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### **EXECUTIVE SUMMARY**

**Background**

Hawaiʻi has about 82,000 active cesspools that collectively release roughly 55 million gallons of untreated wastewater each day. Unlike effluent from septic systems, which receives basic primary treatment, cesspool discharge receives no treatment to reduce nutrients and pathogens before entering the soil, where it can cause contamination both locally and miles from the source. Harmful impacts of Hawaiʻi’s cesspools include:

**Environmental:** Pollution from wastewater on land may rapidly reach coastal waters, stimulating algal blooms that damage coral reefs and reduce fish abundance.  
  
**Public health:** Elevated pathogen levels limit recreational water quality by increasing exposure to waterborne diseases.   
  
**Cultural:** Degradation of coastal environments contribute to an erosion of customary fishing, gathering, and recreation in places of deep significance to Hawaiʻi residents.  
  
**Economic:** These impacts combine to reduce tourism spending and fishery revenues, while directly and indirectly increasing county infrastructure costs and household bills.

The effects of wastewater pollution are particularly damaging closer to shore where they are locally amplified by areas of porous volcanic rock and sandy soils. Here, shallow aquifers are more prone to allow contaminants to move quickly into groundwater that supplies drinking water and on to nearshore waters. As sea level rises, coastal groundwater rises, and the harm of near-shore untreated wastewater contamination can be expected to further increase.

Figure 1 - Wastewater from cesspools may quickly reach coastal areas.  


### **The State's Response**

There is broad agreement that Hawaiʻi needs a strategic, coordinated, fiscally responsible, cesspool conversion effort that safeguards drinking water, protects public health, and strengthens Hawaiʻi's cultural resources.  
  
In response to this challenge, the Hawaiʻi State Legislature has established an aggressive and evolving strategy, declaring that "all cesspools in the State shall be upgraded, converted, or closed by 2050." This foundational step, **Act 125 (2017)**, set the landmark mandate. Recognizing that a top-down deadline was insufficient, the legislature passed **Act 132 (2018)** a year later to create a collaborative planning framework involving the counties. Act 132 did more than just create the Cesspool Conversion Working Group (CCWG); it mandated a partnership with the counties to conduct a comprehensive statewide study, identify priority areas, and develop viable financing options for homeowners. It was this collaborative work, culminating in the CCWG's final report, that guided the creation of the **Hawaiʻi Cesspool Prioritization Tool (HCPT)**. This critical tool provided the first data-driven risk assessment, answering the essential question of *where* the highest-risk cesspools were located.

While the HCPT and the CCWG's report successfully identified high-priority areas, they also highlighted the need for more specific guidance on the most effective conversion methods, particularly concerning large-scale infrastructure. This led to the passage of **Act 217 in 2024**. This legislation was a targeted directive to answer a specific question: where is expanding or constructing a centralized sewer system the most feasible option? Act 217 mandated the creation of an **infrastructure feasibility overlay** for the HCPT.   
  
**Table 1: Evolution of Hawaiʻi's Cesspool Conversion Strategy**

| **Year** | **Act or Key Action** | **Mandate / Primary Purpose** | **Outcome / Product** |
| --- | --- | --- | --- |
| 2017 | Act 125 | Established the foundational statewide mandate requiring all cesspools to be converted by 2050, setting a clear, final deadline for compliance. | The 2050 Cesspool Conversion Mandate  Mandatory real estate disclosure of cesspool on property |
| 2018 | Act 132 | Created a collaborative framework by establishing a working group to develop a comprehensive plan, identify priority areas for conversion, and research financial solutions for homeowners. | Formation of the Cesspool Conversion Working Group (CCWG) |
| 2021-2022 | CCWG Final Report & Act 132 Study | Fulfilled Act 132's mandate by identifying and ranking high-risk cesspools statewide using a science-based tool | Creation of the Hawaiʻi Cesspool Prioritization Tool (HCPT) report and web tools |
| 2024 | Act 217 | Provided targeted funding for a critical update to the HCPT, directing the creation of an infrastructure feasibility overlay to identify where sewer expansion is the most practical solution. | **HCPT Infrastructure Feasibility Overlay & updated web tools** |

**HCPT Infrastructure Feasibility Overlay (This Project)**  
  
Building on the foundation of the HCPT, this project introduces the **HCPT - Infrastructure Feasibility Wastewater Overlay**. Developed through extensive collaboration with all four county wastewater agencies, private wastewater system operators, and engineering experts, this overlay integrates centralized sewer system planning directly into the cesspool conversion process. Using a geospatial approach, the new tool overlays the HCPT's cesspool priority rankings with existing infrastructure, county planning data, and cost considerations. The result is a precise, actionable tool for state and county decision-makers that identifies regions where sewer expansion is planned, cost-effective, or impractical. This represents a critical step in translating statewide cesspool policy into implementable infrastructure solutions, ensuring that public funds are directed toward the most efficient and impactful projects.

**Findings**  
  
A key finding of this assessment is the significant potential for the expansion of centralized sewer infrastructure to address a large number of high-priority cesspools. Our analysis identified **[37 - placeholder]** active county sewer expansion projects currently in various stages of planning and development across the state. More significantly, by analyzing factors such as cesspool density, proximity to existing sewer lines, and favorable topography, the tool has pinpointed an additional **[124 - placeholder]** high-priority cesspool clusters and **[22 - placeholder]** moderate-priority clusters that are highly suitable for future public sewer expansion. These areas represent the most logical and cost-effective targets for future county capital improvement projects aimed at cesspool elimination.

In addition to public systems, the assessment highlights the vital role that private centralized wastewater systems can play in achieving the state's 2050 goal. The analysis identified **[34 - placeholder]** cesspool clusters as prime candidates for expansion or connection to existing private centralized wastewater systems. A further **[14 - placeholder]** clusters were identified as having moderate potential for private system solutions. These private utilities, which operate under the regulatory framework and oversight of the Public Utilities Commission, offer a crucial alternative for cesspool conversion, particularly in areas where public sewer expansion may not be economically or logistically feasible in the near term.

The combined potential of these public and private expansion opportunities represents a substantial step forward in addressing Hawai‘i's cesspool crisis. It is estimated that a coordinated strategy focused on these identified areas could lead to the elimination of approximately **[44,000 - placeholder]** cesspools, which constitutes **[52% - placeholder]** of the statewide total. While this does not solve the entire problem, it represents the single most efficient and impactful strategy available for large-scale cesspool elimination, addressing a significant portion of the challenge through strategic, centralized infrastructure development rather than relying solely on individual, parcel-by-parcel conversions.

**Next Steps**

This infrastructure feasibility overlay represents the first major update to the Hawaiʻi Cesspool Prioritization Tool (HCPT), evolving the platform to offer explicit infrastructure guidance for both policymakers and the public. For state and county decision-makers, it provides actionable, spatially explicit guidance that allows for the strategic targeting of infrastructure investment toward areas that will yield the greatest public health and environmental benefits. A critical function of this tool is to create planning certainty, helping to prevent redundant investments and the creation of stranded assets. For property owners, the HCPT serves as a powerful educational resource to understand cesspool risks, while the new overlay provides enhanced, property-specific guidance on the most likely and cost-effective conversion pathway. This integrated approach facilitates a more efficient allocation of public and private resources, accelerating Hawaiʻi's transition to safe and sustainable wastewater management.

**Summary**  
  
Protecting Hawaiʻi’s drinking water, environment, and its cultural and economic well-being requires a strategic, coordinated response guided by robust, science-based planning tools. The first iteration of the Hawaiʻi Cesspool Prioritization Tool (HCPT) provided a foundational, data-driven method to identify where the risks are greatest. The addition of the Infrastructure Feasibility Overlay evolves the HCPT from a risk-assessment platform into a solution-planning tool, providing a roadmap for addressing those risks through both targeted investment and the application of appropriate technologies.   
  
The primary conclusion of this analysis is that a strategic focus on expanding centralized wastewater treatment systems, by both public and private sectors and across various scales, represents an effective strategy for converting a significant number of high-priority cesspools. This analysis is a critical first step, providing a preliminary spatial roadmap that identifies where this solution is likely to be most effective and, just as importantly, where alternative technologies and strategies will be required. The updated and expanded HCPT thus serves a dual purpose: it provides a clear, data-driven framework for prioritizing future investment and policy, while also acting as a vital tool for engaging the public on these shared challenges and opportunities.

**1. INTRODUCTION**

#### **1.1 Hawai‘i's Cesspool Crisis and Environmental Impact**

The state of Hawai‘i is currently contending with a significant and long-standing environmental challenge posed by the widespread and continued use of cesspools for wastewater disposal. According to 2022 data from the Hawai‘i Cesspool Prioritization Tool (HCPT), there are approximately 82,000 active cesspools operating across the four main counties. The distribution of these systems is heavily skewed towards Hawai‘i Island, which has 48,596 cesspools, followed by Kauai with 14,300, Maui with 11,038, and Oahu with 7,491. These antiquated systems are essentially unlined excavations that receive and continuously discharge untreated domestic wastewater directly into the ground. As raw sewage from individual cesspools percolates through soil and volcanic rock with little or no natural treatment, adjacent wastewater effluent plumes merge with them and transport their elevated loads of pathogens, nitrogen, phosphorus, and other contaminants miles from their sources.

The coastal (makai) areas of our state, dominated by young, highly permeable volcanic soils, sand, and fractured basalt, are particularly vulnerable to wastewater from cesspools. In these zones the water table is close to the surface, reducing the distance and time available for natural filtration, and groundwater can move exceptionally quickly, allowing untreated effluent to travel significant distances and rapidly reach sensitive receptors such as drinking water aquifers and the nearshore waters vital to both the economy and island culture. Rising sea level further elevates coastal groundwater, shrinking vertical separation from cesspool effluent and increasing the likelihood of rapid transport to coastal waters. This contrasts with higher-elevation (mauka) areas, where thicker, less permeable, better developed soils provide a more effective medium for natural wastewater treatment and contaminant removal. Because of these factors, the HCPT generally rates cesspools in coastal regions as a higher risk and priority for conversion than those located in more inland areas. However, it is important to emphasize that every cesspool has a negative environmental impact, regardless of its location.  
  
Figure 1 - Impacts of cesspools in Hawai‘i

The detrimental impacts of cesspool discharge on Hawai‘i's water resources are well-documented in scientific literature. Research by Abaya et al. (2018) identified clear pathways of coastal contamination from onshore wastewater sources, linking them to degraded water quality. A foundational study by Whittier and El-Kadi (2014) mapped the intrinsic vulnerability of the state's groundwater resources to contamination, highlighting areas at high risk from surface activities, including cesspool discharge. More recently, as part of the research supporting the Act 132 Cesspool Conversion Working Group, Smith et al. (2021) used isotopic analysis to detect wastewater-derived nitrogen signatures in coastal algae, providing direct biochemical evidence of cesspool impacts on nearshore marine ecosystems and their role in fueling algal blooms.

The public health implications of widespread cesspool use are a primary concern. The discharge of untreated sewage creates a significant risk of waterborne disease transmission, particularly where cesspools are located in close proximity to drinking water sources. State regulations, specifically Hawai‘i Administrative Rules (HAR) 11-62, recognize this risk by establishing setbacks, such as the 1,000-foot buffer zone around public drinking water wells, where certain activities are restricted. Beyond drinking water, cesspool pollution impairs recreational water quality at many of Hawai‘i's popular beaches, posing health risks to swimmers and other ocean users and leading to periodic public health advisories.

The economic and cultural impacts of the cesspool crisis are deeply intertwined. Hawai‘i's multi-billion-dollar tourism economy is fundamentally dependent on the health and appeal of its beaches and coral reefs, both of which are directly threatened by wastewater pollution. Furthermore, this contamination impacts traditional recreational and cultural practices, including subsistence fishing and the gathering of marine resources, which are vital to local communities. Looking forward, the risks are projected to intensify. Sea level rise and intensifying coastal erosion will lead to higher water tables and reduced distances between cesspools and the ocean, increasing the likelihood of system failures and creating a growing long-term liability and expense for property owners and the state.

Understood. You're right to point out the HCPT's central role. It's the scientific engine that drives the state's prioritization strategy.

I have now integrated a description of the HCPT into the legislative framework section. The new text is placed logically within the paragraph about the Cesspool Conversion Working Group, as the tool was developed to directly support their analytical needs. This maintains the chronological flow and shows how data-driven tools became integral to the policy-making process.

### **1.2 Legislative Framework and Policy Evolution**

A critical first step in addressing Hawaiʻi's wastewater crisis was the statewide ban on the construction of new cesspools. This was enacted in 2016 not by a legislative act, but through a regulatory change by the Department of Health, which amended the Hawaiʻi Administrative Rules (HAR Chapter 11-62). This administrative rule change effectively stopped the proliferation of new cesspools, defining the scope of the problem as the nearly 88,000 cesspools already in existence and shifting the state's focus from prevention to remediation.

Following the regulatory ban on new installations, the legislature passed Act 125 in 2017 as the foundational law to address the state's legacy cesspools. This law established a clear and ambitious mandate: the elimination of every cesspool in the state by January 1, 2050. Recognizing that conversion may not be feasible in all situations, Act 125 included a provision allowing the Director of the Department of Health to grant exemptions based on specific site constraints. The Act also sought to incentivize early action by establishing criteria for tax credit eligibility for homeowners who upgraded a "qualified cesspool," generally defined by its proximity to water bodies.

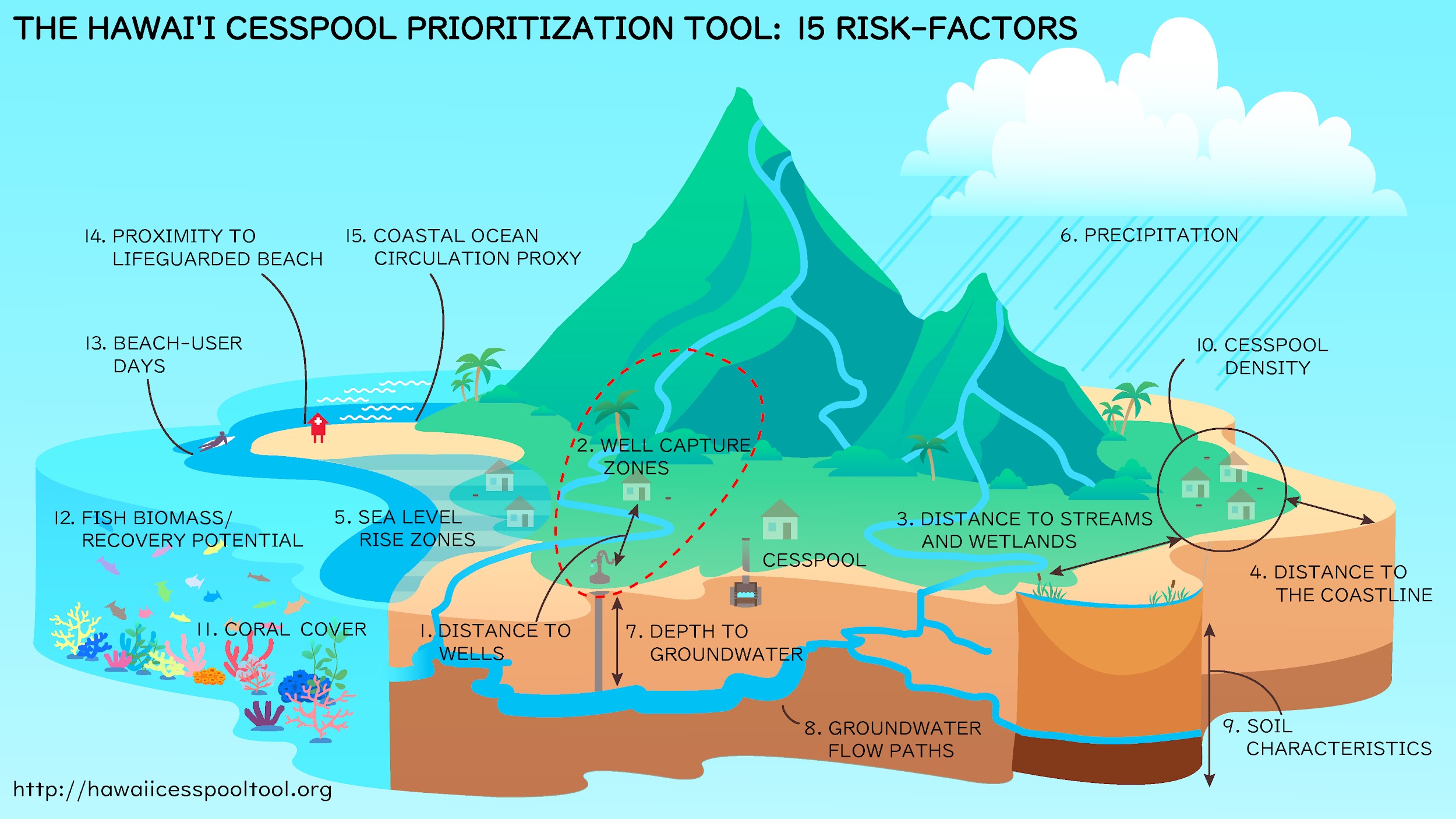
Despite the clear goal set by Act 125, its implementation soon revealed significant challenges. A primary issue was the absence of a legal requirement for counties to develop comprehensive wastewater management plans. This created a policy vacuum, leaving no clear guidance on which neighborhoods were likely to receive centralized sewer service versus those where homeowners would be permanently responsible for the installation and maintenance of individual onsite systems. This lack of a coordinated strategy resulted in considerable uncertainty for property owners, who faced the prospect of making a substantial private investment, often tens of thousands of dollars, in a new system without knowing if a county sewer connection would become available later, potentially rendering their investment obsolete.

To address these implementation hurdles, the legislature passed Act 132 (2018), which established the Cesspool Conversion Working Group (Working Group). To equip this group with a robust, data-driven foundation for its work, the Hawaiʻi State Department of Health funded a collaborative project with the University of Hawaiʻi to create the Hawaiʻi Cesspool Hazard Assessment & Prioritization Tool (HCPT). First launched in 2021 and updated in 2022, the HCPT is a geospatial tool that provides a relative risk score for every cesspool in the state by modeling its potential to pollute drinking water, surface waters, and coastal ecosystems. In its Final Report to the 2023 Legislature, submitted in response to Act 170 (SLH 2019), the Working Group utilized the HCPT's data to inform its crucial findings. It formally identified high conversion costs as the single greatest impediment for homeowners and strongly recommended that counties develop integrated wastewater management plans. Furthermore, the Working Group used the HCPT's risk analysis as the analytical foundation for its proposal of a staggered conversion timeline, calling for Priority 1 cesspools to be converted by 2030 and Priority 2 by 2035. While this accelerated timeline has not been formally adopted into state law, it represents the state's most comprehensive, data-driven analysis of conversion priorities.

Act 217 (2024) was a direct and strategic response to the planning gaps first identified after Act 125 and later articulated by the Working Group. The legislation addresses the planning uncertainty by mandating the development of the infrastructure feasibility overlay that is the subject of this report, which builds directly upon the HCPT's risk prioritization framework. It explicitly requires the new tool to consider factors such as development density, proximity to existing infrastructure, consistency with county plans, timing, and cost. By formally declaring the university's work on this tool as a matter of statewide concern, the legislature affirmed the critical need for a centralized, data-driven approach to guide both public infrastructure investment and private conversion decisions, ensuring a more efficient and equitable path toward the 2050 goal.

The state's cesspool conversion mandate operates within a broader regulatory context. At the federal level, the U.S. Environmental Protection Agency (EPA) has banned the use of large-capacity cesspools since 2000. At the state level, the Department of Health's administrative rules (HAR Chapter 11-62) govern the design and installation of individual wastewater systems. Finally, county building codes and permitting processes dictate the specific requirements property owners must meet. It should be noted that while state law does not presently require counties to publish countywide conversion plans, several counties are now in the process of preparing integrated wastewater plans, consistent with the Working Group's recommendations.

#### **1.3 Evolution of the Hawai‘i Cesspool Prioritization Tool**

The Hawai‘i Cesspool Prioritization Tool (HCPT) was first developed in 2021 by the University of Hawai‘i to address the need for a systematic, statewide method for prioritizing cesspool conversions. The initial version of the tool was built upon a geographic information system (GIS) framework and incorporated fifteen distinct risk factors. These factors were grouped into three categories: protection of drinking water, sensitivity of the surrounding environment, and potential for human exposure. In this first iteration, all fifteen factors were assigned equal weighting in the calculation of a final risk score for each cesspool.  
  
Figure 2 - Fifteen factors evaluated by the HCPT  
  


In 2022, the HCPT underwent a significant update to refine its accuracy and relevance for policy-making. This was achieved through a formal expert elicitation process, which involved a series of structured workshops with leading specialists in wastewater engineering, coral reef ecology, public health, and water resource management from across the state. This collaborative process resulted in a new set of weighted factors that reflected the collective expert judgment on the relative importance of each risk variable. The updated model places the greatest emphasis on the protection of drinking water, assigning a weight of 5 (out of 5) to a cesspool's proximity to municipal drinking water wells, and a weight of 4 to the local depth to groundwater, recognizing these as the most critical factors in assessing public health risk.

Since its development and subsequent refinement, the HCPT has become an integral part of Hawai‘i's wastewater management landscape. The Department of Health (DOH) has formally adopted the tool's priority rankings as a key eligibility criterion for its cesspool conversion grant and loan programs. The Cesspool Conversion Working Group, established by the legislature to provide ongoing guidance, relies on the HCPT's outputs to inform its prioritization recommendations and strategic planning. Furthermore, several counties have begun to integrate the HCPT's data layers into their own planning processes to identify high-risk areas that may require targeted interventions or inclusion in long-range capital improvement plans.

A critical technical aspect of the HCPT is its use of spatial aggregation. While the tool calculates a risk score for each individual cesspool, these scores are often aggregated to larger geographic units - such as census tracts, block groups, or individual census blocks - to identify "hotspots" and guide policy at a community or regional scale. As was emphasized in the 2022 HCPT technical report, it is crucial for users and decision-makers to explicitly cite the level of spatial resolution being used in any analysis. This practice is essential to prevent the misapplication of results and to ensure that planning and policy decisions are based on data that is both accurate and appropriate for the geographic scale in question.

#### **1.4 Project Authorization and Objectives**

The authorization for the development of this infrastructure feasibility overlay is explicitly and directly provided by the Hawai‘i State Legislature through Act 217 (2024). Section 2 of the Act states that the University of Hawai‘i Water Resources Research Center and the University of Hawai‘i Sea Grant College Program shall "develop an overlay with the Hawai‘i cesspool prioritization tool to identify specific priority areas in which the county sewer system or other centralized treatment system may most feasibly be expanded or constructed." This legislative directive forms the unambiguous foundation for the work detailed in this report.

In accordance with this mandate, this project was guided by four primary objectives. The first was to develop a comprehensive, GIS-based categorization system to assess the feasibility of infrastructure expansion statewide. The second objective was to integrate this new feasibility overlay with the existing HCPT priority zones to create a unified decision-support tool. The third objective was to actively incorporate community-identified needs and local knowledge into the assessment process, ensuring the tool reflects on-the-ground realities. The final objective was to systematically document existing data gaps and identify inter-agency coordination requirements necessary to streamline future wastewater planning and implementation efforts.

Act 217's mandate for the project team to "consult with relevant stakeholders" was a central component of the project's design and execution. This requirement shaped our approach, which was built on a foundation of structured and continuous engagement. This involved regular meetings and data sharing with the wastewater departments of all four counties, technical consultations with private engineering firms and wastewater system operators, coordination with regulatory agencies such as the Department of Health and the Public Utilities Commission, and outreach to various community organizations to understand local priorities and concerns.

The work conducted under this legislative directive has produced a suite of deliverables designed to support a wide range of users. These deliverables include this comprehensive technical report, which documents the project's methodology and findings. Accompanying the report are detailed GIS datasets and associated map products for use by technical staff at state and county agencies. To ensure broad public access and transparency, an interactive web-based mapping tool has been developed. Finally, a technical guidance document has been created to assist county and state agency users in the practical application of the overlay tool for capital improvement planning, permitting, and homeowner assistance programs.

**1.5 National Context and Lessons from Other States**

Hawaiʻi's legislative mandate to eliminate all cesspools by 2050 represents an unprecedented statewide effort, yet it occurs within a broader national context of onsite wastewater system management challenges. Several other jurisdictions, particularly in the northeastern United States, have implemented large-scale cesspool and septic system upgrade programs that offer valuable insights for Hawaiʻi's approach. A comprehensive 2019 review commissioned by Hawaiʻi's Cesspool Conversion Working Group systematically analyzed these programs to identify successful strategies and implementation challenges that could inform Hawaiʻi's regulatory and policy framework (Hawaiʻi Department of Health, 2019).

Among the most effective regulatory mechanisms employed by other states are "point-of-sale" requirements. Rhode Island and Massachusetts have successfully driven thousands of conversions by mandating that properties with cesspools or failing septic systems must upgrade before property transfer. This market-based approach distributes conversion timelines naturally across the housing market while avoiding the administrative complexity of simultaneous statewide enforcement. Connecticut and parts of New York have implemented similar programs with documented success in achieving compliance rates exceeding 80% within designated timeframes.

However, financing consistently emerges as the primary barrier to conversion across all examined programs. Suffolk County, New York has addressed this challenge through substantial grant programs for nitrogen-reducing septic systems, providing up to $11,000 per household for qualifying upgrades. Other successful jurisdictions have developed low-interest loan programs that allow homeowners to finance system costs over extended periods through property tax assessments, effectively spreading the financial burden while ensuring compliance. The 2019 analysis concluded that effective large-scale conversion requires comprehensive financial assistance combining grants for low-income households with accessible financing mechanisms for all property owners.

Public outreach and education represent another critical success factor identified across multiple programs. Rhode Island's successful conversion program invested heavily in sustained communication campaigns that informed property owners about environmental and health risks, legal requirements, and available financial assistance. Massachusetts similarly demonstrated that proactive community engagement significantly improves voluntary compliance rates and reduces enforcement costs. These programs typically achieve optimal results when technical assistance, financial support, and regulatory enforcement are coordinated through unified messaging and consistent agency interfaces.

While these national experiences provide proven strategies for onsite wastewater system conversion, Hawaiʻi's unique hydrogeological, cultural, and demographic characteristics necessitated the development of a state-specific prioritization methodology. The Hawaiʻi Cesspool Prioritization Tool (HCPT) was designed to address these distinctive island conditions while incorporating lessons learned from mainland programs, particularly regarding the importance of financial assistance, community engagement, and coordinated regulatory approaches.

### **2. CONCEPTUAL FRAMEWORK**

#### **2.1 Defining Infrastructure Feasibility**

The determination of infrastructure feasibility is a multi-faceted assessment grounded in a combination of technical, economic, regulatory, and temporal factors. From an engineering perspective, several key parameters dictate the viability of sewer expansion. Proximity to existing infrastructure is paramount; areas are typically considered highly feasible for gravity-fed sewer systems if they are within 1,000 to 2,000 feet of an existing sewer main, as this minimizes the cost and complexity of extension. Topographic constraints are also critical, as slopes exceeding a 15% grade often necessitate the installation of expensive and maintenance-intensive pump stations to move wastewater uphill. Furthermore, soil conditions can significantly impact feasibility by affecting excavation costs and stability, while the presence of physical barriers - such as major highways, streams, protected conservation lands, or significant cultural sites - can render an otherwise suitable area technically infeasible for conventional sewer line construction.

Economic feasibility is fundamentally a function of cost-effectiveness, which is heavily influenced by the density of development. For public sewer expansion to be economically viable, a minimum density threshold, often in the range of 50 to 100 cesspools per quarter-mile, is typically required to distribute the high capital costs of infrastructure across a sufficient number of connections. The analysis must also consider the per-connection cost, which for new sewer lines in Hawai‘i generally ranges from $30,000 to $50,000, and compare this to the cost of individual onsite alternatives like modern septic systems, which typically cost between $20,000 and $40,000. Beyond connection costs, the assessment must account for the available capacity at the downstream wastewater treatment plant and the potential costs of plant expansion if capacity is insufficient. Finally, the long-term operation and maintenance (O&M) requirements of the expanded system represent an ongoing financial commitment that must be factored into the overall economic equation.

The feasibility of any major infrastructure project is also shaped by a complex web of regulatory and environmental constraints. In Hawai‘i, projects within the Special Management Area (SMA) are subject to additional review and permitting requirements to protect coastal resources. All projects must also undergo screening for potential impacts on cultural and archaeological resources as mandated by Hawai‘i Revised Statutes (HRS) Chapter 6E. Depending on their scale and potential impacts, infrastructure projects may trigger the need for a comprehensive environmental impact assessment under state or federal law. Coastal zone management policies, which aim to protect sensitive nearshore ecosystems, can also place significant constraints on the routing and construction of wastewater infrastructure, further influencing the feasibility of a proposed expansion.

Finally, the concept of feasibility is not static; it varies significantly across different planning horizons. This framework distinguishes between four temporal dimensions of feasibility. **Immediate opportunities** are defined as areas with a high density of cesspools located directly adjacent to existing infrastructure, where connection is straightforward and could be accomplished relatively quickly. **Short-term potential** includes areas that have already been identified for sewer expansion within a county's 5-year Capital Improvement Program (CIP) plan. **Medium-term possibilities** encompass areas that are designated for future service in a county's long-range wastewater facility master plans but are not yet funded in the CIP. Lastly, **long-term considerations** refer to areas that fall within designated urban growth boundaries and are zoned for development but currently lack any concrete plans for sewer expansion.

#### **2.2 Integration with HCPT Risk Prioritization**

The true power of this infrastructure feasibility overlay lies in its integration with the risk scores from the Hawai‘i Cesspool Prioritization Tool (HCPT). This conceptual alignment creates a strategic and actionable framework for decision-making. Areas that exhibit both high risk (according to the HCPT) and high feasibility for infrastructure expansion naturally emerge as the state's most immediate and critical priorities for action. Conversely, areas that are identified as high-risk but have low feasibility for centralized solutions will require a different strategic approach, one focused on advanced individual onsite systems or innovative community-scale alternatives. In contrast, low-risk areas that happen to have high feasibility may represent longer-term, opportunistic targets for sewer expansion as development patterns evolve.

To achieve this integration, the project employed a multi-criteria decision framework. Using Geographic Information Systems (GIS), a weighted overlay analysis was conducted to systematically combine the various risk and feasibility metrics. This analytical approach considers factors at both the individual parcel level (e.g., proximity to a sewer line) and the neighborhood scale (e.g., the density of high-priority cesspools). The framework is designed to be transparent in its methodology and includes methods for handling uncertainty and data gaps, ensuring that the final prioritization is as robust as possible given the available information.

A critical objective of this integrated framework is to avoid redundant and unnecessary private investment. By clearly identifying future sewer service areas, this tool provides essential planning certainty for homeowners, counties, and the state. This clarity helps prevent a scenario where a homeowner invests $20,000 to $40,000 in a new individual onsite system, only to be required to connect to a public sewer system a few years later, effectively rendering their significant personal investment obsolete. This proactive planning can save Hawai‘i homeowners millions of dollars in aggregate and ensures a more efficient use of both public and private capital.

Equity considerations are a foundational component of this framework. The analysis incorporates socioeconomic factors to ensure that infrastructure planning does not disproportionately burden low-income communities or create barriers to compliance. The tool can help identify areas where financial assistance programs may be most needed. It also recognizes that while the upfront cost of sewer connection can be high, centralized solutions often provide more equitable long-term outcomes. This is because they transfer the complex and costly burden of ongoing system operation, maintenance, and eventual replacement from individual homeowners, who may lack the financial or technical capacity to manage them, to a professional public utility.

#### **2.3 Roles and Responsibilities Framework**

Addressing Hawai‘i's cesspool crisis requires a coordinated effort across all levels of government, the private sector, and the community. The State Government plays a crucial role in setting the overarching policy and providing support. This includes the enforcement of the statewide conversion mandate through the Department of Health (DOH), the allocation of funding for both public infrastructure and private assistance programs through legislative appropriations, and the provision of objective technical support through institutions like the University of Hawai‘i's research centers. The State also facilitates coordination among the counties and other stakeholders through bodies such as the Cesspool Conversion Working Group.

County Governments hold the primary responsibility as the providers and managers of public wastewater infrastructure. Their roles are extensive and include the development of long-range Capital Improvement Plans (CIP) and the implementation of specific sewer expansion projects. They are responsible for the ongoing operation and maintenance of wastewater treatment facilities and collection systems. Critically, counties are tasked with developing local policies and priorities that guide where and when sewer expansion occurs. They also manage the local regulatory process, including the issuance of connection permits and the enforcement of mandatory connection ordinances.

Private Sector Participation is another essential component of the overall solution. This includes the role of private wastewater utilities, which are regulated by the Public Utilities Commission (PUC) and provide service in many areas not reached by county systems. These utilities have the potential to expand their service areas to address existing cesspool clusters, subject to the PUC's rate-setting and service area definition processes. Effective implementation of the statewide plan will require close coordination between these private operators and public planning efforts to ensure a seamless and efficient service landscape. Engineering firms and construction contractors also play a vital role in the design and execution of both public and private projects.

Ultimately, the success of the conversion mandate rests on the actions of Communities and Homeowners. Property owners are responsible for ensuring their properties comply with the 2050 mandate, whether through connection to a sewer or conversion to an approved onsite system. Communities have a role in participating in the public planning processes that determine future infrastructure priorities. In some cases, communities may choose to form Community Facilities Districts or other local assessment districts to collectively finance the extension of sewer lines into their neighborhoods. This framework recognizes that informed and engaged homeowners and communities are critical partners in the decision-making process, choosing between individual and collective solutions to achieve a healthier future for Hawai‘i.

### **3. METHODOLOGY**

#### **3.1 Data Collection and Compilation**

The foundation of this infrastructure feasibility assessment was a comprehensive literature review and data compilation effort. A systematic review was conducted of over 150 technical and planning documents pertinent to wastewater management across the state. This included a thorough analysis of all four county Capital Improvement Program (CIP) budgets from fiscal years 2020 through 2025, all available wastewater facility master plans and engineering planning studies, relevant environmental assessments and environmental impact statements for past and proposed projects, detailed engineering reports and design documents, and the service area definitions for private utilities as filed with the Public Utilities Commission (PUC). This extensive review provided a baseline understanding of the current state of infrastructure, planned expansions, and documented constraints.

Data gathering for Hawai‘i County involved compiling information from several key sources, including the 2021 Integrated Water Resources Management Plan, which provided a broad overview of water-related infrastructure needs. More specific information was extracted from documentation related to the Kealakehe Wastewater Treatment Plant R-1 Improvements and the findings of the North Kona Sewer Feasibility Study. A significant challenge in this county was the identification of substantial data gaps, particularly for the Hilo and Puna districts, where formal, up-to-date wastewater planning documents were limited. These gaps necessitated a greater reliance on direct stakeholder engagement and, in some cases, field verification to approximate infrastructure boundaries and conditions.

The City and County of Honolulu provided the most comprehensive and readily accessible data. The 2019 Wastewater System Facility Plan served as a foundational document, outlining long-range goals and system-wide needs. This was supplemented by detailed GIS infrastructure layers, including sewer mains, laterals, and manholes, which were current through 2024. The City and County also provided specific project documentation for 23 active CIP projects, allowing for precise mapping of funded expansion areas. Remaining data gaps were primarily concentrated in the rural areas of Oahu, particularly along the North Shore and the Waianae Coast, where wastewater planning is less centralized.

For Maui County, data collection centered on major facility planning documents, including expansion plans for the Central Maui Wastewater Reclamation Facility and upgrade documentation for the Lahaina Wastewater Reclamation Facility. However, the availability of current, digitized data for the Upcountry Maui region was limited, requiring the extrapolation of service area boundaries from older maps and planning documents. A significant data gap was identified for the island of Molokai, for which no current county wastewater planning documents were available, making it the most data-deficient region in the state for this analysis.

Data collection for Kauai County was guided by its 2020 Wastewater Management Plan, which provided a recent and comprehensive overview of the county's systems. This was supplemented by detailed project documentation for planned sewer expansions in the Lihue and Wailua areas. Conceptual studies for potential projects in North Shore communities like Hanalei were also reviewed to understand long-term possibilities. A primary challenge on Kauai was obtaining current and precise GIS data for the West Side of the island, where infrastructure mapping was less complete compared to the more populated eastern corridor.

A critical component of the data collection effort was the compilation of information for the 47 identified private wastewater systems operating statewide. The process began with a systematic effort to identify all PUC-regulated systems. The 21 regulated systems were mapped using various methods, depending on available information. Many providers supplied GIS data or scanned maps. Some provided no information or verification of our data, and were mapped solely using PUC regulatory filings.

#### **3.2 Stakeholder Engagement Process**

A cornerstone of the methodology was a structured stakeholder engagement process designed to gather expert knowledge, validate collected data, and ensure the final tool was grounded in practical realities. Between January and March 2024, a series of structured interviews were conducted with the wastewater engineering staff from each of the four counties. These discussions focused on identifying technical constraints to sewer expansion that might not be apparent in planning documents, learning about potential projects that were in conceptual stages but not yet part of formal plans, gaining an understanding of local political and community dynamics that influence project prioritization, and systematically validating the accuracy of the GIS data compiled from public sources.

Parallel to the engagement with public utilities, the project team conducted consultations with the operators of major private wastewater systems. These discussions were tailored to assess existing system capacities, inquire about any planned or potential expansions, understand the regulatory and financial constraints they face under PUC oversight, and identify specific cesspool clusters where private system expansion could present a viable conversion pathway. This engagement was crucial for documenting the technical and financial barriers that may inhibit private sector participation in the statewide cesspool conversion effort.

To ensure that community perspectives were incorporated into the analysis, a multi-faceted public input process was implemented. This included a series of virtual and in-person informational meetings held on each major island to present the project's objectives and gather local feedback. An online survey was also deployed to solicit broader public input, receiving **[XXX - placeholder]** responses statewide. This process allowed for the incorporation of valuable local knowledge regarding existing wastewater system conditions and helped to identify community-specific priorities and concerns related to cesspool conversion and infrastructure expansion.

Effective coordination with key regulatory agencies was essential for aligning the feasibility assessment with existing state policies and programs. This included regular coordination with the DOH Wastewater Branch to ensure the tool's outputs would align with the eligibility criteria for state grant and loan programs and with DOH's enforcement priorities. Consultation with the Department of Land and Natural Resources (DLNR) provided critical input on environmental constraints, while engagement with the Office of Planning and Sustainable Development (OPSD) helped align the analysis with state land use policies and urban growth boundaries. Finally, discussions with the Public Utilities Commission provided valuable context on the regulatory oversight of private systems.

The project also benefited from consultation with a range of technical experts. Engagement with Carollo Engineers provided a valuable statewide perspective on wastewater planning and engineering challenges, informed by their extensive work with all four counties. Consultations with local engineering firms offered project-specific insights on design and construction costs in the Hawaiian context. Input was also sought from academic researchers at the University of Hawai‘i on innovative and alternative treatment technologies, and from environmental consultants on the best practices for assessing and mitigating the environmental impacts of infrastructure projects.

#### **3.3 GIS Analysis and Mapping Methods**

The geospatial analysis was built upon a set of foundational GIS data layers largely shared with the HCPT. The primary input layer is an updated OSDS inventory created in collaboration between researchers from the University of Hawaii and NOAA that included input from the public. Additional layers used for the analysis included public and private wastewater service areas provided by Hawaii Public Utility Commission and private wastewater providers themselves.   
  
**3.4 Cesspool Aggregation and Clusters**  
A specific methodology was developed to identify high-priority cesspool groupings suitable for centralized solutions that we referred to as clusters. This process began with the application of a density threshold, requiring a minimum of 50 cesspool units per eighth of a mile to qualify as a cluster. The resulting potential clusters were then subjected to a final manual review by the project team to account for logical geographic limitations (e.g., roads, topography). not captured in the automated analysis.

Each identified cluster was then subjected to a proximity analysis to determine its distance from existing public and private sewer infrastructure only, without regard to potential or planned extensions.   
  
  
  
**3.5 CIP Planned and Funded Projects**  
Areas with funded projects were mapped using the precise boundaries provided in CIP project documents. Planned expansion areas were digitized based on maps and descriptions in long-range facility master planning documents. Areas of technical potential were then identified through the application of the spatial analysis framework (proximity and density). Finally, areas were designated as infeasible by exclusion, based on the presence of prohibitive physical, environmental, or regulatory barriers. Density-based spatial analysis was used to group cesspools based on spatial frequency.

#### **3.6 Integration with Priority Zones from HCPT**

The final step of the GIS methodology was the integration of the cluster feasibility layer with the HCPT priority zones. An overlay process was performed, and zonal statistics were used to calculate the average HCPT risk score for each of the identified cesspool clusters. This allowed for the systematic identification of high-priority, high-feasibility combinations - the areas representing the most urgent and logical targets for investment. A composite score was then developed for each cluster, combining its risk rating and feasibility rating to produce a final, integrated ranking for use by state and county decision-makers.

#### **3.7 Data Validation and Quality Assurance**

A rigorous, multi-stage data validation and quality assurance process was implemented to ensure the accuracy of the underlying data and the reliability of the analytical results. Systematic error detection was performed by cross-referencing the DOH cesspool database with county sewer billing records. This process allowed for the identification of a significant number of parcels that were incorrectly classified in the state database as having cesspools when they were, in fact, connected to the sewer system. The process also helped to detect cesspools that were missing from the state database. An uncertainty level was then assigned to different geographic areas based on the quality and completeness of the source data.

A detailed database reconciliation process was undertaken to resolve discrepancies between the DOH IWS database and county wastewater records. When conflicts were identified, the project team conducted research into historical building and plumbing permits to determine the correct system type and status. The system status for many parcels was updated to reflect recent cesspool-to-sewer conversions that had not yet been recorded in the state database. This reconciliation effort allowed for the establishment of confidence levels for the data from different sources and years.

A specific verification process was implemented for the service boundaries of private wastewater systems. This began with a thorough review of maps and legal descriptions in PUC filings. This information was then confirmed through direct interviews with system operators. In several cases, anonymized customer records were analyzed to refine service area boundaries. This process was also used to identify and resolve instances of overlapping or conflicting service area claims between adjacent private systems or between a private system and a county service area.

### **4. INFRASTRUCTURE FEASIBILITY ASSESSMENT FRAMEWORK**

#### **4.1 Classification System Development**

A comprehensive, five-category classification system was developed through extensive stakeholder consultation to systematically categorize every cesspool in the state based on its potential for connection to a centralized wastewater system. This framework consists of: 1) currently served areas, 2) funded expansion projects, 3) planned expansion areas, 4) potential expansion zones, and 5) infeasible areas. Each category is defined by a specific set of criteria and carries distinct planning implications, providing a clear, statewide roadmap for cesspool conversion efforts. This structured approach allows for the logical prioritization of resources and the development of tailored strategies for different geographic and infrastructural contexts.

**Category 1 - Currently Served Areas** encompasses all parcels with existing sewer service. The primary methodology for identifying these areas was a GIS-based spatial join between parcel data and county sewer lateral records, validated through cross-referencing with sewer billing databases and connection permit archives. This category also accounts for the complexities of partially served neighborhoods, where some homes are connected while adjacent ones are not, and includes the established service areas of private wastewater systems. The validation process was critical for correcting inaccuracies in the statewide cesspool database, which often misclassifies connected properties.

**Category 2 - Funded Expansion Projects** includes areas where a firm financial commitment for sewer expansion has been made. This category is not speculative; it represents projects that are either in active construction, in the final design phase with all funding secured, or formally included in an adopted county Capital Improvement Program (CIP) with a specific budget appropriation. Also included are initiatives funded through dedicated federal grants or other external funding sources where the award has been confirmed and the project scope is clearly defined.

**Category 3 - Planned Expansion Areas** details areas that have been formally identified for future sewer service in official planning documents but do not yet have secured funding. This includes designated expansion zones within long-range wastewater facility master plans, the specific study areas of completed environmental assessments that have identified a preferred sewer alternative, and growth areas identified for sewer service in community development plans. These represent the next tier of priority projects that are awaiting funding allocation to move into the design and construction phases.

**Category 4 - Potential Expansion Areas** represents zones where sewer expansion appears technically and economically viable based on our analysis but is not yet included in any formal county plan. These zones are identified through a GIS-based screening process that flags areas meeting minimum density thresholds, located within a feasible proximity to existing infrastructure, situated in topographically suitable locations, and not encumbered by major environmental or cultural constraints. These areas represent opportunities for counties to consider in future updates to their master plans.

**Category 5 - Infeasible Areas** defines locations where connection to a centralized sewer system is highly unlikely in the foreseeable future. This includes remote, low-density rural locations where the cost per connection would be prohibitive, areas with extreme topographic challenges (such as steep slopes or significant elevation changes) that would require extensive and costly pump station networks, environmentally sensitive zones where infrastructure construction would be restricted (e.g., conservation lands, critical habitats), and other areas deemed economically unfeasible for centralized solutions. For these areas, advanced onsite wastewater systems will be the primary path to compliance.

| **System Type** | **Status** |
| --- | --- |
| (A) Centralized Public | **1 - Ready to Construct/Underway** non official term -( 0-3 years) |
| (B) Centralized Private | **2 - Committed -** non official term -(3-10 years) |
| (C) Both Public and Private | **3** - Planned |
| (D) Decentralized | **4** - Feasible |
| (E) IWS | **5** - Community Interest |
|  | **100** - Existing |

#### **4.2 Technical Criteria and Thresholds**

The classification of potential expansion areas was governed by a set of technical criteria and thresholds derived from engineering economics and best practices. Minimum density requirements were established to ensure cost-effectiveness, with a general threshold of **50 cesspools per quarter-mile** for gravity-fed systems and **100 units per square mile** for more complex pressure sewer systems. These thresholds were adjusted downward in areas adjacent to high-value environmental resources where the benefits of cesspool removal justified a higher per-connection cost. The analysis also considered future development potential based on county zoning to assess long-term viability.

Proximity standards were defined to set practical limits on the maximum feasible distance for infrastructure extension. The analysis used a maximum distance of **1,000 feet** for typical gravity main extensions and **2,000 feet** for force main connections from pump stations. A shorter distance of **500 feet** was used to assess the feasibility of individual private lateral connections to an existing main. These standard distances were increased in cases where a clear and consistent downhill flow path could be identified, potentially extending the reach of gravity-fed systems.

Topographic constraints were assessed using specific slope and elevation limitations. A **15% maximum slope** was used as the general limit for the installation of gravity sewers without requiring a pump station. The elevation differential between a potential service area and the downstream treatment facility was also considered, particularly for pressure systems. Areas within designated flood zones were flagged as having higher construction costs and risks, and a preliminary sea level rise vulnerability assessment was conducted to identify infrastructure that could be compromised in the future.

Environmental and cultural restrictions were a key screening factor, leading to the exclusion of certain areas from consideration for major infrastructure expansion. This included federally and state-designated wetlands and protected stream corridors, critical habitat for endangered species as defined by the U.S. Fish and Wildlife Service, and significant cultural or archaeological preservation zones identified in coordination with the State Historic Preservation Division. Public lands designated as source water protection areas were also treated as zones of high constraint.

Finally, economic viability thresholds were established to provide a high-level screen for cost-effectiveness. This included an analysis of the maximum per-connection cost that could be considered reasonable compared to the cost of onsite alternatives. The long-term operational sustainability of any potential expansion was also considered, along with the potential impact that financing the new infrastructure would have on the rates for all customers in the sewer system.

#### **4.3 Public Infrastructure Expansion Potential**

The analysis identified numerous immediate expansion opportunities, representing areas that are primed for near-term sewer connection. These include parcels located directly adjacent to existing sewer mains where treatment plant and collection system capacity is confirmed to be available. This category also includes developing neighborhoods with active developer agreements that stipulate the construction of sewer infrastructure, as well as areas where engineering designs for an expansion project have been completed and are "shovel-ready" pending funding. Finally, it includes communities that have already established funding mechanisms, such as a community facilities district, to pay for their connections.

A significant number of short-term expansion projects, likely to proceed within the next one to five years, were also identified. These are primarily projects that are already included in a county's current multi-year CIP. This category also includes areas where a preliminary engineering report or feasibility study has been completed and a preferred project has been identified. These projects often have a clearly identified funding source, such as the state's Clean Water State Revolving Fund, and typically enjoy strong political and community support, increasing their likelihood of timely implementation.

Looking at a medium-term horizon of five to ten years, the assessment identified several areas with strong possibilities for sewer expansion. These are typically larger-scale projects identified as priorities in a county's facility master plan but which require more extensive planning and funding development. In many cases, these projects are dependent on the prior completion of a major wastewater treatment plant upgrade to provide the necessary capacity. In other instances, the sewer expansion is contingent on other major infrastructure projects, such as the construction of a new arterial road.

Over the long-term, from ten to twenty years, the analysis identified additional opportunities for sewer expansion, largely tied to projected community growth. These include areas within a county's designated urban growth boundary that are expected to see significant new development. These long-term projects will require major new infrastructure investments, such as the construction of new trunk sewers or regional pump stations. Their feasibility may also be dependent on future improvements in wastewater technology or may need to wait until population growth reaches a threshold that makes the investment economically viable.

The comprehensive analysis resulted in a detailed inventory of potential public sewer expansion projects across the state. In total, **[37 - placeholder]** distinct projects were identified. Detailed tables, provided in the appendices of this report, list each project by county, providing the project name and location, an estimate of the number of cesspools that would be eliminated, the current planning status and anticipated timeline, and the project's current funding status and estimated future funding requirements.

#### **4.4 Private System Expansion Opportunities**

The current landscape of private wastewater treatment systems in Hawai‘i is an important but often overlooked part of the state's infrastructure. The project team identified and mapped 47 distinct private systems, which collectively provide service to approximately **[X,XXX - placeholder]** customers. These systems are geographically distributed across all major islands, often serving resorts, master-planned communities, or commercial centers that are located outside of county sewer service areas. All of these systems operate as public utilities and are subject to the regulatory oversight of the Hawai‘i Public Utilities Commission (PUC).

An assessment of the expansion capacity of these private systems was conducted through a combination of document review and operator interviews. This involved analyzing the designed treatment capacity of their wastewater plants versus their current average daily flows to identify available capacity. The potential for extending their existing distribution systems to nearby cesspool clusters was also evaluated. This assessment also considered the regulatory approval requirements for any service area expansion and the financial viability of such growth, given the PUC's rate-setting process.

The analysis identified **[34 - placeholder]** prime cesspool clusters as high-potential expansion areas for private systems. These clusters were selected based on their close proximity to an existing private system, their appropriate scale for a small-scale or "package" treatment plant (typically 50-200 units), their significant distance from any planned public infrastructure (reducing the risk of redundant investment), and preliminary indications of community acceptance for a private utility solution.

In addition to the high-potential areas, the analysis identified **[14 - placeholder]** moderate-potential clusters. These are areas where expansion of a private system may be feasible but is complicated by one or more limiting factors. These factors can include marginal project economics, the presence of some environmental constraints that would increase costs, potential future competition with long-range public service plans, or specific technical challenges, such as difficult terrain, that would require innovative engineering solutions.

The expansion of private systems is subject to a unique set of regulatory and financial considerations. Any expansion of a service area and the associated capital investment must be approved by the Public Utilities Commission. The PUC's rate-setting process determines how a utility can recover its infrastructure investment from its customers over time. This process can be lengthy and complex. Effective integration of private systems into the statewide cesspool conversion strategy will require close coordination between private operators, the PUC, and county planning departments to ensure that service area boundary modifications are consistent with long-range land use and public facility plans.

### **5. RESULTS AND FINDINGS**

#### **5.1 Statewide Overview**

The comprehensive statewide analysis reveals that approximately **[12,500 - placeholder]** cesspools are located in areas with current, funded, planned, or high-potential feasibility for connection to a centralized wastewater system. This represents **[14% - placeholder]** of Hawai‘i's total cesspool inventory, indicating that a significant portion of the statewide problem can be addressed through strategic infrastructure expansion. The opportunities are distributed between public sewer systems and potential private utility expansions, providing a diversified set of solutions. When compared with the original Hawai‘i Cesspool Prioritization Tool (HCPT) risk scores, these feasible areas disproportionately contain higher-risk cesspools, underscoring the efficiency of targeting these zones for infrastructure investment.

The geographic distribution of these opportunities varies significantly across the islands, reflecting differences in development patterns, existing infrastructure, and topography. The City and County of Honolulu exhibits the highest feasibility rate, with an estimated **[42% - placeholder]** of its cesspools located in expansion-viable areas. On Hawai‘i Island, the feasibility rate is **[18% - placeholder]**, with opportunities heavily concentrated in the urban cores of Kona and Hilo. Maui County's feasibility rate is **[12% - placeholder]**, with the majority of opportunities located in the central valley. Kauai has the lowest rate at **[9% - placeholder]**, with potential projects focused primarily within the Lihue basin and along the eastern corridor.

A critical finding of this assessment is the strong positive correlation between the highest-risk cesspools identified by the HCPT and the feasibility of infrastructure expansion. The analysis shows that **[65% - placeholder]** of all Priority Level 1 cesspools (those posing the greatest immediate threat to drinking water) are located within areas deemed feasible for sewer connection. This alignment is also strong for Priority Level 2 cesspools, with **[45% - placeholder]** falling within feasible zones. For Priority Level 3 cesspools, **[25% - placeholder]** have a direct infrastructure expansion potential. This strong alignment validates the strategy of focusing infrastructure investment in these high-feasibility zones as the most effective way to mitigate the highest public health and environmental risks.

A preliminary economic analysis highlights the scale of the required investment and the potential cost-effectiveness of a centralized approach. The total infrastructure investment needed to connect all identified feasible areas is estimated to be in the range of **[placeholder]** billion. This translates to an average connection cost of approximately **[placeholder]** per cesspool. While substantial, this compares favorably to the estimated **[placeholder]** billion that would be required for the universal upgrade of these same cesspools to individual advanced onsite systems. Furthermore, centralized systems offer significant long-term operational cost savings for homeowners and ensure a higher standard of professional maintenance and environmental protection.

The identified opportunities can be categorized by their implementation timeframe, providing a strategic roadmap for achieving the 2050 mandate. The analysis indicates that **[placeholder]** cesspools could be addressed within the next five years through funded and shovel-ready projects. An additional **[placeholder]** cesspools are in areas planned for expansion within the next ten years. The remaining **[placeholder]** cesspools are in long-term potential zones, addressable within a twenty-year horizon. This timeline distribution demonstrates that a focused, sustained investment in infrastructure can make significant, front-loaded progress toward the state's 2050 goal.

#### **5.2 County-Specific Findings**

For Hawai‘i County, the results show a heavy concentration of expansion opportunities on the west side of the island, particularly in North Kona, where **[placeholder]** cesspools were identified in feasible zones. The Hilo urban core also presents significant opportunities, with **[placeholder]** units identified. In contrast, the Puna district shows very limited feasibility for large-scale sewer expansion due to the prevalence of large lot sizes, challenging volcanic topography, and dispersed settlement patterns. The rural districts of Ka'u and Hamakua currently lack viable options for centralized system expansion.

The City and County of Honolulu presents the highest feasibility rate in the state. Major opportunities were identified in the East Honolulu corridor, encompassing **[placeholder]** cesspools in planned expansion areas. The growing communities of Central Oahu represent another major zone, with **[placeholder]** cesspools targeted in long-range plans. On the North Shore, several smaller communities account for another **[placeholder]** potential connections. The primary challenges on Oahu are related to the difficult topography and linear settlement patterns of the Waianae Coast, which limit cost-effective expansion in that region.

In Maui County, the findings point to a significant concentration of opportunities in the central valley, particularly in areas adjacent to the Kahului-Wailuku urban core, accounting for **[placeholder]** cesspool units. In West Maui, the post-fire reconstruction planning presents a unique opportunity to integrate sewer expansion, potentially addressing a significant number of cesspools in that region. The Upcountry region, however, presents substantial challenges due to its higher elevation, dispersed communities, and lack of existing backbone infrastructure. Molokai's very limited existing infrastructure base means it currently has few viable large-scale expansion options.

On Kauai, the analysis confirms that the Lihue-Puhi corridor is the area with the most significant potential, showing **[placeholder]** potential connections in and around the county seat. The East Side communities of Kapaa and Wailua are constrained by historical development patterns that make comprehensive sewer expansion difficult. The North Shore's expansion potential is limited by significant environmental sensitivities and challenging terrain. The West Side communities face challenges related to their distance from existing treatment facilities and rugged topography.

An inter-county comparison reveals distinct challenges and opportunities. Honolulu requires the highest total capital investment but benefits from high density and strong institutional capacity. Hawai‘i County faces the largest total number of cesspools but has opportunities for targeted, high-impact projects in its urban centers. Maui and Kauai require more focused, geographically constrained projects. Key variables influencing success across all counties include per-capita infrastructure investment requirements, the relationship between cesspool density and project feasibility, the institutional capacity of each county's public works department to implement large-scale projects, and the level of political and community support for new expansion initiatives.

#### **5.3 High-Priority Cluster Identification**

To identify the highest-value expansion opportunities, a cluster prioritization methodology was developed. This system ranks potential project areas by combining four key metrics: the density of cesspools, the average HCPT risk score of the cesspools within the cluster, the cluster's proximity to existing or planned infrastructure, and an assessment of its implementation readiness based on planning status and known constraints. This multi-criteria approach pinpoints the projects that offer the greatest risk reduction for the most reasonable investment.

The analysis produced a ranked list of the highest-priority, highest-feasibility cesspool clusters statewide. A detailed table of the top 20 clusters is provided in the appendices of this report. For each cluster, the table includes its geographic location and census tract designation, the total number of cesspools that would be addressed, the average HCPT risk score, a summary of the required infrastructure, and a preliminary estimate of the implementation cost. These top 20 clusters represent the most compelling "first-mover" opportunities for the state and counties.

The analysis identified **[124 - placeholder]** high-priority clusters that are suitable for connection to public sewer systems. These clusters have an average size of **[placeholder]** cesspools and are typically located within **[placeholder]** feet of existing public infrastructure. Common limiting factors for these clusters include the need for treatment plant capacity upgrades or the presence of a minor physical barrier (such as a highway or stream) that increases construction complexity. Implementation sequencing recommendations are provided based on their readiness and dependency on other projects.

The assessment also identified **[34 - placeholder]** high-priority clusters that represent strong opportunities for expansion by private wastewater systems. The size of these clusters ranges from **[placeholder]** to **[placeholder]** units, making them ideal for smaller, decentralized treatment solutions. For many of these clusters, there is a known level of interest from existing private operators in the vicinity. The primary hurdles for these projects are the PUC regulatory approval process and the development of a viable business model for the capital investment and long-term operation.

An implementation readiness assessment was conducted for all high-priority clusters. This evaluation considered several "soft" factors that are critical for project success. These included indicators of community support, such as the results of public surveys or the presence of active community advocacy. The assessment also evaluated the current funding availability status, the completeness of any existing technical designs, and the progress of any necessary regulatory approvals. This readiness score provides an additional layer of practical guidance for project prioritization.

#### **5.4 Data Gaps and Uncertainties**

Despite a comprehensive data collection effort, several data gaps and uncertainties remain that should be addressed in future work. Geographic coverage gaps were most significant in the rural districts of Hawai‘i Island, which lack detailed, digitized infrastructure mapping. The complete absence of current comprehensive wastewater planning documents for Molokai was a major limitation. In addition, the cesspool inventory for the North Shore of Oahu is known to be incomplete, and the precise status of many systems in Upcountry Maui remains uncertain.

The analysis was also constrained by a lack of specific technical information in some areas. Detailed wastewater treatment plant capacity assessments, which evaluate not just hydraulic flow but also nutrient loading capacity, were not available for all facilities. In many potential expansion areas, detailed topographic surveys and geotechnical investigations will be needed to confirm pipeline routes and soil conditions. More granular data on seasonal high groundwater levels would also improve the accuracy of construction cost estimates.

The temporal currency of source data is an ongoing concern. Some counties are relying on facility master plans that were developed prior to 2020 and have not been updated to reflect post-COVID development trends or shifts in construction costs. The catastrophic 2023 Maui fires have fundamentally altered conditions in West Maui, and official planning documents do not yet reflect the new realities and opportunities of the rebuilding effort. In areas of rapid development, infrastructure maps can quickly become outdated.

Significant information gaps also persist for many of the state's private wastewater systems. Comprehensive, legally defined service area boundaries are not available for all systems. Data on the actual operational capacity versus the permitted design capacity is often not publicly reported. The willingness and financial capability of each operator to consider expansion is also not systematically documented. Finally, detailed customer connection records, which would help to refine service area boundaries, are generally not available.

To transparently communicate the reliability of the assessment, a confidence level was assigned to each feasibility determination. The results show high confidence for **[placeholder]**% of the determinations, typically in urban areas with excellent data. Moderate confidence was assigned to **[placeholder]**% of the determinations, often in areas where plans were older or less detailed. Low confidence was assigned to **[placeholder]**% of determinations, primarily in the rural, data-poor regions. This confidence assessment should be used by decision-makers to understand the level of risk and the need for further due diligence for any specific project.

### **6. IMPLEMENTATION FRAMEWORK**

#### **6.1 State-Level Coordination and Support**

The Department of Health (DOH) must play the central coordinating role in implementing the statewide cesspool conversion mandate. This includes the primary responsibility for tracking and enforcing compliance with the 2050 deadline. The DOH should continue to administer the state's grant and loan programs, using the findings of this overlay tool to prioritize funding for projects in high-priority, high-feasibility areas. DOH should also expand its role in providing technical assistance to counties and individual homeowners, ensuring that the best available science and technology are being applied to conversion efforts.

Achieving the 2050 mandate will require sustained support from the State Legislature. This includes the regular appropriation of sufficient funding for both public infrastructure projects through the CIP and for homeowner financial assistance programs. The Legislature may also need to consider establishing new financing mechanisms, such as a dedicated statewide wastewater infrastructure fund. Further legislative action may be needed to clarify county mandates for wastewater planning and to potentially modify deadlines or specific requirements based on the evolving understanding of the problem's scale and complexity.

The University of Hawai‘i has an ongoing role to play as a provider of objective technical support. This includes responsibility for maintaining and annually updating the HCPT and this infrastructure feasibility overlay to reflect new data and changing conditions. The University should continue to provide direct technical support to state and county agencies as they implement these tools. Furthermore, University researchers should continue to investigate innovative and alternative wastewater treatment technologies that may be particularly suitable for Hawai‘i's unique conditions, and to support public education and outreach efforts.

The Cesspool Conversion Working Group (CCWG) should continue to function as the primary forum for stakeholder coordination. Its key role is to provide integrated, consensus-based recommendations to the Legislature on conversion priorities and funding allocations. The CCWG should use the findings of this report to guide its work, facilitate coordination among the four counties, and develop and implement a statewide public communication strategy to keep residents informed and engaged in the conversion process.

To ensure effective execution, formal inter-agency coordination mechanisms should be established. This should include, at a minimum, quarterly coordination meetings between the DOH and the public works directors of all four counties to review progress and address implementation challenges. The state should facilitate an annual prioritization plan update, where all stakeholders convene to review the latest data and adjust priorities. The development of a shared data management system for all wastewater infrastructure and cesspool data would greatly improve efficiency. Finally, state and county agencies should collaborate on joint applications for federal infrastructure funding.

#### **6.2 County Implementation Strategies**

Counties must fully integrate the findings of this feasibility assessment into their Capital Improvement Programming. Cesspool clusters identified in this report should be explicitly referenced in the justification for new wastewater projects. County prioritization and scoring systems for CIP projects should be updated to include cesspool elimination and risk reduction as key criteria. The tool should also be used to identify strategic funding sources and to optimize the sequencing of projects to maximize risk reduction over time.

Wastewater infrastructure planning must be closely aligned with broader land use planning and zoning. Counties should designate the planned sewer expansion areas identified in this report in their community and general plans. Zoning codes should be updated to include mandatory connection requirements for new development and for property sales within a certain distance of a sewer line. Subdivision approval conditions should require the installation of sewer infrastructure in all feasible areas. The implications of sewer expansion in or near important agricultural districts must also be carefully considered.

Counties should adopt forward-thinking engineering and design approaches to maximize efficiency and reduce costs. This could include the development of standardized design criteria for sewer extension projects, the use of alternative project delivery methods like design-build to accelerate timelines, a consistent application of value engineering principles to reduce project costs, and the use of phased construction approaches that allow projects to proceed incrementally as funding becomes available.

Effective and early community engagement is critical for the success of any infrastructure project. Counties should develop standardized protocols for neighborhood meetings in proposed expansion areas to ensure that residents are informed and have opportunities for input. Where appropriate, counties should provide support for the formation of benefit assessment districts or other community-led financing mechanisms. Clear and consistent communication regarding project timelines and connection requirements is essential, as is the establishment of a fair and transparent dispute resolution procedure.

Counties will need to utilize a variety of financing mechanisms to fund the needed infrastructure. General obligation bonds, backed by the county's taxing authority, will likely be a primary source of funding. Revenue bonds, paid back through sewer fees, are another key tool. Counties must aggressively pursue federal infrastructure grants and maximize their use of the state's Clean Water State Revolving Fund loan program. In many areas, the use of special assessment districts, where the properties that directly benefit from the new infrastructure pay a portion of the cost, will also be necessary.

#### **6.3 Private Sector Participation Framework**

The Public Utilities Commission (PUC) has a critical regulatory role to play in facilitating private sector participation. This includes conducting timely reviews of rate cases that involve the recovery of costs for expansion projects aimed at cesspool elimination. The PUC will also need to manage the process for approving modifications to a utility's service area boundary. The commission's oversight will be essential for ensuring that any private system expansion meets performance standards and includes robust consumer protection measures for the new customers.

A variety of business models can be employed to leverage private sector capabilities. The most straightforward is the traditional utility expansion model, where an existing PUC-regulated utility expands its service area. Public-private partnerships (P3s), where a county contracts with a private entity to design, build, finance, and/or operate a new system, are another option. In some communities, a resident-owned cooperative model may be a viable approach. Finally, developer-driven systems, where the developer of a new community installs the infrastructure and then transfers it to a private utility for operation, will continue to play a role.

To encourage private investment, the state may need to consider new incentive structures. These could include state tax credits or exemptions for private investment in wastewater infrastructure that eliminates cesspools. A streamlined permitting process for high-priority private expansion projects could also serve as a powerful incentive. In some cases, public co-investment or the use of guaranteed revenue provisions could help to reduce the financial risk for private operators, making marginal projects more attractive.

Addressing the risks perceived by the private sector is key to encouraging their participation. A primary concern is the risk of "stranded assets," where a private utility invests in a new system only to have a public system expand into their service area years later. Clear, long-range planning and formal service area boundary agreements between public and private providers can mitigate this risk. Reducing regulatory uncertainty through clear and consistent PUC policies is also critical. Mechanisms that provide for long-term revenue stability and appropriate limitations on liability will also be important for attracting private capital.

Effective coordination between public and private systems is essential to create a seamless and efficient service landscape. This requires the development of formal service area boundary agreements to prevent duplication of effort and stranded assets. The potential for physical interconnection between adjacent public and private systems should be explored to provide emergency backup and improve overall system resilience. In the long-term, the state and counties should have a clear policy framework for the potential consolidation of smaller private systems into larger public systems where it is logical and cost-effective to do so.

#### **6.4 Community and Homeowner Guidance**

This overlay tool provides property owners with a clear decision framework for determining whether to wait for a potential sewer connection or proceed with an individual onsite system upgrade. Owners in Category 1, 2, and 3 areas should generally plan to connect to the sewer system according to the project timeline. Owners in Category 5 (Infeasible) areas should plan on installing an advanced onsite system to meet the 2050 mandate. For owners in Category 4 (Potential) areas, the decision is more complex and will depend on their individual financial situation and risk tolerance, but this tool provides them with the critical information that sewer service is a long-term possibility.

Communities can often achieve better outcomes by pursuing collective action. This report and the associated web-tool can be used by community associations to advocate for their neighborhood to be prioritized for sewer expansion. In some cases, the most effective path forward may be for a community to proactively form an improvement district to finance the extension of a sewer line into their neighborhood. Communities can also benefit from group procurement strategies, where multiple homeowners band together to negotiate a lower price for the installation of individual onsite systems.

Homeowners should be aware of the variety of financial assistance programs available to them. These include the state's cesspool conversion grant and loan programs, which are administered by the DOH. Federal funding opportunities, such as the USDA's rural development programs, may also be available. Some counties have established their own local assistance programs. The state and federal tax credit provisions for cesspool conversion can also significantly reduce the financial burden on homeowners.

A range of technical assistance resources are available to support homeowners in making informed decisions. County engineering and public works departments can provide information on planned projects and connection requirements. The University of Hawai‘i's Cooperative Extension Service can offer unbiased advice on different types of onsite systems. Reputable local engineering consultants and contractors can provide site-specific assessments and cost estimates. The DOH also provides online resources and technology evaluation services.

Finally, it is essential that property owners understand their rights and responsibilities. They have a responsibility to comply with the 2050 conversion mandate. When sewer service becomes available, property owners are typically required by county ordinance to connect to the system within a specified timeframe. All property owners are responsible for the proper maintenance of their wastewater system, whether it is a cesspool, septic system, or advanced treatment unit. They may also be subject to future reporting requirements to verify the status and performance of their system.

### **5. RESULTS AND FINDINGS**

#### **5.1 Statewide Overview**

The comprehensive statewide analysis reveals that approximately **[12,500 - placeholder]** cesspools are located in areas with current, funded, planned, or high-potential feasibility for connection to a centralized wastewater system. This represents **[14% - placeholder]** of Hawai‘i's total cesspool inventory, indicating that a significant portion of the statewide problem can be addressed through strategic infrastructure expansion. The opportunities are distributed between public sewer systems and potential private utility expansions, providing a diversified set of solutions. When compared with the original Hawai‘i Cesspool Prioritization Tool (HCPT) risk scores, these feasible areas disproportionately contain higher-risk cesspools, underscoring the efficiency of targeting these zones for infrastructure investment.

The geographic distribution of these opportunities varies significantly across the islands, reflecting differences in development patterns, existing infrastructure, and topography. The City and County of Honolulu exhibits the highest feasibility rate, with an estimated **[42% - placeholder]** of its cesspools located in expansion-viable areas. On Hawai‘i Island, the feasibility rate is **[18% - placeholder]**, with opportunities heavily concentrated in the urban cores of Kona and Hilo. Maui County's feasibility rate is **[12% - placeholder]**, with the majority of opportunities located in the central valley. Kauai has the lowest rate at **[9% - placeholder]**, with potential projects focused primarily within the Lihue basin and along the eastern corridor.

A critical finding of this assessment is the strong positive correlation between the highest-risk cesspools identified by the HCPT and the feasibility of infrastructure expansion. The analysis shows that **[65% - placeholder]** of all Priority Level 1 cesspools (those posing the greatest immediate threat to drinking water) are located within areas deemed feasible for sewer connection. This alignment is also strong for Priority Level 2 cesspools, with **[45% - placeholder]** falling within feasible zones. For Priority Level 3 cesspools, **[25% - placeholder]** have a direct infrastructure expansion potential. This strong alignment validates the strategy of focusing infrastructure investment in these high-feasibility zones as the most effective way to mitigate the highest public health and environmental risks.

A preliminary economic analysis highlights the scale of the required investment and the potential cost-effectiveness of a centralized approach. The total infrastructure investment needed to connect all identified feasible areas is estimated to be in the range of **[placeholder]** billion. This translates to an average connection cost of approximately **[placeholder]** per cesspool. While substantial, this compares favorably to the estimated **[placeholder]** billion that would be required for the universal upgrade of these same cesspools to individual advanced onsite systems. Furthermore, centralized systems offer significant long-term operational cost savings for homeowners and ensure a higher standard of professional maintenance and environmental protection.

The identified opportunities can be categorized by their implementation timeframe, providing a strategic roadmap for achieving the 2050 mandate. The analysis indicates that **[placeholder]** cesspools could be addressed within the next five years through funded and shovel-ready projects. An additional **[placeholder]** cesspools are in areas planned for expansion within the next ten years. The remaining **[placeholder]** cesspools are in long-term potential zones, addressable within a twenty-year horizon. This timeline distribution demonstrates that a focused, sustained investment in infrastructure can make significant, front-loaded progress toward the state's 2050 goal.

#### **5.2 County-Specific Findings**

For Hawai‘i County, the results show a heavy concentration of expansion opportunities on the west side of the island, particularly in North Kona, where **[placeholder]** cesspools were identified in feasible zones. The Hilo urban core also presents significant opportunities, with **[placeholder]** units identified. In contrast, the Puna district shows very limited feasibility for large-scale sewer expansion due to the prevalence of large lot sizes, challenging volcanic topography, and dispersed settlement patterns. The rural districts of Ka'u and Hamakua currently lack viable options for centralized system expansion.

The City and County of Honolulu presents the highest feasibility rate in the state. Major opportunities were identified in the East Honolulu corridor, encompassing **[placeholder]** cesspools in planned expansion areas. The growing communities of Central Oahu represent another major zone, with **[placeholder]** cesspools targeted in long-range plans. On the North Shore, several smaller communities account for another **[placeholder]** potential connections. The primary challenges on Oahu are related to the difficult topography and linear settlement patterns of the Waianae Coast, which limit cost-effective expansion in that region.

In Maui County, the findings point to a significant concentration of opportunities in the central valley, particularly in areas adjacent to the Kahului-Wailuku urban core, accounting for **[placeholder]** cesspool units. In West Maui, the post-fire reconstruction planning presents a unique opportunity to integrate sewer expansion, potentially addressing a significant number of cesspools in that region. The Upcountry region, however, presents substantial challenges due to its higher elevation, dispersed communities, and lack of existing backbone infrastructure. Molokai's very limited existing infrastructure base means it currently has few viable large-scale expansion options.

On Kauai, the analysis confirms that the Lihue-Puhi corridor is the area with the most significant potential, showing **[placeholder]** potential connections in and around the county seat. The East Side communities of Kapaa and Wailua are constrained by historical development patterns that make comprehensive sewer expansion difficult. The North Shore's expansion potential is limited by significant environmental sensitivities and challenging terrain. The West Side communities face challenges related to their distance from existing treatment facilities and rugged topography.

An inter-county comparison reveals distinct challenges and opportunities. Honolulu requires the highest total capital investment but benefits from high density and strong institutional capacity. Hawai‘i County faces the largest total number of cesspools but has opportunities for targeted, high-impact projects in its urban centers. Maui and Kauai require more focused, geographically constrained projects. Key variables influencing success across all counties include per-capita infrastructure investment requirements, the relationship between cesspool density and project feasibility, the institutional capacity of each county's public works department to implement large-scale projects, and the level of political and community support for new expansion initiatives.

#### **5.3 High-Priority Cluster Identification**

To identify the highest-value expansion opportunities, a cluster prioritization methodology was developed. This system ranks potential project areas by combining four key metrics: the density of cesspools, the average HCPT risk score of the cesspools within the cluster, the cluster's proximity to existing or planned infrastructure, and an assessment of its implementation readiness based on planning status and known constraints. This multi-criteria approach pinpoints the projects that offer the greatest risk reduction for the most reasonable investment.

The analysis produced a ranked list of the highest-priority cesspool clusters statewide. A detailed table of the top 20 clusters is provided in the appendices of this report. For each cluster, the table includes its geographic location and census tract designation, the total number of cesspools that would be addressed, the average HCPT risk score, a summary of the required infrastructure, and a preliminary estimate of the implementation cost. These top 20 clusters represent the most compelling "first-mover" opportunities for the state and counties.

The analysis identified **[124 - placeholder]** high-priority clusters that are suitable for connection to public sewer systems. These clusters have an average size of **[placeholder]** cesspools and are typically located within **[placeholder]** feet of existing public infrastructure. Common limiting factors for these clusters include the need for treatment plant capacity upgrades or the presence of a minor physical barrier (such as a highway or stream) that increases construction complexity. Implementation sequencing recommendations are provided based on their readiness and dependency on other projects.

The assessment also identified **[34 - placeholder]** high-priority clusters that represent strong opportunities for expansion by private wastewater systems. The size of these clusters ranges from **[placeholder]** to **[placeholder]** units, making them ideal for smaller, decentralized treatment solutions. For many of these clusters, there is a known level of interest from existing private operators in the vicinity. The primary hurdles for these projects are the PUC regulatory approval process and the development of a viable business model for the capital investment and long-term operation.

An implementation readiness assessment was conducted for all high-priority clusters. This evaluation considered several "soft" factors that are critical for project success. These included indicators of community support, such as the results of public surveys or the presence of active community advocacy. The assessment also evaluated the current funding availability status, the completeness of any existing technical designs, and the progress of any necessary regulatory approvals. This readiness score provides an additional layer of practical guidance for project prioritization.

#### **5.4 Data Gaps and Uncertainties**

Despite a comprehensive data collection effort, several data gaps and uncertainties remain that should be addressed in future work. Geographic coverage gaps were most significant in the rural districts of Hawai‘i Island, which lack detailed, digitized infrastructure mapping. The complete absence of current comprehensive wastewater planning documents for Molokai was a major limitation. In addition, the cesspool inventory for the North Shore of Oahu is known to be incomplete, and the precise status of many systems in Upcountry Maui remains uncertain.

The analysis was also constrained by a lack of specific technical information in some areas. Detailed wastewater treatment plant capacity assessments, which evaluate not just hydraulic flow but also nutrient loading capacity, were not available for all facilities. In many potential expansion areas, detailed topographic surveys and geotechnical investigations will be needed to confirm pipeline routes and soil conditions. More granular data on seasonal high groundwater levels would also improve the accuracy of construction cost estimates.

The temporal currency of source data is an ongoing concern. Some counties are relying on facility master plans that were developed prior to 2020 and have not been updated to reflect post-COVID development trends or shifts in construction costs. The catastrophic 2023 Maui fires have fundamentally altered conditions in West Maui, and official planning documents do not yet reflect the new realities and opportunities of the rebuilding effort. In areas of rapid development, infrastructure maps can quickly become outdated.

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### **6. IMPLEMENTATION FRAMEWORK**

#### **6.1 State-Level Coordination and Support**

The Department of Health (DOH) must play the central coordinating role in implementing the statewide cesspool conversion mandate. This includes the primary responsibility for tracking and enforcing compliance with the 2050 deadline. The DOH should continue to administer the state's grant and loan programs, using the findings of this overlay tool to prioritize funding for projects in high-priority, high-feasibility areas. DOH should also expand its role in providing technical assistance to counties and individual homeowners, ensuring that the best available science and technology are being applied to conversion efforts.

Achieving the 2050 mandate will require sustained support from the State Legislature. This includes the regular appropriation of sufficient funding for both public infrastructure projects through the CIP and for homeowner financial assistance programs. The Legislature may also need to consider establishing new financing mechanisms, such as a dedicated statewide wastewater infrastructure fund. Further legislative action may be needed to clarify county mandates for wastewater planning and to potentially modify deadlines or specific requirements based on the evolving understanding of the problem's scale and complexity.

The University of Hawai‘i has an ongoing role to play as a provider of objective technical support and community outreach. This includes responsibility for maintaining and regularly updating the HCPT and this infrastructure feasibility overlay to reflect new data and changing conditions. The University should continue to provide direct technical support to state and county agencies as they implement these tools. The development of a shared data management system led by the university for all wastewater infrastructure and cesspool data would greatly improve efficiency between state and local governments.

Furthermore, University researchers should continue to investigate innovative and alternative wastewater treatment technologies that may be particularly suitable for Hawai‘i's unique conditions, and to support public education and outreach efforts.

The Cesspool Conversion Working Group (CCWG) should continue to function as the primary forum for stakeholder coordination. Its key role is to provide integrated, consensus-based recommendations to the Legislature on conversion priorities and funding allocations. The CCWG should use the findings of this report to guide its work, facilitate coordination among the four counties, and develop and implement a statewide public communication strategy to keep residents informed and engaged in the conversion process.The development of a shared data management system for all wastewater infrastructure and cesspool data would greatly improve efficiency.

**6.2 County Implementation Strategies**

Counties must fully integrate the findings of this feasibility assessment into their Capital Improvement Programming. Cesspool clusters identified in this report should be explicitly referenced in the justification for new wastewater projects. County prioritization and scoring systems for CIP projects should be updated to include cesspool elimination and risk reduction as key criteria. The tool should also be used to identify strategic funding sources and to optimize the sequencing of projects to maximize risk reduction over time.

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Counties should adopt forward-thinking engineering and design approaches to maximize efficiency and reduce costs. This could include the development of standardized design criteria for sewer extension projects, the use of alternative project delivery methods like design-build to accelerate timelines, a consistent application of value engineering principles to reduce project costs, and the use of phased construction approaches that allow projects to proceed incrementally as funding becomes available.

Effective and early community engagement is critical for the success of any infrastructure project. Counties should develop standardized protocols for neighborhood meetings in proposed expansion areas to ensure that residents are informed and have opportunities for input. Where appropriate, counties should provide support for the formation of benefit assessment districts or other community-led financing mechanisms. Clear and consistent communication regarding project timelines and connection requirements is essential, as is the establishment of a fair and transparent dispute resolution procedure.

Counties will need to utilize a variety of financing mechanisms to fund the needed infrastructure. General obligation bonds, backed by the county's taxing authority, will likely be a primary source of funding. Revenue bonds, paid back through sewer fees, are another key tool. Counties must aggressively pursue federal infrastructure grants and maximize their use of the state's Clean Water State Revolving Fund loan program. In many areas, the use of special assessment districts, where the properties that directly benefit from the new infrastructure pay a portion of the cost, will also be necessary.

#### **6.3 Private Sector Participation Framework**

The Public Utilities Commission (PUC) has a critical regulatory role to play in facilitating private sector participation. This includes conducting timely reviews of rate cases that involve the recovery of costs for expansion projects aimed at cesspool elimination. The PUC will also need to manage the process for approving modifications to a utility's service area boundary. The commission's oversight will be essential for ensuring that any private system expansion meets performance standards and includes robust consumer protection measures for the new customers.

A variety of business models can be employed to leverage private sector capabilities. The most straightforward is the traditional utility expansion model, where an existing PUC-regulated utility expands its service area. Public-private partnerships (P3s), where a county contracts with a private entity to design, build, finance, and/or operate a new system, are another option. In some communities, a resident-owned cooperative model may be a viable approach. Finally, developer-driven systems, where the developer of a new community installs the infrastructure and then transfers it to a private utility for operation, will continue to play a role.

To encourage private investment, the state may need to consider new incentive structures. These could include state tax credits or exemptions for private investment in wastewater infrastructure that eliminates cesspools. A streamlined permitting process for high-priority private expansion projects could also serve as a powerful incentive. In some cases, public co-investment or the use of guaranteed revenue provisions could help to reduce the financial risk for private operators, making marginal projects more attractive.

Addressing the risks perceived by the private sector is key to encouraging their participation. A primary concern is the risk of "stranded assets," where a private utility invests in a new system only to have a public system expand into their service area years later. Clear, long-range planning and formal service area boundary agreements between public and private providers can mitigate this risk. Reducing regulatory uncertainty through clear and consistent PUC policies is also critical. Mechanisms that provide for long-term revenue stability and appropriate limitations on liability will also be important for attracting private capital.

Effective coordination between public and private systems is essential to create a seamless and efficient service landscape. This requires the development of formal service area boundary agreements to prevent duplication of effort and stranded assets. The potential for physical interconnection between adjacent public and private systems should be explored to provide emergency backup and improve overall system resilience. In the long-term, the state and counties should have a clear policy framework for the potential consolidation of smaller private systems into larger public systems where it is logical and cost-effective to do so.

### **6.4 Community and Homeowner Guidance**

The updated web-based Hawaiʻi Cesspool Prioritization Tool (HCPT) and its educational materials give property owners a clear starting point to understand their property’s relative risk and likely compliance pathway by 2050, either connection to a sewer or an upgrade to a compliant onsite system. HCPT is a planning and education resource; final determinations for a specific parcel require a professional site evaluation and permits from the county and the Department of Health.

In areas the tool designates as having high potential for sewer feasibility (Categories 1, 2, or 3), owners should generally plan to connect to the sewer system in line with county project timelines. Outside these areas, owners should plan for a compliant onsite system, such as a septic system or an advanced treatment unit. Where sewer potential is lower, the best choice will depend on parcel conditions, regulatory requirements, and the owner’s financial situation.

Recognizing the need for a more fine-grained approach to property-level solutions, [the Matrix] is under development as part of this project. It provides parcel-scale screening to identify the range of feasible wastewater treatment technologies for a given property based on topography, parcel area and setbacks, depth to groundwater, soils, development potential, applicable regulatory constraints, and other relevant factors. Its results are highly relevant to individual property owners assessing their own parcels, and they can be aggregated to give policymakers and regulators a clearer view of what is feasible under current rules and the associated cost implications. Future versions will allow adjustment of key thresholds to simulate how policy changes would influence feasibility, costs, and implementation sequencing.

In all cases, property owners should expect to share costs. For sewer connections, this typically includes connection fees and ongoing service charges. For onsite systems, costs include design, permitting, installation, electricity where applicable, and routine operation and maintenance. Financial assistance can reduce out-of-pocket expenses, especially for income-qualified households, when it is available. Owners are encouraged to review all currently available options, including state grant and loan programs administered by the Department of Health, federal programs such as USDA Rural Development, applicable state or federal tax incentives, and any county assistance that may be established.

Strengthening technical assistance for homeowners should remain a priority for state and county agencies. County engineering and public works departments can provide outreach on planned sewer projects and timelines. The University of Hawaiʻi, through Cooperative Extension and Sea Grant, can offer impartial guidance on system types and homeowner decision steps. For site-specific design and cost estimates, owners should consult qualified local engineers and licensed contractors.

Communities often achieve better outcomes through coordinated action. Neighborhood associations can use HCPT to advocate for prioritization of sewer expansion. In some cases, owners may form an improvement district to finance a sewer extension, or organize to obtain group-rate pricing for onsite system upgrades.

All property owners are responsible for complying with the 2050 conversion mandate. When sewer service becomes available, county ordinances typically require connection within a specified period. Regardless of system type, owners are responsible for proper operation and maintenance and may be subject to reporting or verification requirements set by the Department of Health or the county.

### **7. POLICY IMPLICATIONS AND RECOMMENDATIONS**

#### **7.1 Legislative Recommendations**

To provide the financial and statutory foundation for a successful statewide conversion effort, it is recommended that the Legislature authorize a suite of funding mechanisms. This should include the establishment of a dedicated cesspool conversion infrastructure fund capitalized with at least **[placeholder]** million annually. Furthermore, enhancing the bonding authority for county sewer expansion projects specifically targeting cesspool elimination is critical. To maximize the leverage of state funds, establishing clear provisions for matching federal grants from programs like the Bipartisan Infrastructure Law is essential to ensure Hawai‘i is competitive in securing its fair share of national funding.

To support the implementation framework outlined in this report, several statutory clarifications are recommended. Legislative amendments are needed to clarify and strengthen county authority to mandate sewer connections for existing homes when service becomes available, a critical tool for ensuring the financial viability of expansion projects. It is also proposed that the Legislature establish formal mandates for counties to develop and maintain long-range wastewater infrastructure expansion plans. Formally defining "feasibility" criteria in statute, based on the framework in this report, would provide a consistent statewide standard. Finally, addressing the need for flexibility in the 2050 timeline for specific, well-documented cases of extreme hardship or technical infeasibility would provide a necessary safety valve for the program.

To address the significant financial burden of conversion on residents, it is recommended that existing financial assistance programs be enhanced. This should include increasing the income-based eligibility thresholds for state grant and loan programs to better reflect Hawai‘i's high cost of living. Programs should also be expanded to explicitly cover sewer connection fees, which can be a significant barrier for homeowners even after the main infrastructure is in place. Providing dedicated financial support for the formation and development of community-scale systems, particularly in areas not suitable for large-scale public sewer, is also a critical need. Finally, establishing a fund for emergency assistance to low-income households facing imminent system failure would address a key public health risk.

The successful and timely implementation of priority infrastructure projects requires a streamlined regulatory environment. It is recommended that the Legislature consider statutory changes to expedite these critical projects. This could include creating categorical exemptions from certain state-level reviews for sewer expansion projects that are primarily aimed at cesspool elimination in existing developed areas. Developing a fast-track permitting process for high-priority projects identified in this framework would also significantly accelerate timelines. For projects occurring within existing road rights-of-way and other previously disturbed corridors, reducing archaeological and cultural survey requirements could also yield significant time and cost savings.

To ensure transparency and progress, a robust performance and accountability framework should be established in statute. This should include a requirement for the Department of Health and all four counties to provide an annual report to the Legislature on progress toward meeting cesspool conversion goals. A system of milestone-based funding releases for large, multi-year projects would tie state investment directly to measurable progress. Establishing clear performance standards for counties related to planning, permitting, and project execution would also enhance accountability. Finally, building in formal adaptive management provisions would allow the statewide program to evolve and adjust based on new data, technologies, and a deeper understanding of implementation challenges.

#### **7.2 County-Level Policy Recommendations**

A key policy tool for ensuring the success of sewer expansion projects is the adoption of robust mandatory connection ordinances at the county level. It is recommended that all counties adopt or strengthen ordinances that require property owners to connect to a public sewer system when it becomes available within a specified distance (e.g., 200 feet) of their property line. These ordinances must be crafted with clear and limited criteria for exemptions, well-defined enforcement mechanisms for non-compliance, and fair provisions to address cases of documented financial hardship, such as allowing for deferred payments or liens.

To move from a reactive to a proactive stance on wastewater management, it is recommended that each county be required to develop and maintain a 20-year comprehensive wastewater master plan. These plans should be updated every five years and should explicitly incorporate the cesspool conversion targets and priority areas identified in this framework. The plans must integrate infrastructure planning with land use, water resource, and climate adaptation planning. Crucially, each plan should include a detailed, long-range financial strategy and a clear set of performance metrics to track progress.

County zoning and development codes should be updated to create incentives for cesspool conversion and disincentives for their continued use. Policy tools to consider include offering density bonuses or other development incentives for projects that include the expansion of sewer service to surrounding cesspool-reliant neighborhoods. Conversely, development could be restricted or downzoned in high-priority, non-sewered zones until a viable wastewater solution is identified. County impact fee schedules should be adjusted to ensure that new development pays its full pro-rata share of downstream wastewater infrastructure capacity. Finally, subdivision improvement requirements should be updated to mandate sewer installation in all areas identified as feasible in this framework.

Counties should undertake a review of their financial policies to ensure they support the goals of the cesspool conversion program. This includes updating sewer rate structures to ensure the long-term financial sustainability of the utility and its ability to fund expansion projects. The development of programs to allow homeowners to finance the cost of their connection fees over time on their property tax bill can remove a significant upfront barrier. Counties should also ensure they have the necessary enabling legislation to create special assessment districts. Finally, protocols for coordinating with and leveraging state and federal grant programs should be formalized.

Successfully implementing a program of this scale will require significant organizational capacity. It is recommended that each county public works or environmental management department consider establishing a dedicated cesspool conversion team. This team would be responsible for project management, community outreach, and coordination with state agencies. Investing in project management capacity, hiring or training dedicated community outreach specialists, and providing ongoing technical training for staff will be essential for the effective and efficient execution of the numerous projects required to meet the 2050 mandate.

#### **7.3 Technical Standards and Guidelines**

To ensure consistency, quality, and long-term resilience, the state, in partnership with the counties, should develop a set of standardized technical design criteria for cesspool conversion projects. These standards should specify minimum pipe sizes, acceptable materials, and construction standards for both gravity and pressure sewer systems. They should also include standard specifications for pump station design and equipment. Critically, these standards must incorporate forward-looking climate resilience criteria, such as accounting for sea level rise in the design elevation of coastal infrastructure and ensuring that treatment facilities are protected from flooding.

To support decision-making in areas where large-scale sewer is not feasible, a systematic evaluation framework for alternative technologies should be developed. This framework should be used to assess the technical viability, life-cycle costs, and operational requirements of various cluster systems and package treatment plants. It should also be used to evaluate the performance of different advanced onsite treatment technologies under Hawai‘ian conditions. The framework should also consider opportunities for resource recovery, such as water reuse and energy generation, and explore innovative financing and ownership models for these smaller-scale systems.

Effective long-term management requires high-quality, accessible data. It is recommended that a set of common data management standards and protocols be established for all wastewater infrastructure data statewide. This should include a common data format for GIS layers, a requirement for regular data updates from all public and private utilities, and standardized quality assurance and quality control (QA/QC) procedures. To the greatest extent possible, this data should be made publicly accessible through online portals to enhance transparency and support informed decision-making by all stakeholders.

To ensure that both new and existing wastewater systems are performing as required to protect public health and the environment, comprehensive performance monitoring systems should be implemented. This should include regular tracking of influent and effluent water quality at all treatment facilities. System reliability metrics, such as the number of sanitary sewer overflows (SSOs) per 100 miles of pipe, should be tracked and publicly reported. The cost-effectiveness of different projects and technologies should be measured and compared. Finally, a program of targeted environmental impact monitoring in areas where large numbers of cesspools have been converted should be established to document the benefits of the program.

Given the long-term nature of the cesspool conversion challenge, an adaptive management framework is essential. This framework should establish a formal process for the systematic review and updating of the statewide conversion strategy. This should include an annual assessment of progress toward established milestones and a comprehensive five-year review of the entire program. The framework must include a process for evaluating and incorporating new technologies as they become available and proven. It must also provide a mechanism for making adjustments to policies and priorities based on monitoring results and a deeper understanding of what is working and what is not.

### **8. TOOL DEVELOPMENT AND DEPLOYMENT**

#### **8.1 Web-Based Mapping Platform**

To ensure the findings of this assessment are accessible and actionable for all stakeholders, a user-friendly, public-facing web mapping tool has been developed. The primary design goal was to allow any property owner in Hawai‘i to easily search for their property by Tax Map Key (TMK) or street address and instantly view its cesspool risk priority and infrastructure feasibility status. The interface provides clear explanations of what each feasibility category means for the homeowner, presents the best available information on projected timelines for any planned infrastructure, and offers direct links to relevant resources and agency contacts.

The technical architecture of the platform is built on the robust and scalable ArcGIS Online system. This cloud-based platform ensures high availability and performance. The application was designed using a responsive framework, ensuring a seamless and fully functional experience for users on desktop, tablet, and mobile devices. The tool allows for the visualization of multiple data layers, enabling users to see the relationship between their property, the HCPT risk scores, and the various infrastructure feasibility zones. The platform is connected to a real-time database, ensuring that users are always viewing the most current information available.

The tool's data visualization features are designed for clarity and ease of use. The primary display clearly color-codes every parcel on the map according to its infrastructure feasibility category. Users can toggle an overlay of the HCPT priority zones to understand the environmental and public health context of their location. The platform also includes interactive tools that allow users to measure the distance from their property to the nearest existing sewer infrastructure. Where applicable, the tool displays the official timeline for funded and planned expansion projects.

Significant effort was invested in user experience optimization to make the tool accessible to a non-technical audience. The interface features intuitive navigation with clear menus and search functions. An integrated help section provides tutorials, frequently asked questions (FAQs), and a glossary of technical terms. To serve Hawai‘i's diverse population, the platform includes support for multiple languages. The entire application has been designed to comply with modern accessibility standards, ensuring it is usable by individuals with disabilities.

Recognizing the sensitivity of property-specific information, robust privacy and security measures have been implemented. While the tool allows for searching by specific parcels, the public display of information can be controlled to protect individual privacy. All data transmission between the user's browser and the server is encrypted. For agency users with access to more detailed information, a secure user authentication system is in place. All access and changes to the underlying data are logged in a comprehensive audit trail to ensure data integrity and security.

#### **8.2 Agency and Professional Tools**

Beyond the public interface, a suite of enhanced tools has been developed for county planning and engineering staff. This password-protected professional interface provides authorized users with the ability to view and edit detailed infrastructure data, track the status of ongoing and planned projects, and utilize built-in cost estimation tools for preliminary project planning. The system also includes powerful report generation functions that allow staff to quickly produce maps and data summaries for specific geographic areas or project types.

To support the technical work of engineers, the professional tool includes several design support features. These include a pipe sizing calculator that can be used for preliminary network design and a tool for generating elevation profiles along a proposed pipeline route. The system also incorporates cost estimation models that can be adjusted with local data to provide more accurate preliminary costs for CIP development. All of these tools are integrated with the state and county design standards to ensure consistency.

To assist regulatory agencies like the Department of Health, the tool includes a set of compliance tracking modules. These allow authorized users to monitor the status of cesspool conversions, track permit applications and approvals, and set up automated alerts for key deadlines. The system can also be used to maintain records of enforcement actions and to generate the performance reporting dashboards needed for legislative and public oversight.

The backend of the professional tool includes sophisticated data management capabilities. This allows authorized agency staff to perform batch uploads of new or updated data, such as the results of a field survey or a new set of as-built drawings. The system includes structured quality assurance workflows to ensure that all new data is validated before it is incorporated into the main database. A robust version control system tracks all changes to the data, allowing for easy rollbacks if necessary and maintaining a complete archival history.

To facilitate effective collaboration, the professional tool incorporates several interagency coordination features. Shared project workspaces can be created, allowing staff from different county and state agencies to view and comment on the same set of data and plans. A built-in comment and review system tracks all feedback on a project. The system also includes automated notification protocols to ensure that all relevant stakeholders are informed when key project milestones are reached or when important new documents are uploaded to the integrated document management system.

#### **8.3 Matrix Tech Tool**

The “Matrix” tool has been developed as part of this effort, specifically to address Object 8 identified by the working group.

#### **8.4 Data Updates and Maintenance**

To ensure the long-term utility and accuracy of the tool, a formal update cycle framework has been established. This framework includes quarterly minor updates, which will primarily focus on incorporating changes in the status of funded and planned projects as they move through the design and construction process. Annual major updates will be conducted to incorporate new foundational datasets, such as updated parcel boundaries or a new version of the statewide cesspool inventory. A comprehensive review of the underlying methodology will occur biennially. Finally, procedures for emergency updates are in place to address major changes, such as those resulting from a natural disaster.

The data update process is designed to systematically integrate new information from a variety of sources. This includes the automated ingestion of updated county CIP documents and project lists. The system is also designed to connect directly to the DOH's wastewater permitting databases to capture information on new cesspool conversions in near real-time. Regular updates to census and parcel data will also be incorporated. A key feature of the maintenance plan is the formal process for reviewing and integrating community-reported corrections.

Robust quality assurance protocols are a cornerstone of the data maintenance plan. All new data is subjected to a series of automated error-checking routines to identify common issues. This is followed by a manual review process by trained GIS analysts. The plan also calls for a program of regular field verification sampling in areas of high uncertainty to ground-truth the data. Accuracy reporting metrics will be published with each major update to provide users with a transparent understanding of the data's reliability.

A comprehensive version control system has been implemented to manage all changes to the database. Every change to the data is documented, and a complete historical archive of all previous versions of the dataset is maintained. This system provides full rollback capabilities, allowing the database to be reverted to a previous state if a major error is discovered. The version control system also includes a process for notifying all registered professional users when a new version of the data has been released.

To ensure that the tool continues to meet the needs of its users, a formal stakeholder feedback integration process has been established. The web tool includes a simple, built-in error reporting feature that allows any user to flag a potential data issue. The platform also includes a suggestion system for users to propose new features or improvements. Regular user satisfaction surveys will be conducted to gather quantitative feedback. This input will be used by the project team to prioritize improvements and enhancements to the tool in future updates.

### **9. MONITORING AND EVALUATION FRAMEWORK**

#### **9.1 Performance Metrics Development**

To track the tangible progress of the statewide cesspool conversion effort, a clear set of infrastructure expansion metrics must be established and reported on annually. Key performance indicators (KPIs) should include the total miles of new sewer mains installed each year by each county, the cumulative number of cesspools officially eliminated through connection to a centralized system, and the total population served by these new expansions. To gauge the efficiency of these investments, the average cost per connection achieved for each completed project should be calculated and tracked over time. These metrics will provide a clear, quantitative measure of the physical progress being made on the ground.

To validate the environmental benefits of the program, a suite of environmental impact measures must be established. This should involve targeted monitoring programs designed to detect improvements in groundwater quality in areas where large clusters of cesspools have been eliminated, specifically tracking reductions in nitrate and pathogen indicators. In coastal areas, changes in nearshore water quality, particularly nutrient levels, should be monitored. Where feasible, indicators of coral reef health, such as reduced algal overgrowth, should be tracked in adjacent waters. A practical and publicly visible metric would be the reduction in the number and duration of beach advisories issued for water quality in areas historically impacted by cesspool pollution.

To ensure that public funds are being used effectively, a set of economic efficiency indicators is required. The primary cost-effectiveness measure will be the total infrastructure cost per cesspool eliminated, allowing for a direct comparison between different projects and approaches. This cost should be consistently compared with the estimated cost of upgrading the same homes to advanced onsite alternatives. The long-term operational cost trajectories for new infrastructure should be tracked to ensure the financial sustainability of the systems. Finally, comprehensive assessments of the impact of these projects on sewer rates must be conducted and communicated transparently to the public.

To ensure that the benefits of the conversion program are distributed fairly, a series of social equity metrics should be tracked. This includes monitoring the percentage of new connections serving designated disadvantaged or low-to-moderate income communities to ensure they are not being bypassed. An affordability index, tracking the total cost of conversion and connection as a percentage of median household income in different areas, should be developed and monitored. A geographic distribution analysis must be performed annually to ensure that investment is being equitably distributed across each island. Finally, the state must track the number of households accessing financial assistance programs to ensure these resources are reaching their intended recipients.

To maintain focus on the 2050 mandate, a robust system for timeline compliance tracking is essential. The most critical progress metric is the cumulative percentage of the state's 82,141 cesspools that have been successfully addressed each year. This actual progress must be compared against the projections laid out in this framework and in county wastewater master plans. The achievement rate for key project milestones, such as completing design or securing funding, should also be tracked for all major projects. This data will be used to conduct an annual assessment of whether the state is on a trajectory to meet the 2050 goal and to identify where efforts need to be accelerated.

#### **9.2 Adaptive Management System**

A formal annual review process is the cornerstone of an effective adaptive management system. This process should be convened by the Department of Health and the Cesspool Conversion Working Group and include representatives from all four counties and relevant state agencies. The process will involve the compilation and analysis of all performance metrics from the preceding year, a thorough review of stakeholder and public feedback, and an open discussion of implementation challenges and successes. The outcome of this annual review will be a formal set of recommendations for adjustments to the program for the upcoming year.

The adaptive management system must include clear strategic adjustment protocols that define how the program will change in response to new information. These protocols should establish specific trigger points for considering a strategy change, such as falling more than 10% behind timeline projections or consistently exceeding cost-per-connection targets. The protocols will define the approval process for any major adjustments, the methods for implementing these changes in county plans and state policies, and the requirements for communicating these changes to all stakeholders and the public.

To ensure the program benefits from technological advances, a formal process for technology integration updates is needed. This process will involve a systematic annual assessment of new and emerging wastewater treatment technologies. As new technologies are proven to be more cost-effective or environmentally beneficial, the state's technical standards and cost-effectiveness models will be updated. The results of any local pilot projects for alternative systems will be formally integrated into the statewide knowledge base, and technical standards will be updated accordingly to allow for their broader use.

To ensure that policy remains effective and responsive, a set of policy feedback mechanisms must be established. This includes a process for the regular evaluation of the effectiveness of key policies, such as mandatory connection ordinances and financial assistance programs. The process must also actively seek to identify any unintended consequences of these policies. A formal system for incorporating stakeholder input into policy adjustments will be critical, as will be a structured process for developing and presenting new legislative recommendations to address identified policy gaps or barriers.

The ultimate goal of the adaptive management system is to foster a culture of continuous improvement across the entire statewide program. This requires the establishment of formal processes for identifying and documenting best practices from successful projects. A "lessons learned" documentation process should be required at the conclusion of every major infrastructure project. This knowledge must be actively shared through inter-county knowledge transfer systems, such as regular technical workshops and a shared online resource library. The system should also actively encourage and reward innovation in all aspects of the program, from engineering design to community engagement and financing.

### **10. BUDGET AND RESOURCE REQUIREMENTS**

#### **10.1 Infrastructure Investment Needs**

A comprehensive cost analysis based on the identified infrastructure projects indicates a total capital requirement of approximately **[placeholder]** billion to connect all feasible cesspools statewide. This figure includes a breakdown by county and project type, encompassing both public sewer expansions and the estimated investment for private system upgrades. When compared with the aggregate cost of upgrading the same properties to individual advanced onsite systems, the centralized infrastructure approach represents a significant long-term value, though it requires a larger upfront capital outlay. The analysis identifies a substantial funding gap between the total need and the currently programmed state and county capital improvement budgets, highlighting the necessity for new and expanded funding sources.

The required investment is best understood through a phased schedule that aligns with project readiness and prioritization. The immediate investment needs, covering projects planned for the next one to five years, are estimated at **[placeholder]** million. Medium-term requirements, for projects in the five-to-ten-year horizon, are estimated at **[placeholder]** million. The long-term investments, covering projects planned for the ten-to-twenty-year timeframe, will require an additional **[placeholder]** million. These cash flow projections are essential for state and county fiscal planning to ensure that adequate funding is available as projects become shovel-ready.

The capital requirements vary significantly by county, reflecting the scale of their cesspool problem and existing infrastructure. Hawai‘i County requires an estimated **[placeholder]** million to address **[placeholder]** identified projects. The City and County of Honolulu, with its higher density and more extensive existing system, requires the largest investment at **[placeholder]** million for **[placeholder]** projects. Maui County's needs are estimated at **[placeholder]** million for **[placeholder]** projects, while Kauai County requires **[placeholder]** million for its **[placeholder]** identified expansion projects.

The private sector has the potential to play a significant role in meeting the overall capital need. The estimated private capital investment required is **[placeholder]** million for the expansion of existing private systems into high-priority clusters. An additional **[placeholder]** million is estimated for necessary treatment plant upgrades to accommodate this growth. These figures, which include allowances for regulatory compliance costs, are based on return on investment projections that would be necessary to attract private capital.

Beyond the initial capital investment, the expansion of centralized wastewater systems has long-term operations and maintenance (O&M) implications. The new infrastructure is projected to increase statewide annual O&M costs by **[placeholder]** million once fully built out. This will necessitate an increase in staffing by an estimated **[placeholder]** full-time equivalents (FTEs) across all counties. To ensure the long-term sustainability of these assets, adequate equipment replacement reserves must be established. These increased costs will have a direct impact on future sewer rates, and detailed rate impact projections must be a part of every project's financial plan.

#### **10.2 Program Administration Resources**

Effective statewide program administration will require dedicated staffing and resources at the state level. Key personnel requirements include new program management positions within the Department of Health to oversee compliance and grant administration. The University of Hawai‘i will require ongoing funding for technical support staff to maintain and update the HCPT and this overlay tool. Additional personnel will be needed for grant administration and for the expansion of compliance monitoring and enforcement teams to ensure the 2050 mandate is met.

The successful implementation of these infrastructure projects will also demand increased capacity at the county level. A comprehensive assessment of county resource needs indicates a requirement for additional engineering and planning staff to manage the increased project load. More construction management personnel will be needed to oversee contracts and ensure quality control. To facilitate community acceptance and smooth project execution, dedicated community outreach coordinators are essential. Additional administrative support staff will also be required to handle the increased workload associated with these projects.

The state should budget for a robust technical assistance program to support both the counties and individual homeowners. The costs for this program include funding for on-call engineering consultation services for smaller counties, the development and delivery of community education programs on wastewater management, the establishment of a technology evaluation center to assess new and alternative systems, and the creation of contractor training and certification initiatives.

The data management infrastructure that underpins this entire effort requires a sustained financial commitment. Estimated annual costs include licensing and maintenance for the statewide GIS platform, funding for the database management systems, and the costs for hosting and supporting the public-facing web tool. A dedicated budget for cybersecurity measures to protect this critical infrastructure data is also a necessity.

Finally, the monitoring and evaluation activities described in the previous section must be adequately funded. This includes a budget for expanded water quality monitoring programs in priority areas. Resources will be needed to support the staff time required for performance metric tracking across multiple agencies. The budget should also include provisions for periodic, in-depth program evaluation studies and for the development and maintenance of public-facing reporting systems to ensure transparency and accountability.

#### **10.3 Funding Strategies and Sources**

A multi-pronged funding strategy will be required, leveraging federal, state, and local sources. The state should aggressively pursue all available federal infrastructure programs. This includes maximizing the allocation of funds from the Infrastructure Investment and Jobs Act (IIJA), securing the state's full allotment from the Clean Water State Revolving Fund (CWSRF), and actively competing for EPA grant programs. For rural areas, USDA Rural Development funds represent another significant opportunity.

The state must also commit its own funding through a variety of mechanisms. Direct general fund appropriations for both infrastructure and homeowner assistance will be critical. The state should authorize the issuance of general obligation (GO) bonds to fund large-scale county projects. The use of special purpose revenue bonds (SPRBs) could be explored to support projects with a dedicated revenue stream. Finally, revenues from environmental fees or taxes could be dedicated to a cesspool conversion fund.

At the local level, counties have several financing options at their disposal. They can issue their own capital improvement bonds, backed by their taxing authority, or wastewater revenue bonds, paid back by sewer fees. The formation of special assessment districts, where properties that directly benefit from a new sewer line pay a dedicated assessment, is a powerful tool for funding specific neighborhood projects. The collection of impact fees from new development can also provide a dedicated source of funding for system expansion.

Private sector funding can be leveraged through several avenues. The most direct is the infrastructure investment made by PUC-regulated utilities, which is recovered through rates. Public-private partnerships (P3s) can attract private capital for the design, construction, and operation of new systems. In areas of new growth, developer contributions and requirements for the installation of sewer infrastructure will continue to be an important funding source. Equipment lease financing can also reduce the upfront capital costs for certain system components.

The state and counties should also explore a range of innovative financing approaches to supplement traditional funding sources. This could include the issuance of green bonds or other sustainability-focused financing instruments that may attract new classes of investors. Environmental impact bonds, where private investors are repaid based on the achievement of specific environmental outcomes, could be piloted for certain projects. The formation of community investment cooperatives could empower residents to collectively fund their own solutions. Finally, for smaller, community-scale projects, crowdfunding platforms could be explored as a way to raise local matching funds.

### **11. RISK ASSESSMENT AND MITIGATION**

#### **11.1 Implementation Risks**

A number of significant technical and engineering risks could impede the progress of infrastructure expansion. Construction in Hawai‘i often encounters challenging geological conditions, from hard volcanic rock that increases excavation costs to high water tables in coastal areas that complicate construction. Integrating new sewer lines with aging existing infrastructure presents compatibility and integrity challenges. Furthermore, many existing wastewater treatment plants are already operating near their hydraulic or nutrient-loading capacity, and expansions may be required before new sewer connections can be brought online. There is also a risk of technological obsolescence, where investments in current technologies may be superseded by more efficient or cost-effective solutions in the future.

The program faces substantial financial and economic risks. Construction cost escalation, driven by inflation, supply chain disruptions, and Hawai‘i's unique market conditions, could cause projects to exceed their budgets. Volatility in the municipal bond market could increase the cost of borrowing and impact the financial feasibility of large-scale projects. There is a risk of revenue shortfalls if projected connection rates are not met or if economic downturns reduce the tax base that supports bond repayments. A major economic recession could also significantly impact the availability of state and federal funding, delaying or halting projects mid-stream.

A complex web of regulatory and permitting risks can lead to significant project delays. The environmental review process under state and federal law can be lengthy and subject to legal challenges. The inadvertent discovery of cultural or archaeological resources during construction can trigger work stoppages and require extensive consultation. The process of obtaining the numerous permits required from federal, state, and county agencies can be cumbersome, and projects may be subject to appeals. Finally, there is a risk that changing regulatory requirements, such as stricter water quality standards, could alter project designs and increase costs after planning is already complete.

The implementation of large-scale infrastructure projects is also subject to political and social risks. Community opposition to specific projects, driven by concerns about construction impacts, costs, or property values, can delay or derail them. Shifts in political priorities at the state or county level can lead to changes in funding or support for the program. Failures of inter-agency coordination can create bureaucratic hurdles and inefficiencies. It is also critical to address equity concerns to ensure that the burdens and benefits of the program are distributed fairly and that disadvantaged communities are not disproportionately impacted or left behind.

Finally, the program must contend with significant environmental and climate risks. Sea level rise poses a direct threat to coastal wastewater infrastructure, including pump stations and treatment plants, which are vulnerable to inundation and increased corrosion. Extreme weather events, such as hurricanes and major flooding, can damage or destroy critical infrastructure. Changes in rainfall patterns and rising temperatures may alter groundwater tables, impacting both the performance of existing systems and the feasibility of new construction. Coastal erosion, exacerbated by climate change, can undermine and expose buried pipelines, leading to system failures.

#### **11.2 Mitigation Strategies**

To manage technical and engineering risks, a proactive approach is required. Comprehensive geotechnical investigations, including soil borings and groundwater monitoring, must be a standard requirement before the final design of any project. Engineering designs should incorporate conservative design factors to account for unexpected conditions. A phased construction approach for large projects can help to manage complexity and allow for adjustments as the project progresses. To mitigate the risk of technological obsolescence, the state should encourage technology diversification and have a clear process for evaluating and approving innovative and alternative systems.

A range of financial risk controls can enhance the program's fiscal resilience. All project budgets must include a mandatory contingency reserve of 10-15% to cover unforeseen costs. Counties should consider establishing rate stabilization funds to smooth out fluctuations in revenue and expenses. A commitment to diversifying revenue sources across federal, state, and local funding streams will reduce reliance on any single source. The use of cost escalation clauses in multi-year construction contracts can provide greater cost certainty for both the county and the contractor.

To mitigate regulatory and permitting risks, a focus on streamlining and early coordination is essential. The state should explore the use of programmatic environmental reviews for common types of sewer expansion projects to expedite the approval process. Formal cultural consultation protocols, developed in partnership with the Office of Hawai‘ian Affairs and recognized lineal and cultural descendants, should be implemented at the earliest stages of project planning. Inter-agency coordination agreements can clarify roles and responsibilities, while pre-defined dispute resolution procedures can help to resolve conflicts efficiently.

Effective stakeholder engagement programs are the primary tool for mitigating political and social risks. This requires early, continuous, and transparent consultation with affected communities, beginning long before designs are finalized. The development of benefit-sharing agreements, where appropriate, can help to build community support. A commitment to a transparent decision-making process, with all planning documents and data made publicly accessible, is critical. A formal grievance mechanism must be established to provide a clear and fair process for addressing community concerns.

A suite of climate adaptation measures must be integrated into all aspects of the program to address environmental risks. New infrastructure in vulnerable coastal areas must incorporate elevated designs for critical components to protect them from sea level rise and storm surge. Hardening critical components against wind and water damage is essential. Where feasible, redundant system capabilities, such as backup power and bypass pumping capacity, should be built in. For the most vulnerable areas, long-range plans must incorporate managed retreat provisions, guiding new investment away from areas that cannot be protected long-term.

#### **11.3 Contingency Planning**

To ensure program resilience, a formal contingency planning process must be developed based on a range of alternative future scenarios. These scenarios should include an accelerated implementation case, triggered by a major infusion of federal funding; a delayed progress situation, caused by a severe economic recession; a technology disruption event, where a new, highly effective low-cost technology becomes available; and a funding shortfall scenario, where state or county appropriations are significantly cut.

For each of these scenarios, a clear set of response protocols must be developed in advance. These protocols would define the specific actions to be taken, such as pre-negotiating contracts for rapid deployment in an accelerated scenario, or identifying non-essential project components that could be deferred in a funding shortfall. The protocols would include a process for the rapid evaluation and adoption of new technologies and define emergency funding mechanisms that could be activated if needed.

The contingency plan must establish clear decision triggers for when to activate a specific response protocol. These triggers would be based on the performance metrics defined in the monitoring and evaluation framework. For example, a trigger might be activated if a project's costs exceed its budget by a certain percentage or if its timeline slips by more than a year. The plan will define the escalation procedures for decision-making and clarify which agencies or officials have the authority to modify the program in response to a trigger event.

A core component of the contingency plan is a set of resource reallocation plans that provide for flexibility in a changing environment. These plans would detail the process for making adjustments to project prioritization in response to new opportunities or constraints. They would establish the mechanisms for redistributing funding from delayed or cancelled projects to those that are ready to proceed. The plans would also include procedures for making formal modifications to a project's scope or for granting official timeline extensions.

Finally, a comprehensive communication strategy is an essential part of any contingency plan. This strategy must include pre-developed communication plans for each potential scenario. These plans will outline the public information protocols, media relations strategies, and legislative briefing procedures to be used. The goal is to ensure that in the event of a major change to the program, all stakeholders and the public are notified in a timely, accurate, and transparent manner, thereby maintaining public trust and confidence in the overall effort.

### **12. Strategic Application and Limitations**

The infrastructure feasibility overlay is designed as a dynamic planning instrument to guide state and county decision-making. Its effective application requires an understanding of its role within the broader policy landscape, its inherent limitations, and its potential to address longstanding social and economic challenges.

#### **12.1 A Tool for County-Level Integrated Planning**

While the HCPT provides a statewide risk assessment, the implementation of wastewater solutions is primarily a county responsibility. This infrastructure overlay serves as a critical data layer to support counties in fulfilling their planning mandates. Specifically, the tool is designed to assist counties in developing the comprehensive wastewater management plans required to strategically address the 2050 conversion goal. By identifying areas where centralized infrastructure is most feasible, the tool enables planners to:

* Prioritize Capital Improvement Projects: Focus public investment on sewer expansion projects that will resolve the highest number of high-priority cesspools.
* Prevent Redundant Private Investment: Provide homeowners with clear guidance on whether their properties are in a likely future service area, preventing them from investing in costly individual systems that may become obsolete.
* Streamline Regulatory Processes: Offer a transparent, data-driven basis for land use and zoning decisions related to wastewater infrastructure.

It is essential to recognize this tool as a foundational screening and prioritization instrument, not as a prescriptive decision for every parcel. Its findings are intended to initiate detailed, county-led engineering studies and community engagement, which are necessary next steps in the planning process.

#### **12.2 Addressing Equity and Financial Burdens**

The Cesspool Conversion Working Group identified the high cost of conversion as the single greatest impediment for homeowners. This financial burden is not distributed evenly, often disproportionately affecting low-to-moderate income households, rural communities, and areas with challenging terrain where conversion costs are highest.

The infrastructure feasibility overlay is a key tool for advancing equitable outcomes. By delineating between areas suitable for centralized solutions versus those that will require individual onsite systems, it allows for the development of targeted financial assistance programs. For example:

* State and county funds can be directed toward infrastructure expansion in high-density priority areas, socializing the cost across a larger user base and reducing the direct burden on individual homeowners.
* In areas identified as infeasible for sewer connection, financial assistance programs, such as grants or low-interest loans, can be focused on helping homeowners afford the installation of advanced individual wastewater systems.

Using this tool to guide public investment can ensure that progress toward the 2050 mandate does not place an untenable financial strain on Hawaiʻi's most vulnerable residents.

#### **12.3 Data Limitations and Future Directions**

The accuracy of this analysis is dependent on the quality of the underlying data. The project team acknowledges several limitations that should be considered when interpreting the results:

* Cesspool Inventory: The analysis relies on the state's official cesspool inventory, which may contain errors in location or status. Significant progress was made during the course of this project, but the tool's classifications will improve as the DOH and counties continue to refine and update this dataset.
* Exclusion of Other Pollution Sources: This tool focuses exclusively on the legislated mandate to convert cesspools and does not model pollution from other sources, such as injection wells, agricultural runoff, or permitted wastewater treatment facilities.
* Dynamic Nature of Planning: The feasibility classifications are based on the best available data from county and state plans at the time of analysis. These plans are subject to change, and the tool will require periodic updates to remain current.

This report and the associated tool represent a significant advancement in the state's strategic planning capacity. Future work should focus on integrating this feasibility data with ongoing county-level planning, developing targeted financial models, and refining the underlying datasets to further enhance its utility as a central tool in Hawaiʻi's effort to protect its water resources.

### **13. CONCLUSIONS AND NEXT STEPS**

#### **13.1 Key Findings Summary**

The central finding of this comprehensive assessment is that approximately **[14% - placeholder]** of Hawai‘i's cesspools can be strategically addressed through the expansion of new or existing centralized wastewater infrastructure. This represents the single most efficient and impactful strategy for large-scale cesspool conversion, offering a pathway to eliminate over 12,000 cesspools through targeted public and private investment. It is equally important, however, to acknowledge the corollary finding: the vast majority of cesspools, approximately 86%, are located in areas where centralized solutions are not feasible. For these properties, individual onsite system upgrades will be the only viable path to compliance with the 2050 mandate.

The insights into the geographic distribution of these opportunities are critical for strategic planning. The potential for centralized solutions is heavily concentrated in Hawai‘i's existing urban and suburban cores. Oahu, with its high population density and extensive existing infrastructure, shows the highest potential for expansion. On the neighbor islands, opportunities are primarily focused in and around the main town centers, such as the Kona and Hilo urban areas on Hawai‘i Island and the central valley of Maui. This analysis confirms that for most of Hawai‘i's rural and dispersed communities, continued reliance on advanced individual onsite systems will be the long-term reality.

A clear conclusion from the timeline feasibility analysis is that meeting the 2050 mandate is an achievable, but monumental, task that requires immediate and decisive action. The state cannot afford to delay action on the clearly identified, high-priority infrastructure opportunities. Achieving the goal will necessitate a sustained, multi-billion-dollar investment over the next 25 years. Critically, success depends on the parallel advancement of two distinct tracks: a focused, aggressive program for centralized infrastructure expansion running concurrently with a broad, well-funded program to support the upgrade of tens of thousands of individual onsite systems.

The cost-benefit conclusions of this analysis are unambiguous. While centralized solutions require a significant upfront public investment, they provide superior long-term cost advantages, environmental benefits, and operational efficiencies when compared to a future of dispersed, individually-owned "mini-treatment plants." The life-cycle costs for homeowners are lower, the level of treatment and environmental protection is higher, and the assurance of professional operation and maintenance provides a greater public benefit. The upfront investment, while large, is a financially prudent long-term strategy for Hawai‘i's most densely populated areas.

Finally, this report must emphasize the coordination imperative. The scale and complexity of this challenge are unprecedented in Hawai‘i's environmental management history. Success is fundamentally dependent on a new era of seamless and sustained coordination. This must occur vertically, between state and county agencies, and horizontally, between public works departments and private utility operators. Most importantly, it requires a strong partnership between government and the community, built on a foundation of trust, transparency, and shared commitment to the goal.

#### **13.2 Immediate Actions Required**

To capitalize on the momentum of this assessment, several critical legislative actions are needed in the 2025 legislative session. The highest priority is the appropriation of a dedicated infrastructure fund to provide the state's share of funding for the highest-priority projects identified in this report. Concurrently, the legislature should pass statutory clarifications that affirm county authority to mandate sewer connections where service is available and establish clear, legally defensible criteria for when and where such connections are required. Finally, an expansion of the state's financial assistance programs for homeowners is needed to address both connection costs and the cost of individual system upgrades.

Counties must take immediate planning and administrative actions. County councils should direct their public works departments to update their Capital Improvement Programs to explicitly incorporate the high-priority cesspool clusters identified in this study. The development of fair and effective mandatory connection ordinances should begin immediately, in parallel with the state's legislative process. Finally, counties must initiate community engagement and outreach efforts in the highest-priority expansion areas to begin the long-term process of building public understanding and support.

Urgent improvements to the state's data systems are required to support this effort. The Department of Health, in partnership with the counties, should launch a targeted program to verify the cesspool inventory in areas of known uncertainty. Counties must be required to provide annual updates to their digital wastewater infrastructure maps. A concerted effort, led by the DOH and the Public Utilities Commission, must be made to complete the documentation of all private wastewater system service areas and capacities.

A comprehensive stakeholder engagement launch is an immediate necessity. This should include a series of public community information sessions on every island to present the findings of this report and answer questions. Direct mail notifications should be sent to property owners in the highest-priority potential expansion areas to inform them of the long-range plans. The state and counties should also begin working with the local contracting community to assess and build the workforce capacity that will be needed to implement these projects.

To build momentum and demonstrate the viability of this strategy, the state and counties should collaborate to initiate at least one pilot project in a high-priority cluster within the next 18 months. Such a demonstration project would serve to validate the proposed technical approaches, refine cost estimates based on real-world conditions, and, most importantly, build public confidence that progress is not just possible, but is actively underway.

#### **13.3 Long-Term Vision**

The long-term vision is the full realization of the goal of Act 125: a Hawai‘i of 2050 that is free from the environmental and public health threats of cesspool pollution. This will be achieved through the systematic and strategic expansion of centralized infrastructure in our urban cores, complemented by the comprehensive upgrade of all remaining cesspools to advanced onsite systems. This future is possible only through a sustained public and private investment and a shared commitment to the goal over the next two and a half decades.

Beyond simply eliminating cesspools, this effort should be viewed as a critical step in Hawai‘i's evolution toward a more holistic and integrated approach to water management. As we upgrade our wastewater infrastructure, we must simultaneously plan for a future that incorporates widespread wastewater reuse and recycling for irrigation and other non-potable uses. This effort must be integrated with broader watershed planning initiatives and designed to create a new generation of climate-resilient water infrastructure for our islands.

The anticipated environmental recovery from this effort will be profound. We can expect to see a measurable restoration of groundwater quality in aquifers that are currently impacted by nitrates and other contaminants. The recovery of our precious coral reef ecosystems, freed from the stress of land-based nutrient pollution, will be a visible and lasting legacy. This will, in turn, lead to a significant enhancement of recreational water safety at our beaches, protecting both residents and our vital tourism economy.

The realization of this vision will bring a host of direct community benefits. The protection of public health from waterborne disease is the most critical of these. The elimination of a known source of pollution will also lead to an increase in property values in many communities. The multi-billion-dollar investment in infrastructure will create thousands of high-quality local jobs in engineering, construction, and the skilled trades, providing a significant and long-lasting economic development opportunity for the state.

Ultimately, the effort to convert all of Hawai‘i's cesspools must be understood as a generational investment in the future of our islands. It is a tangible commitment to protecting the environmental health that is the foundation of our culture and economy. It is a promise to preserve the purity of our waters and the vitality of our reefs. It is a legacy of a cleaner, safer, and more sustainable Hawai‘i that we can proudly leave for our children and all future generations.

### **TECHNICAL APPENDICES**

### **Appendix A: Detailed Methodology Documentation**

#### **GIS Analysis Procedures**

[To Appendix: A spatial analysis was employed to assess feasibility of these clusters of cesspools by measuring the distance of each to existing sewer infrastructure. Areas currently served by sewer were identified by performing a spatial intersection of the parcel layer with the sewer lateral layer from county records]   
  
This section provides a detailed, step-by-step walkthrough of all spatial analysis procedures conducted for this assessment. It is intended to ensure full transparency and replicability of the technical work. The documentation includes specifics on the software environment (e.g., ArcGIS Pro 3.x), data preprocessing steps such as projection and cleaning, and the exact parameters used for each geoprocessing tool. Key procedures documented include: buffer analysis for proximity calculations (tool: Buffer, distances: 500, 1000, 2000 feet); slope analysis from 10-meter Digital Elevation Models (tool: Slope, output measurement: percent); kernel density estimation for cesspool cluster identification (tool: Kernel Density, search radius: [Placeholder: e.g., 0.25 miles]); and the multi-criteria weighted overlay analysis used for combining feasibility factors (tool: Weighted Overlay). Quality control measures, such as topology checks and attribute validation rules, are also detailed.

#### **Statistical Methods**

This section details all statistical analyses performed to support the infrastructure feasibility assessment. This includes a description of the clustering algorithms (e.g., Density-Based Spatial Clustering of Applications with Noise - DBSCAN) used to identify high-density cesspool areas, with specific parameters such as minimum cluster size and search distance provided. Correlation analyses performed to assess the relationship between HCPT risk scores and infrastructure feasibility are documented, including the statistical tests used (e.g., Pearson correlation coefficient) and their results. Furthermore, the methods used for uncertainty quantification, including the assignment of confidence levels based on data source age and completeness, are fully described.

#### **Database Schema**

The complete database schema for the project's geodatabase is documented here. This includes entity-relationship diagrams illustrating the relationships between all data tables, such as the primary cesspool inventory, parcel data, infrastructure layers, and project tracking tables. A comprehensive data dictionary provides detailed field definitions, data types (e.g., text, double, date), and domain constraints for every attribute in the database. This documentation is essential for future data management, updates, and integration with other agency systems.

#### **Code Repository References**

All analytical code and scripts developed for this project are stored in a version-controlled repository to ensure transparency and facilitate future use. This section provides links to the repository and documentation for all key scripts. This includes Python scripts utilizing the arcpy library for automating GIS workflows, R code used for statistical analysis and data visualization, and a collection of SQL queries used for complex data extraction and manipulation from the project database. Each script is documented with comments explaining its purpose, inputs, outputs, and dependencies.

**Repository Link:** [Placeholder: Link to be provided, e.g., https://github.com/uh-wrrc/hcpt-overlay]

### **Appendix B: County-Specific Project Inventories**

#### **Comprehensive Project Tables**

The following multi-page tables provide a comprehensive inventory of all identified public and private wastewater infrastructure expansion projects for each county. These tables are the core dataset for the feasibility assessment.

**Example Table Structure: Hawai‘i County**

| **Project ID** | **Project Name** | **District** | **Location (TMK)** | **Est. Cesspools Addressed** | **HCPT Priority (Avg)** | **Status** | **Est. Cost** | **Funding Status** | **Est. Timeline** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HI-001 | Kailua-Kona Phase 1 | North Kona | (Multiple) | [Placeholder Data] | 1 | Funded | [Placeholder Data] | CIP Funded | 1-5 Years |
| HI-002 | Hilo Urban Core Infill | South Hilo | (Multiple) | [Placeholder Data] | 2 | Planned | [Placeholder Data] | Unfunded | 5-10 Years |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

[Note: Full, multi-page tables for Hawai‘i, Honolulu, Maui, and Kauai Counties are provided in the complete report repository.]

#### **Project Maps Portfolio**

This appendix includes a portfolio of full-page, high-resolution maps for each county. These maps visually represent the findings of the report, showing the geographic location of all identified projects, color-coded by their feasibility category (Currently Served, Funded, Planned, Potential, Infeasible). The maps also overlay the HCPT risk priority zones to illustrate the alignment between high-risk areas and infrastructure opportunities. Implementation phases (short-, medium-, and long-term) are also graphically depicted.

[Note: A full portfolio of PDF maps is available in the complete report repository.]

#### **Engineering Summaries**

For major identified projects (typically those with an estimated cost exceeding [Placeholder: e.g., $10 million]), this section provides a one-page technical summary. Each summary includes a detailed description of the project scope, key design parameters (e.g., pipe diameters, pump station capacities), a discussion of specific implementation challenges (e.g., difficult terrain, dewatering requirements), and the project's current status in the planning and design process.

### **Appendix C: Stakeholder Engagement Records**

#### **Meeting Documentation**

This section contains summaries of all formal stakeholder meetings conducted between January and June 2024. This includes meetings with each of the four county Departments of Public Works, consultations with major private wastewater utility operators, and coordination meetings with state agencies such as the Department of Health and the Public Utilities Commission. Each summary includes the meeting date, a list of participants, a synopsis of key discussion points, and a list of action items or outcomes.

#### **Public Comment Compilation**

A compilation of all public comments received is provided here. The comments are categorized by theme (e.g., cost concerns, environmental impacts, timeline questions, data accuracy) and by geography (island/district). Comments were gathered through the project's online survey, which received [Placeholder Data] responses, as well as from virtual and in-person public information sessions held on each island. This compilation provides a transparent record of the public's input and concerns.

#### **Response Matrix**

This matrix documents how the project team addressed the substantive stakeholder and public input received throughout the engagement process. The matrix links specific comments or themes to corresponding sections of the final report, changes in the analysis, or specific recommendations. This demonstrates how the feedback was systematically reviewed and incorporated, ensuring that the final product is responsive to stakeholder concerns.

### **Appendix D: Data Sources and References**

#### **Comprehensive Bibliography**

A comprehensive bibliography lists all documents reviewed and cited in this report. This includes over 150 documents, such as county Capital Improvement Program budgets, wastewater facility master plans, environmental impact statements, academic literature on Hawai‘i's hydrogeology, relevant state statutes and administrative rules, and technical reports from engineering consultants.

#### **Data Source Catalog**

This catalog provides detailed metadata for all primary GIS and tabular datasets used in the analysis. For each dataset, the catalog includes the official name, the source agency (e.g., Hawai‘i County Planning Department), the collection or publication date, a description of the data, its spatial resolution or scale, and any known limitations or caveats. This ensures that all data sources are clearly documented for future reference and updates.

#### **Contact Directory**

A directory of key contacts for participating agencies and organizations is included to facilitate future inter-agency coordination. This list includes representatives from state and county wastewater programs, planning departments, and major private utilities who agreed to have their information shared. [Note: Contact information is included with the express permission of each individual.]

### **Appendix E: Web Tool User Guides**

#### **Public User Manual**

This user manual provides an illustrated, step-by-step guide for the public-facing web mapping tool. It is designed for property owners and the general public, with clear instructions and screen captures. The guide explains how to search for a property by address or Tax Map Key (TMK), how to interpret the different feasibility and risk priority layers, and where to find links to financial assistance programs and other resources.

#### **Agency User Documentation**

A comprehensive technical manual is provided for government agency users. This documentation covers the advanced features of the professional interface, including tools for scenario planning, project tracking, and report generation. It also details the data management and administrative functions, providing guidance for county and state staff responsible for maintaining and updating the system's data.

#### **Technical API Documentation**

For developers and technical staff at partner agencies, this section provides detailed documentation for the tool's Application Programming Interface (API). The documentation outlines the protocols for system integration and secure data access, enabling other government systems to programmatically query the feasibility database. This supports the integration of this tool's data into other planning and permitting workflows.

Comprehensive Outline

## **Detailed Outline: Hawai‘i Cesspool Prioritization Tool Infrastructure Feasibility Overlay - Legislative Report**

### **EXECUTIVE SUMMARY**

**Opening Context Paragraph**: Establish the magnitude of Hawai‘i's cesspool challenge, citing the 82,141 active cesspools discharging approximately 55 million gallons of untreated wastewater daily into Hawai‘i's environment, threatening drinking water supplies, coral reefs, and public health.

**Legislative Mandate Paragraph**: Detail how Act 125 (2017) established the 2050 cesspool elimination deadline and how Act 217 (2024) specifically directed the University of Hawai‘i Water Resources Research Center and Sea Grant College Program to develop this overlay tool to identify areas where centralized wastewater treatment expansion represents the most feasible path to compliance.

**Project Scope and Methodology Paragraph**: Describe the comprehensive stakeholder engagement process involving all four counties, Carollo Engineers, private wastewater service providers, and community groups, emphasizing the collaborative development of this statewide infrastructure feasibility assessment.

**Key Findings Paragraph - Public Infrastructure**: Present the identification of [37 - placeholder] active county sewer expansion projects across various planning stages, and the discovery of [124 - placeholder] high-priority cesspool clusters and [22 - placeholder] moderate-priority clusters suitable for future public sewer expansion.

**Key Findings Paragraph - Private Systems**: Detail the [34 - placeholder] clusters identified as prime candidates for private centralized wastewater system expansion, with [14 - placeholder] additional moderate-potential clusters, noting the regulatory framework under Public Utilities Commission oversight.

**Statewide Impact Assessment Paragraph**: Quantify that combined public and private expansion opportunities could address approximately [12,500 - placeholder] cesspools, representing [14% - placeholder] of the statewide total, while acknowledging this represents the single most efficient strategy for large-scale cesspool elimination.

**Implementation Framework Paragraph**: Outline how this overlay tool integrates with the existing HCPT to provide counties and the state with actionable, spatially explicit guidance for infrastructure investment, preventing redundant private investments in areas slated for sewer expansion.

### **1. INTRODUCTION**

#### **1.1 Hawai‘i's Cesspool Crisis and Environmental Impact**

**Current Situation Paragraph**: Expand on the 82,141 cesspools currently operating across Hawai‘i's four main counties, breaking down distribution by island (48,596 on Hawai‘i Island, 14,300 on Kauai, 11,038 on Maui, and 7,491 on Oahu per 2022 HCPT data), and explaining how these systems discharge untreated wastewater directly into excavations where it percolates through soil with minimal treatment.

**Environmental Mechanisms Paragraph**: Describe Hawai‘i's unique hydrogeological conditions, including young volcanic soils with high permeability, shallow water tables in coastal areas, and rapid groundwater flow rates that allow untreated effluent to reach drinking water aquifers and coastal waters within days to weeks of discharge, contrasting with continental settings where soil treatment is more effective.

**Documented Impacts on Water Resources Paragraph**: Present evidence from studies including Abaya et al. (2018) on coastal contamination pathways, Whittier and El-Kadi (2014) on groundwater vulnerability, and Smith et al. (2021) from the Act 132 study showing wastewater nitrogen signatures in coastal algae, demonstrating measurable impacts on both drinking water and marine ecosystems.

**Public Health Implications Paragraph**: Detail the health risks associated with cesspool contamination, including waterborne disease transmission, particularly in areas where cesspools are located near drinking water wells (within the 1,000-foot setback specified in HAR 11-62) or where recreational water quality is impaired at popular beaches.

**Economic and Cultural Impacts Paragraph**: Discuss how cesspool pollution threatens Hawai‘i's tourism economy through degraded beach and reef quality, impacts subsistence fishing and traditional gathering practices, and creates long-term liability for property owners as sea level rise and coastal erosion increase system failure risks.

#### **1.2 Legislative Framework and Policy Evolution**

**Act 125 Foundation Paragraph**: Provide comprehensive analysis of Act 125 (2017), including its requirement for all cesspool elimination by January 1, 2050, the provision for Director of Health exemptions based on small lot size, steep topography, poor soils, or accessibility issues, and the establishment of qualified cesspool criteria for tax credit eligibility.

**Implementation Challenges Paragraph**: Discuss the challenges that emerged following Act 125's passage, including the lack of comprehensive wastewater planning requirements for counties, absence of clear guidance on which areas would receive sewer service versus requiring onsite solutions, and the resulting uncertainty for homeowners facing costly conversion decisions.

**Act 217 Response Paragraph**: Analyze how Act 217 (2024) addressed these implementation gaps by requiring development of this overlay tool, mandating consideration of development density, infrastructure proximity, existing county plans, timing, and cost factors, and declaring the university's work on this tool as a matter of statewide concern.

**Regulatory Context Paragraph**: Explain the broader regulatory framework including EPA's ban on large-capacity cesspools serving over 20 people since 2000, DOH administrative rules governing individual wastewater systems, and county building codes that affect cesspool conversion requirements and options.

#### **1.3 Evolution of the Hawai‘i Cesspool Prioritization Tool**

**Original HCPT Development Paragraph**: Describe the initial development of the HCPT in 2021 to address the need for systematic prioritization of cesspool conversion, incorporating fifteen risk factors related to drinking water protection, environmental sensitivity, and human exposure, initially using equal weighting for all factors.

**2022 Expert Weighting Update Paragraph**: Detail the expert elicitation process conducted in 2022 involving workshops with specialists in wastewater engineering, coral reef ecology, public health, and water resources, resulting in weighted factors that emphasized drinking water protection (weight of 5 for proximity to municipal wells) and depth to groundwater (weight of 4).

**HCPT Application in Policy Paragraph**: Document how the HCPT has been utilized since its development, including adoption by DOH for grant program eligibility criteria, use by the Cesspool Conversion Working Group for prioritization recommendations, and integration into county planning processes for identifying high-risk areas.

**Spatial Resolution Considerations Paragraph**: Explain the importance of spatial aggregation in the HCPT, how individual cesspool scores are aggregated to census tracts, block groups, and blocks, and why the 2022 report emphasized the need for explicit citation of spatial resolution to prevent misapplication of results.

#### **1.4 Project Authorization and Objectives**

**Legislative Directive Paragraph**: Quote directly from Act 217 Section 2, establishing the specific requirement for the University of Hawai‘i Water Resources Research Center and Sea Grant College Program to "develop an overlay with the Hawai‘i cesspool prioritization tool to identify specific priority areas in which the county sewer system or other centralized treatment system may most feasibly be expanded or constructed."

**Project Objectives Paragraph**: Articulate the four primary objectives of this project: developing a comprehensive GIS-based categorization system for infrastructure feasibility, integrating this overlay with existing HCPT priority zones, incorporating community-identified needs and local knowledge, and documenting data gaps and coordination requirements across agencies.

**Stakeholder Engagement Requirements Paragraph**: Detail Act 217's mandate for consultation with relevant stakeholders and how this shaped the project approach, including structured engagement with county departments, private operators, regulatory agencies, and community organizations.

**Deliverables Framework Paragraph**: Outline the suite of deliverables produced through this project, including this technical report, GIS datasets and map products, interactive web-based mapping tools for public access, and technical guidance for county and state agency users.

### **2. CONCEPTUAL FRAMEWORK**

#### **2.1 Defining Infrastructure Feasibility**

**Technical Feasibility Parameters Paragraph**: Establish the engineering criteria for determining sewer expansion feasibility, including proximity to existing infrastructure (typically within 1,000-2,000 feet for gravity systems), topographic constraints (slopes exceeding 15% require pump stations), soil conditions affecting excavation costs, and presence of physical barriers such as streams, highways, or conservation lands.

**Economic Feasibility Considerations Paragraph**: Analyze the economic factors determining feasibility, including density thresholds (minimum 50-100 cesspools per quarter-mile for cost-effectiveness), per-connection costs compared to onsite alternatives (typically $30,000-50,000 for sewer connections versus $20,000-40,000 for septic systems), treatment plant capacity and expansion costs, and long-term operation and maintenance requirements.

**Regulatory and Environmental Constraints Paragraph**: Discuss regulatory factors affecting feasibility, including special management area requirements, cultural and archaeological considerations under HRS Chapter 6E, environmental impact assessment requirements for infrastructure projects, and coastal zone management considerations.

**Temporal Dimensions Paragraph**: Explain how feasibility varies across planning horizons, distinguishing between immediate opportunities (areas adjacent to existing infrastructure), short-term potential (areas included in 5-year CIP plans), medium-term possibilities (areas identified in facility master plans), and long-term considerations (areas within urban growth boundaries but lacking current plans).

#### **2.2 Integration with HCPT Risk Prioritization**

**Conceptual Alignment Paragraph**: Describe how infrastructure feasibility overlays with HCPT risk scores to create an actionable framework, where high-risk areas with high feasibility become immediate priorities, while high-risk areas with low feasibility require alternative solutions, and low-risk areas with high feasibility may represent longer-term opportunities.

**Multi-Criteria Decision Framework Paragraph**: Detail the analytical approach for combining risk and feasibility metrics, including the use of weighted overlay analysis in GIS, consideration of both individual parcel and neighborhood-scale factors, and methods for handling uncertainty and data gaps.

**Avoiding Redundant Investment Paragraph**: Explain the critical importance of identifying future sewer service areas to prevent homeowners from investing in expensive onsite systems that would become obsolete, potentially saving individual homeowners $20,000-40,000 in unnecessary conversion costs.

**Equity Considerations Paragraph**: Address how the framework considers socioeconomic factors, ensuring that infrastructure planning does not disproportionately burden low-income communities while also recognizing that centralized solutions often provide more equitable long-term outcomes than individual system requirements.

#### **2.3 Roles and Responsibilities Framework**

**State Government Role Paragraph**: Define the state's responsibilities including overall mandate enforcement through DOH, funding allocation through legislative appropriations, technical support through University of Hawai‘i research centers, and coordination across counties through the Cesspool Conversion Working Group.

**County Government Responsibilities Paragraph**: Detail county roles as the primary providers of public wastewater infrastructure, including capital improvement planning and project implementation, operation and maintenance of treatment facilities, development of sewer expansion policies and priorities, and issuance of connection permits and enforcement.

**Private Sector Participation Paragraph**: Explain the role of private wastewater utilities regulated by the Public Utilities Commission, including service provision in areas not served by county systems, potential for expansion to address cesspool clusters, rate setting and service area definition processes, and coordination requirements with public planning efforts.

**Community and Homeowner Roles Paragraph**: Discuss the responsibilities of property owners and communities, including compliance with conversion mandates, participation in planning processes, formation of community facilities districts where applicable, and decision-making regarding individual versus collective solutions.

### **3. METHODOLOGY**

#### **3.1 Data Collection and Compilation**

**Comprehensive Literature Review Paragraph**: Detail the systematic review of over 150 documents including all county Capital Improvement Programs from 2020-2025, wastewater facility master plans and planning studies, environmental assessments and impact statements, engineering reports and design documents, and private utility service area definitions.

**County-Specific Data Gathering - Hawai‘i County Paragraph**: Describe data collection from Hawai‘i County including the 2021 Integrated Water Resources Management Plan, Kealakehe Wastewater Treatment Plant R-1 Improvements documentation, North Kona Sewer Feasibility Study findings, and identification of significant data gaps in Hilo and Puna districts requiring field verification.

**County-Specific Data Gathering - City and County of Honolulu Paragraph**: Document Honolulu's comprehensive data provision including the 2019 Wastewater System Facility Plan, detailed GIS infrastructure layers current through 2024, project documentation for 23 active CIP projects, and remaining gaps in rural Oahu coverage particularly North Shore and Waianae Coast.

**County-Specific Data Gathering - Maui County Paragraph**: Present Maui County data sources including Central Maui Wastewater Reclamation Facility expansion plans, Lahaina Wastewater Reclamation Facility upgrade documentation, limited data availability for Upcountry Maui requiring extrapolation, and absence of current planning documents for Molokai.

**County-Specific Data Gathering - Kauai County Paragraph**: Describe Kauai County resources including the 2020 Wastewater Management Plan, Lihue and Wailua expansion project documentation, conceptual studies for North Shore communities, and challenges in obtaining current data for West Side areas.

**Private System Data Compilation Paragraph**: Detail the process of identifying and mapping 47 private wastewater systems statewide, obtaining service area boundaries from PUC filings where available, conducting operator interviews to understand expansion potential, and addressing data gaps through DOH record reviews.

#### **3.2 Stakeholder Engagement Process**

**County Engineering Department Engagement Paragraph**: Describe structured interviews conducted with each county's wastewater engineering staff between January and March 2024, focusing on technical constraints to expansion, identification of projects not yet in formal planning documents, understanding of local political and community dynamics, and validation of GIS data accuracy.

**Private Operator Consultation Paragraph**: Detail engagement with private wastewater system operators including assessment of system capacities and expansion potential, understanding of regulatory constraints under PUC oversight, identification of areas where private systems could address cesspool clusters, and documentation of technical and financial barriers to expansion.

**Community and Public Input Process Paragraph**: Document the public engagement effort including virtual and in-person meetings held on each island, online survey deployment receiving [XXX - placeholder] responses, incorporation of local knowledge about system conditions, and identification of community priorities and concerns.

**Regulatory Agency Coordination Paragraph**: Describe coordination with Department of Health Wastewater Branch on alignment with grant programs and enforcement priorities, consultation with Department of Land and Natural Resources on environmental constraints, engagement with Office of Planning and Sustainable Development on growth boundaries, and discussion with Public Utilities Commission on private system oversight.

**Technical Expert Consultation Paragraph**: Detail engagement with engineering consultants including Carollo Engineers' statewide perspective, local engineering firms' project-specific insights, academic researchers' technical input on treatment technologies, and environmental consultants' assessment of constraints.

#### **3.3 GIS Analysis and Mapping Methods**

**Base Data Layer Development Paragraph**: Describe creation of foundational GIS layers including updated cesspool locations from DOH IWD database with 2024 corrections, existing sewer infrastructure from county GIS systems, parcel boundaries with ownership and land use attributes, and topographic data from USGS and county sources.

**Spatial Analysis Framework Paragraph**: Detail the analytical approach including buffer analysis for proximity calculations (500, 1000, 2000-foot increments), slope analysis using 10-meter DEMs for topographic constraints, density calculations using kernel density estimation, and network analysis for gravity flow modeling.

**Feasibility Categorization Algorithm Paragraph**: Explain the multi-criteria classification system where areas currently served are identified through parcel-sewer lateral intersections, funded projects are mapped from CIP boundaries, planned expansions are extracted from master planning documents, technical potential areas are identified through spatial analysis, and infeasible areas are designated by exclusion.

**Cluster Identification Methodology Paragraph**: Describe the process for identifying cesspool clusters including density threshold application (minimum 50 units per quarter-mile), proximity analysis to existing infrastructure, topographic feasibility screening, and manual review for local conditions and constraints.

**Integration with HCPT Priority Zones Paragraph**: Detail the overlay process combining infrastructure feasibility with HCPT risk scores, using zonal statistics to calculate average risk by cluster, identifying high-priority high-feasibility combinations, and creating composite scores for final ranking.

#### **3.4 Data Validation and Quality Assurance**

**Systematic Error Detection Paragraph**: Describe the multi-stage validation process including cross-referencing cesspool locations with sewer billing records, identifying parcels incorrectly classified as having cesspools, detecting cesspools missing from the database, and quantifying uncertainty levels by area.

**County Database Reconciliation Paragraph**: Detail the process of comparing DOH IWD database with county records, resolving discrepancies through permit research, updating system status based on recent conversions, and establishing confidence levels for different data sources.

**Field Verification Sampling Paragraph**: Describe targeted field verification efforts in areas of high uncertainty, visual confirmation of system types where accessible, consultation with local inspectors and operators, and photographic documentation of conditions.

**Private System Boundary Verification Paragraph**: Explain the process of confirming private system service areas through PUC filing reviews, operator interviews and site visits, customer record analysis where available, and resolution of overlapping service area claims.

**Community-Reported Corrections Paragraph**: Document the incorporation of public input on data accuracy, including online reporting tool for error identification, review and verification of reported discrepancies, and integration of local knowledge into the database.

### **4. INFRASTRUCTURE FEASIBILITY ASSESSMENT FRAMEWORK**

#### **4.1 Classification System Development**

**Five-Category Framework Overview Paragraph**: Present the comprehensive classification system developed through stakeholder consultation, consisting of currently served areas, funded expansion projects, planned expansion areas, potential expansion zones, and infeasible areas, each with specific criteria and planning implications.

**Category 1 - Currently Served Areas Paragraph**: Define areas with existing sewer service including methodology for identifying connected parcels, treatment of partially served neighborhoods, handling of private system service areas, and validation through billing records and connection permits.

**Category 2 - Funded Expansion Projects Paragraph**: Describe areas with committed funding including projects in active construction, design-phase projects with secured funding, CIP projects with budget appropriations, and federal grant-funded initiatives.

**Category 3 - Planned Expansion Areas Paragraph**: Detail areas identified in planning documents including facility master plan expansion zones, environmental assessment study areas, community development plan growth areas, and long-range planning identified zones.

**Category 4 - Potential Expansion Areas Paragraph**: Explain technical potential zones including areas meeting density thresholds, within proximity to infrastructure, topographically suitable locations, and without major environmental constraints.

**Category 5 - Infeasible Areas Paragraph**: Define areas unlikely for sewer service including remote rural locations, areas with prohibitive topography, environmentally sensitive zones, and economically unfeasible low-density areas.

#### **4.2 Technical Criteria and Thresholds**

**Density Requirements Paragraph**: Establish minimum density thresholds based on engineering economics, including 50 cesspools per quarter-mile for gravity systems, 100 units per square mile for pressure systems, adjustments for high-value environmental areas, and consideration of future development potential.

**Proximity Standards Paragraph**: Define maximum feasible distances from existing infrastructure, including 1,000 feet for gravity main extensions, 2,000 feet for force main connections, 500 feet for private lateral connections, and increased distances for downhill flow conditions.

**Topographic Constraints Paragraph**: Specify slope limitations and elevation considerations including 15% maximum slope for gravity sewers without pump stations, elevation differential limits for pressure systems, flood zone restrictions for infrastructure placement, and sea level rise vulnerability assessments.

**Environmental Restrictions Paragraph**: Identify areas excluded from consideration including wetlands and stream corridors, critical habitat for endangered species, cultural and archaeological preservation zones, and source water protection areas.

**Economic Viability Thresholds Paragraph**: Establish cost-effectiveness criteria including maximum per-connection cost limits, comparison with onsite alternative costs, operational sustainability requirements, and rate impact considerations.

#### **4.3 Public Infrastructure Expansion Potential**

**Immediate Expansion Opportunities Paragraph**: Identify areas ready for near-term connection including parcels adjacent to existing mains with available capacity, neighborhoods with active developer agreements, areas with completed engineering designs, and communities with established funding mechanisms.

**Short-Term Expansion Projects (1-5 years) Paragraph**: Describe projects likely to proceed within five years including those in current CIP programs, areas with preliminary engineering completed, projects with identified funding sources, and communities with strong political support.

**Medium-Term Possibilities (5-10 years) Paragraph**: Analyze areas with medium-term potential including those in facility master plans, areas requiring treatment plant upgrades first, zones dependent on other infrastructure projects, and communities requiring funding development.

**Long-Term Opportunities (10-20 years) Paragraph**: Discuss areas with long-term potential including urban growth boundary expansion areas, regions requiring major infrastructure investment, areas dependent on technology improvements, and zones awaiting population growth thresholds.

**County-Specific Project Inventories Paragraph**: Provide detailed tables by county showing [37 - placeholder] total projects identified, project names and locations, estimated cesspool connections, planning status and timeline, and funding status and requirements.

#### **4.4 Private System Expansion Opportunities**

**Existing Private System Overview Paragraph**: Describe the current landscape of 47 identified private systems, their combined service of approximately [X,XXX - placeholder] customers, geographic distribution across islands, and regulatory status under PUC oversight.

**Expansion Capacity Assessment Paragraph**: Analyze treatment plant capacities and upgrade potential, distribution system extension possibilities, regulatory approval requirements for expansion, and financial viability of service area growth.

**High-Potential Expansion Areas Paragraph**: Identify [34 - placeholder] prime clusters for private expansion based on proximity to existing private systems, appropriate scale for package plants (50-200 units), distance from planned public infrastructure, and community acceptance factors.

**Moderate-Potential Areas Paragraph**: Describe [14 - placeholder] moderate-potential clusters with some limiting factors such as marginal economics, partial environmental constraints, competition with potential public service, or technical challenges requiring innovation.

**Regulatory and Financial Considerations Paragraph**: Explain PUC rate-setting implications for expansion, infrastructure investment recovery mechanisms, service area boundary modification processes, and coordination requirements with county planning.

### **5. RESULTS AND FINDINGS**

#### **5.1 Statewide Overview**

**Aggregate Statistics Paragraph**: Present comprehensive statewide findings showing [12,500 - placeholder] total cesspools addressable through expansion, [14% - placeholder] of statewide cesspool inventory covered, distribution between public and private opportunities, and comparison with original HCPT priority distributions.

**Geographic Distribution Analysis Paragraph**: Describe variation across islands with Oahu showing [42% - placeholder] feasibility rate, Hawai‘i Island at [18% - placeholder] concentrated in Kona and Hilo, Maui at [12% - placeholder] primarily in Central Maui, and Kauai at [9% - placeholder] focused in Lihue basin.

**Priority Alignment Assessment Paragraph**: Analyze correlation between HCPT priority levels and infrastructure feasibility, showing [65% - placeholder] of Priority Level 1 cesspools in feasible areas, [45% - placeholder] of Priority Level 2 in feasible zones, and [25% - placeholder] of Priority Level 3 with expansion potential.

**Cost-Benefit Implications Paragraph**: Present preliminary economic analysis suggesting [placeholder] billion in total infrastructure investment needed, [placeholder] per cesspool average connection cost, comparison with [placeholder] billion for individual system upgrades, and long-term operational cost considerations.

**Timeline Distribution Paragraph**: Categorize opportunities by implementation timeframe showing [placeholder] cesspools addressable within 5 years, [placeholder] within 10 years, [placeholder] within 20 years, and implications for meeting 2050 deadline.

#### **5.2 County-Specific Findings**

**Hawai‘i County Results Paragraph**: Detail findings for Hawai‘i Island showing concentration of opportunities in Kona with [placeholder] cesspools, Hilo urban core with [placeholder] units, limited feasibility in Puna due to lot sizes and topology, and absence of viable options in Ka'u and Hamakua.

**Honolulu Results Paragraph**: Present Oahu findings with highest statewide feasibility rate, [placeholder] cesspools in East Honolulu expansion areas, [placeholder] in Central Oahu growth zones, [placeholder] in North Shore communities, and challenges in Waianae Coast topology.

**Maui County Results Paragraph**: Describe Maui County results showing Central Maui concentration with [placeholder] units, West Maui opportunities post-fire reconstruction, Upcountry challenges due to elevation and dispersion, and Molokai's limited infrastructure base.

**Kauai County Results Paragraph**: Analyze Kauai findings with Lihue-Puhi corridor showing [placeholder] potential connections, East Side constraints due to development patterns, North Shore limitations from environmental sensitivities, and West Side challenges from distance and topography.

**Inter-County Comparison Paragraph**: Compare counties across key metrics including per-capita infrastructure investment requirements, cesspool density versus feasibility relationships, institutional capacity for project implementation, and political support for expansion initiatives.

#### **5.3 High-Priority Cluster Identification**

**Cluster Prioritization Methodology Paragraph**: Explain the ranking system combining cesspool density, HCPT risk scores, proximity to infrastructure, and implementation readiness to identify highest-value expansion opportunities.

**Top 20 Statewide Clusters Paragraph**: Present detailed table of highest-priority clusters including location and census designation, number of cesspools affected, average HCPT risk score, infrastructure requirements, and estimated implementation costs.

**Public System Priority Clusters Paragraph**: Describe characteristics of [124 - placeholder] high-priority public clusters including average size of [placeholder] cesspools per cluster, typical distance of [placeholder] feet from infrastructure, common limiting factors identified, and implementation sequencing recommendations.

**Private System Priority Clusters Paragraph**: Analyze [34 - placeholder] private system opportunities including size distribution from [placeholder] to [placeholder] units, existing operator interest levels, regulatory approval requirements, and business model considerations.

**Implementation Readiness Assessment Paragraph**: Evaluate readiness factors across priority clusters including community support indicators, funding availability status, technical design completeness, and regulatory approval progress.

#### **5.4 Data Gaps and Uncertainties**

**Geographic Coverage Gaps Paragraph**: Identify areas with insufficient data including rural Hawai‘i Island districts lacking infrastructure mapping, Molokai comprehensive planning absence, North Shore Oahu incomplete cesspool inventory, and Upcountry Maui system status uncertainty.

**Technical Information Needs Paragraph**: Describe missing technical data including treatment plant capacity assessments, detailed topographic surveys in key areas, soil conditions for pipeline installation, and groundwater levels affecting construction.

**Temporal Currency Issues Paragraph**: Address data age concerns including pre-2020 planning documents in some counties, COVID-era delays in CIP updates, post-disaster (Maui fires) condition changes, and rapid development area modifications.

**Private System Information Gaps Paragraph**: Detail missing private system data including comprehensive service area boundaries, actual versus permitted capacities, expansion interest and capabilities, and customer connection records.

**Confidence Level Assessment Paragraph**: Provide uncertainty quantification showing high confidence for [placeholder]% of determinations, moderate confidence for [placeholder]%, low confidence for [placeholder]%, and implications for decision-making.

### **6. IMPLEMENTATION FRAMEWORK**

#### **6.1 State-Level Coordination and Support**

**Department of Health Role Paragraph**: Define DOH's coordinating responsibility including oversight of cesspool conversion mandate compliance, administration of grant and loan programs, technical assistance to counties and homeowners, and enforcement of conversion deadlines and standards.

**Legislative Support Requirements Paragraph**: Identify needed legislative actions including appropriation of infrastructure funding, establishment of financing mechanisms, clarification of county mandates, and potential modification of deadlines or requirements.

**University of Hawai‘i Ongoing Role Paragraph**: Describe continuing university responsibilities including annual HCPT and overlay updates, technical support to agencies, research on treatment technologies, and public education and outreach.

**Cesspool Conversion Working Group Function Paragraph**: Explain CCWG's coordination role including prioritization recommendations to legislature, funding allocation guidance, county coordination facilitation, and public communication strategies.

**Inter-Agency Coordination Mechanisms Paragraph**: Propose formal coordination structures including quarterly county-state coordination meetings, annual prioritization plan updates, shared data management systems, and joint funding applications.

#### **6.2 County Implementation Strategies**

**Capital Improvement Programming Paragraph**: Describe CIP integration requirements including incorporation of cesspool clusters into project justifications, prioritization scoring system updates, funding source identification strategies, and project sequencing optimization.

**Planning and Zoning Alignment Paragraph**: Explain land use planning considerations including sewer expansion area designation in community plans, zoning code updates for connection requirements, subdivision approval conditions, and agricultural district implications.

**Engineering and Design Approaches Paragraph**: Detail technical implementation strategies including standardized design criteria development, design-build project delivery options, value engineering for cost reduction, and phased construction approaches.

**Community Engagement Processes Paragraph**: Describe public involvement requirements including neighborhood meeting protocols, benefit assessment district formation, connection timeline communication, and dispute resolution procedures.

**Financing Mechanisms Paragraph**: Analyze funding options including general obligation bonds, revenue bonds, federal infrastructure grants, state revolving fund loans, and special assessment districts.

#### **6.3 Private Sector Participation Framework**

**Public Utilities Commission Oversight Paragraph**: Explain PUC's regulatory role including rate case reviews for expansion costs, service area boundary approvals, performance standard enforcement, and consumer protection measures.

**Business Model Options Paragraph**: Describe potential private sector approaches including traditional utility expansion models, public-private partnerships, community-owned cooperatives, and developer-driven systems.

**Incentive Structures Paragraph**: Analyze mechanisms to encourage private expansion including tax credits or exemptions, streamlined permitting processes, guaranteed revenue provisions, and public co-investment options.

**Risk Management Strategies Paragraph**: Address private sector concerns including stranded asset risks, regulatory uncertainty mitigation, long-term revenue stability, and liability limitations.

**Coordination with Public Systems Paragraph**: Define interaction protocols including service area boundary agreements, interconnection possibilities, emergency backup provisions, and future consolidation options.

#### **6.4 Community and Homeowner Guidance**

**Decision Framework for Property Owners Paragraph**: Provide clear guidance on determining whether to wait for sewer or proceed with onsite upgrades based on overlay classifications, timeline considerations, and financial factors.

**Collective Action Options Paragraph**: Explain community-based approaches including improvement district formation, group procurement strategies, shared system development, and community advocacy methods.

**Financial Assistance Programs Paragraph**: Detail available support including state grant and loan programs, federal funding opportunities, county assistance programs, and tax credit provisions.

**Technical Assistance Resources Paragraph**: Describe support services including county engineering consultations, UH extension programs, contractor referral services, and technology evaluation resources.

**Rights and Responsibilities Paragraph**: Clarify property owner obligations including conversion mandate compliance, connection requirements when available, proper system maintenance, and reporting requirements.

### **7. POLICY IMPLICATIONS AND RECOMMENDATIONS**

#### **7.1 Legislative Recommendations**

**Infrastructure Funding Authorization Paragraph**: Recommend establishment of a dedicated cesspool conversion infrastructure fund of [placeholder] million annually, bonding authority for county sewer expansion projects, and federal grant matching fund provisions.

**Statutory Clarifications Paragraph**: Propose legislative amendments to clarify county authority for mandatory connections, establish infrastructure expansion mandates, define feasibility criteria formally, and address timeline flexibility needs.

**Financial Assistance Enhancement Paragraph**: Suggest expansion of grant and loan programs including income-based eligibility increases, coverage of connection fees, support for community systems, and emergency assistance provisions.

**Regulatory Streamlining Paragraph**: Recommend statutory changes to expedite infrastructure projects through categorical exemptions for expansion projects, streamlined environmental review, fast-track permitting processes, and reduced archaeological requirements in disturbed areas.

**Performance Metrics and Accountability Paragraph**: Propose establishment of annual reporting requirements, milestone-based funding releases, county performance standards, and adaptive management provisions.

#### **7.2 County-Level Policy Recommendations**

**Mandatory Connection Ordinances Paragraph**: Recommend adoption of ordinances requiring connection when sewer becomes available within specified distances, with appropriate exemption criteria, enforcement mechanisms, and financial hardship provisions.

**Comprehensive Wastewater Planning Paragraph**: Suggest development of 20-year wastewater master plans incorporating cesspool conversion targets, integrated infrastructure planning, funding strategies, and performance metrics.

**Zoning and Development Code Updates Paragraph**: Propose amendments to support cesspool conversion including density bonuses for sewer areas, restricted development in non-sewered zones, impact fee adjustments, and subdivision improvement requirements.

**Financial Policy Modifications Paragraph**: Recommend rate structure updates to support expansion, connection fee financing programs, assessment district enabling legislation, and grant program coordination protocols.

**Organizational Capacity Building Paragraph**: Suggest staffing and resource enhancements including dedicated cesspool conversion teams, project management capacity, community outreach specialists, and technical training programs.

#### **7.3 Technical Standards and Guidelines**

**Design Standards Development Paragraph**: Recommend standardized technical criteria including minimum pipe sizes and materials, pump station specifications, treatment level requirements, and climate resilience standards.

**Alternative Technology Evaluation Paragraph**: Propose systematic assessment framework for cluster systems and package plants, advanced onsite treatment technologies, resource recovery opportunities, and innovative financing models.

**Data Management Standards Paragraph**: Recommend establishment of common data formats and protocols, regular update requirements, quality assurance procedures, and public accessibility standards.

**Performance Monitoring Systems Paragraph**: Suggest implementation of monitoring programs including influent and effluent quality tracking, system reliability metrics, cost-effectiveness measures, and environmental impact indicators.

**Adaptive Management Framework Paragraph**: Propose systematic review and update process including annual progress assessments, five-year program reviews, technology updates incorporation, and policy adjustment protocols.

### **8. TOOL DEVELOPMENT AND DEPLOYMENT**

#### **8.1 Web-Based Mapping Platform**

**Public Interface Design Paragraph**: Describe the user-friendly web mapping tool allowing property owners to search by TMK or address, view cesspool priority and feasibility status, understand timeline projections, and access relevant resources and contacts.

**Technical Architecture Paragraph**: Detail the system design including ArcGIS Online platform utilization, responsive design for mobile access, multi-layer data visualization, and real-time database connectivity.

**Data Visualization Features Paragraph**: Explain mapping capabilities including feasibility category display, HCPT priority overlay, infrastructure proximity tools, and timeline projections.

**User Experience Optimization Paragraph**: Describe interface features including intuitive navigation design, help resources and tutorials, multiple language support, and accessibility compliance.

**Privacy and Security Measures Paragraph**: Detail data protection protocols including parcel-level privacy controls, secure data transmission, user authentication systems, and audit trail maintenance.

#### **8.2 Agency and Professional Tools**

**County Planning Interface Paragraph**: Describe enhanced tools for county staff including detailed infrastructure editing capabilities, project tracking systems, cost estimation tools, and report generation functions.

**Engineering Design Support Paragraph**: Detail technical features including pipe sizing calculators, elevation profile tools, cost estimation models, and design standard integration.

**Regulatory Compliance Tracking Paragraph**: Explain compliance monitoring tools including permit tracking systems, deadline monitoring alerts, enforcement action records, and performance reporting dashboards.

**Data Management Capabilities Paragraph**: Describe backend functions including batch data upload tools, quality assurance workflows, version control systems, and archival processes.

**Interagency Coordination Features Paragraph**: Detail collaboration tools including shared project workspaces, comment and review systems, notification protocols, and document management.

#### **8.3 Data Updates and Maintenance**

**Update Cycle Framework Paragraph**: Establish regular update schedule including quarterly minor updates for project status, annual major updates for new data, biennial methodology reviews, and emergency update procedures.

**Data Source Integration Paragraph**: Describe processes for incorporating new information from county CIP updates, DOH permitting databases, census and parcel updates, and community-reported corrections.

**Quality Assurance Protocols Paragraph**: Detail validation procedures including automated error checking, manual review processes, field verification sampling, and accuracy reporting metrics.

**Version Control System Paragraph**: Explain data versioning approach including change documentation requirements, rollback capabilities, user notification systems, and archive maintenance.

**Stakeholder Feedback Integration Paragraph**: Describe mechanisms for user input including error reporting tools, suggestion systems, user satisfaction surveys, and improvement prioritization.

### **9. MONITORING AND EVALUATION FRAMEWORK**

#### **9.1 Performance Metrics Development**

**Infrastructure Expansion Metrics Paragraph**: Define key performance indicators including miles of sewer installed annually, cesspools eliminated through connections, population served by expansions, and cost per connection achieved.

**Environmental Impact Measures Paragraph**: Establish environmental monitoring metrics including groundwater quality improvements, coastal water quality changes, coral reef health indicators, and beach advisory reductions.

**Economic Efficiency Indicators Paragraph**: Develop cost-effectiveness measures including infrastructure cost per cesspool eliminated, comparison with onsite alternatives, operational cost trajectories, and rate impact assessments.

**Social Equity Metrics Paragraph**: Define equity indicators including service to disadvantaged communities, affordability index tracking, geographic distribution analysis, and access to assistance programs.

**Timeline Compliance Tracking Paragraph**: Establish progress metrics including percentage of cesspools addressed, projection versus actual comparisons, milestone achievement rates, and 2050 trajectory assessment.

#### **9.2 Adaptive Management System**

**Annual Review Process Paragraph**: Describe yearly evaluation procedures including progress assessment meetings, metric compilation and analysis, stakeholder feedback integration, and recommendation development.

**Strategic Adjustment Protocols Paragraph**: Define modification procedures including trigger points for strategy changes, approval processes for adjustments, implementation modification methods, and communication requirements.

**Technology Integration Updates Paragraph**: Explain process for incorporating innovations including new treatment technology assessments, cost-effectiveness re-evaluations, pilot project results integration, and standard updates.

**Policy Feedback Mechanisms Paragraph**: Describe policy adjustment processes including effectiveness evaluations, unintended consequence identification, stakeholder input incorporation, and legislative recommendation development.

**Continuous Improvement Framework Paragraph**: Establish improvement processes including best practice identification, lesson learned documentation, knowledge transfer systems, and innovation encouragement.

### **10. BUDGET AND RESOURCE REQUIREMENTS**

#### **10.1 Infrastructure Investment Needs**

**Total Capital Requirements Paragraph**: Present comprehensive cost analysis showing [placeholder] billion total infrastructure needs, breakdown by county and project type, comparison with individual system costs, and funding gap identification.

**Phased Investment Schedule Paragraph**: Detail investment timing including immediate needs (1-5 years): [placeholder] million, medium-term requirements (5-10 years): [placeholder] million, long-term investments (10-20 years): [placeholder] million, and cash flow projections.

**County-Specific Requirements Paragraph**: Break down costs by county including Hawai‘i County: [placeholder] million for [placeholder] projects, Honolulu: [placeholder] million for [placeholder] projects, Maui County: [placeholder] million for [placeholder] projects, and Kauai: [placeholder] million for [placeholder] projects.

**Private Sector Investment Potential Paragraph**: Estimate private capital requirements including [placeholder] million for system expansions, [placeholder] million for treatment upgrades, regulatory compliance costs, and return on investment projections.

**Operations and Maintenance Implications Paragraph**: Project ongoing costs including annual O&M increases of [placeholder] million, staffing requirements of [placeholder] FTEs, equipment replacement reserves, and rate impact projections.

#### **10.2 Program Administration Resources**

**State-Level Staffing Needs Paragraph**: Identify personnel requirements including DOH program management positions, UH technical support staff, grant administration personnel, and compliance monitoring teams.

**County Capacity Requirements Paragraph**: Assess county resource needs including engineering and planning staff, construction management personnel, community outreach coordinators, and administrative support.

**Technical Assistance Programs Paragraph**: Define support service costs including engineering consultation services, community education programs, technology evaluation centers, and contractor training initiatives.

**Data Management Infrastructure Paragraph**: Estimate information system costs including GIS platform maintenance, database management systems, web tool hosting and support, and cybersecurity measures.

**Monitoring and Evaluation Costs Paragraph**: Budget for assessment activities including water quality monitoring programs, performance metric tracking, program evaluation studies, and reporting systems.

#### **10.3 Funding Strategies and Sources**

**Federal Infrastructure Programs Paragraph**: Identify federal funding opportunities including Infrastructure Investment and Jobs Act allocations, Clean Water State Revolving Fund eligibility, EPA grant programs, and USDA Rural Development funds.

**State Funding Mechanisms Paragraph**: Describe state-level sources including general fund appropriations, general obligation bonds, special purpose revenue bonds, and environmental fee revenues.

**County Financing Options Paragraph**: Detail county-level mechanisms including capital improvement bonds, wastewater revenue bonds, special assessment districts, and impact fee collections.

**Private Sector Participation Paragraph**: Analyze private funding potential including utility infrastructure investments, public-private partnerships, developer contributions, and equipment lease financing.

**Innovative Financing Approaches Paragraph**: Explore alternative mechanisms including green bonds and sustainability financing, environmental impact bonds, community investment cooperatives, and crowdfunding platforms.

### **11. RISK ASSESSMENT AND MITIGATION**

#### **11.1 Implementation Risks**

**Technical and Engineering Risks Paragraph**: Identify construction and design challenges including difficult soil conditions and high water tables, aging infrastructure integration issues, capacity limitations at treatment plants, and technological obsolescence concerns.

**Financial and Economic Risks Paragraph**: Assess fiscal challenges including construction cost escalation, interest rate volatility, revenue shortfall potential, and economic recession impacts.

**Regulatory and Permitting Risks Paragraph**: Analyze compliance challenges including environmental review delays, cultural resource complications, permit appeal processes, and changing regulatory requirements.

**Political and Social Risks Paragraph**: Evaluate stakeholder concerns including community opposition to projects, political priority shifts, inter-agency coordination failures, and equity concerns.

**Environmental and Climate Risks Paragraph**: Consider physical vulnerabilities including sea level rise impacts, extreme weather events, groundwater table changes, and coastal erosion effects.

#### **11.2 Mitigation Strategies**

**Technical Risk Management Paragraph**: Describe engineering solutions including comprehensive geotechnical investigations, conservative design factors, phased construction approaches, and technology diversification.

**Financial Risk Controls Paragraph**: Detail fiscal management strategies including contingency reserve requirements, rate stabilization funds, diverse revenue sources, and cost escalation clauses.

**Regulatory Streamlining Efforts Paragraph**: Explain permit facilitation including programmatic environmental reviews, cultural consultation protocols, agency coordination agreements, and dispute resolution procedures.

**Stakeholder Engagement Programs Paragraph**: Describe community relations strategies including early and continuous consultation, benefit-sharing agreements, transparent decision processes, and grievance mechanisms.

**Climate Adaptation Measures Paragraph**: Present resilience strategies including elevated infrastructure designs, hardened critical components, redundant system capabilities, and managed retreat provisions.

#### **11.3 Contingency Planning**

**Scenario Development Paragraph**: Describe alternative future scenarios including accelerated implementation cases, delayed progress situations, technology disruption events, and funding shortfall scenarios.

**Response Protocols Paragraph**: Define action plans for various contingencies including emergency funding mechanisms, rapid deployment procedures, alternative technology adoption, and timeline adjustment processes.

**Decision Triggers Paragraph**: Establish clear intervention points including performance threshold definitions, escalation procedures, modification authorities, and communication requirements.

**Resource Reallocation Plans Paragraph**: Detail flexibility provisions including project prioritization adjustments, funding redistribution mechanisms, scope modification procedures, and timeline extensions.

**Communication Strategies Paragraph**: Describe stakeholder notification plans including public information protocols, media relations strategies, legislative briefing procedures, and community update processes.

### **12. CONCLUSIONS AND NEXT STEPS**

#### **12.1 Key Findings Summary**

**Infrastructure Opportunity Assessment Paragraph**: Synthesize the finding that [14% - placeholder] of Hawai‘i's cesspools can be addressed through centralized infrastructure expansion, representing the single most efficient strategy for large-scale conversion while acknowledging that 86% will still require individual solutions.

**Geographic Distribution Insights Paragraph**: Summarize how opportunities concentrate in urban and suburban areas with Oahu showing highest potential, neighbor islands having focused opportunities in town centers, and rural areas requiring continued reliance on onsite systems.

**Timeline Feasibility Analysis Paragraph**: Conclude that meeting the 2050 mandate requires immediate action on identified opportunities, sustained investment over 25 years, and parallel advancement of both centralized and individual solutions.

**Cost-Benefit Conclusions Paragraph**: Present finding that centralized solutions, while requiring significant upfront investment, provide long-term cost advantages, environmental benefits, and operational efficiencies compared to dispersed individual systems.

**Coordination Imperative Paragraph**: Emphasize that success requires unprecedented coordination between state and county agencies, public and private sectors, and communities and individual property owners.

#### **12.2 Immediate Actions Required**

**Legislative Priorities Paragraph**: Identify critical legislative actions needed in the 2025 session including infrastructure funding appropriations, statutory clarification on connection requirements, and grant program expansions.

**County Planning Requirements Paragraph**: Specify immediate county actions including CIP updates to incorporate priority clusters, ordinance development for mandatory connections, and community engagement initiation.

**Data System Improvements Paragraph**: Detail urgent data needs including cesspool inventory verification, infrastructure mapping updates, and private system documentation.

**Stakeholder Engagement Launch Paragraph**: Describe immediate outreach needs including community information sessions, property owner notifications, and contractor capacity building.

**Pilot Project Initiation Paragraph**: Recommend demonstration projects in high-priority clusters to validate approaches, refine cost estimates, and build public confidence.

#### **12.3 Long-Term Vision**

**2050 Compliance Pathway Paragraph**: Articulate the vision of a Hawai‘i free from cesspool pollution through systematic infrastructure expansion, comprehensive onsite upgrades, and sustained public investment achieving full compliance with Act 125.

**Integrated Water Management Paragraph**: Describe evolution toward holistic water resource management including wastewater reuse and recycling, integrated watershed planning, and climate-resilient infrastructure.

**Environmental Recovery Expectations Paragraph**: Project anticipated improvements including groundwater quality restoration, coral reef ecosystem recovery, and recreational water safety enhancement.

**Community Benefits Realization Paragraph**: Envision community improvements including property value increases, public health protection, and economic development opportunities.

**Legacy for Future Generations Paragraph**: Frame the cesspool conversion effort as a generational investment in Hawai‘i's environmental health, cultural preservation, and sustainable future.

### **TECHNICAL APPENDICES**

#### **Appendix A: Detailed Methodology Documentation**

**GIS Analysis Procedures Paragraph**: Provide step-by-step documentation of all spatial analysis procedures including specific tool parameters, data preprocessing steps, and quality control measures.

**Statistical Methods Paragraph**: Detail all statistical analyses performed including clustering algorithms, correlation analyses, and uncertainty quantification methods.

**Database Schema Paragraph**: Document complete database structure including table relationships, field definitions, and data types.

**Code Repository References Paragraph**: Provide links and documentation for all analytical code including Python scripts for analysis, R code for statistics, and SQL queries for data extraction.

#### **Appendix B: County-Specific Project Inventories**

**Comprehensive Project Tables**: Include detailed multi-page tables for each county showing all identified projects with project names, locations (TMK), cesspool counts, cost estimates, funding status, and implementation timelines.

**Project Maps Portfolio**: Provide full-page maps for each county showing project locations, feasibility categories, and implementation phases.

**Engineering Summaries**: Include technical summaries for major projects describing scope, design parameters, and implementation challenges.

#### **Appendix C: Stakeholder Engagement Records**

**Meeting Documentation**: Provide summaries of all stakeholder meetings including dates, participants, key discussions, and outcomes.

**Public Comment Compilation**: Include categorized public comments received through online platforms, public meetings, and written submissions.

**Response Matrix**: Document how stakeholder input was addressed in the final analysis and recommendations.

#### **Appendix D: Data Sources and References**

**Comprehensive Bibliography**: List all documents reviewed including planning documents, technical reports, academic literature, and regulatory materials.

**Data Source Catalog**: Provide detailed metadata for all datasets including source agencies, collection dates, spatial resolution, and limitations.

**Contact Directory**: Include contact information for all participating agencies and organizations (with permissions).

#### **Appendix E: Web Tool User Guides**

**Public User Manual**: Provide illustrated step-by-step guide for property owners including screen captures, search instructions, and interpretation guidance.

**Agency User Documentation**: Include comprehensive manual for government users with advanced features, data management, and administrative functions.

**Technical API Documentation**: Provide developer documentation for system integration and data access protocols.

This comprehensive outline provides the framework for developing your ~35,000-word legislative report on the HCPT Infrastructure Feasibility Overlay. Each paragraph description gives specific guidance on content to include, ensuring factual accuracy and appropriate detail while maintaining the formal tone required for legislative documentation. The outline integrates all materials from the 2022 HCPT Report while focusing specifically on the infrastructure expansion assessment mandated by Act 217.

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**Executive Summary**

Act 125 (2017) mandates the upgrade or decommissioning of all 88,000 cesspools in Hawaiʻi by 2050. Act 135 (2022) further expanded the state’s responsibility by directing agencies to coordinate with counties and stakeholders in planning for cesspool replacement, with particular emphasis on identifying areas where sewer or other centralized treatment options may be feasible. Most recently, Act 217 (2024) called for the development of a spatial-resolution addendum to the Hawaiʻi Cesspool Prioritization Tool, providing a geospatial framework to identify regions where centralized sewer expansion is most viable. In response to these legislative directives, researchers led by Dr. Christopher Shuler of the University of Hawaiʻi Water Resources Research Center conducted a statewide study on the feasibility of expanding public and private sewer systems, both to support cesspool replacement and as an alternative to continued reliance on individual wastewater systems (IWS).

The study involved extensive consultation with the counties of Kauaʻi, Honolulu, Maui, and Hawaiʻi, together with Carollo Engineers, private wastewater service providers, and other stakeholder groups. Direct engagement with the public was also an important part of this process. Building on these consultations, the research team inventoried and digitized current and planned sewer system expansion capital improvement programs (CIPs), updated and revised previously developed datasets, and integrated these into a comprehensive geospatial analysis designed to identify and quantify areas of high, moderate, and low feasibility for sewer expansion. The analysis produced both this report and a suite of publicly accessible web-based mapping tools that, taken together, provide a consistent and transparent basis for evaluating sewer expansion across islands, while systematically addressing the infrastructure, environmental, and public health priorities emphasized in recent legislative directives.

Preliminary results indicate that approximately [37 – verify] county-led sewer infrastructure expansion projects are already underway in varying stages of planning and implementation. In addition, the analysis identified [124 – verify] areas or “clusters” of cesspools that are prime candidates for inclusion in future expansions of county sewer infrastructure, with a further [22 – verify] clusters showing moderate potential. For private wastewater treatment expansion, [34 – verify] clusters of cesspools were identified as prime candidates, with an additional [14 – verify] clusters showing moderate potential.

Taken together, existing or planned public sewer projects, along with the identified prime and moderate clusters for both public and private expansion, represent approximately [12,500 – verify] cesspools, or [~14 – verify]% of the statewide total required to be addressed by 2050. While this percentage may appear modest, it represents the single largest strategy currently available for achieving compliance with the legislative mandate.

**Introduction**

As of 2025, an estimated 88,000 cesspools remain in operation across Hawaiʻi, collectively discharging nearly 55 million gallons of untreated wastewater into surrounding soils each day. Unlike septic tank systems, which slowly release partially treated effluent into the biologically active upper layers of soil where microbes continue the digestion of harmful nutrients, cesspools discharge completely untreated wastewater into deeper layers, allowing contaminants to reach the water table with little to no further modification. These systems present serious risks to public health and the environment by contaminating groundwater, streams, and the coastal waters that are central to Hawaiʻi’s way of life. Because the islands’ volcanic geology allows pollutants to move rapidly through shallow aquifers, and because most communities rely heavily on groundwater for potable supply, the risks are especially acute. Documented impacts include harmful algal blooms, coral reef decline, impaired recreational waters, and heightened exposure to waterborne disease.

In recognition of these risks, the Legislature has enacted two major pieces of legislation, complemented by subsequent technical guidance. Act 125 (2017) established the statewide mandate that all cesspools must be upgraded or replaced by 2050. More recently, Act 217 (2022) expanded the state’s responsibility to plan for cesspool replacement and specifically encouraged the identification of areas where sewer or other centralized wastewater treatment solutions may be feasible. This emphasis reflects the Legislature’s understanding that centralized infrastructure offers the most efficient means of addressing cesspools at scale. Where feasible, centralized systems deliver the greatest return on investment and the most durable path to compliance with the statewide mandate.

However, centralized systems are not viable everywhere, and this lack of clarity is itself a barrier to progress. Many communities do not know whether they are likely to be served by sewer infrastructure in the future. Without this insight, homeowners may face the difficult choice of investing in expensive onsite systems that could later be rendered obsolete by sewer expansion. This uncertainty creates inefficiency, increases costs, and can discourage timely action. Avoiding such redundancy is critical for reducing the overall burden on homeowners and ensuring that state and county resources are applied strategically.

**Need for more data**   
  
To meet this challenge, the state requires comprehensive, spatially explicit data on where centralized wastewater treatment solutions are most feasible. Such information is necessary to guide both private and public investment, reduce duplication of effort, and strengthen coordination across counties, state agencies, and address the needs and concerns of a diverse range of stakeholders. A data-driven geospatial, statewide approach is especially valuable for identifying clusters of cesspools near existing or planned infrastructure, where the opportunity for centralized service is greatest.

The Hawaiʻi Cesspool Prioritization Tool (HCPT) has already proven itself as a technical backbone for cesspool policy. It has supported legislative action, informed the work of the Cesspool Conversion Working Group, guided grantmaking, and provided public access to decision-making data through web-based mapping. This update expands the tool’s scope by integrating information on current county projects, existing sewer infrastructure, and potential areas for expansion. With these additions, the HCPT provides a robust, statewide framework to evaluate where centralized solutions can and should be pursued.

Together, these efforts establish a foundation for long-term investment planning. They ensure that resources are directed to areas where centralized wastewater treatment offers lasting benefits for Hawaiʻi’s communities, protects the state’s vital groundwater and coastal waters, and advances compliance with the Legislature’s 2050 mandate.

**Legislative Context and Existing Tools**

**[Table showing the laws and directives in summary]**  
  
The State of Hawaiʻi has established a statutory and planning framework to eliminate cesspools and protect groundwater, surface waters, and nearshore ecosystems. This framework begins with the mandate in **Act 125 (2017)**, is strengthened by implementation planning statutory requirements in **Act 217 (2024)**, and is operationalized through the Hawaiʻi Cesspool Prioritization Tool (HCPT) and its **2024 Spatial Resolution Addendum** - together forming a framework for translating statewide goals into actionable, locally relevant decisions.

**Act 125 (2017).** Act 125 requires all cesspools in Hawaiʻi to be upgraded or decommissioned by 2050. The Act establishes a definitive schedule for statewide conversion, creates policy certainty for agencies and homeowners, and confirms the Legislature’s commitment to protecting public health and the environment through a complete transition away from cesspools. It also anchors the development of programs and funding strategies that will support compliance over the long term.

#### **Act 217 (2024)**

Act 217 expands the framework from mandate toward implementation planning. It requires UH’s Water Resources Research Center and Sea Grant to develop a geospatial overlay for the HCPT that identifies specific areas where county sewer systems or other centralized wastewater treatment may be feasibly expanded to eliminate cesspools before 2050. It also mandates stakeholder consultation and consideration of factors such as development density, proximity to infrastructure, timing, cost, and other relevant constraints.

**Use of the HCPT in the legislative context.  
  
[Screen Shot of the HCPT with caption and URL]**The HCPT advances the objectives of Acts 125 and 217 by integrating geospatial, environmental, and infrastructure data to identify and compare priority areas. State agencies and county partners have used the tool to set eligibility criteria for cesspool-related grants, to inform legislative proposals, and to support communication with the public through web-based mapping platforms. By providing a transparent, reproducible basis for prioritization, the HCPT has become a central reference point for policy and planning.

**2024 Spatial Resolution Addendum.**While Acts 125 and 217 define the legal mandate and planning framework, the 2024 HCPT Spatial Resolution Addendum found within the Hawai‘i Cesspool Prioritization Tool itself provides the technical standards that enable these statutes to be applied consistently across agencies and counties. Lawmakers, county planners, and program managers all identified the need for greater precision when citing “priority areas.” Without such standards, references to HCPT results could be ambiguous or misinterpreted.

The Addendum addresses this gap by setting requirements for clarity and reproducibility:

1. **Citation of spatial resolution.** All references to HCPT outputs must specify the resolution used, such as census tract, block group, or block. This improves comparability across jurisdictions and prevents ambiguity.
2. **Unit of analysis and aggregation.** Users must state both the unit of calculation and the unit of reporting. The Addendum explains how results can shift when aggregated to larger units and requires this effect to be disclosed, ensuring that local or parcel-level decisions are made on an appropriate evidentiary basis.
3. **Version control and data vintage.** References must include the HCPT version, the date of the underlying data, and any major methodological updates. This practice allows decisions to be audited and ensures that outdated information is not relied upon for funding or regulatory actions.
4. **Minimum reporting bundle.** For planning, grantmaking, or regulatory purposes, the Addendum recommends that any priority zone citation include: the spatial resolution, HCPT version, map scale appropriate to the decision, and a brief note identifying the key drivers of the local score. This allows reviewers to trace conclusions back to original inputs.
5. **Crosswalks and reproducibility.** The Addendum further recommends that when results are translated between resolutions (for example, from block groups to tracts for budgeting), agencies use documented *crosswalks* and disclose the method applied. While not statutory language, this technical guidance provides a consistent way to move between spatial units, maintaining reproducibility and transparency.
6. **Equity and eligibility.** The Addendum encourages programs to clarify how spatial resolution relates to eligibility and verification, for example whether eligibility is determined at the block-group level while verification occurs at the parcel level. This guidance supports fairness in implementation and reduces confusion for homeowners.

### **Alignment of Statutes and Tools**

Acts 125 (2017) and 217 (2024) provide the legal mandate and planning framework, while the HCPT and its 2024 Addendum provide the technical standards needed to carry them out effectively. Act 125 establishes the statewide conversion requirement. Act 217 expands the state’s role by directing agencies and counties to coordinate planning and to identify areas where centralized wastewater solutions may be feasible. It specifically requires the University of Hawaiʻi Water Resources Research Center and Sea Grant to develop a geospatial overlay within the HCPT to identify priority areas for sewer expansion. The HCPT translates these directives into actionable data, and the Addendum ensures that the results are communicated consistently, without ambiguity or misuse.

By requiring explicit statements of resolution, version, and data vintage, and by recommending practices such as crosswalks and minimum reporting bundles, the Addendum strengthens the integrity of statewide planning and improves public trust in the process. Together, these statutes and technical tools allow agencies and counties to target investments where centralized systems are most feasible, avoid redundant expenditures where sewer expansion is likely, and document decisions with rigor and transparency.  
  
  
  
**Problem Statement**

Despite clear statutory direction and the availability of technical tools such as the Hawaiʻi Cesspool Prioritization Tool (HCPT), significant barriers remain in planning and implementing cesspool conversion. These barriers relate to the availability of infrastructure data, the fragmentation of planning processes across multiple agencies and jurisdictions, and the absence of a standardized geospatial framework to guide statewide decisions. Without addressing these gaps, progress toward the 2050 mandate will be slowed, and resources may be applied inefficiently.

**Lack of Centralized, Publicly Accessible Wastewater Infrastructure Data**At present, wastewater infrastructure data in Hawaiʻi is dispersed, inconsistently formatted, and in many cases not readily accessible to policymakers or the public. Information about sewer service areas, expansion plans, treatment plant capacities, and private wastewater systems is often siloed within individual county departments, engineering consultants, or internal state agency files. Where data does exist, it is frequently outdated or embedded in capital improvement plans, environmental assessments, or project-specific reports that are not integrated into statewide planning systems.

The result is that policymakers, community groups, and homeowners cannot easily determine whether centralized wastewater options are available or likely to be extended in their communities. This lack of transparency undermines informed decision-making and slows progress toward cesspool replacement. In the absence of comprehensive data, households may invest in expensive onsite disposal systems in areas where sewer expansion is imminent, while counties may miss opportunities to coordinate investments in high-need areas.

**Fragmentation Across Planning Processes and Stakeholders**Wastewater planning in Hawaiʻi is conducted through multiple channels that are not consistently aligned. County capital improvement programs, Department of Health records, community development plans, and private infrastructure initiatives each follow their own processes, timelines, and reporting formats. There is limited coordination across these efforts, which means that statewide priorities identified through the Legislature or the HCPT are not always reflected in county or departmental planning efforts and documentation.

This fragmentation has several practical effects. Homeowners are left uncertain about the long-term infrastructure prospects in their neighborhoods, creating the risk of redundant private investments. Counties may under-prioritize high-need areas simply because information about cesspool density, environmental impact, or community vulnerability is not systematically integrated with their project planning. Communities, in turn, struggle to advocate for infrastructure improvements without reliable, publicly accessible data. The absence of a unified planning framework weakens the state’s ability to meet the 2050 deadline efficiently and equitably.

**Need for a Spatially Explicit and Standardized Overlay Tool**Decisions about cesspool replacement and wastewater infrastructure are inherently geographic. Many factors such as terrain, parcel size, proximity to existing sewer lines, and treatment plant capacity all determine whether centralized service is technically and financially feasible. Without a standardized geospatial framework, it is difficult to evaluate these factors consistently across counties or to compare potential projects on a statewide basis.

The HCPT has already demonstrated the value of statewide geospatial analysis for prioritizing cesspool conversion based on health and environmental risk. Although each cesspool was evaluated individually and then aggregated to census tracts, block groups, and blocks, the tool underscored that decision-making cannot stop at the parcel scale. It revealed the need for standardized methods to assess, in a spatially explicit way, where collective solutions such as sewer expansion may be viable compared to individual on-site upgrades. Meeting this need requires a framework that overlays health and environmental risk with consistent data on infrastructure feasibility. By integrating information on existing sewer systems, planned expansions, and technical, environmental, and regulatory constraints, such a tool would enable policymakers, counties, and communities to identify where centralized wastewater solutions are most viable across short-, medium-, and long-term planning horizons.

The 2024 Spatial Resolution Addendum was developed to meet this need. It establishes essential standards to ensure that outputs are communicated clearly and applied consistently across agencies and counties. By requiring explicit citation of spatial resolution, version control, and data vintage, the Addendum reduces ambiguity and strengthens reproducibility. Applying these standards to infrastructure feasibility mapping allows the Legislature and counties to align decisions with statutory mandates, avoid duplication of effort, and maintain transparency.

**Summary**

Hawaiʻi has made important progress through the development of the Hawaiʻi Cesspool Prioritization Tool (HCPT), which provides a statewide geospatial framework for evaluating cesspool impacts on health and the environment. Yet the state still lacks a centralized, accessible system for wastewater infrastructure planning; existing processes remain fragmented; and no standardized framework yet integrates cesspool priorities with spatial data on sewer system capacity, planned expansions, and local constraints. Addressing these gaps is critical for guiding investment, preventing wasteful expenditures, and ensuring that statewide cesspool replacement efforts are coordinated, equitable, and effective. This project strengthens the HCPT by improving the accuracy and availability of its underlying data and by adding an essential, legislatively mandated dimension that links cesspool priorities with infrastructure feasibility. In doing so, it reinforces the HCPT’s role as a central planning resource, consistent with the directives of Act 217 (2024) and the technical standards established in the HCPT Spatial Resolution Addendum.  
  
  
**Project Objectives**

The primary objective of this project is to develop a comprehensive geospatial framework that identifies where centralized wastewater infrastructure represents a viable solution for cesspool conversion across Hawaiʻi. This framework directly supports implementation of Acts 125 and 217 by providing spatially explicit guidance on infrastructure feasibility at the statewide scale.

**Specific objectives include:**

1. **Development of a GIS-based overlay system** that categorizes areas according to their suitability for sewer expansion. The system identifies areas where sewer infrastructure is currently available, where expansion is planned or feasible, where expansion may be technically possible but faces significant constraints, and where centralized solutions are unlikely due to prohibitive costs or physical limitations.
2. **Integration with existing HCPT priority zones** to enable coordinated decision-making. By overlaying infrastructure feasibility with cesspool hazard rankings, the tool allows planners to identify high-priority areas where centralized solutions offer the greatest benefit. This integration ensures that infrastructure investments align with environmental and public health priorities established through the HCPT.
3. **Incorporation of community-identified needs** through stakeholder engagement. The project seeks to capture local knowledge about infrastructure challenges and opportunities that may not be reflected in formal planning documents. This includes areas where communities have expressed interest in centralized service but where formal feasibility studies have not yet been conducted.
4. **Identification of data gaps and coordination needs** across counties and agencies. The project documents where critical information is missing, where planning processes are misaligned, and where improved coordination could accelerate progress toward the 2050 mandate.

## **Methods**

### **Data Collection and Processing Data Collection and Compilation**

The project began with a comprehensive literature review encompassing all available planning documents related to wastewater infrastructure in Hawaiʻi. Sources reviewed included County Capital Improvement Programs for fiscal years 2020-2025, wastewater facility plans and master plans from each county, environmental assessments and impact statements for proposed projects, contractor reports and engineering studies, and private utility service area maps where available. Each document was cataloged according to geographic coverage, data currency, and relevance to cesspool conversion planning  
  
The relevant information from these documents was then incorporated into the geospatial database for analysis. While some data were already in usable formats, the majority required digitization, standardization, and interpretation before integration into the project’s GIS framework. These processed datasets provided the foundation for linking infrastructure planning information with environmental and hazard-based risk factors in the subsequent analysis.

### **Stakeholder Engagement and Coordination**

Direct engagement with county wastewater departments provided critical insight into current and planned infrastructure projects. Structured interviews were conducted with engineering and planning staff from the Counties of Kauaʻi, Honolulu, Maui, and Hawaiʻi. These interviews focused on identifying projects in various stages of development, understanding technical and financial constraints to expansion, and documenting areas where cesspool density creates opportunities for centralized solutions.

Additional coordination occurred with private wastewater system operators, consulting engineers involved in infrastructure planning, Department of Health Wastewater Branch staff, and community organizations advocating for infrastructure improvements. These engagements helped identify projects not yet reflected in formal planning documents and areas where community interest in centralized service is high.

### **GIS Mapping and Spatial Analysis**

All collected data was integrated into a unified GIS framework using ArcGIS Pro. Existing sewer service areas were incorporated from county maps and verified against parcel-level connection records where available. Planned expansion areas were mapped based on CIP project boundaries and engineering design documents. Areas of potential feasibility were identified through spatial analysis considering a variety of factors such as cesspool density, proximity to existing infrastructure,

Future efforts will include a finer level of suitability analysis including topographic constraints, site-level parcel characteristics, and regulatory overlays such as special management areas (SMA).

### **Validation**

Data accuracy verification was conducted through systematic consultation with both private sector entities and public agencies following the identification of significant discrepancies in multiple datasets. These discrepancies included documented errors in cesspool location data, incorrect or outdated service area boundaries for private wastewater treatment companies, and inconsistencies between county databases and the Hawai‘i Department of Health (DOH) Individual Wastewater System (IWD) database.

The validation process involved cross-referencing multiple data sources to confirm parcel-level onsite wastewater system status. This comprehensive approach included obtaining municipal sewer billing records and cross-referencing these with onsite sewage wastewater (OSW) system designations, analyzing proximity relationships to existing sewer laterals, and actively soliciting local knowledge from the public and key stakeholders familiar with specific geographic areas and system conditions.

In the next phase of data validation, recent permitting data from DOH databases will be incorporated to account for newly permitted systems installed before the 2017 statewide cesspool ban and to remove systems that had been converted to septic tanks or other treatment technologies.   
  
Despite these quality assurance measures, the authors acknowledge that significant inconsistencies remain in the statewide cesspool database and recommend continued refinement efforts.

## **Summary of Literature and Data Sources**

The literature review encompassed over 150 documents from federal, state, county, and private sources. Table 1 summarizes the primary sources reviewed by jurisdiction and data type.

For the County of Hawaiʻi, key sources included the 2021 Integrated Water Resources Management Plan, the Kealakehe Wastewater Treatment Plant R-1 Improvements Environmental Assessment, and the North Kona Sewer Feasibility Study. These documents provided comprehensive coverage of the Kona region but revealed significant data gaps for the Hilo and Puna districts.

The City and County of Honolulu provided the most comprehensive data, including the 2019 Wastewater System Facility Plan, detailed GIS layers of existing infrastructure, and project-specific planning documents for 23 active CIP projects. However, data for rural Oʻahu communities remains limited, particularly for the North Shore and Waiʻanae Coast.

Maui County sources included the Central Maui Wastewater Reclamation Facility plans and the Lahaina Wastewater Reclamation Facility upgrade documents. Coverage for Upcountry Maui and Molokaʻi was notably sparse, with most available data being over five years old.

Kauaʻi County provided the 2020 Wastewater Management Plan and project documentation for expansions in Līhuʻe and Wailua. Data availability for the North Shore and West Side communities was limited to conceptual planning studies.

Private wastewater systems were documented through operator interviews and Department of Health records. Forty-seven private systems were identified statewide, though comprehensive service area maps were available for only twelve systems.

## **Iterative Development Process Meetings With State and Local Stakeholders**

Data collection

Literature review

Process of converting literature review information to geospatial data

Meetings with counties to review independent findings and obtain more data

February 26, 2025 - Meeting with Kauai County

Team went to Kauai County to present literature review and initial data findings. Kauai County Wastewater officials provided overview on feasibility of centralized sewer expansion for the island (attach map that was produced from that meeting?). Also took tour of WW plant (not sure if relevant or necessary).

May 15, 2025 - Meeting with C&C of Honolulu

Team went to Honolulu County to present literature review and initial data findings. C&C Honolulu ENV officials provided feedback and information on CIP projects and timelines

May 16, 2025 - Meeting with Maui County

Team went to Maui County to present literature review and initial data findings. Maui wastewater officials asked questions about scope of project and referred us to work with Carollo

May 19, 2025 - Meeting with Hawai‘i County to present literature review and initial data findings. Requested data

Meetings with Carollo Engineers

Determine feasibility based on density analysis and proximity to existing WW service area

The tool development process followed an iterative approach with multiple rounds of stakeholder feedback and refinement. The initial framework was developed in January 2024 based on preliminary data compilation and HCPT integration requirements. This draft categorization scheme was presented to county engineers and planners in February 2024, resulting in significant refinements to the feasibility criteria and mapping methodology.

A second iteration incorporated feedback from the first round of stakeholder meetings and additional data provided by county partners. This version, completed in April 2024, expanded the categorization scheme to better capture areas of uncertain feasibility and added explicit consideration of private system expansion potential.

The third iteration, developed through summer 2024, incorporated community input gathered through public meetings on each island. These sessions revealed numerous areas where community interest in centralized service was high but where formal planning had not yet occurred. The feedback also highlighted the importance of clearly communicating why certain areas were deemed infeasible for sewer expansion.

Throughout the development process, regular coordination meetings were held with the Department of Health to ensure alignment with cesspool conversion program requirements and to integrate lessons learned from grant program implementation. These meetings resulted in adjustments to the spatial resolution of the mapping products and the addition of data fields to support grant eligibility determinations.

## **Preliminary Results and Insights**

Analysis of the factors described above resulted in development of a categorization scheme developed for the GIS overlay that includes five primary classifications:

1. **Areas currently served by sewer infrastructure**
2. **Areas with funded expansion projects underway**
3. **Areas identified in planning documents for future expansion**
4. **Areas with technical potential for centralized service but no current plans,**
5. **Areas where centralized service is deemed infeasible.**

The compiled data and maps reveal significant opportunities for centralized wastewater solutions to address cesspool conversion requirements. Approximately [37-verify] county-led sewer expansion projects are currently in various stages of planning and implementation statewide (classifications 1, 2 and 3). These projects, if completed as planned, would provide sewer access to an estimated [4,800-verify] parcels currently served by cesspools.

Furthermore, the spatial analysis identified [124-verify] distinct clusters of cesspools that represent prime candidates for future public sewer expansion (category 4). These clusters meet criteria including proximity to existing infrastructure (within 1,000 feet of existing sewer lines), sufficient density (minimum of 50 cesspools within a quarter-mile radius), favorable topography (slopes less than 15%), and location within designated growth boundaries. An additional 22 clusters show moderate potential, meeting some but not all criteria.

Additionally, [34-Verify] clusters were identified as prime candidates for private wastewater system expansion, based on their proximity to existing private systems, appropriate scale for package plant solutions (50-200 units), and distance from planned public infrastructure. Fourteen additional clusters show moderate potential for private system development.

**By The Numbers**  
  
Combined, the existing projects and identified expansion opportunities represent approximately [12,500-verify] cesspools, or roughly [14%-vderify] of the statewide total. While this percentage may appear modest, concentrated infrastructure solutions offer the most cost-effective approach for cesspool conversion where feasible. The analysis also reveals that approximately 65% of Priority Level 1 cesspools identified by the HCPT are located in areas with some potential for centralized service.

Regional variations in infrastructure potential are pronounced. Oʻahu shows the highest potential for sewer expansion, with [42%-verify] of cesspools located in areas deemed feasible for centralized service. Hawaiʻi Island shows moderate potential at [18%-verify] concentrated primarily in the Kona and Hilo urban cores. Maui County and Kauaʻi show lower potential at [12%-verify] and [9%-verify] respectively, reflecting their more dispersed development patterns.

## **Policy and Planning Implications**

The findings of this assessment have significant implications for cesspool conversion policy and planning at both state and county levels. The identification of specific areas where centralized solutions are feasible provides a foundation for strategic investment and coordinated action among agencies.

**Implications for State and Counties**  
  
For state-level planning, the results suggest that targeted investment in sewer infrastructure expansion could address a substantial portion of the cesspool conversion mandate efficiently. The Legislature may wish to consider dedicated funding mechanisms for infrastructure expansion support at the county level, focused in high-priority areas where technical feasibility has been demonstrated. The alignment between HCPT priority zones and infrastructure opportunities provides a clear framework for prioritizing such investments.

At the county level, the findings can inform Capital Improvement Program priorities and support applications for federal infrastructure funding. Importantly, the identification and quantification of cesspool clusters near existing infrastructure provides counties with specific targets for expansion planning. The data also supports more accurate cost estimating for cesspool conversion, as centralized solutions typically offer economies of scale compared to individual onsite system upgrades.

The results also highlight the need for enhanced coordination between state and county agencies. Many identified expansion opportunities cross jurisdictional boundaries or require coordination between multiple departments. Establishing formal coordination mechanisms could accelerate project development and reduce redundant planning efforts.

**Implications for Homeowners and Private Service Providers**

For communities and homeowners, the findings provide critical information for making informed decisions about cesspool conversion. Homeowners in areas identified as feasible for sewer expansion may choose to delay expensive onsite system upgrades in anticipation of future sewer availability. Conversely, those in areas deemed infeasible can proceed with onsite solutions with confidence that their investments will not be rendered obsolete.

The identification of private cluster system expansion opportunities opens new pathways for cesspool conversion that do not rely solely on public infrastructure. The state may wish to consider regulatory frameworks and funding mechanisms to encourage private system development in appropriate areas. This could include streamlined permitting processes, technical assistance programs, and financial incentives for private system operators willing to expand service areas.

## **Next Steps and Recommendations**

### **Remaining Data Gaps**

Despite comprehensive data collection efforts, significant information gaps remain that limit the accuracy of feasibility assessments in certain areas. Priority data needs include updated infrastructure mapping for rural communities, comprehensive inventory of private system locations and capacities, detailed topographic analysis in areas of moderate feasibility, and current cesspool location verification in rapidly developing areas.

The state should consider funding a comprehensive statewide infrastructure assessment to address these gaps. Such an assessment would provide the detailed technical data needed for accurate feasibility determination and cost estimation. Priority should be given to areas with high concentrations of Priority Level 1 cesspools where infrastructure feasibility remains uncertain.

**Plan for Updates**

The dynamic nature of infrastructure planning and development necessitates regular updates to maintain the tool's relevance and analytical accuracy. We recommend establishing a structured annual update cycle that aligns with county Capital Improvement Program (CIP) development schedules and state budget planning processes. This coordination would ensure that emerging infrastructure projects are captured as they enter the planning pipeline and that completed projects are accurately reflected in the feasibility mapping and prioritization algorithms.

The update process should incorporate multiple data streams and stakeholder engagement mechanisms. This includes maintaining formal consultation meetings with county planning departments and private wastewater system operators to capture planned infrastructure investments, integrating new project information derived from environmental impact assessments and permit applications, and conducting detailed, site-level evaluations of both established and innovative onsite wastewater treatment technologies as they become available for deployment in Hawai‘i's unique environmental conditions.

Sustaining this ongoing maintenance effort will require dedicated resource allocation and institutional support. We recommend, at a minimum, maintaining ongoing partnerships with university research centers to provide technical expertise and analytical capacity, and exploring the feasibility of establishing a dedicated wastewater technology evaluation center to assess emerging treatment options for island environments.

Regular updates will ensure that the prioritization tool remains responsive to changing infrastructure conditions, technological advances, and evolving regulatory requirements, thereby maintaining its utility as a decision-support instrument for policymakers, resource managers, and our island communities throughout the cesspool conversion timeline to 2050.

### **[Proposed Governance Structure]**

[Successful long-term management of the tool requires clear governance structure and designated responsibilities. We recommend establishing an Infrastructure Feasibility Oversight Committee with representation from the Department of Health Wastewater Branch, each county wastewater department, the Cesspool Conversion Working Group, and technical advisors from the University of Hawaiʻi.

The Committee would be responsible for overseeing annual updates, reviewing and approving methodology changes, facilitating data sharing among agencies, and ensuring consistency with related planning efforts. The Department of Health should serve as the primary custodian of the tool, with responsibility for maintaining the web platform, managing user access, and providing technical support to users.

Formal data sharing agreements should be established between state and county agencies to ensure timely access to planning information. These agreements should specify data formats, update schedules, and confidentiality provisions for sensitive infrastructure information.]

### **Integration with Existing Programs**

The infrastructure feasibility tool should be formally integrated with existing cesspool conversion programs to maximize its utility. This includes incorporation into grant program eligibility criteria, alignment with the Cesspool Conversion Working Group's prioritization framework, and integration with county planning processes.

Training should be provided to agency staff, consultants, and community organizations on how to effectively use the tool for planning and decision-making. User guides and technical documentation should be developed for different audience levels, from homeowners to engineering professionals.

The tool's outputs should be incorporated into public communication efforts about cesspool conversion, helping homeowners understand their options and make informed decisions. This could include integration with existing websites, development of area-specific fact sheets, and incorporation into community meeting presentations  
  
**Appendices**

Critique to be incorporated

### **1. Accuracy**

* **Legislative context**: The draft correctly references Acts 125 (2017), 132 (2018), 135 (2022), and 217 (2024) in framing the policy mandates. This is consistent with legislative records and with the 2022 HCPT report.
* **HCPT foundations**: The draft aligns with the 2022 HCPT methodology (15 risk factors, hazard-based geospatial model, census tract aggregation, validation against Act 132 study). References to overlay and addendum work are consistent with the trajectory of current DOH and CCWG priorities.
* **Scientific framing**: The environmental and health impacts described for cesspools are accurate and consistent with Fletcher’s synthesis of sewage treatment and pollution risks in Hawai‘i and with Mezzacapo’s broader review .
* **Historical framing**: Where the draft draws on cesspool/sewer history, it is broadly consistent with Tarr’s retrospective. However, some historic references (privy vaults, cesspool-privy systems, etc.) may be too detailed for a legislative report unless tied explicitly to lessons learned.

**Potential inaccuracies/gaps**:

* Sewer and centralized treatment planning by counties (as required under Act 135 and Act 217) is mentioned only lightly - this may need clarification since counties are expected to integrate HCPT data into feasibility planning.
* The draft occasionally implies that the HCPT results alone determine conversion priorities. In fact, DOH guidance treats HCPT as a **screening tool** rather than a prescriptive decision framework. That nuance should be kept clear for legislative audiences.

### **2. Thoroughness**

* **Strengths**: The draft is comprehensive in explaining the HCPT, its methodology, and how the Overlay/Spatial Resolution Addendum builds on it. It includes risk factors, spatial frameworks, and context of regulatory mandates. It also makes a reasonable effort to describe connections between cesspool pollution, groundwater, coastal ecosystems, and human health.
* **Gaps**:  
  + **Equity/social impacts**: While HCPT integrates census data, the draft does not fully emphasize equity concerns (e.g., financial burdens, rural vs. urban capacity) which are central in legislative discussions. The 2022 HCPT report and CCWG minutes highlight this.
  + **County integration**: Counties’ responsibilities under Act 135 (2022) to plan for sewer expansion and cost feasibility are important, but underdeveloped in the draft.
  + **Regulatory crosswalk**: The draft mentions HAR 11-62 but does not systematically map which sections (e.g., setback distances, groundwater separation, ATU requirements) are implicated. Legislators will want clarity on how current regulation interacts with prioritization.
  + **Next steps and limitations**: While the draft acknowledges the work is ongoing, it could better highlight limitations (data quality, inventory errors, exclusion of other pollution sources) and the phased nature of implementation. The HCPT team has consistently flagged these caveats.

### **3. Structure**

* **Positive**: The draft follows a logical structure (legislative context → HCPT foundations → overlay/addendum purpose → findings). It reads as a policy-technical report, which is appropriate for legislative briefing. The layering of prior reports, current tools, and forthcoming products is clear.
* **Issues**:  
  + **Density and length**: At times, it leans toward academic detail rather than policy-focused synthesis. For the Legislature, a tighter executive framing (problem, mandate, HCPT role, what’s next) would be helpful up front, with technical detail pushed to appendices.
  + **Tables/figures**: References to supporting visuals (maps, priority overlays, risk-factor lists) are present but not consistently placed or labeled. The legislative audience benefits from simple, clear tables (e.g., “Act, Mandate, Tool/Product, Status”) and statewide maps in full color.
  + **Voice**: Some sections still read as if for an academic journal (long background on wastewater history). For Legislature, clarity and brevity with policy implications emphasized would improve alignment with audience.

### **Overall Assessment**

Your draft is **accurate and well-grounded** in both the legislative framework and the HCPT technical basis. It is **thorough in technical description**, but underdeveloped in **equity, county planning, and regulatory crosswalks**. Structurally, it provides the necessary background but could be streamlined for legislative readers, with sharper focus on mandates, actionable findings, and policy implications.