

Gulf Coast Region
Water Quality Management Plan
Update: 2005

Appendix III:
On-Site Sewer Facilities -
Considerations, Solutions, and Resources

“To promote the preservation, protection, and enhancement of ground water and surface water quality through coordination and integration of water quality programs in the 13-county Gulf Coast Region.

H-GAC Water Quality Management Program Mission Statement

August 22, 2005

HOUSTON-GALVESTON AREA COUNCIL

**PREPARED IN COOPERATION WITH THE
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ON-SITE SEWER FACILITIES (OSSF) in the HOUSTON-GALVESTON AREA COUNCIL REGION: 2005

INTRODUCTION

In its 2004 Water Quality Management Plan (WQMP), the Houston-Galveston Area Council (H-GAC) identified a number of regional watershed issues to address H-GAC goals to (1) protect the region's water resources, (2) improve water quality, and (3) ensure the quality of habitat and estuaries. These include the problem of on-site sewer systems, storm water pollution, permitting and enforcement, and protection of Galveston and Matagorda Bays. On-site sewer facilities (OSSF) were chosen as the top priority. Their potential immediacy of possible impact on water quality in the entire region and possible human health affects warrant consideration.

To address the OSSF problem, H-GAC initiated a three-year H-GAC study under the WQMP to collect information on the magnitude of the problem, develop a task force to propose solutions, prepare a regional template for action using several communities in pilot programs, prepare an action plan, and implement the findings.

This document covers research to identify incidence of and associated risk from illness related to OSSF malfunctioning, outreach materials for educational purposes, possible solutions used in the region, and a regulatory framework, including location of OSSF violations by selected county. Information is examined in light of what would most benefit the stakeholders in the region. Emphasis is directed toward new and creative approaches to resolving the OSSF problem with an emphasis on assisting "working poor," ethnic and/or minority populations.

Because of unforeseen budgetary constraints, the first year will be the only year in the project. If funding becomes available in the future, H-GAC will use this study as the basis for the next phase.

Sanitation Service

The United States has made tremendous progress in the last 50 years to ensure that its citizens have access to adequate sanitation. The nation progressed from 73% of households having adequate sanitary infrastructure readily available in 1950 to 99.3 percent, based on the 2000 census.¹ Sanitary infrastructure falls into two categories: centralized and decentralized. Centralized facilities, operated by municipalities or other legally constituted entities, provide the majority of this service. These wastewater treatment facilities discharge large volumes of treated effluent directly to the region's water bodies. Decentralized wastewater treatment systems, generally called septic systems or

on-site sewer facilities (OSSF) are so-named because they treat sewage at the location where it is produced – “on-site” at individual homes or businesses. Treated effluent for the most part, stays on site. These small, decentralized facilities provide approximately 25% of the sanitary services in the U.S. and in the H-GAC region. Currently, one third of all new housing and development uses OSSF for sanitation needs.² While the remaining number of un-served or under-served households is statistically small, nationwide they comprise more than 670,000 households and 1.95 million people. Initial EPA estimates indicate approximately 47,000 households and 150,000 people in Texas are so affected.

According to the Environmental Protection Agency (EPA), after contamination by improperly stored or transported substances, state and local authorities view failing septic systems as the second largest threat to groundwater quality in the nation.³ Improperly installed and maintained, inadequately sized, and/or malfunctioning OSSFs affect the region’s water quality¹ because OSSF effluent can contaminate both ground and surface water with bacteria, nitrates and other harmful components.

The local governments in the 13-county H-GAC region take many measures to assure adequate sanitation, including building facilities for municipal and private domestic wastewater treatment, industrial wastewater treatment facilities and using OSSF. According to 2000 Census data, the number of on-site sewer facilities in the H-GAC region is approximately 213,000 (Table 1). This figure is considerably larger than the EPA figure for the entire state of Texas and is an indication that the effects of OSSF on regional water quality may be greater than initially thought at the national level. Individual county figures are also included in Table 1.

EPA estimates that between 10% and 20% of all on-site systems do not adequately treat sewage, and more than half of the systems are over 30 years old.^{2, 4} In certain areas, as many as 40% of the OSSF may be failing, malfunctioning, or inadequately designed systems. This translates to affect between 15,000 and 26,000 households or 50,000 to 85,000 people in the H-GAC region. No specific demographic identifies the population with inadequate or malfunctioning OSSF systems. They are located in both rural and urban communities in the region, often in clusters or pockets within adequately served municipalities or adjacent to utility districts. Twice as many citizens without adequate sanitary service reside in urban as rural areas. Over a third of the population served by OSSF has an income below the official federal poverty level. Many are “working poor,” and/or members of minorities. Half own their own homes and half are renters.¹

Possible Health Risks

More than a million people in the U.S. become ill each year because of exposure to raw sewage through sanitary sewer malfunctions that reach water bodies and/or contaminate groundwater and shallow water wells.^{3, 4} Additionally, OSSF overflows or malfunctions can contaminate yards, children’s playground equipment, pets, gardens, and swimming pools. Untreated or raw sewage contains bacteria like E. coli, viruses, helminthes

TABLE 1
Number of On-Site Sewer Facilities
in H-GAC Region by County - U. S. Census*

CATEGORY	TOTAL POPULATION		PUBLIC SEWER		SEPTIC SEWER		PERCENT INCREASE
	1990	2000	1990	2000	1990	2000	INCREASE
CENSUS	1990	2000	1990	2000	1990	2000	SEPTIC SEWER
TEXAS	16,986,510	20,851,820	5,690,550	6,985,381	1,266,713	1,554,953	22.7
COUNTY							
AUSTIN	19,832	23,590	4,045	4,646	4,665	5,358	14.8
BRAZORIA	191,707	241,767	48,231	58,669	25,772	31,350	21.6
CHAMBERS	20,088	26,031	3,904	5,006	3,991	5,117	28.2
COLORADO	18,383	20,390	4,540	5,015	3,875	4,281	10.4
FORT BEND	225,421	354,452	66,912	100,697	9,721	14,629	50.5
GALVESTON	217,399	250,158	86,366	97,032	12,733	14,306	12.3
HARRIS	2,818,199	3,400,578	1,125,588	1,244,802	44,120	48,793	10.6
LIBERTY	52,726	70,154	8,125	9,629	13,894	16,465	18.5
MATAGORDA	36,928	37,957	12,182	12,229	6,023	6,046	0.4
MONTGOMERY	182,201	293,768	43,561	66,499	29,763	45,436	52.7
WALKER	50,917	32,663	10,285	11,826	7,771	8,936	14.9
WALLER	23,390	32,663	4,272	5,789	4,398	5,958	35.5
WHARTON	39,955	41,188	9,509	9,701	6,349	6,477	2.0
TOTALS	3,897,146	4,755,205	1,427,520	1,631,540	173,075	213,152	

*Note: H-GAC was not able to compare these data with information obtained directly from the individual counties. Counties generally record the number of permitted OSSFs within their jurisdictional boundary. In most cases, permits are issued for new or repair construction only. There is no mechanism for recording the number of systems associated with older homes.

intestinal worms) and parasites (e.g. Cryptosporidium). Most of those stricken suffer minor complaints (stomach cramps, diarrhea, headache, vomiting, and low-grade fever), but untreated sewage also spreads life-threatening ailments like cholera and Hepatitis A.⁵ Some of these pathogenic organisms and the diseases they cause appear in Table 2.

TABLE 2

Infectious Agents Potentially Present in Untreated Domestic Wastewater

Organism	Disease Caused
Bacteria	
<i>Escherichia coli</i>	Gastroenteritis
<i>Leptospira</i>	Leptospirosis
<i>Salmonella typhi</i>	Typhoid Fever
<i>Salmonella</i> (= 2,100 serotypes)	Bacillary dysentery
<i>Vibrio cholerae</i>	Cholera
Protozoa	
<i>Cryptosporidium parvum</i>	Cryptosporidiosis
<i>Entamoeba histolytica</i>	Amoebic dysentery
<i>Giardia lamblia</i>	Giardiasis
Viruses	
<i>Various Enteroviruses</i>	Gastroenteritis, Meningitis
<i>Hepatitis A virus</i>	Infectious hepatitis

Source: EPA Wastewater Technology Fact Sheet: Ultraviolet Disinfection⁶

Public health officials report the number of cases of Hepatitis A in the H-GAC region each year. These are shown in Table 3. Considering the population of the region, the number of reported viral hepatitis cases is small. However, the exact number of people actually affected by malfunctioning OSSF in the H-GAC region is difficult to determine. Many of the symptoms of illness related to exposure to raw sewage are similar to common varieties of influenza. Therefore, the connection between illness and exposure to raw sewage is often hard to establish. According to the Centers for Disease Control (CDC), the range of severe symptoms include acute dehydrating diarrhea (cholera), prolonged febrile illness with abdominal symptoms (typhoid fever), acute bloody diarrhea (dysentery), and chronic diarrhea (Brainerd diarrhea). Pathogens may contaminate water bodies used for recreational purposes, such as lakes, bayous, and bays. While persons are in the water, exposure to pathogens occurs, but people do not become ill until after arriving home. Thus, the connection between recreational exposure to contaminated water and the symptoms of the illness can be overlooked. Additionally, some affected may not have the financial

resources to seek medical attention. There have been no major outbreaks of cholera, typhoid, or Hepatitis A in the H-GAC region for some time. However, there are small sporadic outbreaks of some illnesses, such as Hepatitis A.

TABLE 3

Viral Hepatitis Cases Reported in H-GAC Region⁷

Residence Area	1992	1993	1994	1995	1996	1997	1998	1999	Total
Austin	0	0	0	1	0	0	5	2	8
Brazoria	21	15	13	18	18	54	27	10	176
Chambers	1	0	1	2	1	1	2	1	9
Colorado	0	0	1	1	0	0	1	1	4
Fort Bend	28	15	24	43	17	61	68	41	297
Galveston	42	26	48	49	57	41	62	37	362
Harris	491	642	726	796	792	768	551	157	4,923
Liberty	11	2	5	5	3	0	7	7	40
Matagorda	8	3	1	1	4	5	19	4	45
Montgomery	13	8	3	5	10	7	24	34	104
Walker	68	39	24	24	24	6	12	11	208
Waller	0	1	1	1	7	2	3	2	17
Wharton	3	1	2	3	5	4	10	7	35
Total	686	752	849	949	938	949	791	314	6,228

An incidence of Hepatitis A in north Harris County in 1990 was traced to raw sewage in near by drainage ditches.⁸ Additional incidences may be identified from county and city health department records. In other parts of the country, such incidences have raised concern about malfunctioning or inadequate treatment facilities to a level sufficient for corrective action.

In addition to illness caused directly from pathogens, there is also a risk to infants who are exposed to nitrates, compounds formed from nitrogen. In water bodies, excess nitrogen comes from untreated sanitary wastewater containing urine, feces, food waste, and cleaning compounds.⁹ “Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) in infants, which reduces the ability of the blood to carry oxygen. If left untreated, methemoglobinemia can be fatal for affected infants.⁹ A drinking water maximum contaminant level has been set for nitrates (10 milligrams per liter) because of this health risk. Even properly functioning conventional septic systems, however, may not remove enough nitrogen to attain this standard in their effluent.⁹ Methemoglobinemia

from exposure to water contaminated with nitrates does not appear to be a recorded health problem in the H-GAC region. This does not mean that the risk does not exist, however.

In the H-GAC region, elevated levels of fecal coliform and other sewage bacteria have resulted in beach closures, restrictions on contact recreations in certain streams and bayous, and shellfish bed closures. "Untreated sewage (causes) swimmers and water skiers (to) develop skin rashes, amoebic dysentery, and parasitic worm diseases... Shellfish can transmit nearly every waterborne pathogen to humans. These pathogens cause gastrointestinal illness or more seriously, Hepatitis, Typhoid and Cholera."¹⁰ Drought conditions or extreme flooding, the latter the results of sewage washed from its source and into water bodies, exacerbate related health problems.

Difficulty of the Task

Closing the gap between citizens with adequate sanitary facilities, and citizens who do not, is a difficult proposition - malfunctioning OSSF systems are a collection of the most intractable situations affecting water quality.¹ Either there is no good solution, or the solution is too costly to implement, for the provider, the property owner, the resident, or all three. Further complicating the matter, a large number of current OSSFs may not be adequately operated or maintained and/or are nearing the end of their design life expectancy and the owners may not be aware of OSSF malfunction.

Problems with OSSF may also be societal in nature. If certain individuals lack the resources to solve their own OSSF situation, those in society with sufficient resources must decide how to solve the OSSF problem for them. This includes determining whether it is acceptable to have prescribed pockets of homes with sewage flowing across front yards and alongside children's playgrounds existing in the community, along waterways, or near beaches. The level of impact on public drinking water and acceptable human health risks associated with cholera, hepatitis, and other water borne diseases in the region remains to be determined.

The incidences of illness in humans resulting from exposure to untreated sewage are spectacular in drawing attention, but thankfully, relatively rare. The one of the most notable in Texas was contamination of Brushy Creek near Austin in 1994.¹⁰ An errant discharge from a municipal sewage plant made several dozen residents ill. Thus far, H-GAC found no recorded data indicating OSSF inadequacies or malfunctioning in point of fact cause illness in humans in its region. Without this type of occurrence coupled with media impetus, OSSF problems are seen as isolated nuisances. In an era of shrinking federal, state and local funds for services, it is difficult to secure funding to correct nuisances.

ASSESSING THE PROBLEM – LOCATION

Prior Studies

Malfunctioning, inadequate OSSF problems have occurred in the H-GAC region for a long time. An H-GAC study in 1999, entitled On-Site Sewage Target Communities, identified localities with OSSF problems in need of correction. (Figure 1). This was by no means an all-inclusive list of regional problems, but rather an assessment of conditions. It was a collection of communities in the region generally known to have malfunctioning or inadequate OSSFs, as identified by area officials and environmental professionals. Because of the physical size and population of the OSSF target communities, the proposed solution was to provide municipal wastewater service to the communities, which was cost prohibitive. In the intervening 6 years, only one community of the original 25 has had problems addressed – the Aldine community area in Harris County. Here construction of a facility to serve the Tasfield portion of Aldine is under way and design for North Houston Heights is nearing completion. Plans for other projects in the Aldine community area are in various stages of implementation. With funding from the Aldine Taxing Authority, supported by business in the area, solutions for Aldine are likely to succeed.

The Gulf Coast Authority evaluated two other communities, Beaumont Place and Fruitland Place, in a 2004 study funded by the Galveston Bay Estuary Program (GBEP). The study determined needs, engineering, feasibility and funding requirements to correct OSSF problems in these communities. Beaumont Place consists of 750 homes with a population of 2,500. Resident annual income is 33% below that for the surrounding county. The capital cost estimate to correct its OSSF problems ranged from 5.4 to 7.3 million dollars. Options included either building new wastewater facilities or providing service through the City of Houston. Based on the income of the residents this cost is prohibitive. Fruitland Place has an approximate population about 800 in 255 homes. Resident annual income is 24% below the average for the surrounding county. Estimated cost to alleviate its OSSF problems is approximately 2.5 million dollars, also cost prohibitive. Clearly, it is not possible to solve the region's OSSF problems by providing municipal wastewater service to everyone. New and creative approaches to resolving the OSSF problem, with an emphasis on assisting "working poor," ethnic and/or minority populations are needed.

2005 Evaluation of Incidence of OSSF Problems

H-GAC obtained records of OSSF permits issued and complaints/violations received from selected counties in the region from 2001 to 2005. In this initial phase of H-GAC's research, counties with the highest numbers of OSSF systems and/or greatest growth rate were examined. These included records of violations for Harris, Fort Bend, Galveston, Brazoria, Montgomery and Waller Counties. As additional funding becomes available, H-GAC will obtain information for the other seven counties in its region.

According to information provided by the counties, the number of permits issued between 2001 and 2005 in selected counties is small (Table 4). There are several reasons why individuals obtain OSSF permits in most counties. The first is for installing a new septic system; second, to replace an old system; or finally, they own a septic system identified by the authorized agency to be failing resulting in an involuntary repair of their system. In this latter case, a home or business owner must obtain a permit in order for repair work to begin. It is noteworthy that not all systems issued permits are actually installed. Fort Bend County data is slightly different, the figures provided by the county represent those OSSF that were constructed, inspected, and found to have met OSSF construction standards, and were thus allowed to be placed into operation by the county.

Table 4

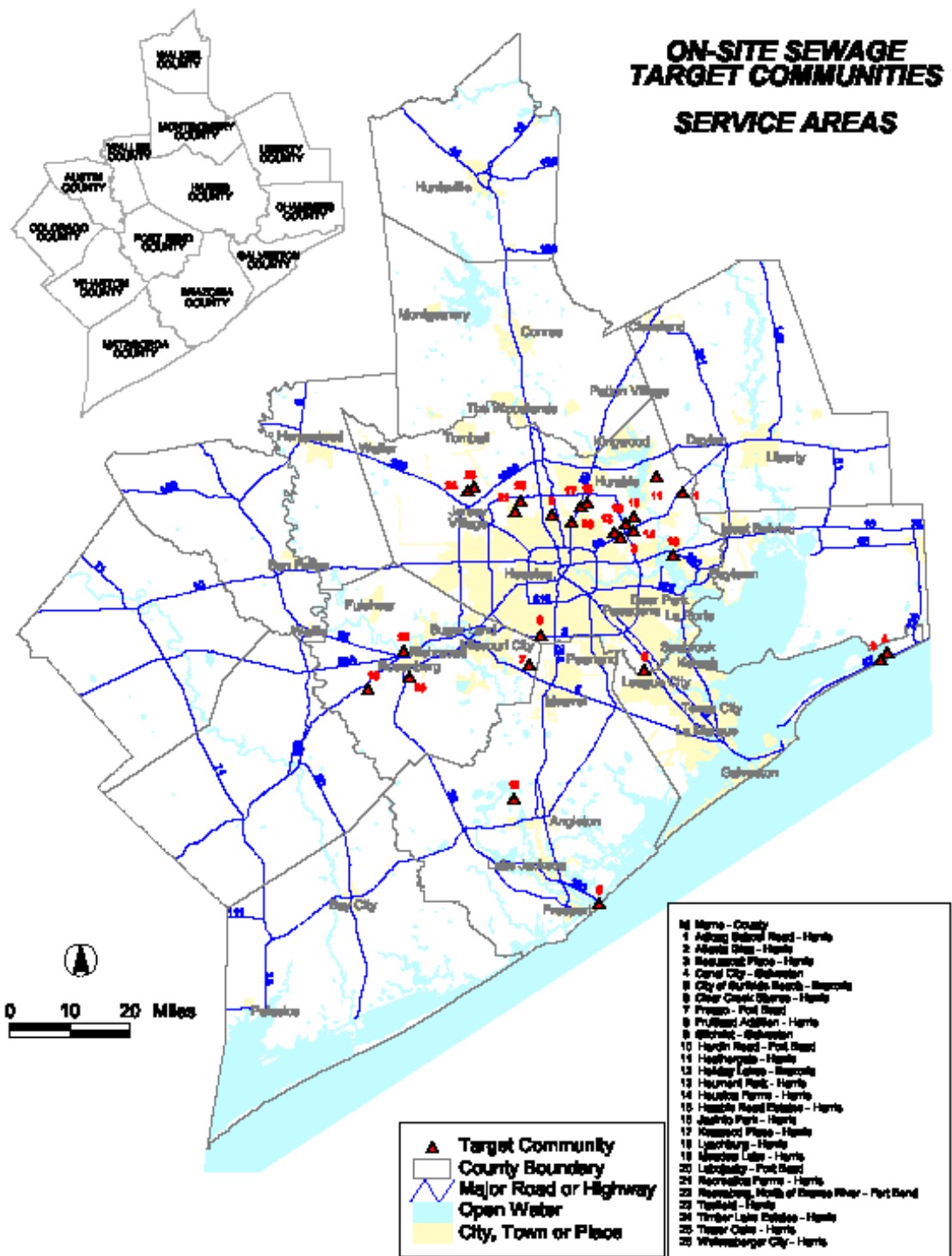
Numbers of OSSF Permits Issued in Selected Counties, 2001 - 2005

Number of OSSF Permits Issued					
	2001	2002	2003	2004	2005 (7/05)
Brazoria	No data available	755	796	735	332
Fort Bend	371	476	509	472	225
Galveston	432	461	506	566	178 (4/05)
Harris	1388	1397	1424	1174	603 (6/05)
Montgomery	2072	2304	2256	2239	1205
Waller	287	380	345	302	381

Complaints/Violations recorded are those identified by private citizens, reported to, and investigated by the county. Records are generally in the form of street address and type of violation. Some were electronic, others only in hard copy form. Often the initial information received included storm water and other violations along with those for OSSF. In these cases, H-GAC sorted mixed source violations to obtain the OSSF set. Where necessary, H-GAC converted the data to electronic format. Counties generally do not have the workforce to monitor OSSF once installed either in new construction or in response to repair. According to county records, the levels of complaints/violations are seen in Table 5. This number is small considering the number of OSSF systems in each county according to the U.S. Census. Examination of county records may produce misleading results because they only contain data on reported violations.

The number of septic systems in the most populous counties in the H-GAC region has increased dramatically in the past 20 years (Table 6). However, the actual number of complaints/violations identified by the counties is small in relation to the estimated number of malfunctioning and/or failing OSSF. Either the estimate for potentially failing systems is entirely incorrect, or the number of systems reported hugely under estimates the magnitude of the problem. Small numbers could be the result of several factors. First, after initial installation inspection, no additional inspections occur at regular intervals to

Figure 1



**TABLE 5
OSSF Complaints/Violations 2002-2005**

OSSF Complaints/Violations					
Entity	2002	2003	2004	2005 (7/05)	Percentage of Complaints/Violations to Total OSSF*
Brazoria	169	137	90	15	0.29%
Fort Bend	305	278	256	123	1.75%
Galveston	58	111	84	35	0.59%
Harris	509	611	577	308	1.18%
Montgomery	370	442	447	473	0.98%
Waller	13	40	58	20	0.97%
Trinity River Authority	N/A	41	86	66	1.08%**
San Jacinto River Authority	4.50	4.50	4.50	4.50	0.30%**

*County Data: 2004 Violations/2000 Total septic systems Table 1; Trinity River Authority - 7,950 septic systems; San Jacinta River Authority - 1,500 septic systems.

**Table 6
Summary of Septic Systems, Failures and Violations By Selected Counties**

CATEGORY	SEPTIC SEWER		Estimated Number of Failing Septic Systems Based On EPA's 20% OSSF Failure Rate	Number of OSSF Complaints/Violations
	1990	2000		
CENSUS	1990	2000	2000	2004
COUNTY				
BRAZORIA	25,772	31,350	6270	90
FORT BEND	9,721	14,629	2925.8	256
GALVESTON	12,733	14,306	2861.2	84
HARRIS	44,120	48,793	9758.6	577
MONTGOMERY	29,763	45,436	9087.2	447
WALLER	4,398	5,958	1191.6	58

determine if the OSSF is properly maintained. Counties simply do not have the workforce to do so. Secondly, it is likely that OSSF problems are under reported – neighbors, turning in neighbors is not an efficient way to identify violations. Alternatively, the OSSF problems are not as large as originally believed. Further study is required to discern which of these reasons is correct.

H-GAC uses Graphical Information Systems (GIS) technology to display locations of violations on aerial maps of selected communities. Many clusters or “hot spots” of frequent OSSF violations were identified in the counties who submitted complaint/violation data electronically (Brazoria, Fort Bend, Harris, and Waller). These are presented in Appendix I. Data for Montgomery County was also obtained, but in hard copy. These data must be converted to electronic format before entry into the GIS system. It is difficult to determine the exact incidence of OSSF complaints/failures in county records, because of imprecise definitions of what constitutes a complaint and/or violation.

Identifying OSSF violation clusters using the aerial maps and GIS serves two purposes. First, it assists in identifying target communities as possible candidates for the proposed Target Community Assessment Team process, described in subsequent sections. Secondly, it also indicates areas where enforcement can be concentrated and possible health issues monitored. Those clusters immediately adjacent to water bodies should be given priority for remediation and enforcement because of the possibility that sewage may affect large numbers off site.

H-GAC also maintains databases that include the service area boundaries for cities, municipal utility districts, and other political subdivisions. When used in conjunction with the violation data, these data indicate possible solutions to the OSSF problem by the violator receiving sanitary sewer service from a major provider in the area. Taken together these databases indicate whether a particular cluster has been by-passed for service by a service provider, indicating another option for service.

Detailed GIS reviews of violations along Bastrop Bayou in Brazoria County, and Harris County Precinct 2 were conducted because of H-GAC’s partnership with other on-going research in these areas. Dickinson Bayou, in Galveston County, should be examined using the GIS method in the future, because of a previous OSSF study in that area. These maps appear in Appendix II.

ASSESSING THE PROBLEM: HEALTH AFFECTS, HEALTH RISKS

Malfunctioning, antiquated, or poorly installed on-site sewer systems have long been reported to be a “significant source of ground water contamination leading to waterborne disease outbreaks and other adverse effects” throughout the U.S.⁹ However, in the H-GAC region, this connection is difficult to make. According to the Centers for Disease Control (CDC), “Sporadic cases are under-reported. CDC surveillance may detect a small

proportion of outbreaks in the United States." ¹¹ Determining factors for health effects are hard to identify. These include

- Severity of the health impact;
- Population affected by the disease;
- Quality-of-life impact on this population;
- Strength of the evidence supporting the connection between the disease and the suspected cause; and
- Proportion of the health risk attributable to the OSSF problem.¹²

The CDC indicates there is a special risk for Hepatitis A for Hispanic populations, a large number of whom reside in the H-GAC region. Using data from CDC's Viral Hepatitis Surveillance Program (VHSP), the incidence of Hepatitis A nationwide is 17.6 per 100,000 in persons of Hispanic ethnicity, versus a rate of 7.5 per 100,000 in non-Hispanics, a more than two-fold difference.¹² Incidence rate in U.S. counties with a high Hispanic population (greater than 15%) to counties with a lower Hispanic population (less than 15%) show counties having a high Hispanic population had an incidence rate that averaged 2.1 times higher. OSSF malfunction and/or inadequacies may be part of the problem that generated these statistics.¹¹

The consensus of many local officials, regulatory authorities, environmental groups, health providers, staff and some in the public sector is that the H-GAC region is no different from any other part of the country – there is a connection between untreated waste from OSSF, disease, and other adverse effects. There is very little actual data from the region to support this idea.

To establish such a connection, H-GAC examined federal, state and local sources of information. These were by no means all-inclusive, but covered a broad spectrum of possibilities and were intended as a first step laying the foundation for year two of the proposed H-GAC study on the relationship between OSSF, waterborne disease, and water quality. The list of initial governmental contacts appears in Table 7 and the public contacts in Table 8.

In our initial round of contacts, the following were unable to provide any information about waterborne disease outbreaks in the H-GAC region and/or if found, their relationship to OSSF difficulties:

American Water Resources Association
Centers for Disease Control
Children's Environmental Health Institute
City of Houston Health Department
Harris County Health Department
M. D. Anderson Cancer Center
Sam Houston Resource Conservation & Development Council
Texas Commission Environmental Quality

Initial Contacts: General Considerations

Texas A & M Extension Services

Dr. Bruce Lesikar, Texas A & M Extension Services, indicated that currently there is very little data to positively linking illness to failing septic systems. Mr. Lesikar felt outreach to and education of the end user, the public, is extremely important. This coupled with better maintenance and enforcement is required to protect the public and the environment. Installation of automatic reporting/monitoring devices on septic systems, pioneered in the United States by Harris County, would help log and trigger OSSF failure alarms as well as remind of regular maintenance. The tools to address the septic/illness problems exist, but lack public, private and governmental support for implementation. According to Dr. Lesikar, the most reasonable way to address OSSF issues contains the following key points.

- Getting one neighbor to fix his or her septic system, that person will then report others who have a failing system, a chain reaction will occur;
- Water quality bacteria tracking - providing scientific proof that the waste is from humans and not other animals; and
- A better review of septic systems operation and maintenance.

Texas Sea Grant

For most of the nearly 35 years of the Texas Sea Grant College Program's existence, its emphasis was largely focused on research that dealt with living marine resources and the environment in which they live. In recent years, emphasis has changed to include economic development and human activity along the coast. Dr. John Jacob suggested further investigation is needed for possible OSSF problems on Bolivar Island, in Galveston County, and along Dickinson Bayou, which has a history of failing OSSF and was the subject of a 1996 study by the Galveston County Health District.

Other Organizations

Several organizations did not have information themselves, but suggested other avenues of inquiry. Texas On-Site Wastewater Association (TOWA) provided several reference articles related to municipal wastewater treatment facility failure, but not OSSF failure, and their links to waterborne disease. These references may be found in the Bibliography.

TABLE 7

**Initial Governmental Contacts – Identification of Waterborne Disease:
Occurrence in the H-GAC Region Related to OSSF**

Category	Entity
Regulatory Agencies	Centers for Disease Control (CDC) National Institutes of Allergy and Infectious Diseases Texas Commission on Environmental Quality Texas Department of State Health Services Waterborne Outbreaks Water Testing for Bacteria Public Health Region 6/5 South U.S. Environmental Protection Agency Region 6 – Groundwater, OSSF Terra Tech (contractor)
Health Departments	Brazoria County City of Houston Harris County Fort Bend County Galveston County Montgomery County
Engineering Departments	Brazoria County City of Houston Fort Bend County Galveston County Harris County Montgomery County
General	Soil and Water Conservation Districts (SWCD) Texas Cooperative Extension Service U.S. Department of Agriculture Natural Resources Conservation Service

Texas Legislature

House Bill 2510, recently signed into law by the Texas Governor, removes the requirement that all persons who perform maintenance on septic sewer systems must be licensed professionals in favor of allowing the home/business owner to do so. The regulation does contain a provision for training requirements (6 hours), but many in the industry feel that the training requirement will not provide homeowners with enough knowledge and expertise to maintain their systems properly. An additional provision in the Bill exempts any maintenance requirements for parcels over 10 acres in size.

TABLE 8

Initial Non-Governmental Contacts – Identification of Waterborne Disease: Occurrence in the H-GAC Region Related to OSSF

Category	Entity
Universities and Medical Schools	Texas A & M University Extension Services University of Texas Health Science Center University of Texas Medical Branch Baylor College of Medicine M. D. Anderson Cancer Research Center
Trade and Professional Associations	American Water Resources Association (AWRA) National Small Flows Clearing House Texas On-Site Wastewater Association (TOWA) Texas Environmental Health Association (TEHA) National Onsite Wastewater Recycling Association (NOWA)
Scientific Journals	Applied and Environmental Microbiology
Web-based Searches	Environmental Health Human Health Future - Waterborne Disease, Epidemiology
Environmental Organizations	Citizen's League for Environmental Action Now Children's Environmental Health Institute Sam Houston Resource Conservation and Development Texas Environmental Health Association Texas Sea Grants Surf-Rider Foundation
Private	Community Health Organizations Neighborhood Associations

Initial Contacts: Studies from Outside of Texas

A number of studies relating illness in humans to OSSF problems have been performed in various parts of the U.S. Although these locations are dissimilar to the H-GAC region in climate and soil composition, they illustrate issues involved. A few of these studies are included in this report. This is not intended to be an all-inclusive list, but a survey to indicate directions for further literature research.

Borchard et al conducted a study which "investigated whether septic system density was associated with endemic diarrhea illness in children" in **central Wisconsin**. "Results indicate that septic system densities were associated with endemic diarrhea illness in central Wisconsin and the standards for septic systems should be evaluated to ensure that the public health is protected."¹²

The New York Sea Grant Extension Program performed an assessment in 1991. “Nearly half of the homes and businesses in the **Long Island Sound** watershed have septic tank waste disposal. When properly sited and maintained on a routine basis, septic systems are an excellent waste management alternative. However, when not properly sited or maintained, they can cause contamination of surface and groundwater resources, which leads to public health and pollution problems.”¹³

Dr. J. Paul and colleagues performed research on OSSF issues in the **Florida Keys**.

“Sewage waste disposal facilities in the Florida Keys include septic tanks and individual package plants in place of municipal collection facilities in most locations. In Key Largo, both facilities discharge into the extremely porous Key Largo limestone. To determine whether there is potential contamination of the subsurface aquifer and nearby coastal surface waters by such waste disposal practices, we examined the presence of microbial indicators commonly found in sewage and aquatic microbial parameters in injection well effluent, monitoring wells that followed a transect from onshore to offshore, and surface water above these wells in two separate locations in Key Largo in August 1993 and March 1994.” In conclusion, “results suggest that fecal contamination of the shallow onshore aquifer, parts of the near-shore aquifer, and certain surface waters has occurred.”¹⁴

Additional studies showed,

“Domestic wastewater disposal practices in the **Florida Keys** are primarily limited to on-site disposal systems such as septic tanks, injection wells and illegal cesspits. Poorly treated sewage is thus released into the highly porous subsurface Key Largo limestone matrix. To investigate the fate and transport of sewage in the subsurface environment and the potential for contamination of marine surface waters, we employed bacteriophages as tracers in a domestic septic system and a simulated injection well in Key Largo, Florida.” They concluded, “these results suggest that current on-site disposal practices can lead to contamination of the subsurface and surface marine waters in the Keys.”¹⁵

Sea Grant **Washington** evaluated septic information to determine health hazards associated with sewage system failure. “Bacteria and viruses from improperly treated human waste have long been associated with the transmission of typhoid, cholera, salmonella and hepatitis. However, disease outbreaks from contaminated drinking water, though dramatic, are rare. Failed sewage systems more typically cause a different kind of health hazard--shellfish contamination.”¹⁶

Incidents of Sewage Spills and Human Exposure to Sewage in Texas

In 1995, of all Hepatitis A cases occurring in **San Antonio**, 81% occurred in persons of Hispanic ethnicity, although only 56% of the population was Hispanic. The disease is concentrated in central San Antonio in an area of poor, crowded neighborhoods.¹⁷

Hidalgo County, on the border between Texas and Mexico, has had many outbreaks of Hepatitis A; for example, a small outbreak in five individuals in August 2004. The cause of the incident was never determined. However, exposure to raw sewage (OSSF) could be responsible.¹⁸

On June 13, 2005, the **City of Georgetown**, Williamson County, notified the public that a sewage spill had occurred near Blue Hole on the south fork of the San Gabriel River. Individuals who had contact with the water in Blue Hole or downstream through San Gabriel Park any time after noon on Saturday, June 11, 2005 were likely exposed to some sewage.¹⁹

Several streams in the **San Antonio and Leon River Basins**, and in **Peach Creek** in the Guadalupe Basin, have concentrations of bacteria that may pose a health risk for swimmers. A TMDL project is underway to address the impairments in seven of those segments -- Leon River below Proctor Lake, Segment 1221; Peach Creek, Segment 1804B; San Antonio River, Segment 1901; Salado Creek Segment 1910; Walzem Creek. Several streams in the San Antonio and Leon River basins, and in Peach Creek in the Guadalupe Basin, have concentrations of bacteria that may pose a health risk for swimmers. A TMDL project is underway to address the impairments in seven of those segments -- Leon River below Proctor Lake, Segment 1221; Peach Creek, Segment 1804B; San Antonio River, Segment 1901; Salado Creek Segment 1910; Walzem Creek, Segment 1910A; and Upper San Antonio River, Segment 1911.²⁰

H-GAC Region

The Galveston Bay Estuary Program examined **Dickinson Bayou** in 1996 in a study performed in conjunction with the Galveston County Health District.²¹ Their completed report is entitled, *Voluntary Inspection and Information Assistance Program to Reduce Bacterial Pollution Caused by Malfunctioning Septic Systems in Dickenson Bayou*. Fecal coliform contamination was identified as a significant problem in the bayou and thought to be related to contamination from non-point sources in the watershed, including malfunctioning OSSF. Individual property owners systems were examined and outreach material provided on proper care and maintenance of septic systems. The failure rate for systems evaluated in the study was high. Of ninety systems surveyed, thirty-six (40%) were found to have various forms of system failure. Many of the malfunctioning system were on plots too small to effect adequate remediation. Additionally, clay soil in the area and proximity of OSSF to drinking water wells made the only viable corrective action to

be construction of a community-wide wastewater collection and treatment facility, in those areas of the bayou where a number of homes using OSSF are clustered together.

Discussions with Harris County Engineering Staff indicate that several Hepatitis A outbreaks occurred in the county and City of **Houston**.⁸ Data may be accessed through the City of Houston Department of Health if date and location of the incident can be provided. We were unable to obtain specific information, with the exception of one incidence provided by county staff and confirmed by an article in the Houston Chronicle.⁸ Untreated sewage was reported to be visible in drainage ditches adjacent to the outbreak. Further research of the Chronicle archives may provide specific information and locations of additional outbreaks.

Beach pollution resulting in beach closings is not uncommon along the coast in the H-GAC region.²² They are generally confined to small local areas. Most result from high levels of fecal bacteria, which enter coastal waters from untreated or partially treated sewage from a combination of reasons including sanitary sewer over flows, sewer overflows, and malfunctioning OSSF. Gulf coast torrential rains can overload sewer systems, which carry raw sewage to wastewater treatment plants resulting in the discharge of untreated sewage from manholes and bypasses at pump stations and sewage treatment plants. “The discharges flow into local waterways and pollute the water. Rainwater can also pick up pollutants as it washes over land, and boost the overall volume of storm water and polluted runoff that reaches coastal waters. Another significant source of beach water pollution is untreated storm water runoff from cities and rural areas. Additional local sources of pollution in beach waters are boat wastes and malfunctioning septic systems. Severe natural events such as hurricanes and floods may contribute to beach water pollution.”²³ In most cases, the source of the fecal bacteria cannot be identified. “Simple ways individuals can help to clean their local beaches include conserving water, using natural fertilizers, keeping septic systems functioning properly, disposing of boat wastes appropriately, and supporting laws that promote beach water monitoring and cleanup of pollution sources.”²³

Bacterial Total Maximum Daily Load (TMDL) studies are underway for several H-GAC region bayous and streams. The level of Fecal coliform or enteric bacteria in these waters prohibits their use for contact recreation.

Bastrop Bayou is part of the Texas Coastal Preserve, which is the home to some of the last remaining sea grass beds along the Upper Texas Coast. During the spring of 2004, residents in the Bastrop Bayou watershed began voicing concerns about threats to water quality posed by the land spreading of sludge, failing septic systems, illegal dumping, and storm water discharge. Specific concerns included potential bacteria, turbidity, pesticide, and nutrient loading of Bastrop Bayou and Christmas Bay; and how these loadings may adversely affect public health, natural resources, and local economies.

H-GAC secured a grant from the Galveston Bay Estuary Program (GBEP) to conduct a risk assessment of Bastrop Bayou and produce a watershed management plan for the area.

H-GAC initiated water quality monitoring along the Bayou and its tributaries during November 2004. Preliminary data indicate Bastrop Bayou contains elevated concentrations of bacteria and exceeds State of Texas screening levels for contact recreation. While several potential sources of bacteria are present within the watershed (cattle grazing, migratory bird flyways, wildlife, and failing septic systems), local residents believe failing septic systems associated with residential development along Bastrop Bayou and its tributaries may be largely responsible for the elevated bacteria concentrations.

H-GAC is developing an on-site septic system density map that will illustrate the location of septic systems along Bastrop Bayou and its tributaries and, when compared to water quality monitoring data, may help identify reaches of the bayou where the risk of bacteria contamination is greatest.

In September 2005, with additional funding from GBEP, H-GAC will begin a companion study to examine bacterial contamination in selected OSSF sites along Bastrop Bayou. There is little hard evidence of the actual presence of water borne pathogens. E. coli is shown to be a predictive indicator for water borne disease pathogens. This project will obtain sampling data from several OSSF communities and determine if E. coli is present in the water. Data will be used to perform a risk assessment to (1) illustrate the nature and proximity of OSSF problems to system owners in target areas, (2) educate elected officials and the judiciary to the magnitude of the problem, (3) encourage developers to act responsibly, and (4) determine if OSSF contribute to decreased water quality along Bastrop Bayou.

The risk assessments, which will include target local communities/stakeholder input, and involvement, develop a Correction Strategy for failing OSSF strategy, plus a targeted resource CD and Power Point presentations used as educational and outreach tools (English and Spanish). The risk assessment, strategy and resources will form a foundation for addressing similar OSSF issues in 25 other target communities identified in the previous H-GAC study and supplement another H-GAC/GBEP study on the Bastrop

State Revolving Fund Review

H-GAC reviews State Revolving Fund and other loan applications for municipal wastewater treatment plants and distribution lines in the region for conformance to the Gulf Coast Regional Water Quality Management Plan (WQMP). Originally, potential and actual OSSF issues were not considered in this review. In early 2004, H-GAC modified its WQMP to include OSSF concerns. Applicants must address the presence of OSSFs within their service area in order to conform to the Regional WQMP.

GENERAL CONSIDERATIONS FOR PROBLEM RESOLUTION

There are seven basic considerations necessary for resolution of the OSSF problem. Each of these considerations is important in the development of a regional plan to resolve the OSSF issue. These include:

Education, Training, and Outreach to (a) develop programs for county or local government, governing boards (MUD, PUD, FWSD, etc.), practitioners, planners, developers, public, and owners on risk to human health and water quality, duties, applicability, and responsibilities of system operation and management and (b) build community consensus and acceptance of OSSF solutions.

Financing Assistance to (a) identify location of loans, grants, or private donations for projects; (b) qualifying, and applying for financing; (c) evaluate alternative financial arrangements; and (d) conduct income surveys to determine if the communities qualify for grant funds and low-interest loans.

Operation and Management Services (Outreach) to help communities develop sewage rate, tax structures, and/or tax incentives for OSSF operation or remediation, perform preventive and required maintenance, establish long-term planning, improve general system operation and address permitting/regulatory compliance.

Regulatory Framework to provide “an effective approach to achieve efficient and affordable on-site wastewater regulations to manage public health and water quality risks,” and upgrade certification requirements and training for installers and inspectors.²³

Risk Assessment to determine (a) potential adverse affects on human health, water quality, ecosystems, water bodies, and wetlands in order to determine priority status for remediation and (b) performance requirements that protect human health and the environment.

Technical Assistance and Planning to (a) diagnose OSSF wastewater problems and (b) help communities to develop and implement appropriate solutions.

Technical Guidelines for site evaluation, design, construction, operation, and acceptable prescriptive designs for site-specific conditions and use.

The remainder of this document covers research to identify possible solutions used in the region including outreach materials for educational purposes plus regulation and enforcement. Information is examined in light of what would most benefit the stakeholders in the region. Emphasis is directed toward new and creative approaches to resolving the OSSF problem with an emphasis on assisting low-income populations.

FINDING SOLUTIONS – CORRECTING FAILING SYSTEMS

Solution: Target Community Assessment Team

Initially, H-GAC focused effort in several areas. First, the concept of Target Community Assessment Teams (TCAT) was developed using volunteer services of professionals in specific fields. For selected communities, a TCAT could determine technical assistance needs, identifies risk, assess financial requirements and planning priorities. It could also address whether or not community consensus on these needs could be developed for selected local communities. TCAT would prepare a report containing solutions to the particular OSSF issue in the target community, including environmental justice community needs. Specifically, the Assessment could include:

- Fundamental principles – location and GIS mapping, demographics, overview of wastewater characteristics and process, basic engineering principles, hydraulics, and flow calculations, plus public and environmental health concepts;
- Soil and site evaluation - soil morphology, site evaluation, hydrology, performance predictive tools (identify possible models);
- Planning and technical assistance - land use, environmental concerns, risk assessment, scale (individual lot, subdivision, watershed), distributed infrastructure, systems management, materials management;
- Appropriate OSSF technology or alternative – design, installation, certified, installers, monitoring and inspection, operation and maintenance; obtain service from a domestic provider; and
- Plan for consensus building – owners, local and county officials, environmentalists and other stakeholders.

Ultimately, although local officials and interested parties were enthusiastic about the approach, sufficient interest in actually identifying target communities, including providing appropriate contacts, did not materialize. H-GAC believes the concept is valid and TACT volunteers are in place, but the local level of concern is not sufficient to support active resolution of the OSSF issue in the region, using the TCAT mechanism.

Solution: Regional Template

H-GAC looked to develop an OSSF problem solution blueprint from the assessed pilot communities, which will be useful throughout the region. H-GAC explored development of templates for relating a particular type of OSSF problem to a specific solution that is feasible (technical, economically, and politically) within the constraints of a particular type of community (e.g., urban or rural). This approach included exploring alternative systems and generating funding options that are effective, creative, and of low or reasonable cost. Such a blueprint could include the following:

- Plans for infrastructure project - (family and lot size, soil and system type) cost for installation and maintenance;
- Infrastructure finance options;
- Guidelines for responsible installation of facility by certified professional;
- Responsibility for managing and operating facility; and
- Building leadership capacity and consensus with stakeholders in the community, with elected officials, construction and builders, realtors, title companies, OSSF industry professionals, health department, environmental professionals, regulatory compliance, and judges.

H-GAC chose to examine two scenarios, one concerning individual OSSF and a municipal utility district (MUD) and the other violation clusters identified by GIS.

Solution: Individual Homes and a MUD

There is a variety of methods available to address OSSF issues in the region, one of which involves individual homes receiving service from a municipal utility district (MUD). H-GAC explored possibilities, evaluated criteria, and examined the relationship of stakeholders (county officials, homeowner, MUD) to determine the optimum plan template. H-GAC, in conjunction with Fort Bend County (FBC), identified a target on-site sewage community, which fit the criteria - homes served by OSSF and surrounded by a MUD. The community is located near Crabb River Road/FM Rd 2759, FM 762, and US Hwy 59 and is surrounded on three sides by Fort Bend County MUD 116 (Figure 2). Gonyo Road bisects the cluster of homes and businesses. The community consists of approximately 22 homes on 20 tracts of land, plus a Dollar General Store, Self Storage facility and a Fort Bend County (FBC) Road and Bridge facility. All are on OSSF systems and are facilities and residences, which pre-date the creation of the MUD. Eight of these OSSFs are permitted.

The initial approach was to establish a working relationship between an independent MUD attorney, the county, and the MUD to determine if it was in the MUD's best interest to serve the cluster of homes and businesses. Because of the Grand Parkway expansion in the next few years, the FBC Road and Bridge facility will lose land currently used for the OSSF system. The MUD houses its fire protection equipment at that site. Thus, both the county and MUD have an interest in the property receiving sanitary sewer service from the MUD. Funding might be made available to do so by both parties.

In order for the property to be connected to the MUD, lines will have to be routed through the residential part of the community currently served by OSSF. Fort Bend County has an existing program for OSSF remediation through block grant funds. Under the program, the applicant must (1) own the property; (2) had contact with FBC Environmental Health Department; (3) have an existing system; and (4) meet federal to low to moderate-income guidelines. Availability of these funds, in conjunction with some from the county, may help defray costs to the MUD for infrastructure necessary to serve the community. This

project would provide for synergy between the county elected officials, county staff, the MUD, and the homeowners and business operators in the target community. Discussions between stakeholders are currently underway.

Figure 2

Target Community and MUD 116 Locations



Solution: Harris County Precinct 2

H-GAC identified several potential candidates to assist in developing a regional template to address OSSF problems in a wider geographic area through violation and GIS data (See Appendix II). In this case, the opportunity to develop a regional template involves a partnership with Harris County Precinct 2, which recently received a grant to identify OSSF problems within its jurisdiction. The Precinct has several neighborhoods that are currently without public water and wastewater service. Many are unincorporated "islands" of low-income areas relying on poorly functioning on-site sewer facilities. Precinct 2's comprehensive engineering study, funded by EPA, proposes to (1) identify and evaluate areas of need, and (2) assign priority-based on health and environmental concerns. Target communities identified by GIS analysis included Barrett Station, McNair, Linus, and Aldine communities. These communities were also identified in the Precinct 2 study. However, H-GAC used different criteria to identify potential targets. The Precinct 2 study has assumptions, which H-GAC's examination does not. The Precinct study assumes that if the OSSF facility was within city limits, it will be served by the municipality. If it was

in an industrial area, it is assumed it would be served by the industry in close proximity. These assumptions may or may not be valid.

The target communities identified by Precinct 2 have a significant amount of Spanish speaking stakeholders. H-GAC's Spanish portion of the Outreach CD, OSSF PowerPoint Presentations, and other material will be particularly useful in this area. Precinct 2 and H-GAC plan to partner at public outreach meetings in the near future.

Solution: Monitoring Technology

One of the reasons OSSF fail is because of poor maintenance. Harris County commissioned the RMSYS Corporation to develop a monitoring system for OSSF to assist homeowners who want to take care of systems properly. The monitoring system (RMS-100) is a fully automated real time notification and web site application package. It allows the homeowner to record, track, schedule all OSSF maintenance, repairs, reporting, and contract renewals. No extra computer hardware or software is required, just a simple autodialer that retails for around 100 dollars. Data is always secure with redundancy storage and safe password protected entrance to the account. The autodialer can verify visits using a patented "service button." It also monitors alarms, service response to an alarm, and routine service calls. The system is capable of monitoring pressure, pump function, high water, and level of disinfection among other parameters. Monitoring service is additional on a two-year contract.

Thus far, Harris County has received excellent response to the system, which is being tested with selected homeowners in the Aldine area. Retrofitting current systems is relatively easy and builders have become so interested in the system that they are now hard wiring for it into new home construction. Harris County plans to expand use throughout the area, and allows RMSYS to market the technology across the state, and eventually the nation.

FINDING SOLUTIONS: EDUCATION

Outreach

H-GAC believes that the key to resolving the OSSF issue is education and outreach to stakeholders. Towards this goal, H-GAC has prepared an outreach CD with information useful to all these groups. It will assist in development of an outreach template to increase the awareness of OSSF problems in the H-GAC region, enlisting their help to resolve the issues and prevent future problems. Stakeholders include homeowners, homebuilders, realtors, judiciary, local government, developers, elected officials, MUDS, and the public. Much of the information is provided in both English and Spanish. H-GAC, in conjunction with EPA, translated three of EPA's publication for homeowners: Homeowners Guide Overview, Complete Homeowners Guide, and "What Happens When You Flush." This

information will be particularly useful in out reach town meetings in Harris County Precinct 2 target communities, which have a high Hispanic population. The CD includes the following classes of information.

- Glossary of Terms
- Customized Publication Templates for Public Outreach
- Funding Sources and Options
- Homeowner Information - English
- Organizations
- On-Site Sewer Facility Information - Spanish
- Realtor Information (including PowerPoint Presentation)
- Regulations, ordinances and Enforcement
- Small community Information
- Technical Information
- Texas Programs
- Frequently Asked Questions on OSSF

Highlights for homeowners include guides and checklists for care and maintenance of OSSF. For industry professionals there is information on septic systems technologies, design, customer education, performance standards, certification, and evaluation. State and local government officials will benefit from information on developing septic system management programs, funding sources, and new technologies. Additionally, there are voluntary guidelines, funding sources, and enforcement ordinances on the CD as well as links to EPA, TCEQ, and professional and trade associations. A detailed list of material is included in Appendix III.

FINDING SOLUTIONS – REGULATIONS AND ENFORCEMENT

Types of groups that monitor OSSF issues include counties, cities, utility districts (MUD, Public UD, and UD, etc.) and river authorities (San Jacinto, Trinity and Brazos). Generally, the county takes the lead, the exception being in the case of large cities such as Houston, which also have an enforcement program. The basis of all entity regulations and ordinances are promulgated from the State of Texas Administrative Code, Title 30 Environmental Quality, Part 1 Texas Commission on Environmental Quality, Chapter 285 On-Site Sewage Facilities. Additional criteria that are more stringent are added depending on the county and/or local preference and need. A copy of the State of Texas OSSF requirements may be found on the State's website and on the OSSF Outreach CD accompanying this report. Requirements for selected counties in the region are also available on the CD.

Adequate regulatory framework to manage the OSSF problem should include:

- a. Performance requirements that protect human health and the environment;
- b. System management to maintain performance within the established performance requirements;
- c. Compliance monitoring and enforcement to ensure system performance is achieved and maintained;
- d. Technical guidelines for site evaluation, design, construction, operation and acceptable prescriptive designs for specific site conditions and use;
- e. Education/training for all practitioners, planners, and owners;
- f. Certification/licensing for all practitioners to maintain standards of competence and conduct;
- g. Program reviews to identify knowledge gaps, implementation shortcomings and necessary corrective action;²⁴
- h. OSSF Enforcement Manual and Circuit Rider; and
- i. Outreach Circuit Rider to educate end user, installer, seller, government, and realtors and builders.

H-GAC's Civil Enforcement Manual, which includes OSSF, has been distributed to county and district attorneys within the region. This manual is available online at H-GAC's website.

H-GAC provides an Environmental Circuit Rider Prosecutor who provides prosecutorial support to the counties in the H-GAC region. Currently this is in the areas of illegal dumping, air quality, and unauthorized discharge into and adjacent to waters of the State. The unlawful discharge of septic waste including sewage, grease trap waste, and the like, will most likely be addressed through "unauthorized discharge." Roger Haseman, Assistant Harris County District Attorney and Chief of Environmental Crimes Division, serves in this capacity through August 31, 2005. Although there definitely is a need, H-GAC has no plans to fund an OSSF Circuit Rider.

CONCLUSION

On-Site Sewer Systems (OSSF) provides approximately 25% of the sanitation service in the H-GAC 13-county region. According the Environmental Protection Agency (EPA), state and local authorities view septic systems as the second largest threat to groundwater quality in the nation.²⁴ Improperly installed and maintained, inadequately sized, and/or malfunctioning OSSF affect the region's water quality.¹ OSSF effluent can contaminate both ground and surface water with bacteria, nitrates and other harmful components.

It is estimated that between ten to fifteen percent (10% – 15%) or 21,000 to 31,500 of the OSSF systems in the H-GAC region do not function adequately. In some parts of the region (e.g. Dickinson Bayou), there is a failure rate of upwards of forty percent (40%). No specific demographic identifies the population with inadequate or malfunctioning OSSF systems. They are located in both rural and urban communities in the region, often in clusters or pockets within adequately served municipalities or adjacent to utility districts. Twice as many citizens without adequate sanitary service reside in urban as rural areas. Over a third of the population served by OSSF has an income below the official federal poverty level. Many are “working poor,” and/or members of minorities. Half own their own homes and half are renters.¹

Exposure to raw sewage through OSSF sanitary sewer malfunctions occurs when sewage reaches water bodies and/or contaminates groundwater and shallow water wells. Additionally, OSSF overflows or malfunctions can contaminate yards, children’s playground equipment, pets, gardens, and swimming. Untreated or raw sewage from malfunctioning OSSFs contains “bacteria like E. coli, viruses, helminthes (intestinal worms) and parasites (e.g. Cryptosporidium). Most of those stricken suffer stomach cramps and diarrhea (headache, vomiting, and low-grade fever), but untreated sewage also spreads life-threatening ailments like cholera and Hepatitis A.”²⁵ The exact number of people affected by malfunctioning OSSF in the H-GAC region is difficult to determine. According to the Centers for Disease Control (CDC), the range of symptoms from illness resulting from exposure to untreated sewage include acute dehydrating diarrhea (cholera), prolonged febrile illness with abdominal symptoms (typhoid fever), acute bloody diarrhea (dysentery), and chronic diarrhea (Brainerd diarrhea). Many of the symptoms of illness related to exposure to raw sewage are similar to common varieties of influenza. Therefore, the connection between illness and exposure to raw sewage is often hard to establish. In the H-GAC region, fecal coli form and other sewage bacteria have resulted in beach closures, restrictions on contact recreations in certain streams and bayous, and shellfish bed closures.

Closing the gap between citizens with adequate sanitary facilities, and citizens who do not, is a difficult proposition - malfunctioning OSSF systems are a collection of the most intractable situations affecting water quality.¹ Either there is no good solution, or the solution is too costly to implement, for the provider, the property owner, the resident, or all three. Further complicating the matter, a large number of current OSSF may not be adequately operated or maintained and/or are nearing the end of their design life expectancy. OSSF owners may not be aware of these conditions. OSSF problems may also be societal in nature. If certain individuals lack the resources to solve their own OSSF situation. This problem is further complicated by the lack of quantifiable data establishing a clear link between water borne illness and malfunctioning OSSF in the H-GAC region. Without this data, OSSF problems are seen as isolated nuisances. In an era of shrinking federal, state and local funds for services, it is difficult to secure funding to correct nuisances.

Assessing the Problem

Malfunctioning, inadequate OSSF problems have occurred in the H-GAC region for a long time. An H-GAC study in 1999, entitled On-site Sewage Target Communities, identified localities with OSSF problems in need of correction. The Gulf Coast Authority evaluated two other communities, Beaumont Place and Fruitland Place, in a 2004 Gulf Coast Authority study funded by Galveston Bay Estuary Program GBEP). The studies determined needs, engineering, feasibility and funding requirements.

In this 2005 evaluation of the incidence of OSSF problems in the region, H-GAC obtained records of OSSF permits issued and complaints/violations received from selected counties in the region from 2001 to 2005. In this initial phase of H-GAC's research, counties with the highest numbers of OSSF systems and/or greatest growth rate were examined. These included records of violations for Harris, Fort Bend, Galveston, Brazoria, Montgomery and Waller Counties. Data shows that (a) the number of OSSF permitted relative to the number of systems operating in given counties is small (Table 4); and (b) the number of complaints/violations relative to the number of systems is small (Table 5). Either the estimate for potentially failing systems is entirely incorrect, or the number of systems reported hugely underestimates the magnitude of the problem. Small numbers could be the result because of several factors. First, after initial installation inspection, no additional inspections occur at regular intervals to determine if the OSSF is properly maintained. Counties simply do not have the workforce to do so. Secondly, it is likely that OSSF problems are under reported – neighbors, turning in neighbors is not an efficient way to identify violations. Alternatively, the OSSF problems are not as large as originally believed. Further study is required to discern which of these reasons is correct.

H-GAC developed aerial maps using Graphic Information System (GIS) technology to display violation locations in particular counties in the region. Many clusters or “hot spots” of frequent OSSF violations were identified in the counties who submitted complaint/violation data electronically (Brazoria, Fort Bend, Harris, and Waller). Identifying OSSF violation clusters using the aerial maps and GIS serves two purposes. First, it assists in identifying target communities as possible candidates for the proposed Target Community Assessment Team process, described in subsequent sections. Secondly, it also indicates areas where enforcement can be concentrated and possible health issues monitored. Those clusters immediately adjacent to water bodies should be given priority for remediation and enforcement because of the possibility that sewage may affect large numbers off site.

Detailed GIS reviews of violations along Bastrop Bayou in Brazoria County, and Harris County Precinct 2 were conducted because of H-GAC's partnership with other on-going research in these areas. Dickinson Bayou, in Galveston County, should be examined using the GIS method in the future, because of a previous OSSF study in that area.

The consensus of many local officials, regulatory authorities, environmental groups, health providers, staff and some in the public is that the H-GAC region is no different from any

other part of the country – there is a connection between untreated waste from OSSF, disease, and other adverse effects. However, there is very little actual data from the region to support this idea. To establish such a connection, H-GAC examined federal, state and local sources of information. These were by no means all-inclusive, but covered a broad spectrum of possibilities and were intended as a first step laying the foundation for year two in H-GAC's study on the relationship between OSSF, waterborne disease, and water quality.

Several completed and on-going studies in the region are of specific interest. The Galveston Bay Estuary Program examined Dickinson Bayou in 1996 in a study performed in conjunction with the Galveston County Health District.²³ Their completed report is entitled, *Voluntary Inspection and Information Assistance Program to Reduce Bacterial Pollution Caused by Malfunctioning Septic Systems in Dickinson Bayou* in 1996. Fecal coliform contamination was identified as a significant problem in the bayou and thought to be related to contamination from non-point sources un the watershed, including malfunctioning OSSFs. Beach pollution results in beach closings and is not uncommon along the H-GAC region coast.²⁴ They are generally confined to small local areas. Most result from high levels of fecal bacteria, which enter coastal waters from untreated or partially treated sewage from a combination of reasons including sanitary sewer over flows, sewer overflows, and malfunctioning OSSF.

During the spring of 2004, residents in the Bastrop Bayou watershed began voicing concerns about threats to water quality posed by the land spreading of sludge, failing septic systems, illegal dumping, and storm water discharge. H-GAC initiated water quality monitoring along the Bayou and its tributaries during November 2004. Preliminary data indicate Bastrop Bayou contains elevated concentrations of bacteria and exceeds State of Texas screening levels for contact recreation. While several potential sources of bacteria are present within the watershed (cattle grazing, migratory bird flyways, wildlife, and failing septic systems), local residents believe failing septic systems associated with residential development along Bastrop Bayou and its tributaries may be largely responsible for the elevated bacteria concentrations.

H-GAC will begin a companion study to examine bacterial contamination in selected OSSF sites along Bastrop Bayou. There is little hard evidence of the actual presence of water borne pathogens. E. coli is shown to be a predictive indicator for water borne disease pathogens. This project will obtain sampling data from several OSSF communities and determine if E. coli is present in the water. Data will be used to perform a risk assessment to (1) illustrate the nature and proximity of OSSF problems to system owners in target areas; (2) educate elected officials and the judiciary to the magnitude of the problem; (3) encourage developers to act responsibly, and (4) determine if OSSF contribute to decreased water quality along Bastrop Bayou.

H-GAC will work with the Galveston Bay Estuary Program (GBEP) to complete a risk assessment which will include target local communities/stakeholder input and involvement, develop a Correction Strategy for Failing OSSF Strategy, and a targeted

resource CD and Power Point presentation to be used as education and outreach tools (English and Spanish).

H-GAC reviews State Revolving Fund and other loan applications for municipal wastewater treatment plant and distribution lines in the region for conformance to the Gulf Coast Regional Water Quality Management Plan. Originally, potential and actual OSSF issues were not considered in this review. In early 2004, H-GAC modified its WQMP to include OSSF concerns. Applicants must address the presence of OSSF within their service area in order to conform to the Regional WQMP.

Solutions

There are seven basic considerations necessary for resolution of the OSSF problem. Each of these considerations is important in the development of a regional plan to resolve the OSSF issue. These include (a) education, training, and outreach of stakeholders; (b) financing assistance for remediation of OSSF failures; (c) operation and management services to assist local governments in developing sustainable funding to address issues; (d) developing a regulatory framework to provide “an effective approach to achieve efficient and affordable on-site wastewater regulations to manage public health and water quality risks;”²⁶ (e) risk assessment to determine human health and water quality effects plus performance requirements the environment; (f) technical assistance and planning to diagnose problems; develop and implement appropriate solutions; and (g) technical guidelines for site evaluation, design, construction, operation, and acceptable prescriptive designs for site-specific conditions and use.

Specific solutions identified in this document in three areas: correcting malfunctioning OSSF systems, educational outreach, and regulations and enforcement.

Solutions – Correcting Systems

Initially, H-GAC focused effort in several areas: developing the concept of a target community assessment team, exploring regional templates, and examining the feasibility of technical monitoring. First, the concept of Target Community Assessment Teams (TCAT) was developed using volunteer services of professionals in specific fields. For selected communities, TCAT could determine technical assistance needs, identifies risk, assess financial requirements and planning priorities. Although local officials and interested parties were enthusiastic about the approach, sufficient interest in actually identifying target communities, including providing appropriate contacts, did not materialize. H-GAC believes the concept is valid and TACT volunteers are in place, but the local level of concern is not sufficient to support active resolution of the OSSF issue in the region, using the TCAT mechanism.

H-GAC also looked to develop an OSSF problem solution blueprint from the assessed pilot communities, which will be useful throughout the region. H-GAC explored development of templates for relating a particular type of OSSF problem to a specific solution that is feasible (technical, economically, and politically) within the constraints of a particular type of community (e.g. urban or rural). This approach included exploring alternative systems and efficient funding options, creative, and low or reasonable cost. Pilot community possibilities included a small cluster of OSSF served residences surrounded on three sides by a municipal utility district (MUD) and several communities' violation clusters identified by GIS and located within Harris County Precinct 2.

With the first pilot community, the initial approach was to establish a working relationship between an independent MUD attorney, the county, and the MUD to determine if it was in the MUD's best interest to serve the cluster of homes and businesses. This will be followed by outreach to the community to develop a consensus. Funding possibilities include block grant and county funds, as well as a relaxed service rate order from the MUD. Discussions between stakeholders are ongoing.

In the second pilot community, the opportunity to develop a regional template involves a partnership with Harris County Precinct 2, which recently received a grant to identify OSSF problems within its jurisdiction. The Precinct has several neighborhoods that are currently without public water and wastewater service. The target communities identified by Precinct 2 have a significant amount of Spanish speaking stakeholders. H-GAC's Spanish portion of the Outreach CD, discussed in the following paragraph, and other material will be particularly useful in this area. Precinct 2 and H-GAC plan to partner at public outreach meetings in the near future.

One of the reasons OSSF fail is because of poor maintenance. Harris County commissioned the RMSYS Corporation to develop a monitoring system for OSSF to assist homeowners in taking care of systems properly. Thus far, Harris County has received excellent response to the system, which is being tested with selected homeowners in the Aldine area. Retrofitting current systems is relatively easy and builders have become so interested in the system that they are now hard wiring new home construction for it. Harris County plans to expand use throughout the area, and allows RMSYS to market the technology across the state, and eventually the nation.

Solutions – Education

H-GAC believes that the key to resolving the OSSF issue is education and outreach to stakeholders. Towards this goal, H-GAC has prepared an outreach CD with information useful to all these groups. It will assist in development of an outreach template to increase the awareness of OSSF problems in the H-GAC region, enlisting their help to resolve the issues and prevent future problems. Stakeholders include homeowners, homebuilders, realtors, judiciary, local government, developers, elected officials, MUDS, and the public. Much of the information is provided in both English and Spanish. H-GAC, in conjunction

with EPA translated three of EPA's publication for homeowners: Homeowners Guide Overview, Complete Homeowners Guide, and "What Happens When You Flush."

Solutions – Regulation and Enforcement

The basis of all OSSF regulations and ordinances are promulgated from the State of Texas Administrative Code, Title 30 Environmental Quality, Part 1 Texas Commission on Environmental Quality, Chapter 285 On-Site Sewage Facilities. Additional criteria that are more stringent are added depending on the county and/or local preference and need.

H-GAC's Civil Enforcement Manual, which includes OSSF, has been distributed to county and district attorneys within the region.

Summary

In summary, H-GAC proposed a three-year study under the Water Quality Management Plan (WQMP) program to collect information on the magnitude of the OSSF problem in the region, contact local officials for information, develop a task force to propose possible solutions, prepare a regional template for action using several communities in pilot programs, prepare an action plan, and implement the findings. This document covers research to identify incidence of and associated risk from illness related to OSSF malfunctioning, outreach materials for educational purposes, possible solutions used in the region, and a regulatory framework, including location of OSSF violations by county. Information is examined in light of what would most benefit the stakeholders in the region. Emphasis is directed toward new and creative approaches to resolving the OSSF problem with an emphasis on assisting "working poor," ethnic and/or minority populations. Because of unforeseen budgetary constraints, the first year, will be the only year in the project. In the event that funding becomes available in the future, H-GAC will already have record of the status of OSSF in the region and will be able to implement another portion of its plan.

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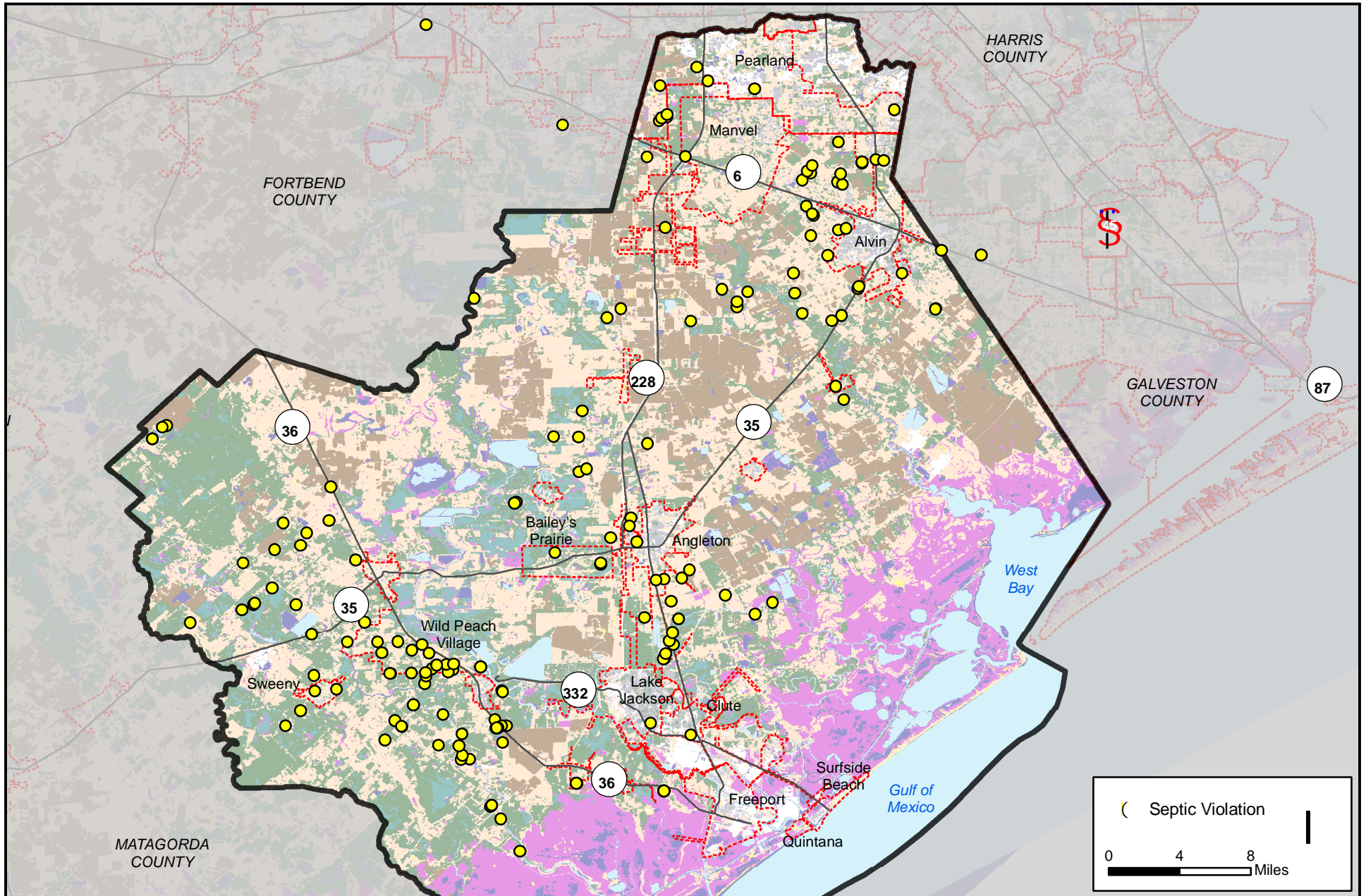
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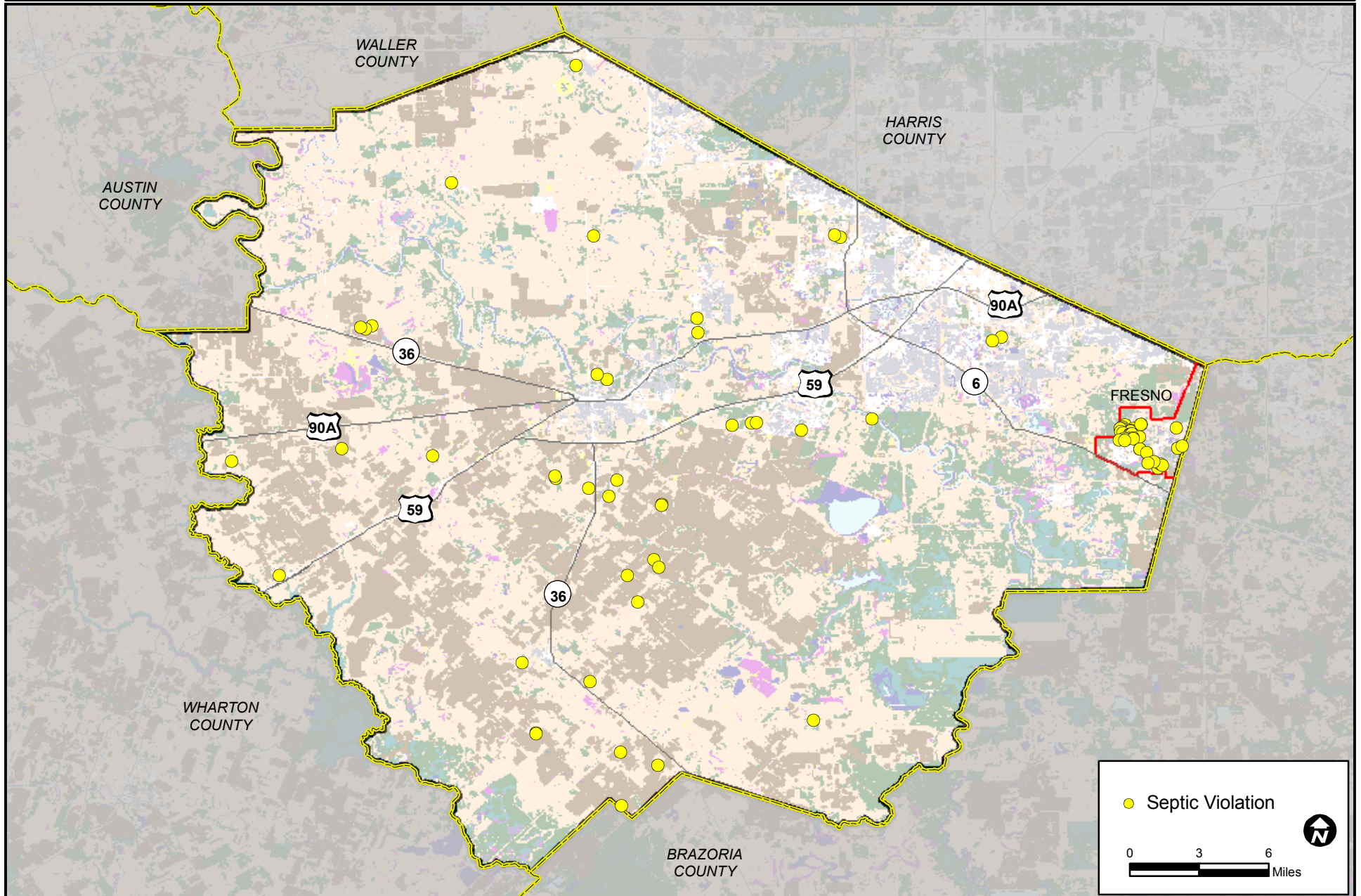
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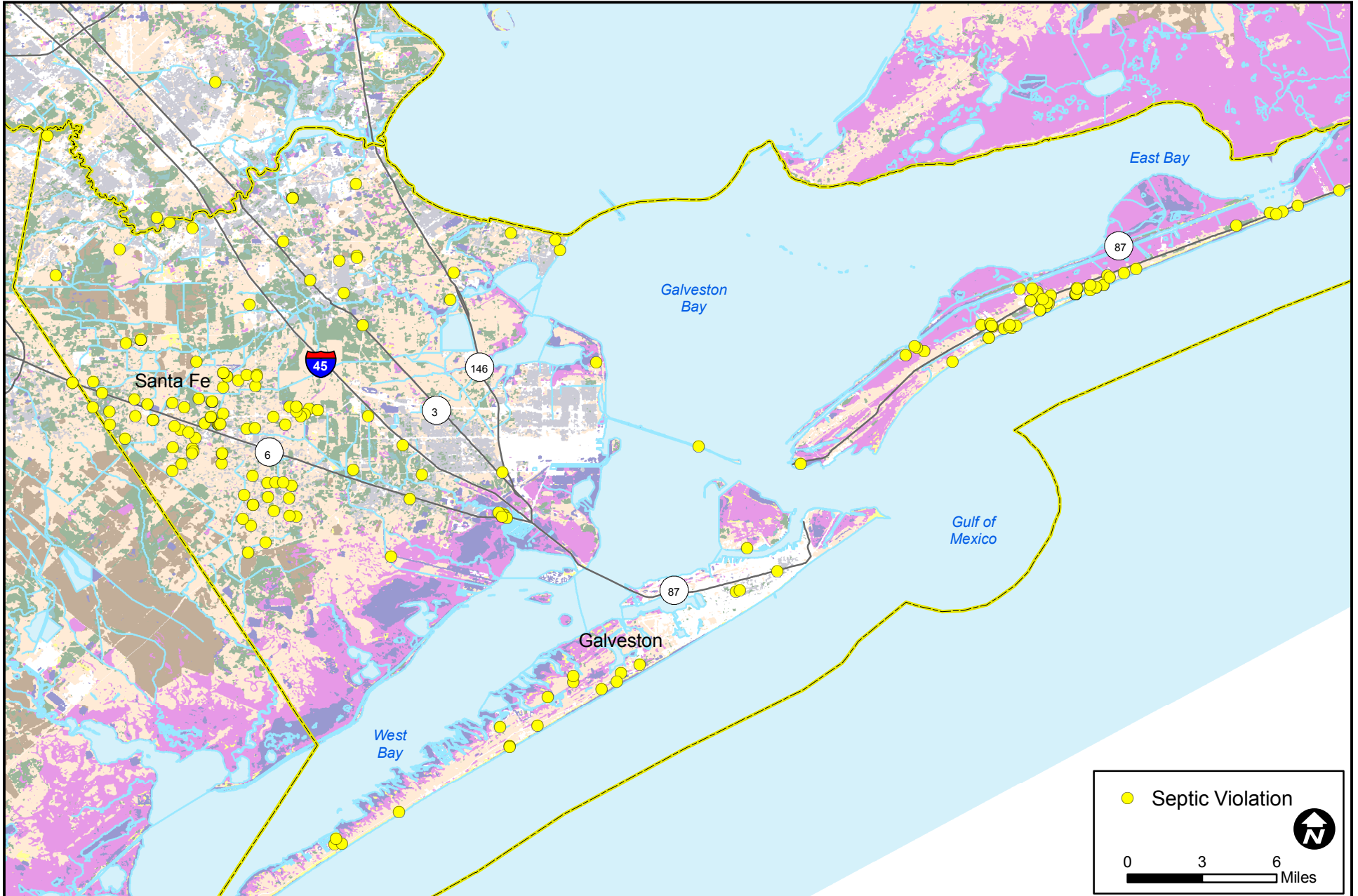
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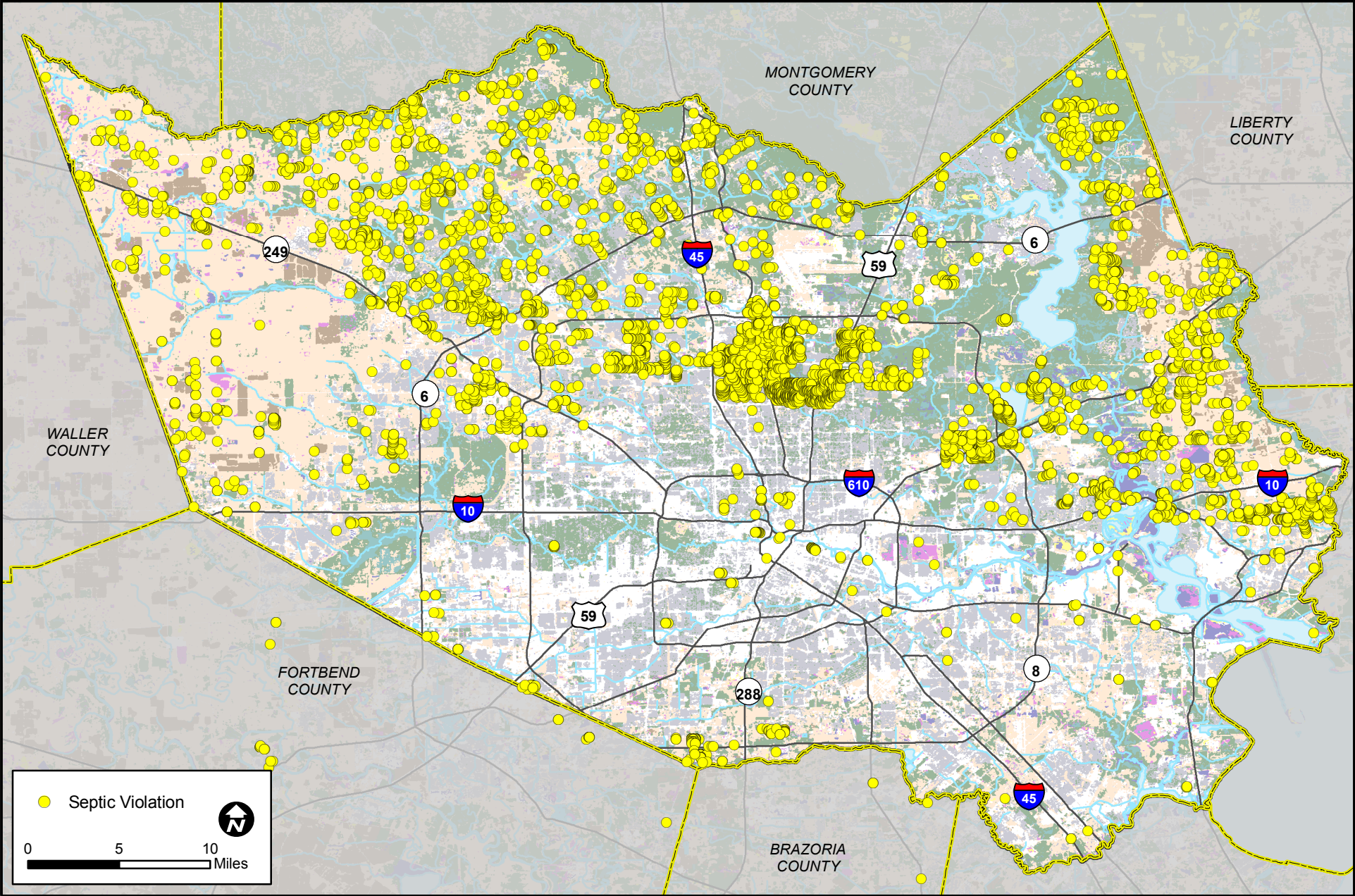
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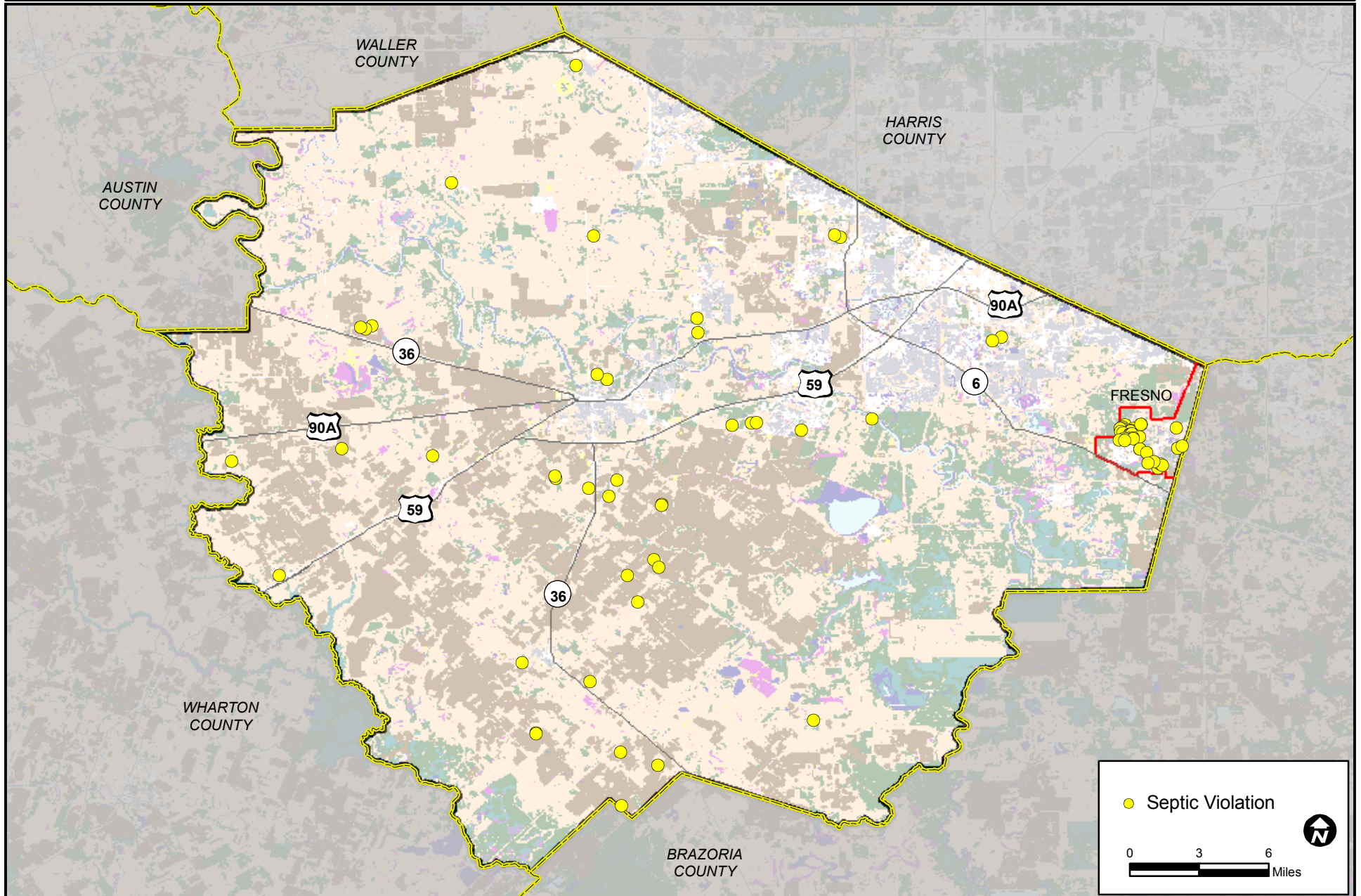
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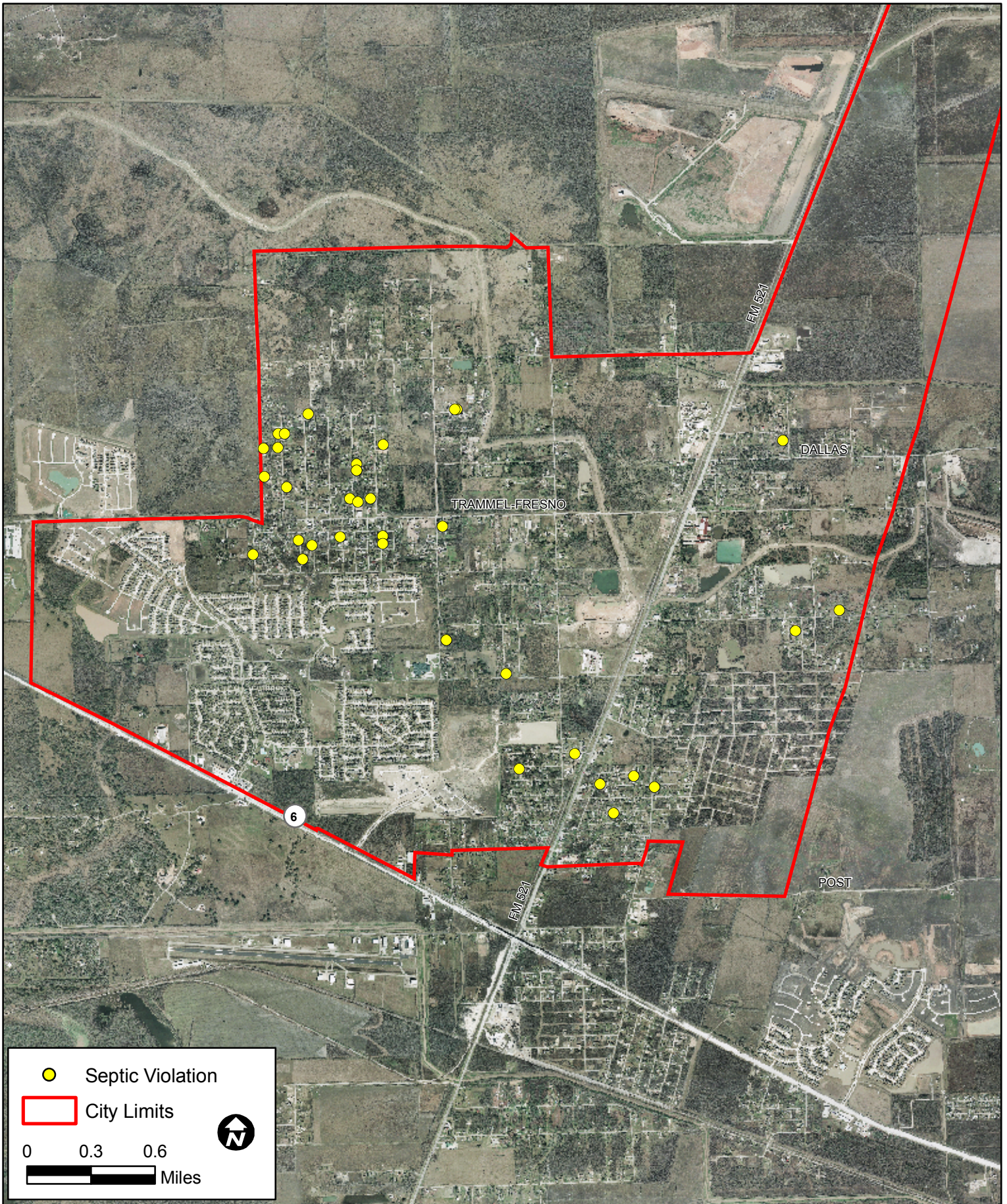
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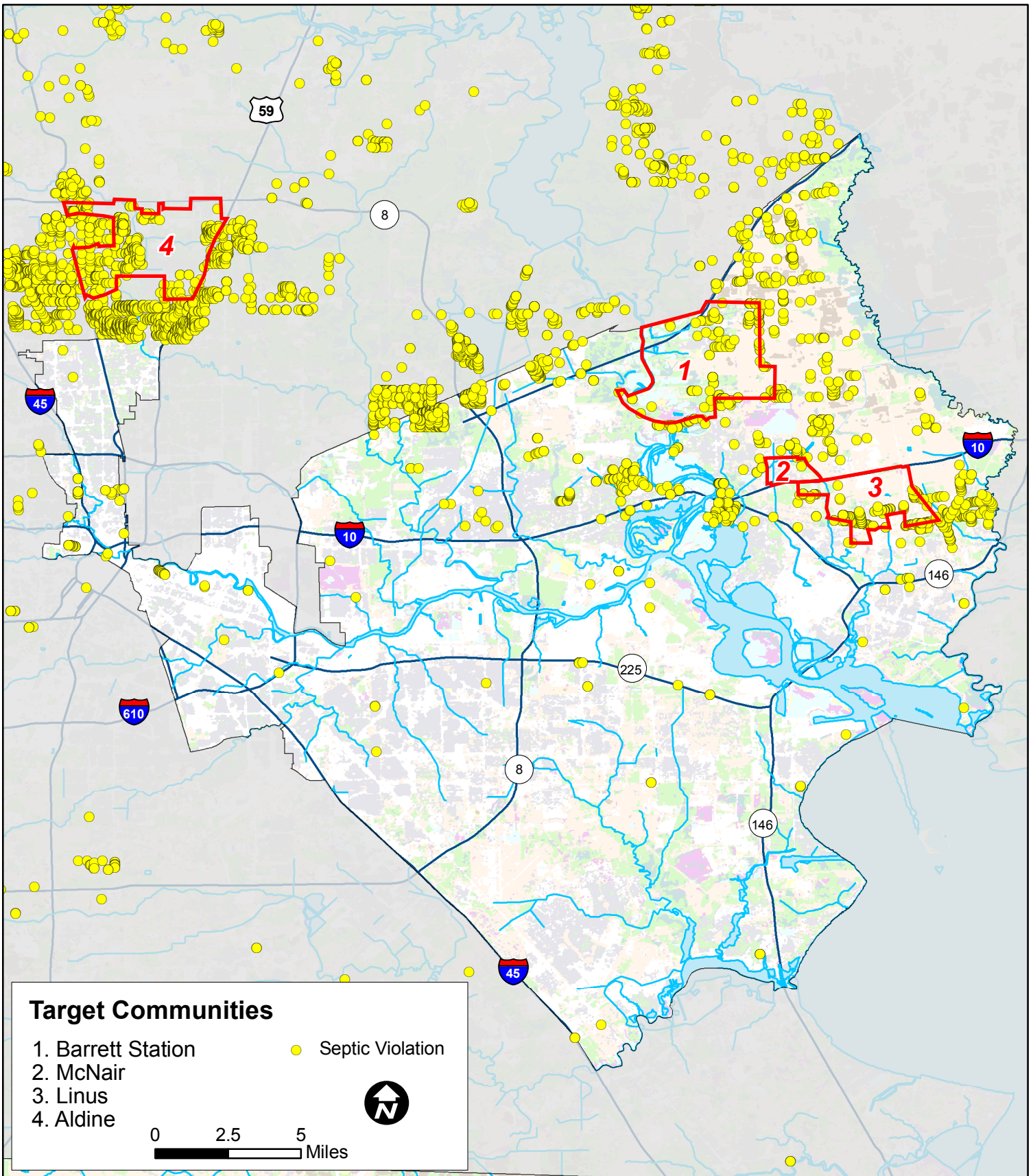
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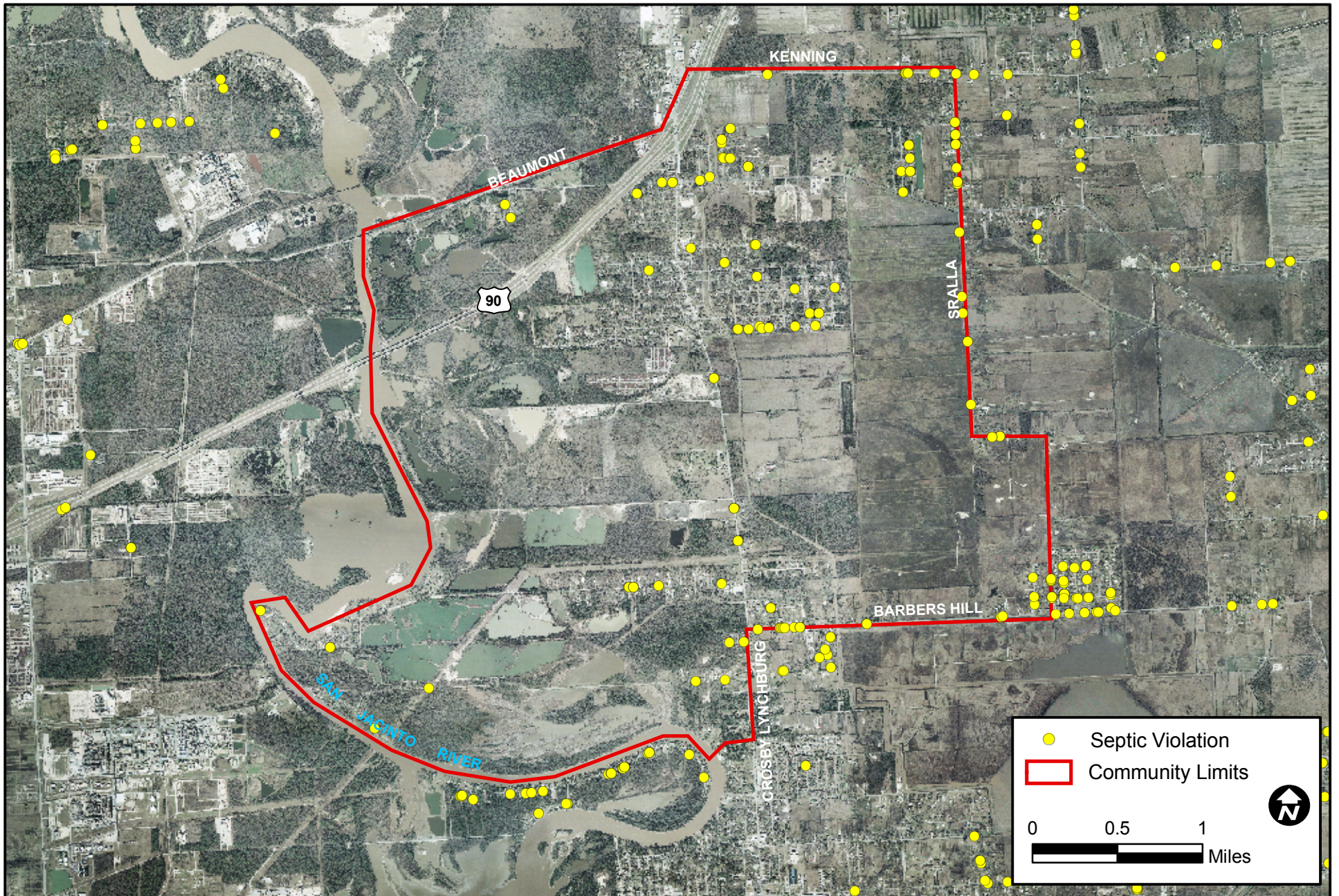
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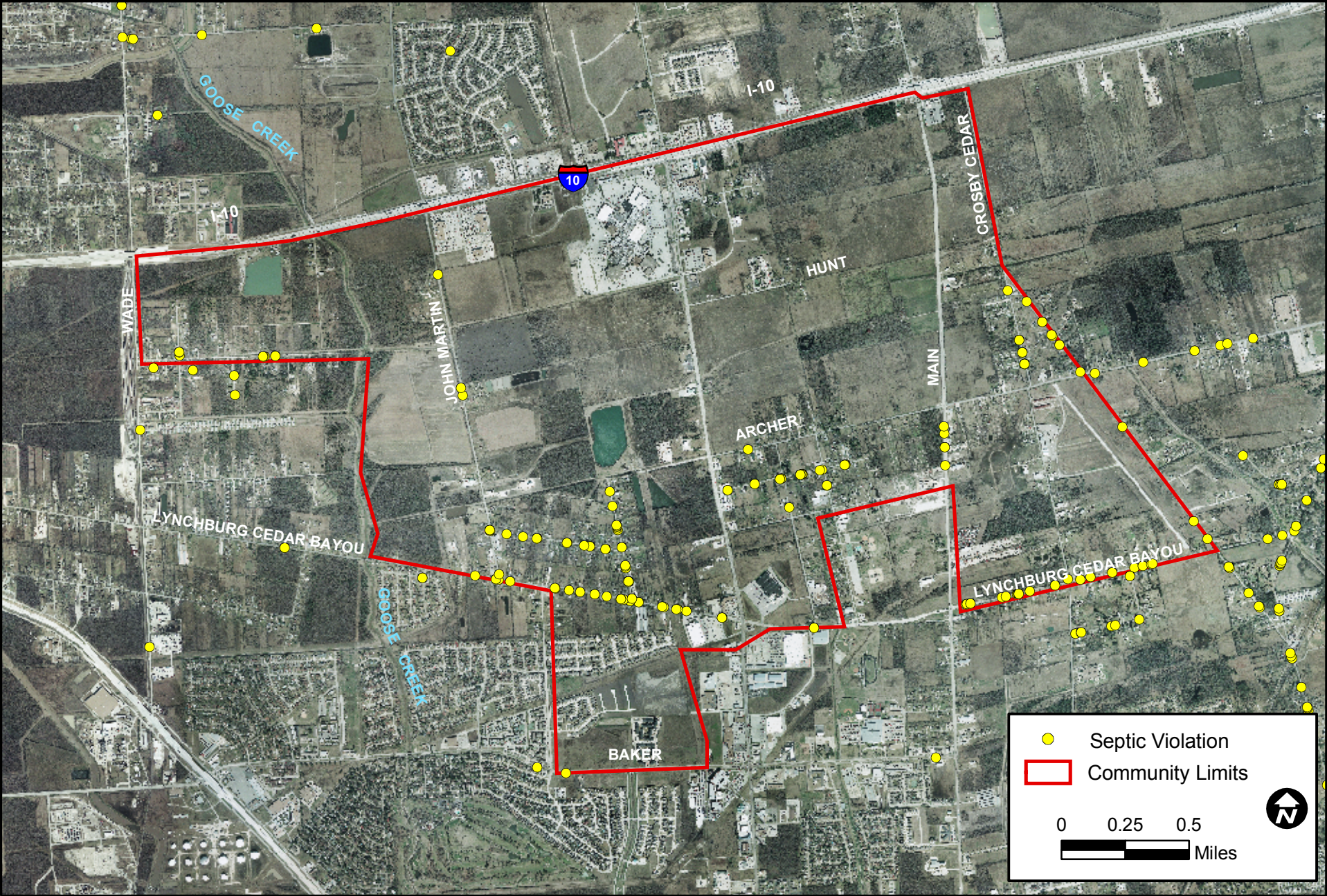
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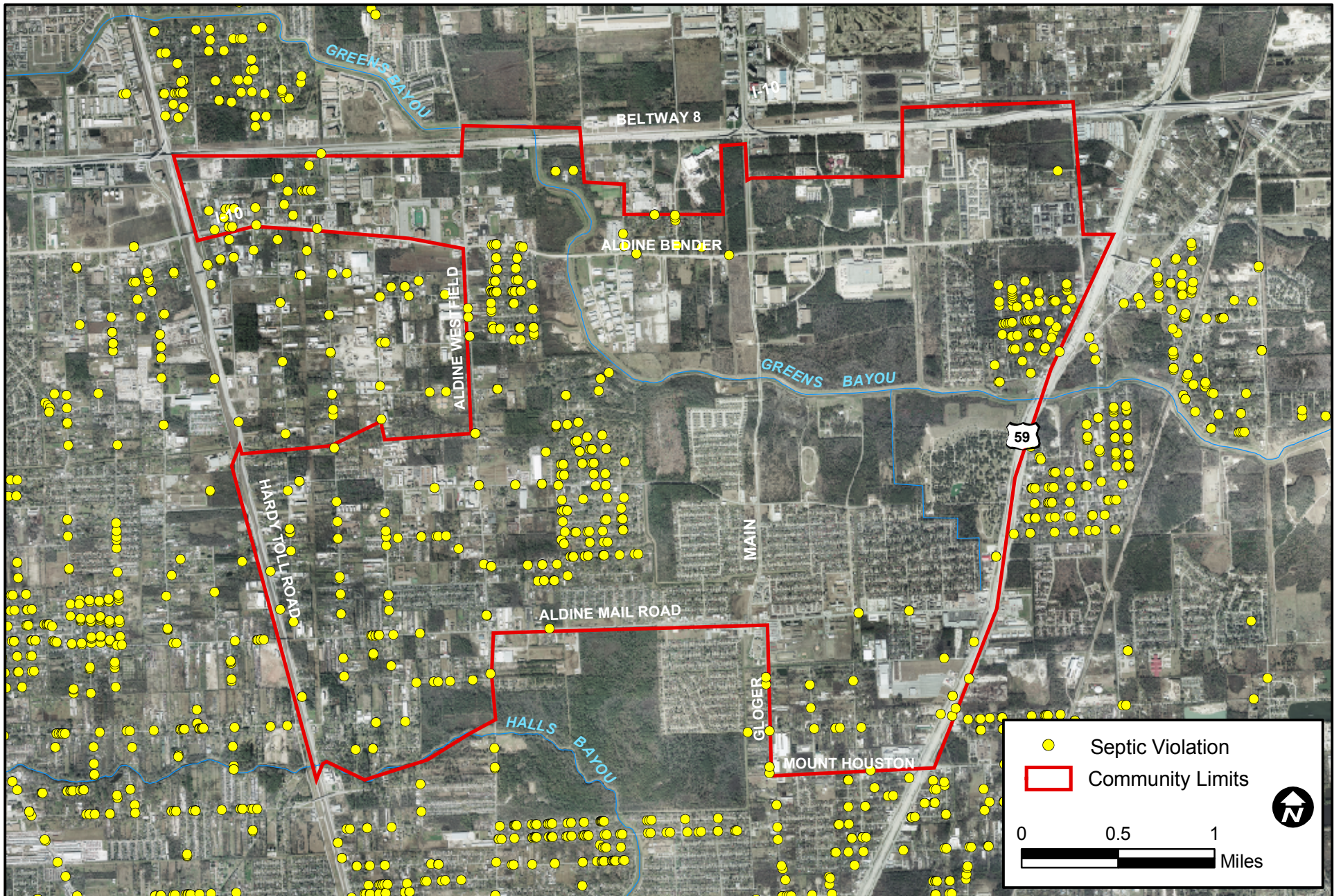
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