MICHAEL P. VICTORINO
Mayor

JEFFREY T. PEARSON, P.E.
Director

HELENE KAU
Deputy Director

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DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAI'I 96793
www.mauiwater.org

September 10, 2020

Honorable Michael P. Victorino
Mayor, County of Maui
200 South High Street
Wailuku, Hawaii 96793

APPROVED FOR TRANSMITTAL

Michael P Victorino 9/12/20
Mayor Date

For Transmittal to:

Honorable Keani Rawlins-Fernandez
Chair, Economic Development and Budget Committee
Maui County Council
200 South High Street
Wailuku, Hawaii 96793

Dear Chair Rawlins-Fernandez:

SUBJECT: AMENDING FISCAL YEAR 2021 BUDGET: DEPARTMENT OF WATER SUPPLY (STATE OF HAWAII, KANAHA BEACH PARK GREYWATER REUSE DEMONSTRATION PROJECT) (EDB-100)

In response to your letter dated September 9, 2020 please find attached the "Graywater Reuse System for Kanahā Beach Park Conceptual Plan and Analysis" prepared by the Department of Water Supply. The analysis continues to evolve as project plans are refined.

We hope you find this information useful. Should you have any questions, please contact me at Ext. 7816.

Sincerely,

Jeffrey T. Pearson

JEFFREY T. PEARSON, P.E.
Director

"By Water All Things Find Life"

8914

Graywater Reuse System for Kanahā Beach Park Conceptual Plan and Analysis

Revision September 2020

Project

Graywater system to capture and reuse water from public showers and sinks
DWS Water Resources & Planning Division
Maui County Parks & Recreation Department

Robert De Robles, Planner VI

Jeffrey T. Pearson, P.E.,
Director of Water Supply

Contents

Executive Summary

The Department of Water Supply (DWS) Water Resources and Planning Division (WRP) has looked into the viability of recycling graywater at Maui County public parks. Public parks are truly valued for promoting better health by providing environmental benefits. Economically, they are proven to positively impact the neighborhood livability and land value if they are properly designed. These reasons alone truly make parks an indispensable space in our urban community and serve as a catalyst for public interests and community needs. People can go to parks and take pride in what was provided for recreation and enjoyment, especially when they are beautiful and safe. However, parks have their operating needs—Potable water, for example, is needed for its restrooms and showers. With so much used potable water going straight down the drain, it makes sense to reclaim and repurpose it for other useful consumptive purposes like landscape irrigation which accounts for a very large percentage of a park's water demands. Depending on a number of tangible factors related to a park's water system design, 30 to 50% of used water may be reused to save money and promote water conservation.

Kanahā Beach Park (KBP) in Central Maui is one of the largest parks on the island with a 40 acre broad white sand beach and broad public activity provisions. It is less than one and a half miles from Downtown Kahului and adjoining neighborhoods. It is frequented by recreational users such as surfers, windsurfers and kite boarders. It is also an important nexus for tourists and local families to enjoy the sun, picnic, relax, play sports and enjoy themselves in designated recreational and swimming areas. With so many visitors over an expansive irrigated area, the potable water consumption needs at KBP is very high. All of KBP's water needs are provided by a DWS potable water line, which feeds its eight (8) outdoor multiple-head showers, eight (8) bathroom faucets, several unregulated hose bibs and an irrigation system to irrigate an expansive grassy landscape.

As potable water consumption continues to rise, WRP proposes the installation of a graywater reuse system with high efficiency (HE) fixtures at KBP. However, in order to achieve and maintain water savings through a graywater system, a redesign of the comfort stations, showers, irrigation system, and landscaping may also be required to function harmoniously together to conserve water. Instead of used graywater from showers and sinks going to waste, it can be collected, treated, and redistributed for a useful, conservative, purpose—landscape irrigation and toilet flushing. Landscape irrigation compared to other water use in the park is the most demanding operation at KBP even though it does not need to be fed by potable drinking water. Likewise, flush toilets can also be fed with graywater instead of costly potable water. A Graywater reuse system can effectively reduce irrigation costs by reintroducing safe, progressively filtered, non-potable water for non-potable applications.

By replacing older showers and bathroom faucets with newer HE showers, stemming unregulated hose bibs, and reconfiguring the irrigation system, WRP has estimated that the daily water consumption at KBP can be reduced dramatically. For example, based on conservative calculations using the duration of a normal operating day, daily consumption comes to about 98,775 gallons per day of approximately 3 million gallons per month for eight (8) showers and eight (8) sinks and irrigation. This amount can still be refined with meter profiling, but will likely result in a 41.1% reduction, or 14.399 million gallons, when 30-40% of the total consumption are from fixtures, which currently translates to about 58,944 gallons per day of the total 35.024 million gallons consumed each year. Reusing water for flush toilets and landscape irrigation will only reduce potable consumption even further, which will certainly help offset future increases in potable water demand, especially if KBP is not slated to be connected to a recycled R-1 water line in the near future. In the event that connecting KBP to R1 becomes an option, the likely cost today to deliver recycled water from the Wailuku/Kahului Waste Water Treatment Facility at a distance of around 1.5 miles will likely top $1.5M if calculated at about $200 per foot of piping.

This Conceptual Plan and Analysis is intended to be used as a review document to understand what a graywater system is and to outline the intended planning, designing, permitting, and engineering requirements for a graywater system for KBP. The project will be a multi-departmental and organizational effort whereby DWS intends to request public and other stakeholder input through public and private media channels to consider before the project is moved from the conceptual phase to a contracted design phase. Some of the other important benefits from this graywater project that may be shared to stakeholders includes:

1. Decreased runoff to beaches
2. Potential initiatives to meet EPA WaterSense, Leadership in Energy and Environmental Design (LEED) or Living Building Challenge criteria
3. Reduced energy use and greenhouse gas production from water treatment plants
4. Enhanced county drought resistance
5. Resilient designing to withstand climate change and sea level rise
6. Improved aesthetics and cultural sensitivity
7. The restoration and rehabilitation of KBP to reduce degradation

Water conservation should be a concerted effort between different county departments with input from local and environmental organizations to be truly successful. The County of Maui Department of Parks and Recreation (DPR) has expressed a strong desire to implement a graywater system for KBP. Together with WRP, it is one of the only viable ways to quickly reduce long-term potable water demand. In conjunction with DPR's 2018 KBP Master Plan, under Key Action 4, to upgrade infrastructure and facilities, a new graywater system also helps to greatly reduce potable water demand and erosion with the installation of "soft" infrastructure such as bioretention swales (bioswales) and native plant landscaping to promote a more sustainable, resilient park. In this regard, WRP will work with stakeholders to develop the right design, processes and policies to raise public awareness and education about this project that will be able to sustain itself in the face of climate change if necessary. Likewise, project planning includes training on system upkeep, data recording, and reporting requirements for DPR staff.

Statement of Problem

Recreational parks are vital to County of Maui communities and the visitors that help drive its economy. To keep them running millions of gallons of potable water is required for normal operation, maintenance and public use. This translates to additional potable water production and tens of thousands of dollars in water bills every month. Since used water essentially goes down the drain as sewage, the added benefit or reuse is lost. DWS produces and delivers water to meet demand regardless of where consumption occurs, but as demand continues to rise, so does water production costs to treat surface and ground water to potable water standards. Parks like KBP requires a very large amount of potable drinking water for landscape irrigation, comfort stations and showers. Conservative estimates based on billing information show an average potable water demand in excess of 35 million gallons per year, at a cost of approximately $500,000.00.

A graywater reuse system connected to efficient fixtures is one solution to address excessive potable water use. The right design can reduce water consumption by more than 30% to 40% alone. However, there are other reasons to make improvements. As examples, toilets only need recycled water for flushing and irrigated landscapes do not need potable water to survive. A modern graywater filtration system can remove harmful contaminants from graywater for landscaping and toilet flushing, which will further reduce demand. Also, by identifying low and higher elevation hydrozones and identifying flood prone areas for bioswales, it may be feasible to water large areas of the park with filtered graywater while reducing erosion issues. With the right type of native vegetation planted in bioswales and xeriscaped hydrozones, the landscaping at KBP can flourish at a much lower monthly water cost and save millions of gallons of potable water production for DWS. Such improvements will actually increase the parks natural resilience, reduce urban heat island effect, and reduce the impact of pollutants into the ocean by helping to reduce excess run-off.

The main objectives of a graywater system project include:

- Objective 1: Reduce outdoor potable water consumption at KBP through a graywater irrigation system
- Objective 2: Design and install a graywater system that is fitting to the park's specific needs, Master Plan, local and cultural needs, and meets all county and state legal requirements
- Objective 3: Help defer new DWS water source development
- Objective 4: Reduce DWS and the DPR operating costs, including energy, treatment and infrastructure maintenance costs
- Objective 5: Promote and encourage customers to learn more about water conservation and graywater reuse in a native Hawaiian plant environment
- Objective 6: Increase coastal preservation and resilience against human activity and flooding by capturing water run-off that promotes land erosion
- Objective 7: Utilize results of the pilot to help transition other parks and public spaces in the County of Maui towards graywater reuse for greater community and infrastructure resilience
- Objective 8: Design resilient and sustainable public water infrastructure and landscaping for hazard mitigation against climate change and sea level rise

Operations and Maintenance (O&M) Considerations

DPR expressed concerns over the long-term O&M of a graywater and irrigation system, and the proposed landscape architecture improvements. To address these concerns, WRP conducted a number of pre-consultations with various prospective consultants to determine the long-term upkeep, usefulness and functionality of the graywater system to assure that the DPR will not be burdened with a larger expense than what is currently being paid for normal KBP O&M.

The benefits to KBP has been addressed under the main objectives of the graywater system. However, WRP will also require the final approved design to be robust, low-maintenance, economical, and effective enough to reach the stated savings over its payback period. Assuming that about 40% of graywater can be recaptured, potable water savings from an average of $30,000 to $40,000 per month for peripheral landscape irrigation would equal about $12,000 to $16,000 per month in potable water savings, respectively. Preliminary discussions with graywater system builders have pegged monthly O&M costs to be at about $800 to $1000 per month. This includes filter change-outs and electricity costs, but does not take into account current routine landscaping costs, depreciation costs or equipment replacement.

To further conserve water use, xeriscaping with native plants in mulched bioswales is expected to help retain moisture, prevent soil degradation, and reduce erosion. Furthermore, efficient landscape and irrigation improvements, will be able to achieve the same results at a lower cost. Therefore, savings from physically reducing consumption and returning reuse water for irrigation will also reduce irrigation demand. The current conceptual system design is slated for 40,000 gallons/day – water that will be reused for irrigation and toilet flushing instead of being retained in the septic system.

Initial Site Survey

WRP has conducted initial investigations into the viability of a graywater system for KBP. The following outlines what has been discovered by WRP so far:

- Two separate restrooms on site
- Up to nine (9) satellite showers with flow rates of 7 to 12 gallons per minute (gpm)
- Up to seven (7) unrestricted water faucets/hose bibs with flow rates of 7-12 gpm
- All bathroom faucets are high flow (<2.2 gpm)
- Requires dual piping bypass to water filtration and return valve to sewer
- Large grass fields (turf) irrigated with targeted water spray heads
- Flood prone area (graywater filtration system and clear water storage tanks need to be elevated due to possible buoyancy forces)
- 100% potable water consumption
- No hydrozones or xeriscaping with native plants
- Highly frequented by the public
- Water bill is high (<$30K mo.)
- Requires deep rooted native plants tolerant to brackish and graywater
- Pressure pumping necessary for size of project
- Optimal system requires photovoltaic (PV) panels
- Limited power grid
- Likely to have several water leaks on main irrigation lines

- The entire park is in a Flood Hazard Area (DFIRM) with velocity hazard and wave action
- The entire park is within a tsunami and dam evacuation zone
- System unlikely to be able to serve expansive grassy turf, but higher elevations, peripheral areas, and bioswales at lower elevations
- Limited to no soft or natural resiliency infrastructure
- Homelessness and vagrancy in the area

Graywater Policy Analysis

There is a waiver for graywater systems in areas that are not serviced by a public owned sewer system. However, graywater use on Maui is still at its infancy with respect to its broader public and private application and acceptance. In addition to public input, policy, program, organizations and planning resources investigated for this project include:

1. Hawaii Plumbing Code
2. Uniform Plumbing Code
3. International Plumbing Code
4. International Green Construction Code
5. Hawaii Revised Statutes Chapter 343 (Environmental Impact Statements)
6. Hawaii Coastal Zone Management Act of 1977
7. Current Planning Coastal Zone Management Program (CZMP)
8. Hawaii Coast Zone Management Program (HICZMP)
9. Beach Management Plan for Maui 2008
10. Hawaii Title 22
11. Hawaii DOH Water Reuse Guidelines
12. Water Environment Research Foundation (WERF): Wastewater as a Renewable Resource
13. The Soap and Detergent Association (SDA): Graywater Awareness & Usage Study
14. The Fresh Water Advisory Council: HI Fresh Water Initiative
15. Hawaii Environmental Policy Act
16. Federal Emergency Management Agency (FEMA) Guidelines and Standards for Flood Risk Analysis and Mapping

Permits and Assessments

1. Management Area (SMA) Assessment
2. Shoreline Setback Area (SSA) Assessment
3. Flood Development Permit (FDP)
4. Archeological Inventory Survey (AIS) (if required)
5. Building, electrical and plumbing permits
6. Hawaii State Department of Health (DOH) Individual Wastewater System (IWS) Application
7. State of Hawaii DOH Water Reuse Permit

The State Building Code Council is currently in the process of adopting a uniform set of statewide building codes. The state building codes includes the 2012 edition of the Uniform Plumbing Code.

The Hawaii State Department of Health (DOH) offers guidelines for the reuse of graywater. These guidelines are in conformance with Chapter 16, Graywater Systems, of the 2012 Uniform Plumbing Code (UPC). In 2007, the Hawaii Legislature enacted Part II of Chapter 107, Hawaii Revised Statutes to establish the State Building

Code. The DOH requires graywater projects to be approved by filling out a Water Reuse Permit and an Individual Wastewater System (IWS) Permit applications with requirements to include engineering diagrams certified by a licensed engineer and relevant information about the project. The DOH does not currently require water quality testing for sub-surface graywater irrigation systems; testing is only needed in the event of surface-level irrigation and sprinkling systems.

As of April 2009, all four counties in the state are waiving the portions of the Uniform Plumbing Code (UPC) to allow the use of washing machine wastewater to be used for subsurface irrigation. These waivers apply only to areas not serviced by a publicly owned sewer system. DOH will be the regulatory agency responsible for the graywater systems located in areas not serviced by publicly owned sewer systems. The Counties will retain regulatory responsibility for the areas serviced by their sewer systems.

Site Information

KBP is adjacent to the Kahului Airport and east of the Kahului Harbor on the north coast of Central Maui. As part of the Kanahā Pond State Wildlife Sanctuary (KPSWS), the North Shore Preservation Corridor (NSPC) and the North Shore Greenway, KBP is very significant to Maui and enjoyed by the general public for its vast range of recreational offerings in and out of the water. It is sewered, but continues to experience more frequent, intense, floods as sea level rises. DWS is working closely with DPR's master plan to design a more resilient, water conserving park.

The site has three (3) designation types as follows: 1. State land use designation of conservation (Limited sub-zone); 2. Wailuku-Kahului Community Plan designation of park; and 3. County zoning designation of airport. It is also located within the Maui Island Plan's urban growth boundary. In total, including lands not being covered by this graywater project (±40 acres), the land area of KBP is about 88.5 acres. The graywater project will be built within the Eastern Planning Area, expanding west into the Central Planning Area as shown in Fig 3 below.

KBP TMK Map

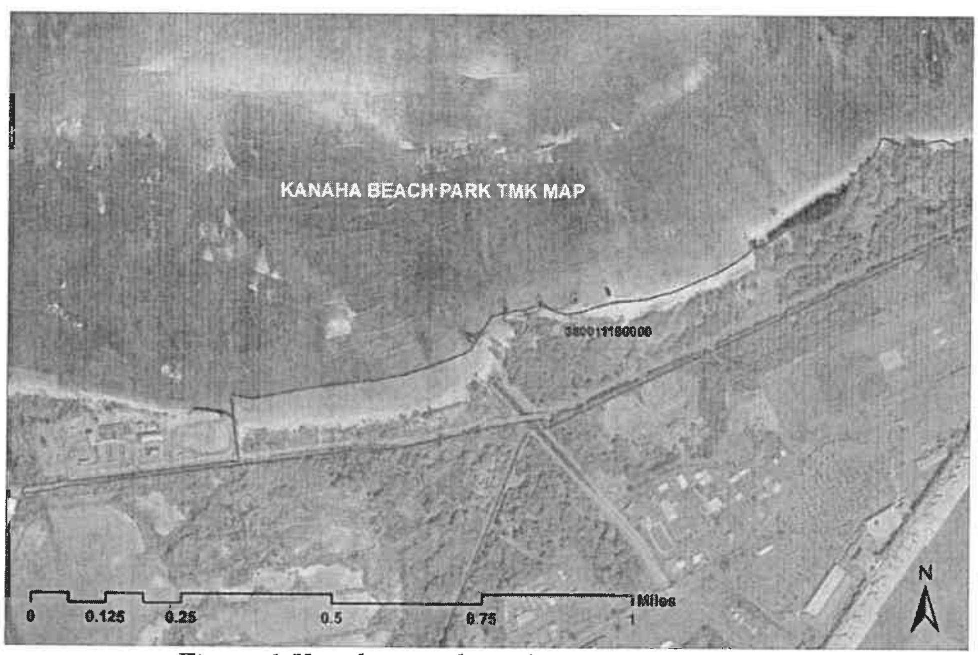


Figure 1 Kanahā Beach Park TMK 38001119 Map

Figure 1 covers the entire park. Figure 2 shows the Eastern and Central Planning Areas of focus for this project.

DPR Planning Areas

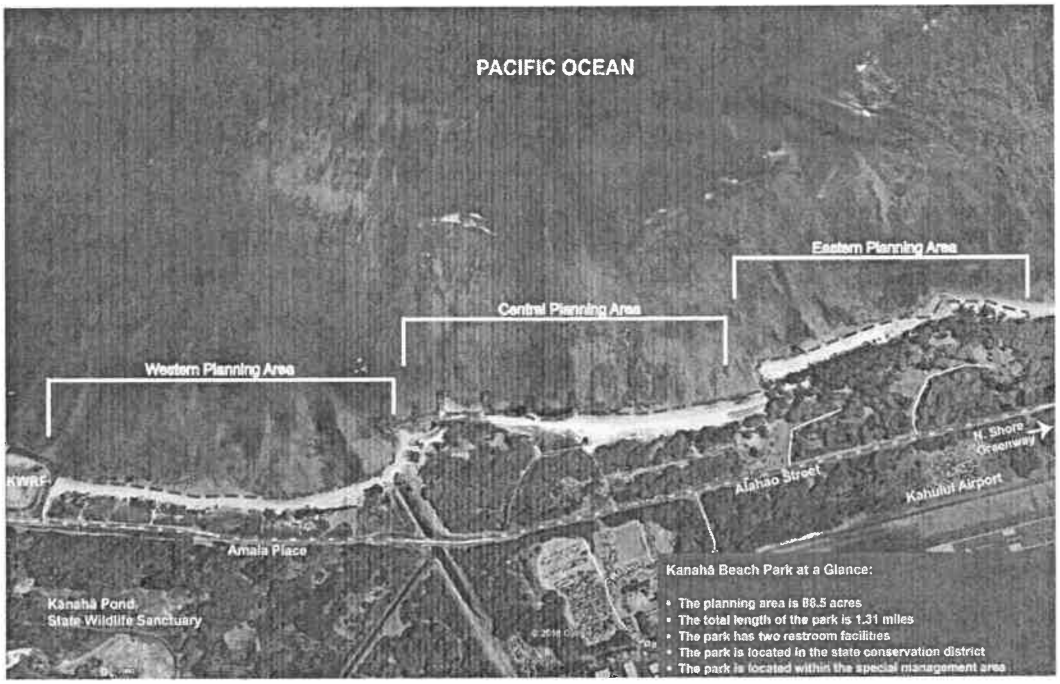


Figure 2 DPR Master Planning Scope of Planning
Source: DPR 2018

DPR Master Planning Map of Site

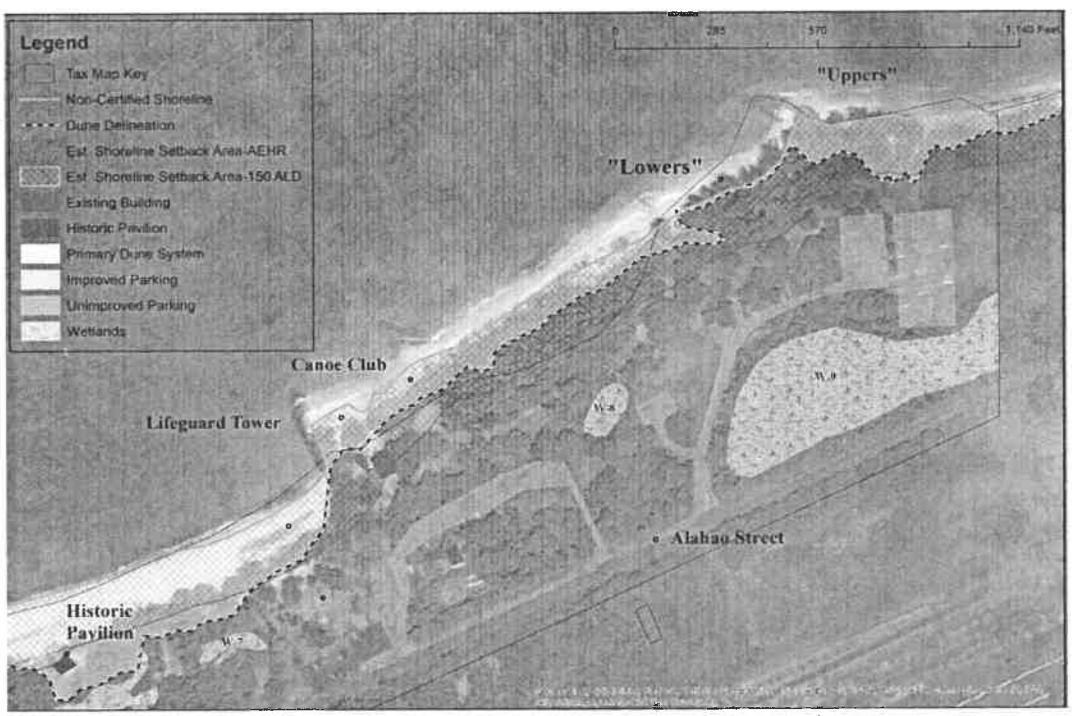


Figure 3 Kanahā Beach Park Eastern and Central Map
Source: DPR 2018

Existing Infrastructure Map

Figure 4 Kanahā Beach Park Comfort Stations (2)

Project Area Boundary Map

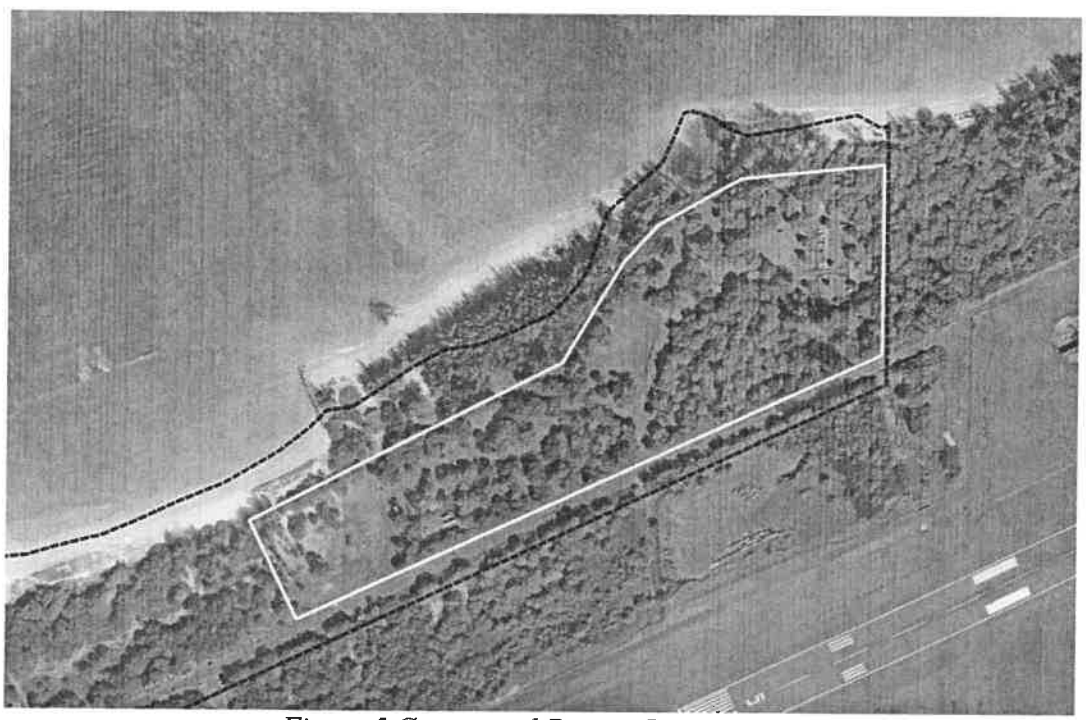


Figure 5 Conceptual Project Irrigation Area

Project Conceptual Siting and Installation Map

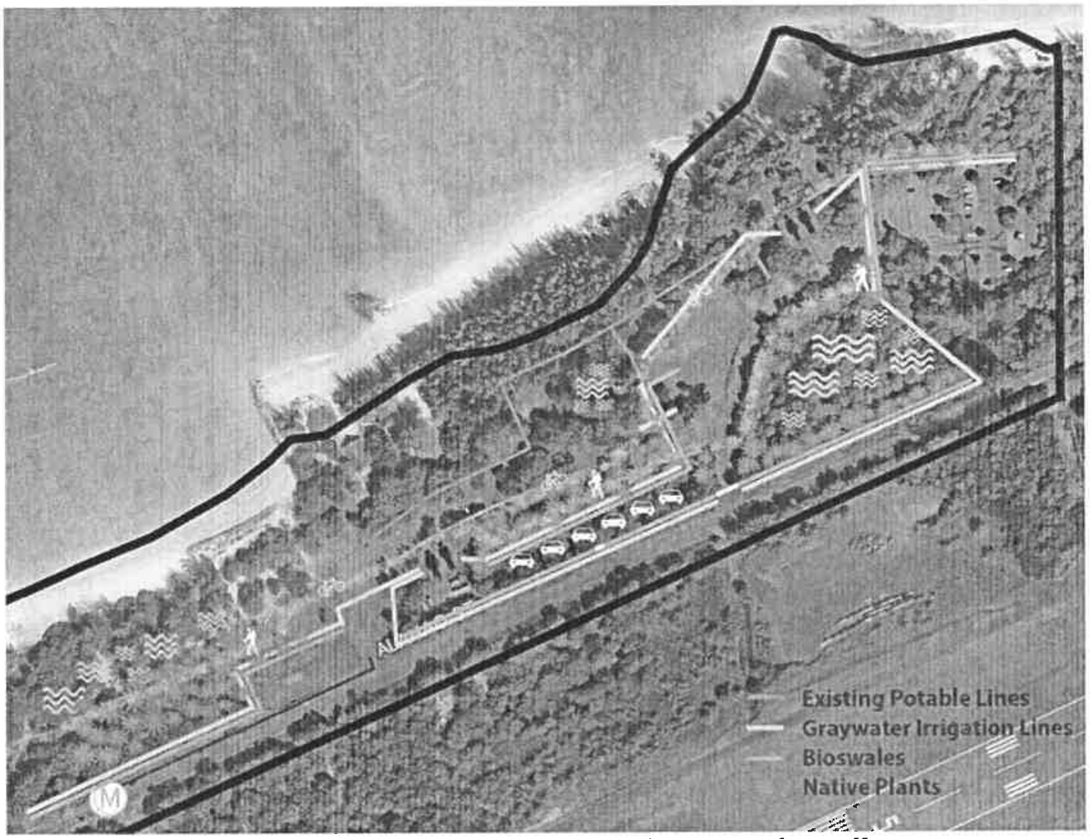
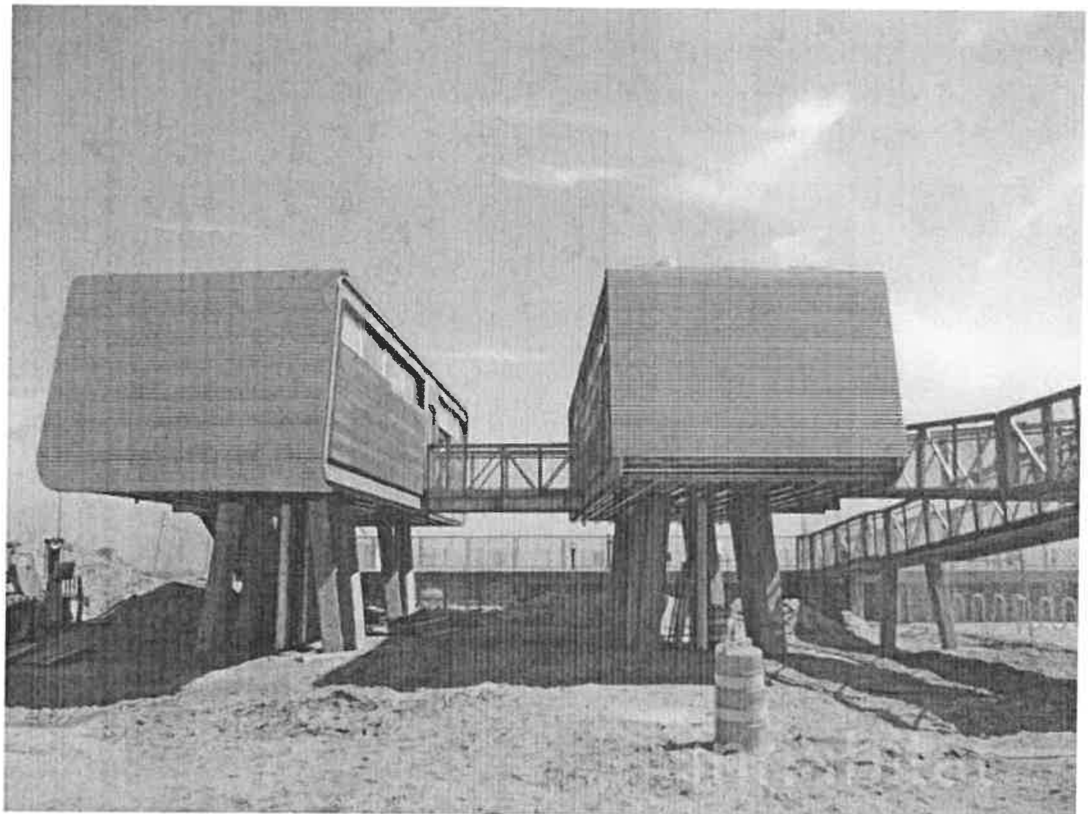


Figure 6 Graywater System Conceptual Siting and installation

Figure 6 shows the initial installation diagram for a conceptual graywater system for KBP. The diagram shows the shower water capture element but does not yet include a sink water capture elements and dual plumbing to return water for toilet flushing.

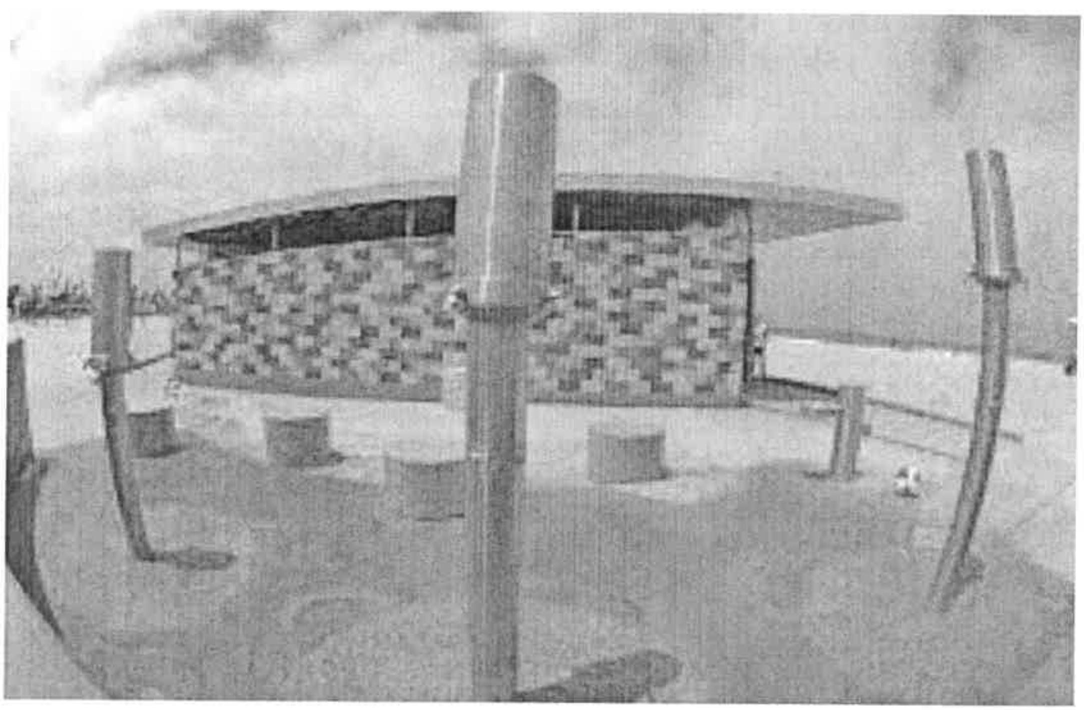
Conceptual Restroom Installation (Flood proof)

Restroom installations on Rockaway Beach, New York. Throughout the country, public beach restrooms are raised off the ground to avoid flooding and reduce the permanency impacts of the building envelope on its surrounding area. This type of design is not new and are also applied elsewhere in the country where heavy flooding occurs. It is also capable of housing, or including on the same footprint, the graywater filtration system, its connected showers, toilets and sinks, and may be entirely shut off and locked during off-park hours to reduce maintenance costs.



Source: Garrison Architects

Under the current project concept, restrooms can incorporate showers and surfboard rinse valves to regulate water consumption and reduce maintenance costs.



Reuse shower and sink water for toilets

For additional potable water savings, filtered water from the graywater system can be returned and reused by flush toilets as shown in Figure 7. Figure 11 includes irrigation.

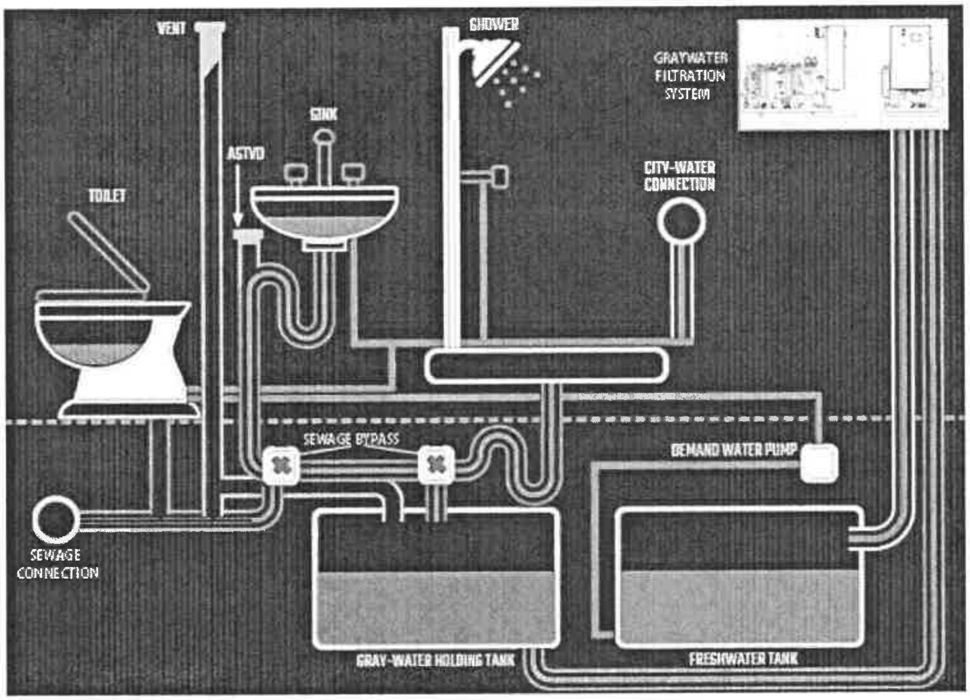


Figure 7 General Graywater Circulation Diagram

Conceptual Hydrozones with Native Plant Xeriscaping

Hydrozones with native plant species based on xeriscaping concepts can further reduce water demand while different elevations can also play a part in determining hydrozones.

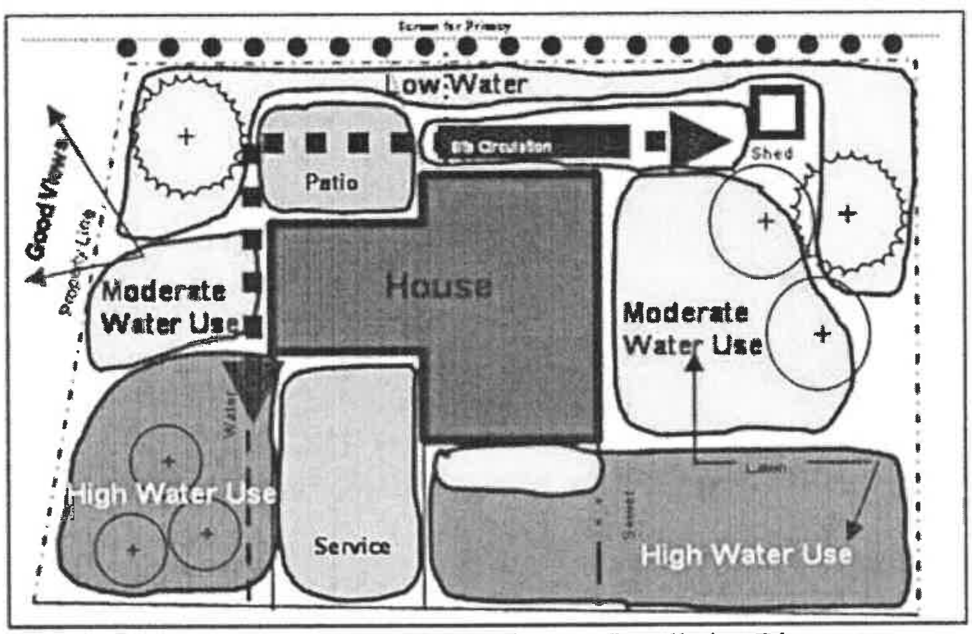


Figure 8 General Hydrozone Installation Diagram

Conceptual Turf and Landscape Irrigation

Applicable graywater irrigation systems must only be subterranean by design under current Hawaii Department of Health (DOH) graywater guidelines. If further cost analysis permits, grassy fields may be irrigated as shown in Figure 9.

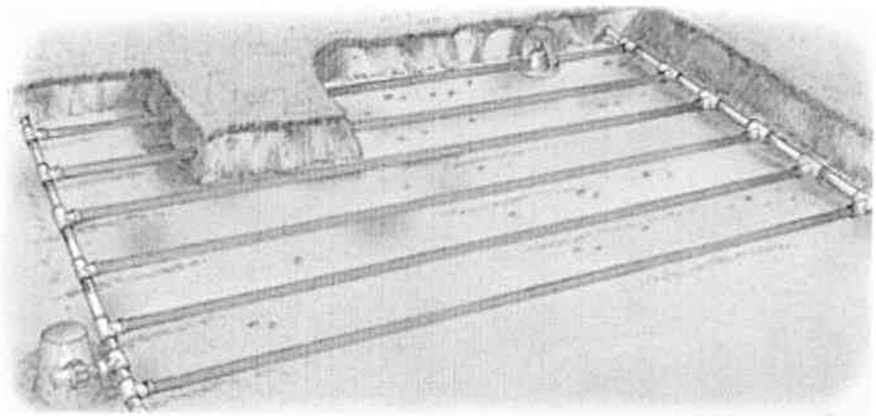


Figure 9 General Subsurface Irrigation Diagram

Conceptual Bioswales

Bioswales are widespread and used to help capture runoff, retain moisture, reintroduce native plant species, collect and redirect stormwater, create rain gardens, provide beautiful aesthetics, and serve as a natural "soft" infrastructure barrier against floodwater and erosion. The photo below is a bioswales located at a large Wailea hotel on Maui.

Source: Hawaii Hotel Reef Stewardship Guide

Conceptual Interactive Public Education

Posting signs at KBP about the graywater system, culturally significant native plants, walkthrough gardening, and reaching out through media outlets is a great way to educate visitors about water conservation and the sustainable approach at KBP.

Current Park Facilities, Showers, Restrooms and Hose Bib Valves

Photo 1 Bathroom 1 (South East)

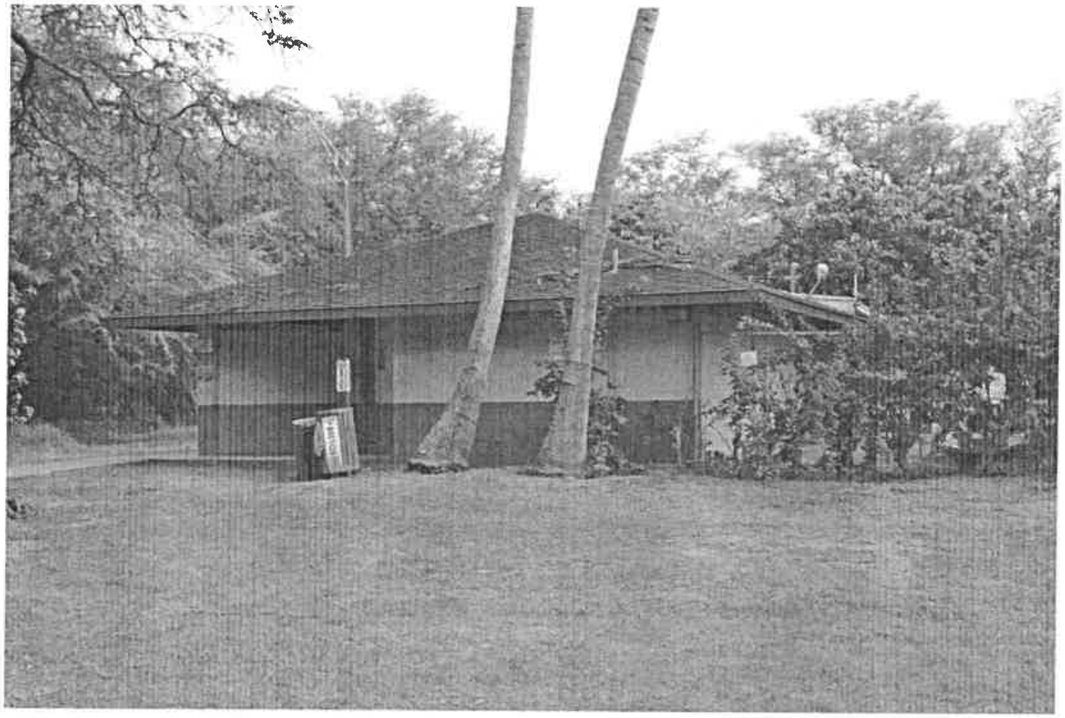
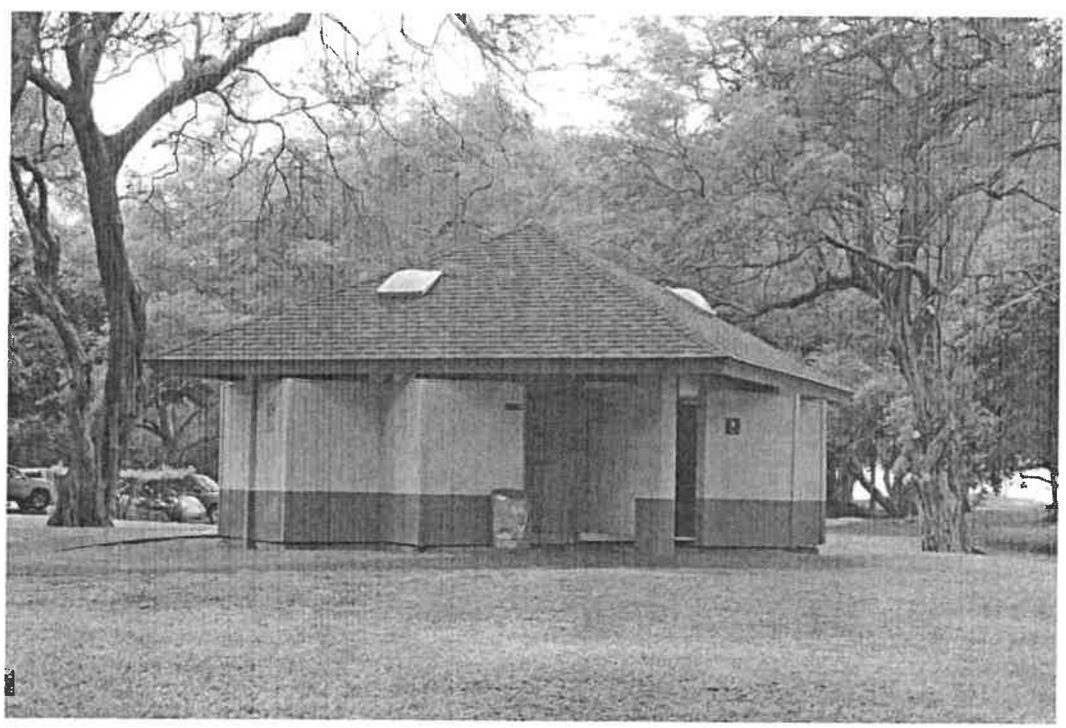
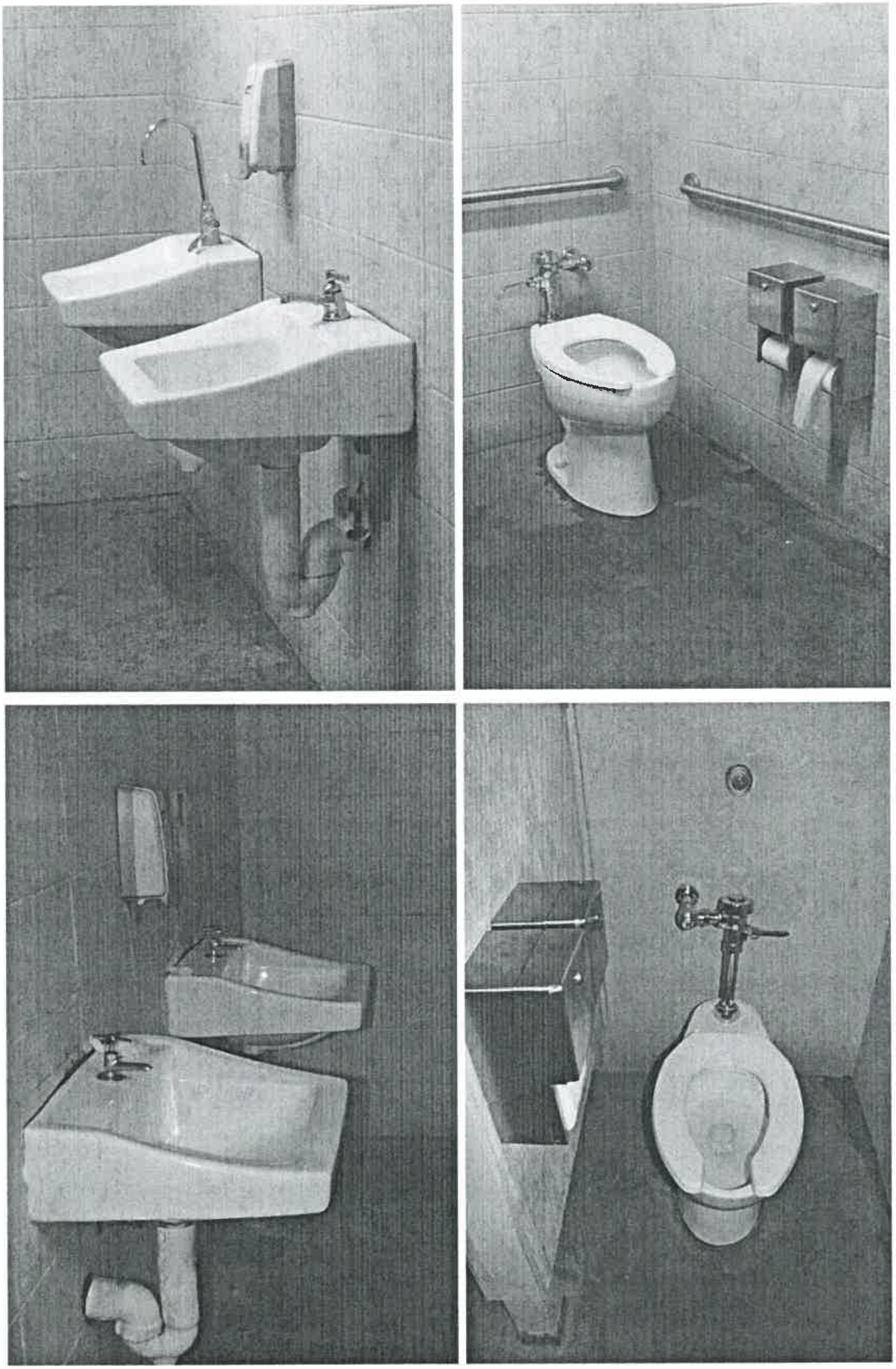


Photo 2 Bathroom 2 (North East)



Photos 3-6 Restroom Sinks and Toilets



Photos 7-11 Outdoor Showers (Current Model Examples at KBP)

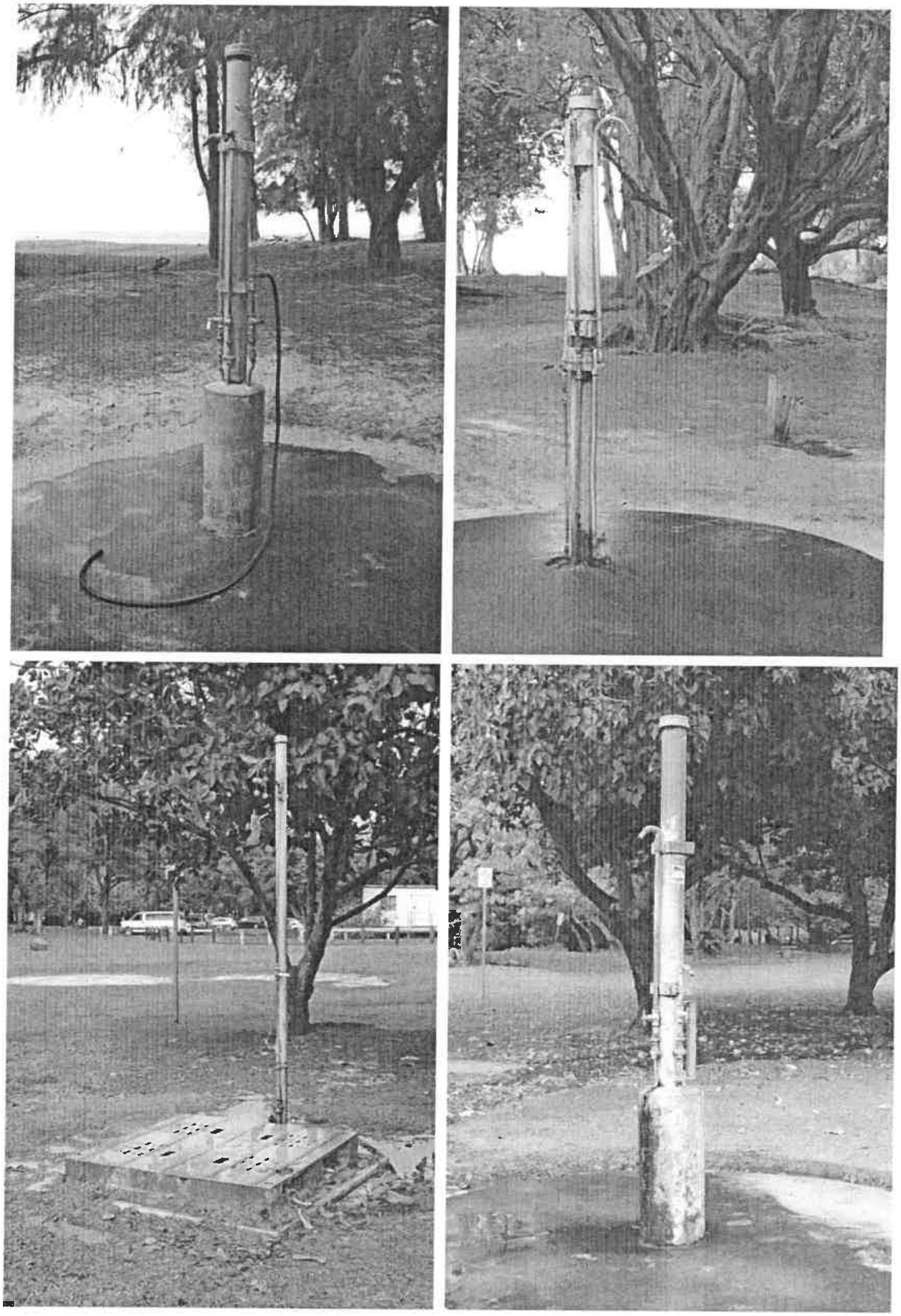
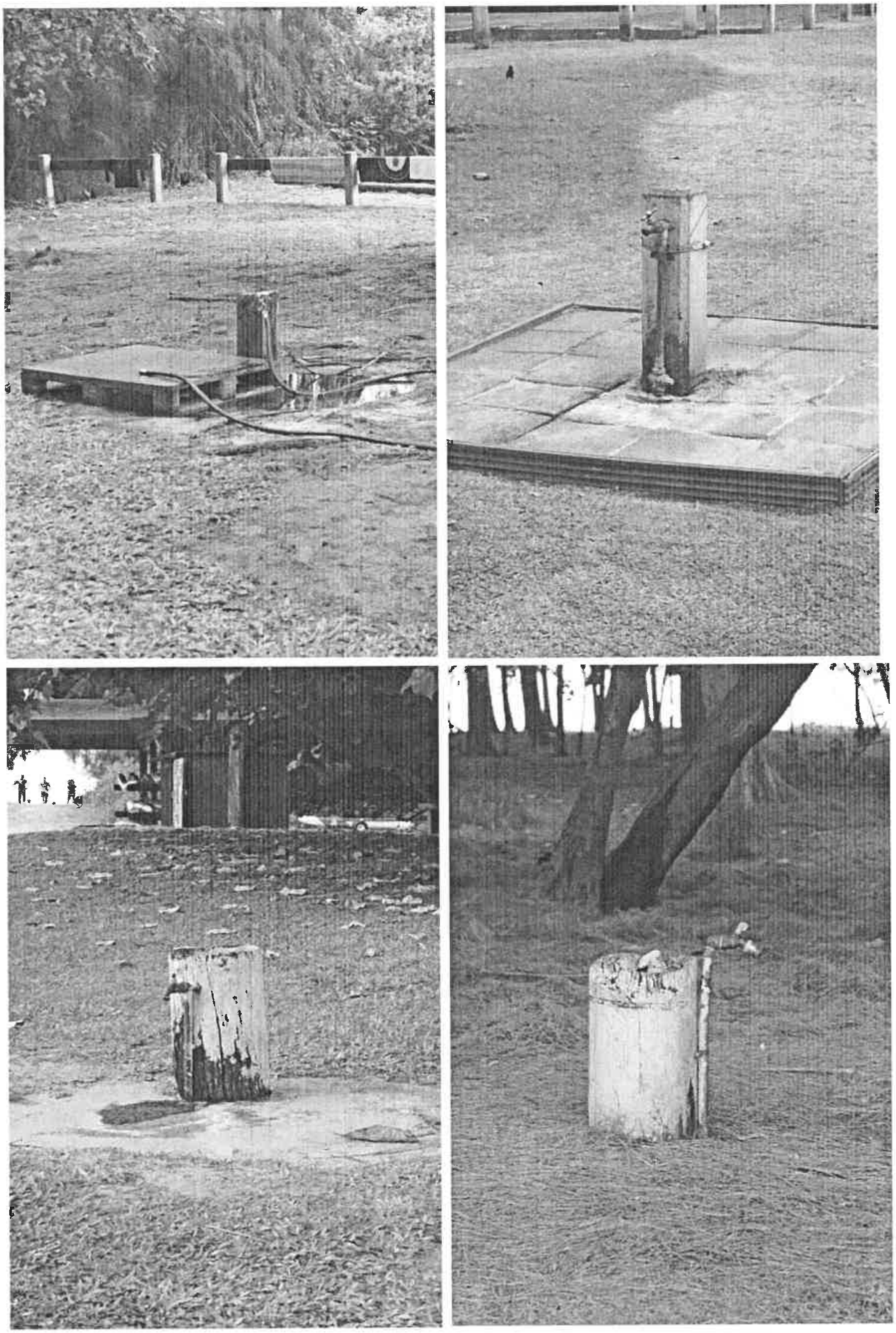


Photo 12-13 Outdoor Hose Bib Valves



Example Graywater System Installation with Process Elements

Graywater System Installation (Showers and sinks)

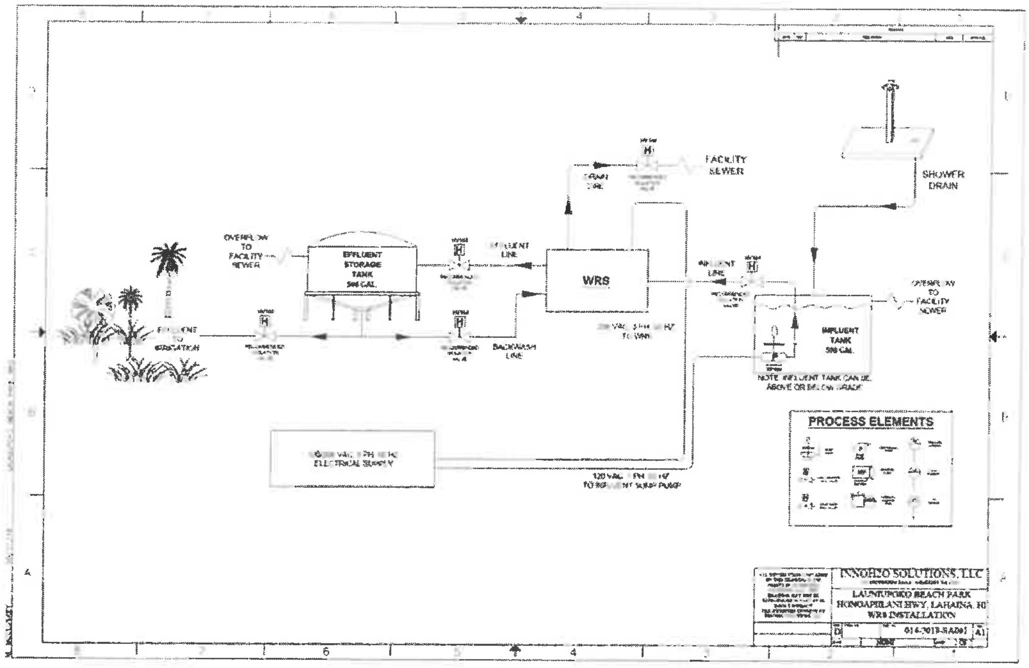


Figure 10 General Graywater Installation Diagram

Graywater Circulation Diagram for KBP

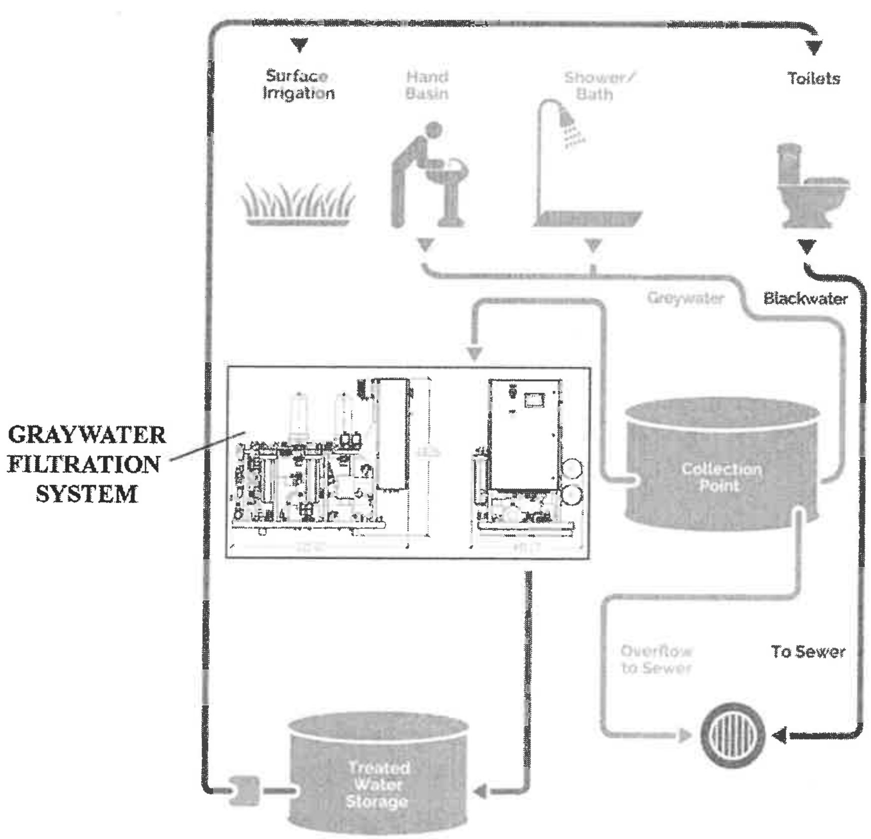


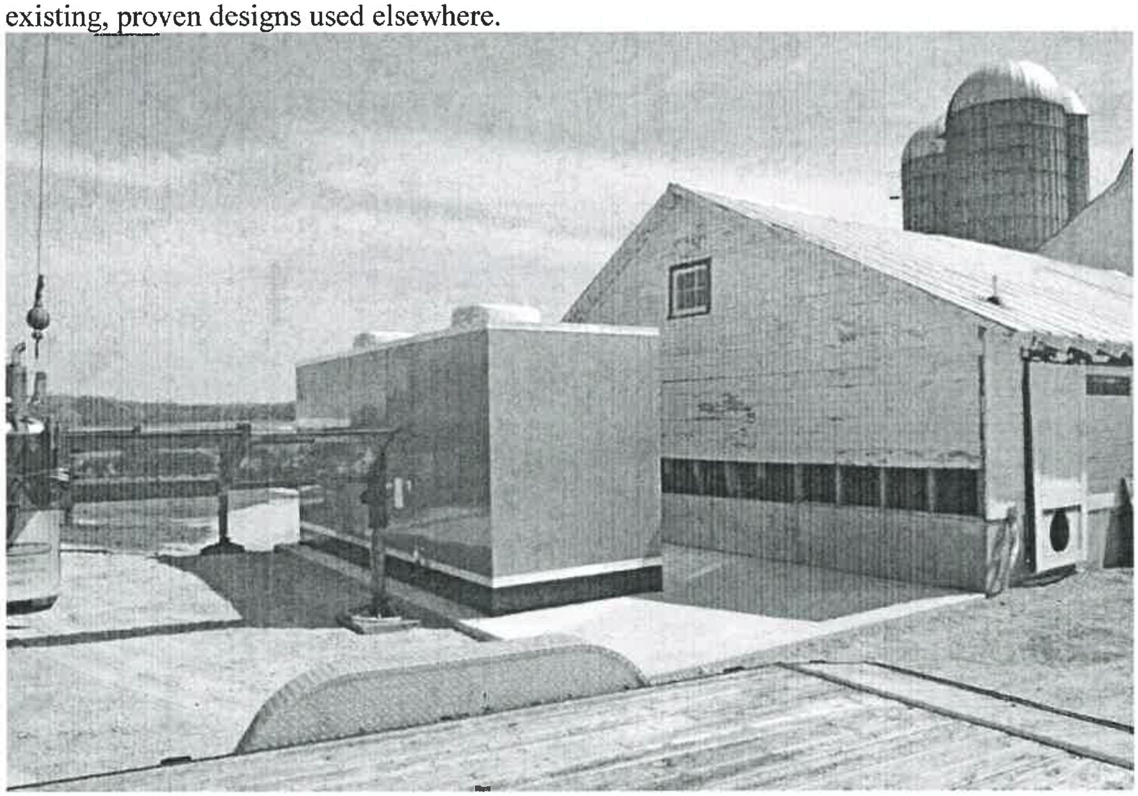
Figure 11 Graywater Process Diagram

Irrigation and Landscapes Design Objectives

WRP proposes two initial objectives for a graywater reuse/recycle pilot project.

(1) Procure a (graywater) licensed consultant to provide these services:

1. Design, and procure a graywater system to capture used water from showers and sinks at the KBP (building).
2. Design and provide graywater to toilets and an irrigation construction plan with hydrozone monitoring of xeriscaped areas (plumbing/building).
3. Bioswale construction plans along Amala Place Road, parking lots and designate low and higher elevation hydrozones that may be prone to flooding (landscape architecture).
4. Include a Design for two (2) ADA prefabricated public restrooms with outdoor showers that may be secured during off hours and where a master water shutoff valve is located (building). Design to be based on high level concept similar to existing, proven designs used elsewhere.



5. Design if possible the consolidation of showers between two restrooms containing retention basins and clear-water tanks from the graywater filtration system to reduce maintenance and water loss (building). Conceptual design.
6. Design and provide photovoltaic construction plans to power the graywater system that conforms to any applicable environmental lighting rules and regulations (electrical/building). Conceptual design.
7. Selection of native, geographically appropriate plants for xeriscaping (landscape architecture).furnish by Maui8 Tropical Plants and Nursery supplied by Maui County

8. Final construction plans to be flood, ADA and fire code compliant (building). In concept only with inadequate funding.
9. Final design plans to be upgradeable to meet EPA WaterSense, Leadership in Energy and Environmental Design (LEED) or the International Living Future Institute Living Building Challenge (LBC) criteria (building), if economically feasible.

Technical Graywater System Design Objectives

(2) Purchase a minimum, Tier 2, graywater reuse system with the following qualities:

1. A minimum of 40,000 gal/day R-2 minimum filtration capability (2 filtration systems) with flow rate monitoring, screening, disinfection through chlorination, filtration and UV, biological treatment (optional) and reservoir clear-water tanks
2. Powder-coated system parts to reduce saltwater corrosion
3. Resiliency proven, robust, and low maintenance

Reconfigurable filtration system for the future addition of other water sources such as rainwater and stormwater

4. Long-term availability of spare parts
5. Maintenance agreement for one (1) year after system is commissioned
6. User manual and repair guide
7. Photovoltaic (PV) panel with aluminum alloy 5086 parts that is International Electrotechnical Commission (IEC) 61701 compliant for sea water corrosion resistance or other renewable power option to power system
8. Manageable sand, dirt and debris pre-filtration system at showers
9. Design of Flood building compliant and stable foundation design to withstand 100 year to 500 year flood events as per FEMA 55, Coastal Construction Manual and ASCE structural and flood resistant design and construction practices to be a T&M change if selected.
10. American Disabilities Act (ADA) Compliant
11. Blue-light filtered LEDs (light-emitting diode) for improvements to ensure lighting is not harmful to birds and animals
12. Landscape architecture (soft) to incorporate only native xeriscaping

The first objective includes pre-design investigations to determine the right system to be installed and the right balance of irrigation and landscaping. This is also when consultations between the stakeholders are held to discuss stakeholder contributions, constraints, responsibilities, and the expected design and outcomes from the graywater system. The Consultant is expected to keep communication fluid between the stakeholders to ensure that assessments and permitting processes are efficient.

The second objective involves the procurement of the graywater system. Preliminary investigations indicates the right filtration capacity of at least 40,000 gallons per day. It also needs to be a minimum Tier 2-3 filtration system capable of meeting and exceeding any minimum regulatory standards set by federal, state and county laws. Since this system will be responsible for irrigation on a daily basis, if needed, a proven, low maintenance system is sought after. The ideal system will also be chosen based on the availability of spare parts in case of impromptu maintenance issues that require part replacements.

Scalability of the system has been discussed to include increasing filtration capabilities, if necessary. KBP also has several unregulated water hose bibs that are indiscriminately used by the public. The water used in these areas should be regulated or its graywater be considered for filtration and reuse, which would further decrease potable water demand. Subject to the 40,000 gallon per day limit of each system to be expanded.

Planning Approach

1. Ensure proper design and successful construction by considering:
    a. Siting location
    b. Area mapping and surveying
    c. Examining existing facilities, utilities and park as-built designs
    d. Flood, runoff and erosion threats
    e. Native landscape requirements
    f. Irrigation infrastructure constraints
    g. Sustainability analysis and environmental certification options
    h. Climate change and sea level rise resiliency options
    i. Applicable graywater rules and regulations
    j. The necessary alignment of policies, permit requirements, and the prospective graywater systems to be installed
    k. Customize a robust graywater system
    l. Initial consultations with Public Works, Current Planning, DPR, State DOH, and review/process required permits
    m. Initial and operational budgetary constraints
    n. Physical and environmental constraints (additional build-outs and system requirements)
    o. Include construction services from design consultant (possible permitting and installation change orders)

Consultant's Scope of Work

The following outlines the Consultants scope of work:

1. Site survey to be based on existing surveys available, whenever possible
2. Design, procure a graywater system, including wet wells and storage tanks to capture and filter used water from showers and sinks around the KBP to be reused for subterranean landscape irrigation and flush toilets as an option in concept but not a specific design.
3. Design a native plant xeriscaped hydrozones with a water budget table for each zone from very low to high usage requirements.
4. Design and provide graywater irrigation construction plans with "smart" hydrozone monitoring.
5. Design and final construction plans for bioswales along Amala Place Road and/or parking lots to capture runoff and impede/redirect flood waters.
6. Design at a high level two (2) prefabricated dual-plumbing public restrooms to each house a graywater system, clear water tanks, and outdoor showers. Restrooms are to be elevated, energy efficient lighting, ADA and flood

compliant.
7. Design elevated, showers that comply with ADA
8. Selection of native, geographically appropriate, plants for xeriscaping.
9. Final design plans to be upgradeable to EPA WaterSense, Leadership in Energy and Environmental Design (LEED) or the International Living Future Institute Living Building Challenge (LBC) criteria, if economically feasible within budget constraint.
10. Ensure that the graywater system meets all graywater laws, regulations, and certified to be capable of controlling concentrations of biostimulants such as nitrogen and phosphorus, disinfect against pathogenic bacteria, parasites, and enteric viruses, and minimize concentrations of organic compounds and inorganic chemicals.
11. Integrate a photovoltaic (PV) construction plans to power the graywater water system (building).
12. Source, and specify all system parts, materials and supplies with cost breakdown contact information of supply sources.
13. Provide an estimate of site civil work.
14. Provide on-site oversight of graywater system installation 8 hours on site
15. Provide user manuals and on-site training.
16. One year (1) year maintenance agreement starting from commission date.
17. Provide complete contract cost breakdown with estimated shipping costs for any supplies and materials.
18. All building permits to be the responsibility of the County of Maui with drawings by consultant signed by a licensed Architect and or licensed State of Hawaii Professional Engineer.

*All plans to be construction ready— signed and stamped by the Consultant's licensed engineer prior to submitting to DWS.

Target Specifications

WRP will continue to work with the stakeholders to determine the proper system design, setup, and optimal calibration for equipment purchased for installation to reduce potable water consumption at KBP and to maintain public safety at all times. This includes coupling a smart irrigation system with tolerant native plant species around hydrozones, photovoltaic (PV) options, and optional bioswales to optimize water runoff capture and reduce erosion from sea level rise and flooding.

An important part of producing target specifications for installations and designing is how to meet future master planning, operational sustainability, site specific constraints, stakeholder scheduling, and other environmental constraints to not only reduce potable water consumption, but to address climate change concerns precipitated by climate change.

Generating Design Concepts and Cost Breakdown

Design concepts will be based on existing as-built, utility, and architectural plans, DPR 2018 Master Plan, water consumption rates, and an existing complete site survey. There will be six (6) initial required plans:

1. Graywater filtration system design plan

2. Comfort station(s) design plan conceptual design
3. Landscape and irrigation design plan
4. Xeriscaped (native) hydrozones design plan with bioswales
5. Subterranean drip irrigation distribution system design plan
6. Photovoltaic (PV) design plan

The total estimated costs will come from the Consultant's proposal that is subject to renegotiation, if necessary. The cost is not expected to deviate from the available funding. However, final costs for construction and installation will be refined during the preliminary design phase before final construction plans are approved to avoid cost over- runs.

Ongoing System Maintenance

WRP estimates the long-term maintenance cost of the graywater system to be in the range of $1500-$2,500 per month (based on information from system builder) once the initial starting supply of replaceable filters are exhausted. Extra water pumps, component units, and specific accessories will be stored in case of unanticipated breakdowns. The initial cost breakdown is as follows:

1. The whole process of replacing filters should only take a few minutes with additional time to check and purge sand and debris from a shower water pre-filter containment unit. There will also be time needed to periodically check irrigation valve boxes and lines. Total time for upkeep and maintenance per month is estimated to be >2hrs, **if conducted on a regular basis.**
2. Although there will be additional vegetation planted, they will be native, low-maintenance, choices that should not be difficult to manage. Therefore, landscape maintenance is considered part of normal park upkeep and will likely require >2hrs of upkeep time monthly.
3. Power requirements for the graywater system will be met by photovoltaic (PV) panels to be securely installed on the roof of the service houses. The system will still be connected to the existing power line in case of PV failure or usage beyond the capacity of the system design
4. A certain amount of landscaping materials and supplies will be needed for maintenance and upkeep. The final cost should be minimal with the use of native plants, but the final cost will be ascertained once the landscaping design is approved.

It is important to consider potable water cost savings from re-using water when determining the long-term costs. Other costs such as electricity for the system will also be met by PV panels. Therefore, the graywater system becomes value-added immediately since the cost of maintenance of the system is less than purchasing the same amount of potable water, even with additional maintenance. Staff will also be provided with system manuals and properly trained to maintain the graywater system.

Stakeholder Responsibilities

WRP

- Project management (PM)
- Project scoping
- Design concept
- Funding procurement
- Due diligence
- Contracting
- Contract with Consultant as a design-build contractor for an appropriate graywater landscaping and irrigation design and installation
- Contract with a contractor to install a graywater system
- Ensure project is managed with minimal delay and cost overruns
- Establish a system upkeep and maintenance program (via service agreement)
- Create a program that collects, records, and reports water savings from graywater use
- Ensure that county and state permits are submitted

DPR

- Assist WRP towards the timely completion of the following permit applications:
    1. Special Management Area (SMA) Assessment
    2. Shoreline Setback Area (SSA) Assessment
    3. SMA permit
    4. SSA permit
    5. Flood Development Permit (FDP) and certified design plan for irrigation system
    6. Archeological Inventory Survey (AIS) (if required)
    7. Building, electrical and plumbing permits
    8. Apply for State of Hawaii DOH IWS permit
    9. Apply for State of Hawaii DOH water reuse permit
- Site visits and quarterly meetings to discuss updates and design options
- Provide a dedicated point of contact (POC) to coordinate with PM, Consultant(s), and Contractor

BUDGET

Other outside sources of funding may be available. Part of this project may also qualify for the Federal Emergency Management Agency Flood Mitigation Assistance Grant Program and sustainability and resiliency funding from the County of Maui Office of Economic Development (OED).

Bill HB1259 SD1 SD1 Appropriation

Phase 1 (FY21) >$275,000 Consulting, design, engineering, graywater filtration system(s), irrigation lines and supplies, plants and materials, redrafts and final design- plants supplied by County, including required permits

Phase 2 (FY22-FY23) <$175,000 Installation, build-outs, landscaping, other O&M, spare parts and supplies. With funding permitting, may include new elevated restrooms and showers to meet flooding concerns

DWS

Phase 1 & 2 >$45,000 Additional consulting, archeological survey (if not covered by County archeologist), and procurement of specific supplies and materials

Parks and Recreation

Part of Phase 2 (FY20) Cost associated with Parks Master Plan, supplies and materials for expansion build-out to accommodate the graywater filter system. Additional monies may be requested from Parks Department for cost of new bathroom improvements, if chosen.

Current Consumption and Potential Savings

On average, KBP can consume over 3 million gallons of water per month as shown if Figure 12. This is equivalent to approximately 98,775 gallons per day (GPD), of which approximately 30-60% is being used by the showers and sinks. This leads to a total amount of approximately 35 million gallons of potable water consumed per year that may not include water loss from leaks.

Kanahā Beach Park (2 Meters in Gallons)	
Total Average Yearly Usage (Gal)	35,024,000
Total Monthly Water Usage (Gal)	3,004,756
Total Daily Water Usage (Gal)	98,775
Percent Used by Fixtures (%)	30-40% est
Daily Water Usage by Fixtures (Gallons)	58,944
Total Amount of Water Saved (GPY)	14,399,310 (41.11%)

Figure 12 Summary of water savings through graywater irrigation for KBP

Estimated Future Consumption Trend

Based on recapturing 41.11% of the total yearly potable consumption a future trend is shown in Figure 13 and Figure 14. The trend assumes monthly variations in consumption rates minus savings.

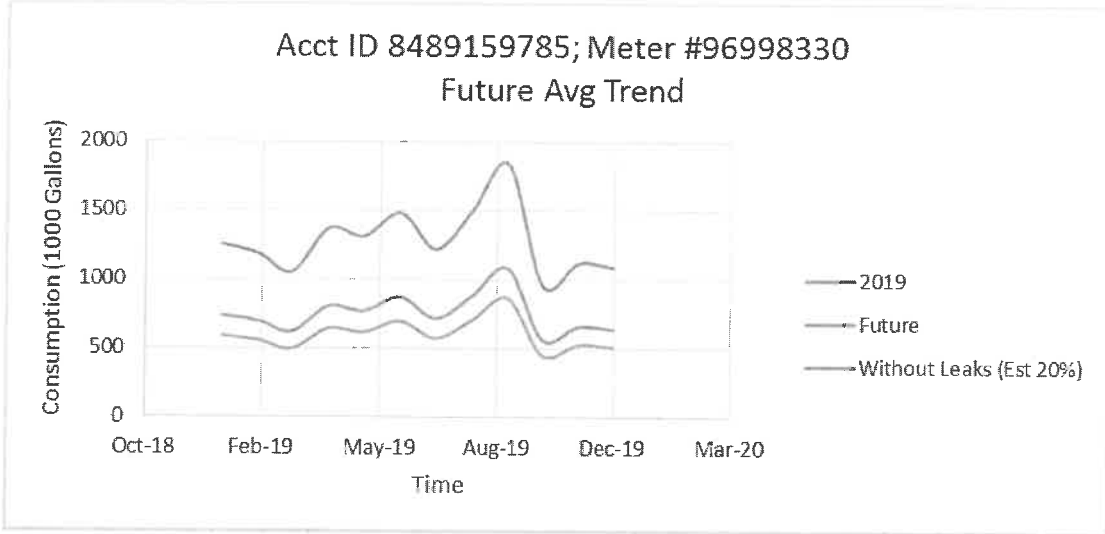


Figure 13 Future Avg. Trend Meter 96998330

An additional estimated 20% can further reduce potable water consumption if leaks are found and addressed. Actual figures can vary depending on further leak investigations.

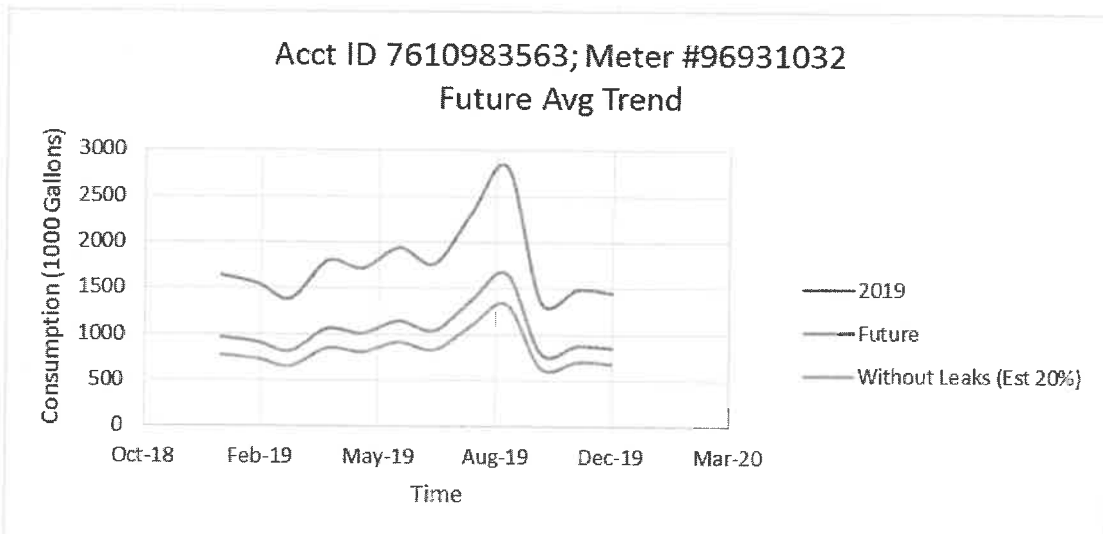


Figure 14 Future Avg. Trend Meter 96931032

Justification

The following are assumptions that we must take into consideration for the monetary justification:

- More than $50,000 is spent on potable water each month at KBP
- Potential average water savings by utilizing a graywater system: 14.4 million gallons per year

- 100% of the graywater that is treated can be reused for landscape irrigation or a portion to be diverted to rejuvenate wetlands under DPR master planning
- One meter registered a demand increase of 18.82% while the other rose to 40.18% from 2018 to 2019
- Bioswales and xeriscaped hydrozones can make KBP more resilient to climate change by serving as a natural "soft" hybrid infrastructure barrier to reduce runoff and diverting floodwaters. Soft infrastructure can be much more resilient and far less costly than "hard" infrastructure
- Consistent with the State of Hawaii's plans to reduce future potable water consumption on Maui
- A great reduction in sewage water and fees, and can reduce potential contamination by treating graywater on-site
- Solar PV, adds another sense of electrical resiliency
- Will improve the park's aesthetics
- Will provide public education and awareness about native plants and the benefits graywater reuse for the benefit of the environment
- Will reduce DWS potable water production costs

DPR currently pays an average of about $28,578.75 per month for about 3,000,000 gallons (see Figure 15 below). By recapturing and reusing an estimated 41.11% (14,399,310.21 gal) of 35,024,000 gallons — the current yearly consumption, County savings would translate to about $181,944.20 per year generating a payback period of about 2.72 years (Figure 16).

Consumption	Acct ID 8489159785; Meter #96998330	Acct ID 7610983563; Meter #96931032	Totals
Jan-18	1164	401	
Feb-18	1394	493	
Mar-18	1244	799	
Apr-18	900	1026	
May-18	994	1159	
Jun-18	1068	1156	
Jul-18	1062	1127	
Aug-18	1027	1210	
Sep-18	1109	762	
Oct-18	1107	1235	
Nov-18	1163	1372	
Dec-18	1275	1642	
Yearly Total (1000 gal)	**13,507.00**	**12,382.00**	**25,889.00**
Yearly Total (1000 gal)	**13,507,000**	**12,382,000**	**24,961.00**
Jan-19	1258	1552	
Feb-19	1189	1387	
Mar-19	1058	1800	
Apr-19	1373	1720	

May-19	1316	1944	
Jun-19	1486	1771	
Jul-19	1223	2316	
Aug-19	1502	2823	
Sep-19	1842	1346	
Oct-19	962	1490	
Nov-19	1121	1453	
Dec-19	1092	1096	
Yearly Total (1000 gal)	**15,422.00**	**19,602.00**	**35,024.00**
2018 to 2019	**+12.42%**	**+41.57%**	**+28.73% Avg.**
Monthly Avg (1000 gal)	**1,279.92**	**1,724.83**	**3,004.76**

Figure 15 Water Usage Profile for KBP for last 2 Years

Average % Potable Water Savings from Reuse	Total Estimated Gallons of Water Saved per Year from KBP Project	Total Money Saved (Per Year)	Payback Period (Years)
41.11%	14,399,310.21	$181,944.20	2.72

Figure 16 Simple payback period for KBP Graywater Project based on yearly % savings

Project Timeline

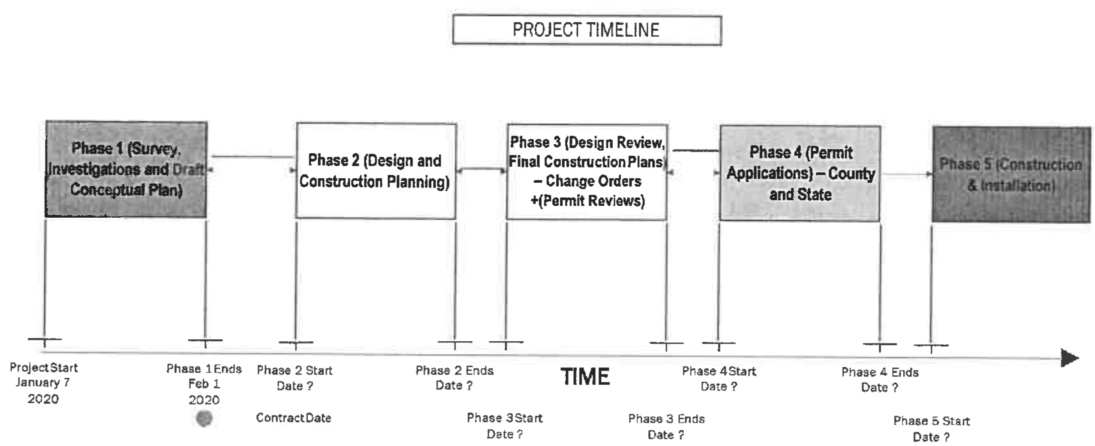


Figure 17 Project Timeline

References

https://health.hawaii.gov/wastewater/files/2016/03/14_Gray_Water_GL.pdf

http://sfwater.org/index.aspx?page=100

031919 MASTER-PLAN_FINALDRAFT Kanahā Beach
S:\PLANNING\CONSERVATION\Greywater\Kanaha Beach Park

Appendix

A. Graywater System Basics

According to the Hawaii Department of Health, wastewater stream coming from sinks, laundry machines and showers may be reused to meet part of the fresh water demand for landscaping. Diverting this wastewater stream to a subsurface irrigation system also reduces the amount of wastewater entering the individual wastewater system (IWS). Although this wastewater stream contains detergents, soaps, and solvents, some of the constituents of these cleaning agents are considered fertilizer for plants. Phosphorous, nitrogen, and potassium are some of the compounds found in graywater that many plants need to survive.

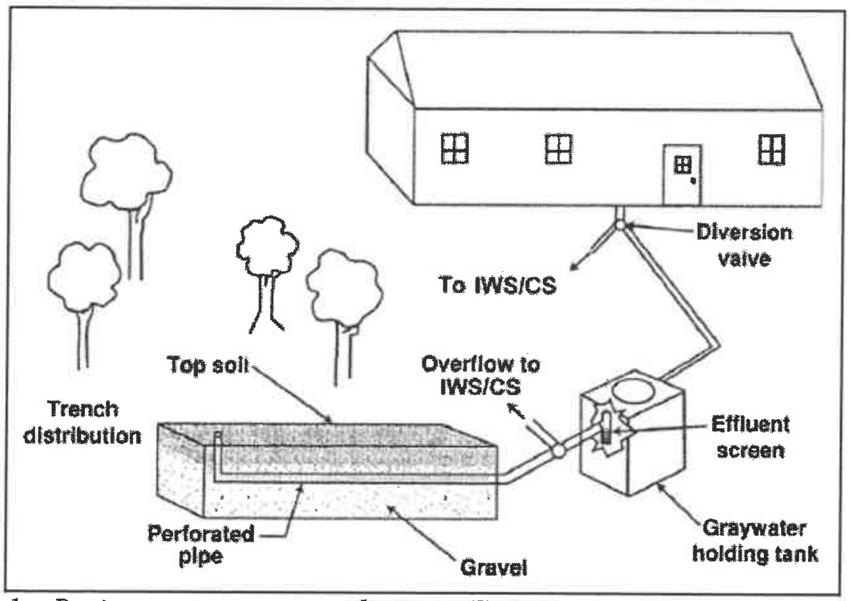


Figure 1 – Basic graywater system diagram (Source: DOH Graywater Guidelines)

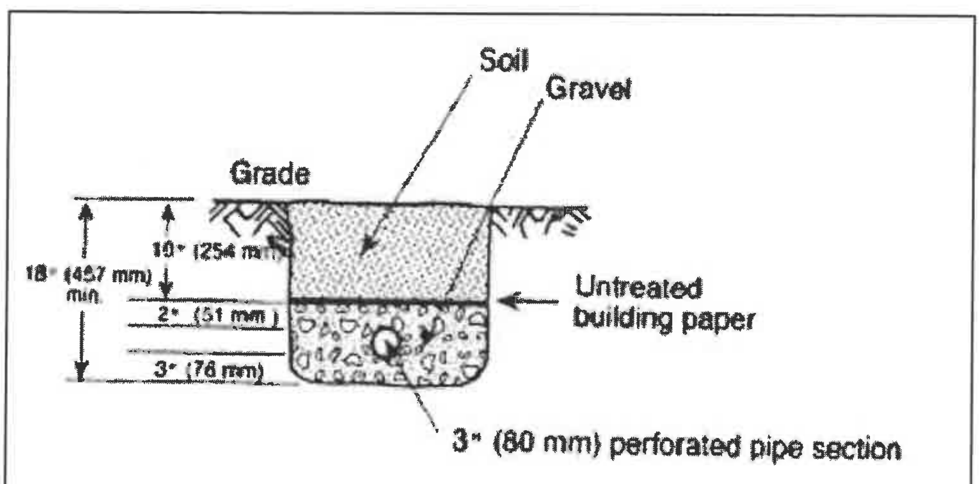


Figure 2 – Profile view of sub-surface irrigation system (Source: DOH)

Generally, most of the graywater and the nutrients in it will be used by plants, and the dynamics of the soil will break down the other contaminants. The potential to harm the environment is dependent upon the constituents in the graywater, the type of soil being watered, and the geological characteristics of the area. Both the graywater system to be installed and the irrigation system must meet high standards to ensure that the public and the environment is safe and protected. That is, the graywater system will filter water to remove harmful chemicals and constituents, resend the water back through the irrigation system to irrigate a native, xeriscape, design landscape that is culturally sensitive and appropriate for the geographic location.

B. Background – Graywater vs. Blackwater

Residential wastewater can be divided into graywater and blackwater. The State of Hawaii, Department of Health Wastewater Branch defines blackwater as wastewater discharged from[1]:

- Toilets and urinals; and
- Food preparation sinks (kitchen sinks)

Blackwater from toilets and urinals and kitchen sinks should never be reused for irrigation because of the high risk of contamination by bacteria, viruses, and other pathogens. Blackwater contains relatively higher concentrations of nitrogen, organic matter, and pathogens than graywater.

The Department of Health defines graywater as wastewater discharged from:

- Showers and bathtubs;
- Hand-washing lavatories;
- Wastewater that has not contacted toilet waste;
- Sinks (not used for disposal of hazardous, toxic materials, food preparation, or food disposal); and
- Clothes-washing machines (excluding wash water with human excreta e.g., diapers).

Graywater from sinks, tub/shower drains, and clothes washers are estimated to be 50% to 80% of the total residential wastewater generated[1]. Additionally, a typical single family residence allocates an average of 30-60% of about 320 gallons per day of total potable water to landscaped yards. Surprisingly, many people are not aware that most plants do not require potable water to maintain. For example, plants in our natural environment depend mostly on rainwater. Nonetheless, more than 50% of treated potable water goes towards landscapes and gardens, totaling nearly 9 billion gallons per day[2].

On Maui, residential water usage rates are similar amongst the island districts, but drier areas such as West and South Maui demand more water on average—490 GPD and 732 GPD per household, respectively. Similar to the rest of the country, most of the household water consumption occurs from common outdoor activities such as washing cars, gardening, and irrigation. However, seasonal and regional variation in rainfall

[1] http://health.hawaii.gov/wastewater/files/2013/06/graywater_guidelines.pdf

[2] US Environmental Protection Agency. *Outdoor Water Use in the United States*.. 14 February 2017. 23 April 2018.

patterns can also affect daily outdoor water usage. There may be an increase in landscape irrigation throughout the island and particularly in the drier zones, as shown if Figure 3, during its longer summer months.

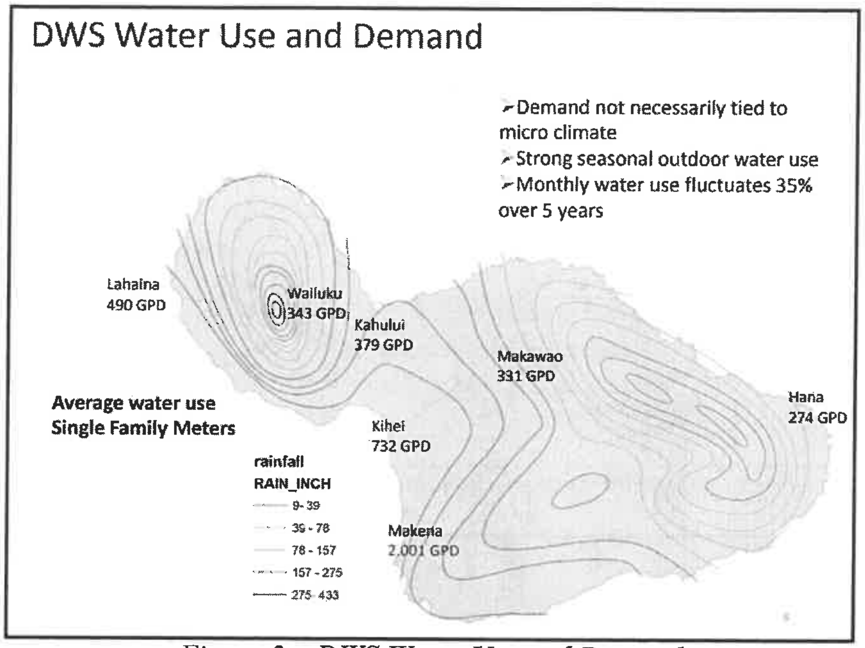


Figure 3 – DWS Water Use and Demand

Wastewater streams coming from sinks, laundry machines and showers have been used for irrigating landscapes for a long time. The systems employed are very basic as shown in Figure 4 below. However, wastewater can also be filtered by a graywater system for reuse to meet more stringent regulations and to provide part or all of the water demand for landscaping. Diverting reusable water to a subsurface irrigation system subsequently reduces the amount of wastewater entering the individual wastewater system (IWS). Although this wastewater stream contains detergents, soaps, and solvents, some of the constituents of these cleaning agents are considered fertilizer for plants. Phosphorous, nitrogen, and potassium are some of the compounds found in graywater that many plants need to survive. Nonetheless, harmful cleaning agents and chemicals can be completely removed from the water when a graywater system is employed. For added safety, current graywater guidelines states that graywater can only be distributed by an underground irrigation system, not sprayed.

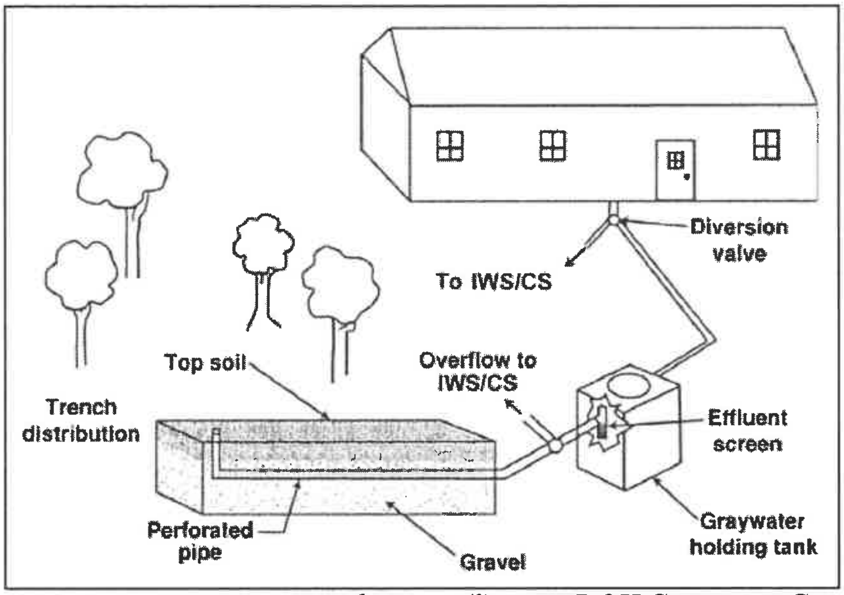


Figure 4 – Basic graywater system diagram (Source: DOH Graywater Guidelines)

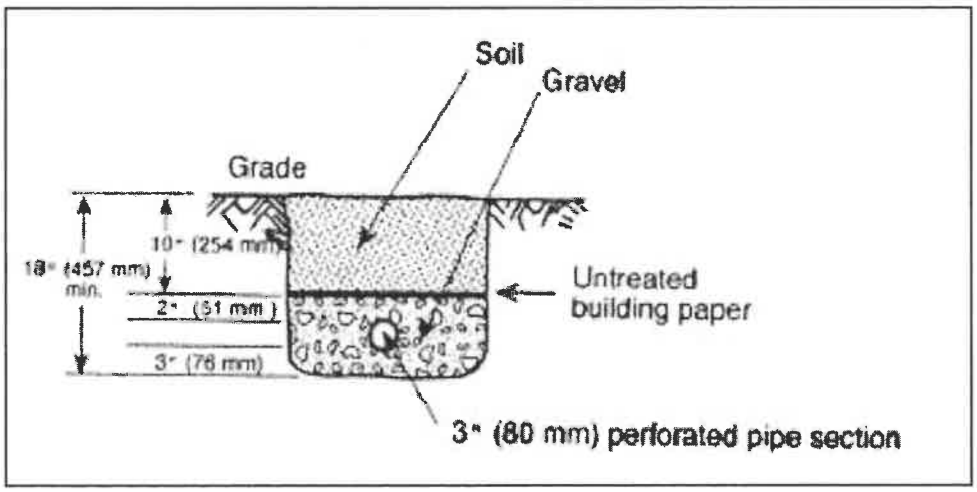


Figure 5 – Profile view of sub-surface irrigation system (Source: DOH)

Generally, even without a graywater filtration system, most of the graywater and the nutrients in it will be used by plants, and the dynamics of the soil will break down the other contaminants. The potential to harm the environment is dependent upon proper piping, the constituents in the graywater, the type of soil being watered, and the geological characteristics of the area.

C. Potential Savings from Graywater Systems

A graywater system has the potential to reduce potable water demand by more than 40%- 50%. The more water is consumed, the more savings can be realized. The consumer can reduce their demand while the water utility can reduce forecasted demand that can delay capital improvements and productions costs.

Another benefit of a graywater system is returning graywater to flush toilets, which do not need potable water. Treated water can be sent back to toilets under a dual plumbing scenario that keeps potable water and graywater separate.

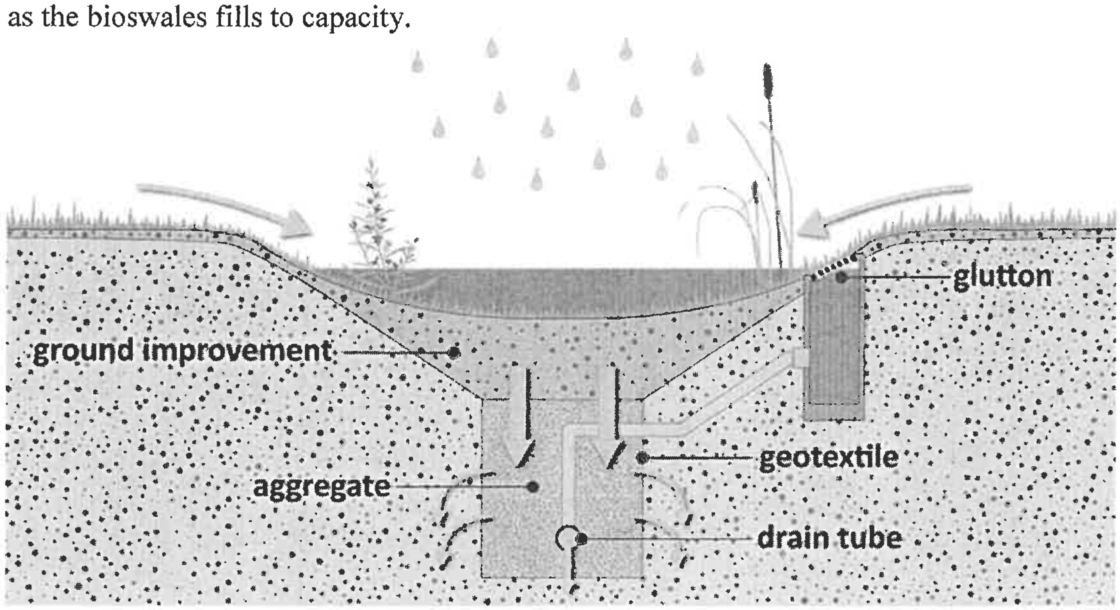
D. Graywater in the State of Hawaii & Maui County

Currently, the Hawaii State Department of Health (DOH) offers guidelines for the reuse of graywater. These guidelines are in conformance with Chapter 16, Graywater Systems, of the 2006 Uniform Plumbing Code (UPC). In 2007, the Hawaii Legislature enacted Part II of Chapter 107, Hawaii Revised Statutes to establish the State Building Code. The DOH requires graywater projects to be approved by filling out a Water Reuse Permit and an Individual Wastewater System Permit (IWS) with required attachments including engineering diagrams certified by a licensed engineer and relevant information about the project. The DOH does not currently require water quality testing for sub-surface graywater irrigation systems; testing is only needed in the event of surface-level irrigation and sprinkling systems.

As of April 2009, all four counties in the state are waiving the portions of the Uniform Plumbing Code (UPC) to allow the use of washing machine wastewater to be used for subsurface irrigation. These waivers apply only to areas not serviced by a publicly owned sewer system. The Department of Health will be the regulatory agency responsible for the graywater systems located in areas not serviced by publicly owned sewer systems. The Counties will retain regulatory responsibility for the areas serviced by their sewer systems.

E. Bioswale Basic Design

Bioswales are excavated linear channels to accumulate and redirect stormwater runoff while absorbing possible pollution with vegetation planted in a water conserving, absorbent, mulch with environmentally a safe gravel matrix capable of absorbing toxic materials and chemicals. As water accumulates, bioswales can also help recharge groundwater sources. Some designs allows water to be piped to secondary retention basins as the bioswales fills to capacity.

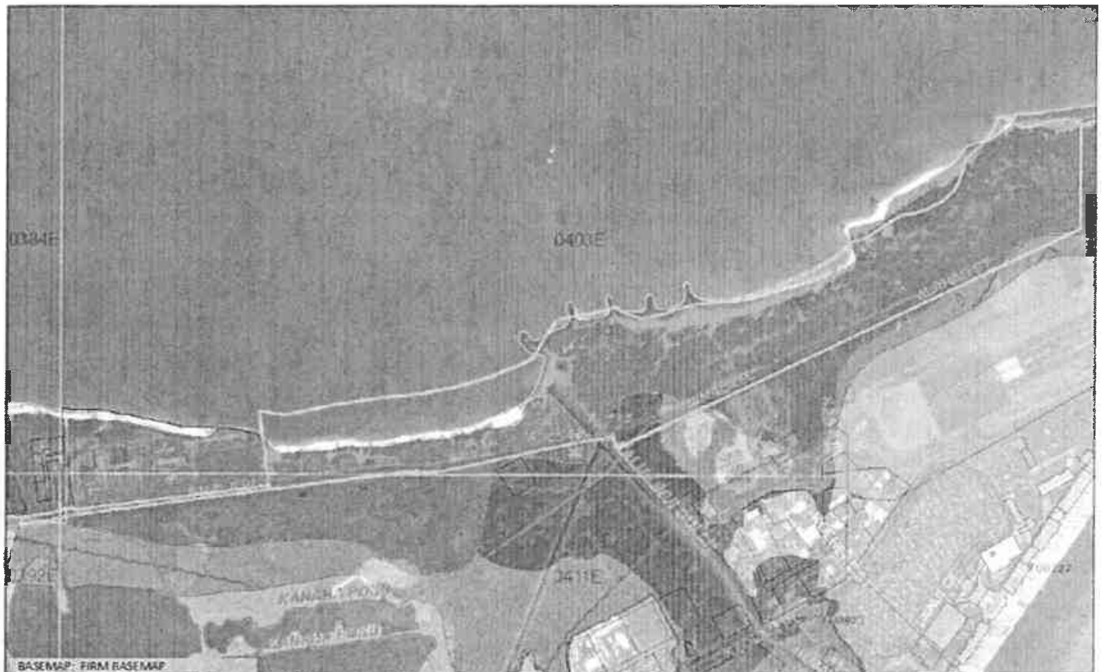


F. DWS Conservation

DWS supports various projects and public outreach campaigns to engage and encourage the public to conserve water. The "Maui County's Landscape and Gardening Handbook", for example, was published in 2011 as a resource for people who want to save water in their yards through water-efficient landscape design and gardening. The book includes useful information on xeriscaping techniques and lists native plants appropriate for each climate zone, among other useful resources.

DWS also continues to provide free high-efficiency water fixtures to the general public to promote awareness and encourage water conservation. In 2018, the DWS launched its High-Efficiency Toilet (HET) Replacement Program which provided over one hundred (100) UHETs to qualified DWS customers. This program has evolved with the procurement of dual-flush toilets that fall well below the current State of Hawaii Uniform Plumbing Code (UPC) flushing maximum. This program is estimated to continue to save up to 2.4 million gallons of water per year and saves DWS thousands of dollars a year in production and sourcing water costs. DWS also continues to expand its Rain Barrel Giveaway Program to areas of Maui that can benefit from capturing rain water for irrigation purposes and areas that are expensive for DWS to deliver water to.

G. Kanahā Beach Park Flood Hazard Assessment Report



Flood Hazard Assessment Report

www.hawaiinfip.org

Property Information

COUNTY:	MAUI
TMK NO:	(2) 3-8-001:119
WATERSHED:	IAO; KAILUA GULCH; KALIALINUI
PARCEL ADDRESS:	ADDRESS NOT DETERMINED PAIA, HI 96779

Notes:

Flood Hazard Information

FIRM INDEX DATE:	NOVEMBER 04, 2015
LETTER OF MAP CHANGE(S):	14-09-2279P
FEMA FIRM PANEL - EFFECTIVE DATE:	1500030392E - SEPTEMBER 25, 2009 1500030403E - SEPTEMBER 25, 2009 1500030411E - SEPTEMBER 25, 2009

THIS PROPERTY IS WITHIN A TSUNAMI EVACUTION ZONE: YES
FOR MORE INFO, VISIT: http://www.scd.hawaii.gov/

THIS PROPERTY IS WITHIN A DAM EVACUATION ZONE: YES (MA-0077; MA-0078; MA-0079; MA-0081; MA-0082; MA-0083; MA-0084; MA-0085, MA-0088, MA-0139; MA-01[illegible] MA-0151)
FOR MORE INFO, VISIT: http://dlnreng.hawaii.gov/dam/

0 600 1,200 ft

Disclaimer: The Hawaii Department of Land and Natural Resources (DLNR) assumes no responsibility arising from the use, accuracy, completeness, and timeliness of any information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the DLNR, its officers, and employees from any liability which may arise from its use of its data or information.

If this map has been identified as 'PRELIMINARY', please note that it is being provided for informational purposes and is not to be used for flood insurance rating. Contact your county floodplain manager for flood zone determinations to be used for compliance with local floodplain management regulations.

FLOOD HAZARD ASSESSMENT TOOL LAYER LEGEND
(Note: legend does not correspond with NFHL)

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD - The 1% annual chance flood (100-year), also know as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. SFHAs include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- Zone A: No BFE determined.
- Zone AE: BFE determined.
- Zone AH: Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- Zone AO: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- Zone V: Coastal flood zone with velocity hazard (wave action); no BFE determined.
- Zone VE: Coastal flood zone with velocity hazard (wave action); BFE determined.
- Zone AEF: Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA - An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- Zone XS (X shaded): Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- Zone X: Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- Zone D: Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase apply, but coverage is available in participating communities.

All withing State Conservation District

The park is entirely within the State Conservation District. Conservation districts are categorized into subzones and regulated pursuant to Section 13-5-13 of the DLNR Hawaii Administrative Rules (HAR). Kanahā Beach Park is located within the Limited subzone.
As a result, any construction or improvements in Kanahā Beach Park may require review and approval by the DLNR OCCL and/or the Board of Land and Natural Resources (Board). The rules for Conservation Districts are administered by DLNR OCCL and the Board pursuant to HAR Chapter 13-5. The rules identify a wide variety of land uses that are permissible based on four categories of agency review. HAR Chapter 13-5-23 identifies land uses that are permissible within the Limited Subzone. Identified land uses within the rules may require no permit from the DLNR or may require a site plan approval, department permit, or board permit depending on the scale and nature of the proposed action.