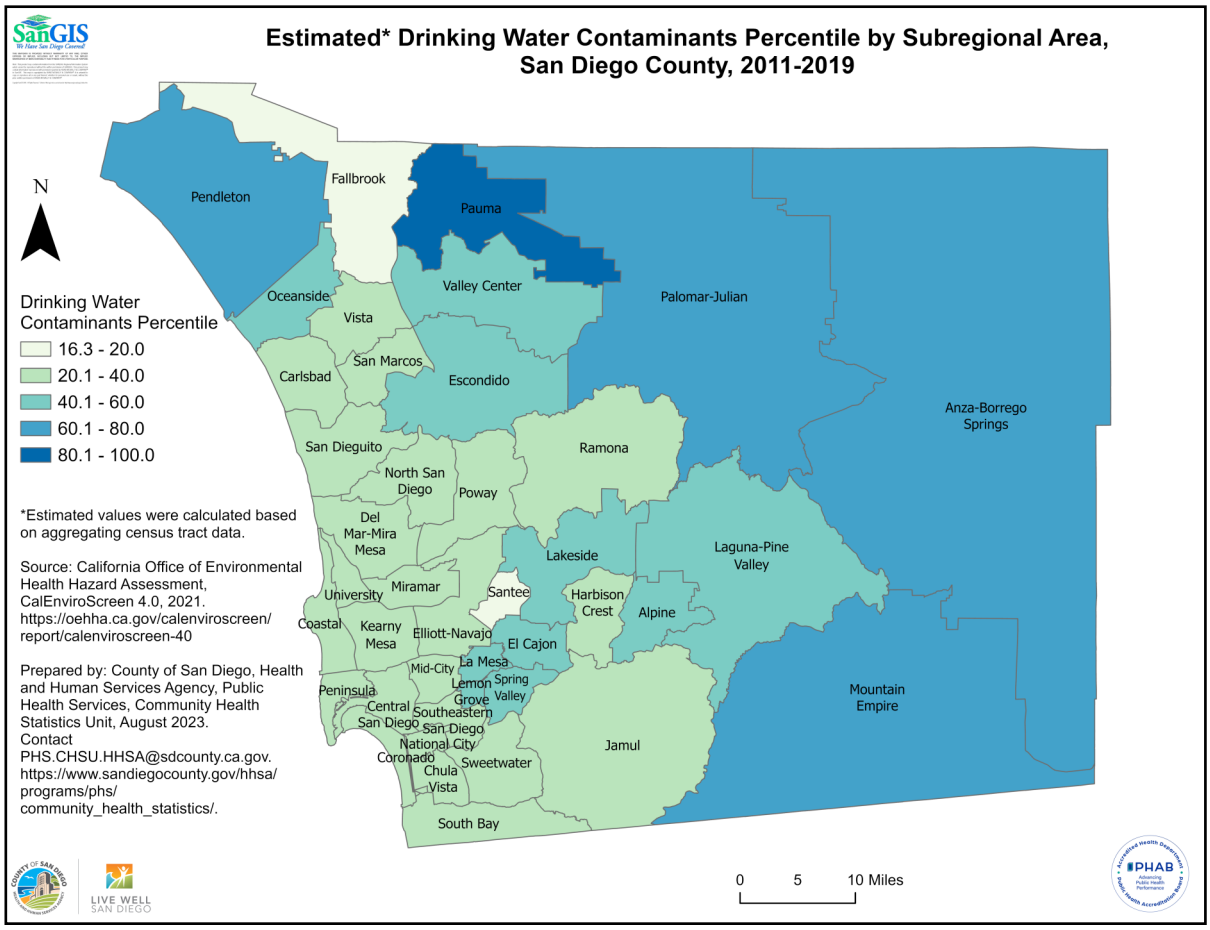


Figure 4: Estimated average drinking water contaminants percentile by subregional area, San Diego County, 2011—2019*

***Table 1:** Subregional Areas with the Highest Estimated* Average of Drinking Water Contaminants Percentile, San Diego County, 2011-2019*

Subregional Area (SRA)	Region	Percentile
Pauma	North Inland	94.83
Mountain Empire	East	78.58
Anza-Borrego Springs	North Inland	62.25
Palomar-Julian	North Inland	61.83
Pendleton	North Coastal	60.06
Lakeside	East	59.30
Oceanside	North Coastal	57.09
Laguna-Pine Valley	East	51.49
Lemon Grove	East	46.39
La Mesa	East	45.25

**Estimated values were calculated based on aggregating census tract data.*

- A higher percentile indicates that there are more contaminants in the water.
- The average drinking water contaminants percentile in **Pauma SRA** in North Inland Region was higher than **94.83%** of the census tracts in California between 2011 and 2019.
- Between 2011 and 2019, **North Inland and East Regions** were impacted with the highest percentile for average drinking water contaminants in San Diego County.

Water Quality

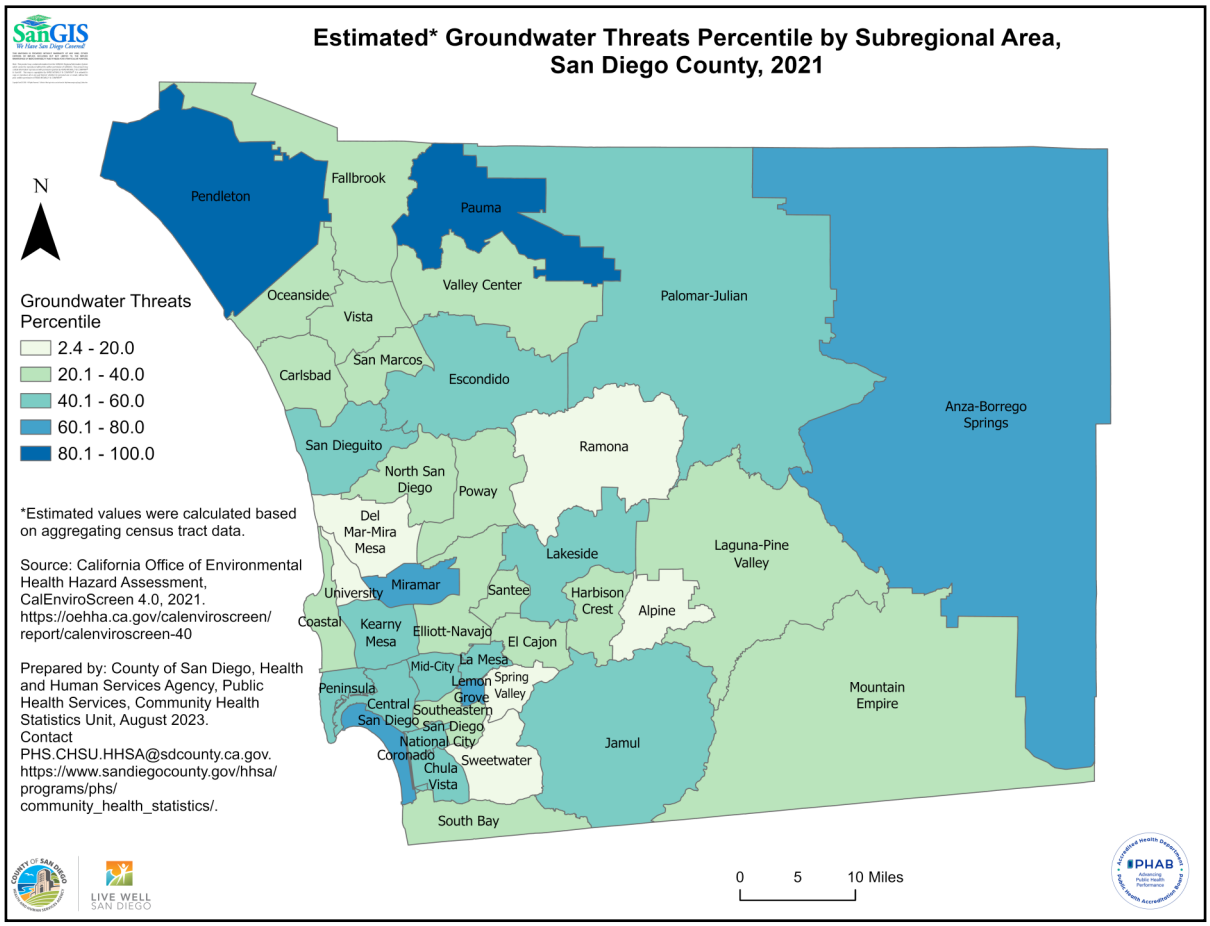


Figure 5: Estimated average groundwater threats percentile by subregional area, San Diego County, 2021*

***Table 2:** Subregional Areas with the Highest Estimated* Average of Groundwater Threats Percentile, San Diego County, 2021*

Subregional Area (SRA)	Region	Percentile
Pendleton	North Coastal	98.67
Pauma	North Inland	83.21
Miramar	North Central	76.17
Anza-Borrego Springs	North Inland	72.49
Coronado	South	62.36
Lemon Grove	East	60.36
Central San Diego	Central	59.11
San Dieguito	North Coastal	54.20
Jamul	East	52.96
Peninsula	North Central	51.75

**Estimated values were calculated based on aggregating census tract data.*

- A higher percentile means there are a greater number of threats to sources of groundwater in a region.
- In 2021, **Pendleton SRA** in North Coastal Region had the **highest average groundwater threats percentile** compared to all other SRAs in San Diego County.
- The average groundwater threats percentile in **Pendleton SRA** in North Coastal Region were higher than **98.67%** of the census tracts in California in 2021.

Water Quality

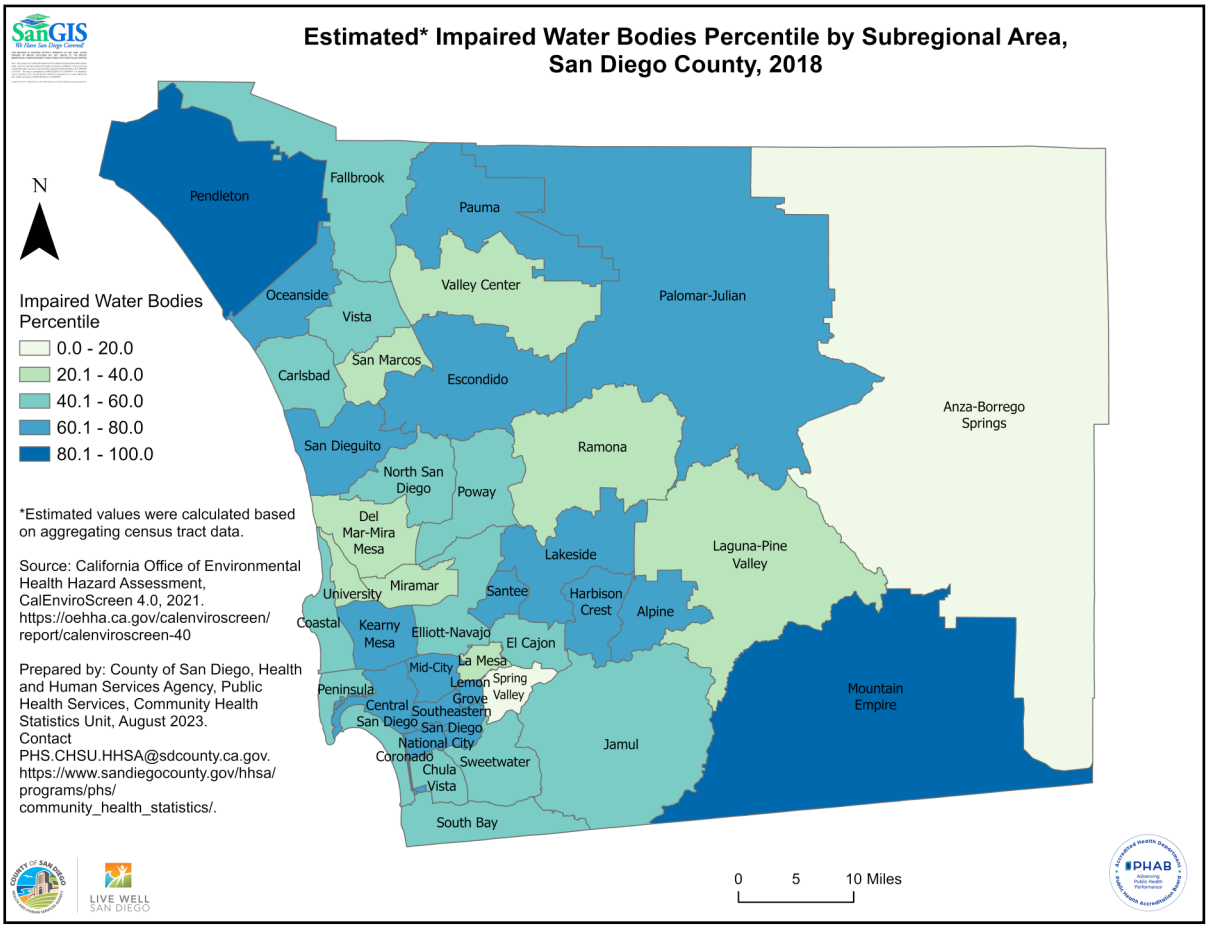


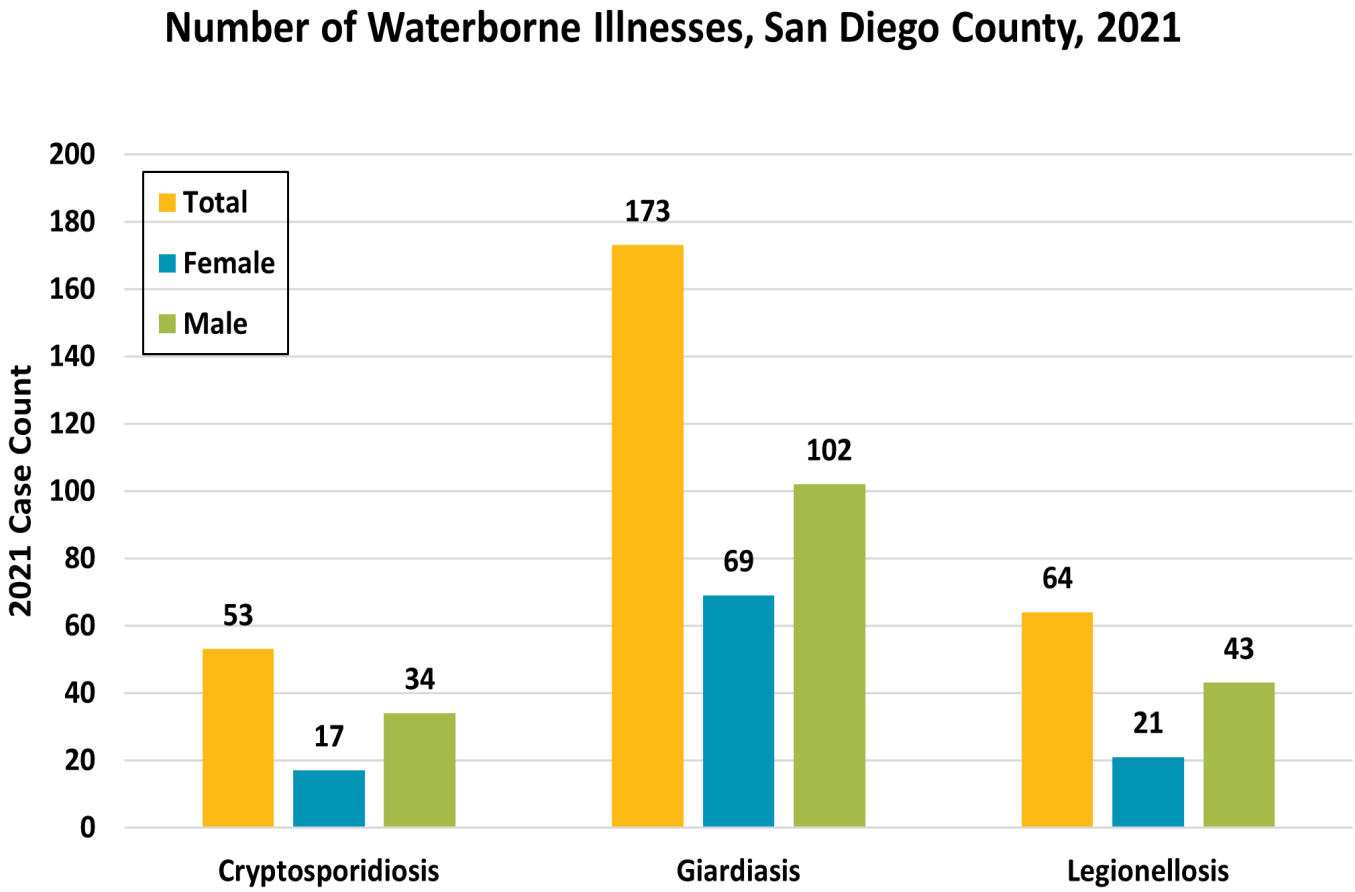
Figure 6: Estimated average impaired water bodies percentile by subregional area, San Diego County, 2018*

***Table 3:** Subregional Areas with the Highest Estimated* Average Impaired Water Bodies Percentile, San Diego County, 2018*

Subregional Area (SRA)	Region	Percentile
Pendleton	North Coastal	96.79
Mountain Empire	East	86.96
Lemon Grove	East	77.25
Southeastern San Diego	Central	75.82
Kearny Mesa	North Central	73.86
Escondido	North Inland	73.11
Pauma	North Inland	72.15
Mid-City	Central	71.15
Santee	East	70.00
San Dieguito	North Coastal	69.65

**Estimated values were calculated based on aggregating census tract data.*

- A higher percentile indicates that more water bodies, such as lakes and rivers, in a region, were impaired and were not meeting water quality standards set by the EPA.
- The average impaired waters percentile in **Pendleton SRA** in North Coastal Region was higher than **96.79%** of the census tracts in California in 2018.



Source: California Department of Public Health. (2021). *Infectious diseases by disease, county, year, and sex [Data set].* https://data.chhs.ca.gov/dataset/infectious-disease. Accessed 07/26/23.

Prepared by County of San Diego, Health and Human Services Agency, Public Health Services, Community Health Statistics Unit, August 2023. Contact 619.692.6672. PHS.CHSU.HHSA@sdcounty.ca.gov. https://www.sandiegocounty.gov/hhsa/programs/phs/community_health_statistics/.

Figure 7: Number of waterborne illnesses, San Diego County, 2021

- In 2021, giardiasis had the highest total number of reported cases when compared to cryptosporidiosis and legionellosis.[24]
- More cases of cryptosporidiosis, legionellosis, and giardiasis were reported among males compared to females in 2021.[24]

Water Quality and Its Complications: Protection of Our Waterways

Ensuring the protection of our water quality is crucial to maintaining its sustainability for drinking, swimming, fishing, and aquatic life protection. Developing watersheds is a way of safeguarding water sources throughout the state. Watersheds refer to land areas near water sources that act as barriers, preventing water from flowing into other rivers or surface water areas. Keeping watersheds safe helps maintain healthy water quality.[8]

Pollutants can contaminate California's streams, rivers, lakes, and coastal waters, making them unsuitable for use and compromising the quality of the water source. To safeguard California's groundwater supply from contamination, it is crucial to take extensive measures to minimize water contamination by limiting sources of contamination such as agricultural and industrial runoff.[8]

There are several other ways to protect water sources, including:

- *Limit use of fertilizers and pesticides*
    - Avoid overusing pesticides, fertilizers, and other materials to prevent harmful runoff from seeping into groundwater and surface water sources.[25]
    - Be cautious when using fertilizers and pesticides during expected rainfall. There is a higher risk of harmful runoff that can contaminate nearby water sources.[25]
- *Cleaning up and preventing littering*
    - Dispose of waste properly. Litter can travel long distances in water and may cause harmful conditions for human health and aquatic life.[26]
- *Conserving Water*
    - To reduce water shortages and the need to treat contaminated water, turn off the tap when running water is not actively being used.[27]

Prevention Tools for Public Health Professionals: Water Quality Critical Pathway

There are many opportunities for public health professionals in the community to help reduce the risk of water quality and to improve the health outcomes of individuals who already have the disease. To assist in community health efforts, a *Water Quality Critical Pathway (shown on page 15)* was developed.

The *Water Quality Critical Pathway* is a tool to be used in health promotion and disease prevention efforts. Its purpose is to identify populations at greater risk from poor water quality, and to identify prevention and early intervention opportunities. The *Water Quality Critical Pathway* displays a diagram of the major risk factors and intermediate outcomes or related diseases that have an impact on, or result from, poor water quality. Risk factors are marked as environmental (solid-colored bars), such as drinking water contaminants or groundwater threats.

Beneath the risk factors diagram is a data grid describing the San Diego resident population in relation to selected elements of the pathway. The data grid is designed to assist in quick identification of opportunities for interventions that might have a high impact on a particular disease. The data represent all San Diegans, not only those with a particular disease. The left axis (bar) indicates the percentile of the population with a known risk factor or intermediate outcome. The right axis (diamond) indicates the frequency of reported incidence of a particular disease within the population that is specified. The data are described fully in the complete version of the Critical Pathways.

In addition, the Community Health Statistics Unit website (www.SDHealthStatistics.com) provides detailed demographic, health and facility data including maps of geographically formatted health data. Also available are links to other County data sources, state, and national sites of interest. For further assistance with data or interpretation, please contact the Community Health Statistics Unit.

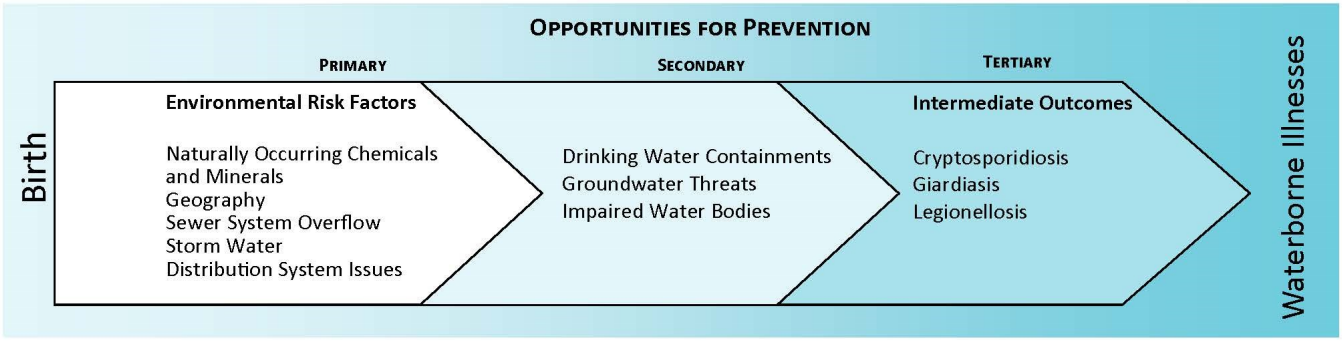
Water Quality Critical Pathway

Critical Pathway

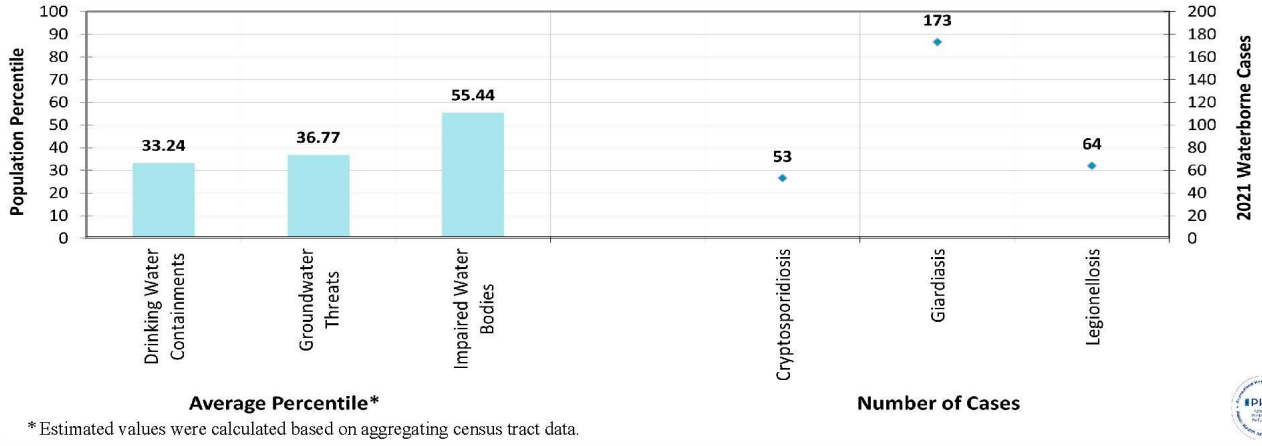
Water Quality

COUNTY OF SAN DIEGO HEALTH AND HUMAN SERVICES AGENCY

LIVE WELL SAN DIEGO



Characteristics of Residents, San Diego County
Selected Elements from Water Quality Pathway



*Estimated values were calculated based on aggregating census tract data.

County of San Diego ▪ Health and Human Services Agency ▪ Public Health Services ▪ Community Health Statistics Unit ▪ www.SDHeathStatistics.com ▪ (619) 692 -6667 10/2023

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