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STATE OF HAWAII
LAND USE COMMISSION

Witness Statement of Noreen Dougherty

February 10, 2021

Q. Please state your name and place of residence.

A. My name is Noreen Dougherty and I live in Kapaʻa, Kauaʻi. I've had the same current residence for almost 24 years, which is within walking distance to Kapaʻa Middle School.

Q. Please discuss your background in education and school administration.

A. I have been an educator in Hawaiʻi for over 40 years, with most of that time spent in Kapaʻa. I went to the University of Kentucky and graduated in 1974 with a major in Elementary Education with a special emphasis in alternative curriculums and methods of teaching. In 1975, began teaching grade 4 in Perth, Australia before moving to Hawaiʻi. I taught English as a Second Language in Kapaʻa Elementary and High Schools in 1978 and 1979. In 1992, I enrolled in Chaminade University's Castle Outreach Program where I completed 30 hours of graduate level Montessori Education classes while working in Kamuela Montessori School on Hawaiʻi island. Kauaʻi did not have a Montessori school at that time. I also received pre-primary education certification by the American Montessori Society in 1994.

In 1996, I opened my own Montessori Hale program in Kapaʻa, Kauaʻi during which time I have been taking additional courses, including over 450 hours in Educational Kinesthetics by the Educational Kinesiology Foundation and other courses. The Montessori Hale Pre-primary (ages 3-6) Program served the Kapaʻa community for over 20 years.

In 2000, I began working at Island School on Kauaʻi to design, create, and establish their preschool. I also taught curriculum development courses for Chaminade University on Kauaʻi, Maui, and Hawaiʻi island that focused on Montessori curriculum design. I have been a keynote speaker for the American Association of University Women and the Hawaiʻi Congress of Parents, Teachers, and Students, also known as the Hawaiʻi State PTSA.

My three children attended Kapaʻa area schools beginning in 1989 to the early 2000s. Throughout that time, I was a member of their Parent, Teacher, and Student Associations and was the vice-president of the Kapaʻa High PTSA. Over the years, I have had close contact with many of the families in the Kapaʻa area and at the Kanuikapono Charter School in Anahola. Many of my preschoolers went on to attend Kapaʻa public schools. Some participated in programs that I sponsored during vacations, educational workshops, and tutorial sessions. Currently, I design and

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implement creative programs for children ages 5-10, offer private educational sessions and various educational and test-prep workshops.

<u>Q. Do you agree with representations that there are sufficient educational and school facilities in the surrounding area to service the proposed HoKua Place development in Kapaʻa?</u>

A. No. I understand that HoKua Place planners are relying on representations that Kapaʻa Elementary school has 904 students and a capacity for 942 students, Kapaʻa Intermediate has 607 students and a capacity for 781 students, and that Kapaʻa High School has 1,083 students with a capacity of 952 students. Leaving aside the obvious overcrowding at Kapaʻa High School, I have concerns about the concept of "capacity" that is being applied to the availability of school services in Kapaʻa.

The State Department of Education (DOE) relies on a concept of student to teacher ratios that was put forth in 2004 and is out of date and inappropriate. Today, students are different and have special needs and complicated behavioral issues. So, I do not agree with any DOE statements indicating that there are sufficient school services for 82 more elementary students, 42 more middle school students, and 32 more high school students. It is not a matter of matching a child to a desk. I would also question how the developer estimated that only 156 school-age children are expected from 769 homes. Hawaiʻi census data indicates an average of three people live in each household, which would mean at least 769 more students, conservatively assuming two adults and one child per house.

In the course of my work I have developed a network of contacts between teachers, staff, and other employees on the Kauaʻi school campuses as well as in the State DOE District office. It is generally known throughout the community of educators on Kauaʻi that student populations are increasing, more students require special education services, the schools are understaffed, many positions remain unfilled, and there is a dire need for further educational workers, particularly for special needs students. Throughout, students, teachers, and parents have had to work through DOE budget cuts. With projected budget cuts due to state finances related to the COVID-19 pandemic, the situation will worsen.

According to data compiled by the U.S. Department of Education's Office of Special Education and Rehabilitative Services, many schools and districts are facing increasing demands for special education services that exacerbates the challenge of nationwide teacher shortages. Across the U.S., students enrolled in special education classes from ages 3 to 21 has been growing since at least 2010. The majority, 95 percent, of students with disabilities ages 6 to 21 years are educated in regular classroom settings such as those in the public school system.

Many of my former Montessori school students and current tutored-students are in the public school system where they have not been able to obtain adequate special needs services. From what I observe, Kapaʻa area schools are understaffed and unable to meet the needs of current students. Even positions that are staffed do not have persons qualified to meet the needs of the kinds of students that are increasingly entering the public school system. I know of parents who advocated for special needs services, but the school administrators told them that they are understaffed and could not supply paraprofessional services.

Based on my decades long experience in the educator community on Kauaʻi, I do not believe there are sufficient school services available for the existing student population and that the adverse impacts on educational quality would be exacerbated by the influx of more students in this area.

<u>Q. Do you believe the proposed HoKua Place development in Kapaʻa is consistent with the 2018 County of Kauaʻi Kākou General Plan?</u>

A. No. The 2018 Kauaʻi General Plan's "opportunity" goal under the economy sector, which is to "Ensure widespread access to health care, education, and services." As stated in response to the above question, the Kapaʻa area public school system is not ensuring widespread access to education and services.

Further the 2018 Kauaʻi General Plan's Policy No. 17 is "Nurture our Keiki", which states: "Value youth as Kauaʻi's most treasured resource. Provide them with safe communities, great schools and facilities, and financially sustainable jobs, housing, and transportation opportunities so they are able to seek livelihoods on Kauaʻi." Kauaʻi is not able to provide great schools and facilities for the existing population of school-age children and adding further students without adequate planning and staffing would exacerbate the situation.

Q. Do you have other concerns about the availability of school services for the HoKua Place project and impacts on school services?

A. I have a related concern about transporting students to school. The state provides bus services. However, the majority of Kapaʻa residents drive their children to school. As things stand now, school related traffic is horrendous. Teachers, parents dropping off students, High school students driving cars, school buses, county buses, and kids walking or riding bikes at the same time as the sunrise is blinding the drivers as it directly shines in their faces. I've taken photographs of the area near Kapaʻa Middle School and roundabout from the Kapaʻa Bypass Road and submitted them as exhibits.

One of the planned entry roads to HoKua Place would intersect with Olohena Road, which road already has three roads merging into it near Kapaʻa Middle School. The other planned road to HoKua Place would be on Kapaʻa Bypass Road. This road is dangerous and when there are accidents, all traffic stops. The addition of more students and more traffic would overwhelm this area and pose risks to public safety. As it is, East Kauaʻi lacks police services. I once called a police officer who told me that there were only two police cars from Līhuʻe to Hāʻena at that time. The school capacity issue is just one of many issues that tie into a larger lack of infrastructure and public services in Kauaʻi.

Q. Does this conclude your testimony?

A. Yes.

Fiscal Benefits
The construction and the subsequent operation and maintenance of the master planned community HoKua Place would generate significant, on-going economic and fiscal benefits for residents of Kauai, as well as for the County and State governments.

Development and construction of the Project facilities would generate employment and consequent tax revenues over several years. Thereafter, the Project supplement that with increased State and County tax revenues through increased property assessments from property owners, as well as additional general excise and increased income taxes from property owners that put their units into the long-term rental market (to say nothing of the increased employment from marketing, maintaining and operating those rental units).

In addition to this additional real estate sales activity, the Project is expected to support long-term impacts, such as additional consumer expenditures, employment opportunities, personal income and government revenue enhancement that are a result of the increase in housing stock (to say nothing of the long-term wealth effects on local owners.)

There are other significant secondary impacts as the excise tax and income (and job) generation works their way through the local economy. It is worth noting that some of these impacts will continue after completion of construction and final occupancy.

Like other major residential development, the increase in the tax base of the county in which development occurs more than offsets the cost imposed on the fire and the police department and other public agencies for their services.

The additional number of personnel to be hired by the fire and police departments is significantly lower to the number of those who will be working on the Project construction, services, et. al. before and after completion. And as the master plan is central to existing fire and police services, these costs will be much less than, say, a similar Project outside of the township areas.

Public Services & Facilities
Police protection for the Kapaʻa, area is provided by the Kauaʻi County Police Department, with its main headquarters located in Līhuʻe. A substation is located in Kapaʻa Town approximately 0.5-mile away from the Property.

Fire protection is currently available for the Kapaʻa area from a new county fire station located on the north end of Kapaʻa Town, approximately 2.0-miles away from the property on Kūhiō Highway.

Petitioner will work with State and Local Civil Defense on incorporating appropriate siren coverage that may include a 121 db(c) omni-directional siren within the 3.1 acres designate for the proposed park area below Kapaa Middle School.

Education
In recent decades the requirement to provide land and money for schools was imposed by state and county agencies as a condition of urbanizing land. The Department of Education (DOE) collected payments of school land and cash from some developers when their Projects were required to make “fair-share contributions” by the State Land Use Commission or the counties to gain Project approval.

The DOE was only granted its own authority to collect impact fees by Act 245, Session Laws of Hawaii 2007.

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Prior to enacting Act 245, the State Legislature in 2005 established a School Impact Fee Working Group ("Working Group"). The Working Group submitted its findings and recommendations in a report, Hawaii School Impact Fee Working Group Report in March 2007.

The 2007 report analyzed salient issues, including "Fair Share" practices; conducted two case studies for specific areas in Central Oahu; and offered impact fee legislative language. The 2007 report also provided a framework, or procedure, for determining fee schedules for those areas of the state experiencing enough new residential development to create the need for new or expanded school facilities.

Act 245 incorporated many of the findings and recommendations in the 2007 Report. The Act authorizes the Board of Education to designate school impact districts. The DOE may charge impact fees within school impact districts where new public schools must be constructed or expanded to accommodate the children from new homes.

The Legislature determined that new residential developments within identified school impact districts create additional demand for public school facilities. Developers of new housing are required to pay a portion of the cost of providing new or enlarged public schools to serve the additional students who will be living in the new housing. The land or fees charged are based on each new development's proportionate share of the additional demand on public school facilities.

At this time, neither Kapaʻa nor any other district on Kauaʻi is designated as a School Impact Fee District. According to Heidi Meeker, Planning Section, DOE Facilities Development Branch, the DOE will not be asking the HoKua Place Project for any contributions or impact fees at this point in time.

DOE does not have any current plan to propose an impact district in Kapaʻa. However, it is possible that a future impact district may cover Kapaʻa. In that event, HoKua Place may be required to pay impact fees, based on the fee schedule established for the district.

Heide Meeker of DOE Facilities Development Branch informed representatives of HoKua Place that the DOE will not be requesting any contribution of impact fees from HoKua Place.

The following is a summary of information concerning existing school facilities serving HoKua Place, estimated student generation due to the Project and other information concerning impacts to school facilities. This information is based on information in DOE's Classroom Utilization Report 2007-2008 (CUR 07-08.), and a letter dated December 26, 2018 from Kenneth G. Masden, II, Public Works Manager of the DOE Planning Section.

The Kapaʻa Middle School is adjacent and to the north of the HoKua Place Project. Kapaʻa High School and Elementary School share a campus, which is located within 2-miles of the Property.

Kapaʻa Elementary School serves grades K-5 and has classroom capacity for 942 students (DOE). The 2018/2019 school year fall enrollment was 904.

Kapaʻa Middle School, has classroom capacity for 781 students, was opened in 1997 and had a fall enrollment for the 2018/2019 school year of 607 students.

Kapaʻa High School has a classroom capacity for 952 students and had a 2018/2019 fall enrollment of 1,083 students.

Note that Kapaʻa Elementary and Middle schools have student enrollment significantly less than the capacity of each school.

Project enrollment is summarized below:

School	Capacity	Enrollment	Excess Capacity
Kapaʻa Elementary	942	904	38
Kapaʻa Middle	781	607	174
Kapaʻa High	952	1,083	-131

In discussions between HoKua Place and the DOE (Heidi Meeker), a preliminary spread sheet that calculated student generation estimates, as well as computed impact fee was provided to HoKua Place.

Below is the indicated student generation for the HoKua Place Project, based on 86-single-family units and 683-multi-family units (estimated Kapaʻa-area-only SGR:)

Student Generation (Rate)	S.F.	M.F.	Student Generation (Students)	
Elementary	0.13	0.10	Elementary	82
Middle	0.06	0.05	Middle	42
High	0.10	0.03	High	32

DOE accepts the estimated student count and agrees with HoKua Place. DOE representative Heidi Meeker stated DOE does not have a have a problem with the general assessment that there is sufficient capacity in the Kapaʻa schools at this point in time to accommodate the students who will reside in the Project.)

Recreational Facilities
There are several parks within Kapaʻa town, including a beach park, that are within walking distance of the Project area. A County owned 1.9-acre park is located within walking distance from the subject property, just south east of the corner of Olohena Road and the Bypass Road roundabout. The park consists of a baseball field, football field, basketball courts, restroom facilities, picnic tables and a barbecue area.

Healthcare Services
Mahelona Medical Center located in Kapaʻa (approximately 2-miles away from the Project) is Kauaʻi's Eastside Critical Access Hospital, providing 24-hour emergency services. The facility is part of the Kauaʻi Region of Hawaiʻi Health Systems Corporation. Both Kapa`a and Līhuʻe (8-miles away) provide healthcare facilities and services.

4.8.2 Potential Environmental Impact & Mitigation Measures

Population
An increasing population base via natural growth and inevitable in-migration, coupled with the intrinsic worldwide demand for Hawaiian tourism and its limited land resources, will help in a revival of the economy, along the well-established, highly cyclical historic trend lines.

The population growth is seen in the following chart.

Photographs by Noreen Dougherty on February 5, 2020 at 3:15pm. 3:18, 3:21pm.

Photo #1: It took 6 minutes to get up to the dark colored telephone pole.

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Photo #2: The roundabout is by the tall silver pole in the photos. The cars are facing south toward Lihue. Hokua Place is across the roundabout, the public bus stop is on the left and the middle School is on the right up the hill on Olohena Rd.

<u>**Witness Statement of John Harder**</u>
February 10, 2021

<u>Q. Please state your name and place of residence.</u>

A. My name is John Harder and I live in Anahola, on Kauaʻi.

<u>Q. Please discuss your background in solid waste issues, particularly on Kauaʻi.</u>

A. I moved to Kauaʻi in 1969 after which I worked initially in construction and then ~~on~~ designing and installing alternative energy systems. In 1989, Kauaʻi County hired me on as their Solid Waste Coordinator and I was tasked with starting up their solid waste management program. While with the county, we constructed a new refuse transfer station in Līhuʻe, closed the existing landfill near Puhi, and implemented the first publicly supported recycling and composting projects in the state. In 1991, I headed the state Department of Health's Office of Solid Waste Management on Oʻahu. In 1999, I moved to Saipan to work on cleaning up one of the worst dumps in the Western Pacific. I came back to Hawaiʻi in 1999 to take over solid waste operations for Maui County. Then in 2006, I returned to Kauaʻi and helped to found Zero Waste Kauaʻi, which is a local nonprofit organization that advocates for sustainable solid waste practices. In 2008, I retired but have worked part time for Kauaʻi County to develop and implement waste diversion strategies.

<u>Q. Please comment on the availability of basic services for the proposed HoKua Place development, specifically solid waste disposal?</u>

A. HoKua Place proposes to use county solid waste disposal for the 86 single family residences and a private solid waste disposal company for the 683 multi-family units in the development. The county residential waste collection operates a service by subscription and costs approximately $120 to $180 per yearr based on the size of solid waste disposal cart provided. The fee includes use of the refuse transfer station for single family residential refuse. For the multi-family residences that will be serviced by private commercial haulers, one of the constraints often faced is the availability of adequate space for additional containers to manage recyclables and greenwaste. At a minimum, any new multi-family developments should have a recycling plan and provide adequate space on-site for those managing recycling and greenwaste activities.

Whether HoKua Place uses county or private services, the waste will have to go somewhere. If the solid waste is sent to the landfill, the existing landfill in Kekaha has already been expanded at least twice. Kekaha landfill is full. The waste taken there keeps building it up higher and higher, and Kekaha will reach capacity – there is less and less time remaining to use it. [The current county solid

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waste coordinator, Allison Fraley, recently explained that that expected life of the Kekaha landfill is only seven years and the county is still "evaluating the feasibility of the vertical expansion of the landfill" as well as other options outside of the landfill. *See* Email from Allison Fraley, Acting Solid Waste Chief, County of Kauaʻi Solid Waste Division, Subject: UIPA response (Jan. 19, 2021).] The ultimate limits of landfilling solid waste need to be addressed prior to allowing any further development.

Although the HoKua Place final environmental impact statement states "the County is currently pursuing a new landfill in a more central location (in the vicinity of Līhuʻe)", it is incorrect to conclude there is "necessary capacity to accommodate the proposed Project." 2019 FEIS at 102. The County has been planning for a new landfill in the area Mauka of Kalepa Ridge (mauka of Hanamaulu Town, about two miles north of Lihue) for a number of years, for well over a decade. However, one question that is currently being reviewed is the location of the proposed landfill due to the high cost of access and the proximity to the Airport. Restarting the site selection process, including public hearings and preparation of an environmental impact statement (EIS) will take considerable time. Landfill capacity is a major issue on the island and every increase in waste generation adds another straw to the camel's back.

Another issue insufficiently addressed by the HoKua Place application is the waste from construction and demolition (C&D) generated during the project's development. The project's final EIS simply states that the project "will seek to reduce, reuse, and recycle materials and waste to the greatest degree possible" and acknowledges that non-recyclable construction materials will have to be disposed of in the Central Kauaʻi Landfill. FEIS V. 1 at 102. The County currently has a draft C&D Recycling ordinance that would require all contractors, as part of the Building Permit process, to submit C&D Recycling Plans. That proposed requirement should be part of any approval for rezoning. The volumes of land clearing debris, scrap lumber, roofing, and other construction waste sent to the landfill should be minimized!

<u>Q. As proposed, does the project propose to use lands that may necessitate unreasonable investment in public infrastructure?</u>

<u>A.</u> HoKua Place is situated in nearly the center of the Kapaʻa/ Wailua district and would almost certainly rely on the existing Kapaa Refuse Transfer Station, just up Apopo Road from the proposed HoKua development. Access off Olohena Road to this station is totally inadequate. In terms of traffic and safety, it is in the wrong place. In addition the refuse transfer station is reaching capacity as more and more development in the Kapaʻa -Wailua area comes on line. Both traffic on the narrow roads accessing the Transfer Station, the capacity of the outdated trash compaction system,

and the overall land available for expansion limit the viability of the facility. It will become necessary for the County to significantly upgrade or relocate the existing facility.

Years ago when I was the County's Solid Waste Coordinator, the County required developers in Lihue to pay, up front, for a portion of the costs of a new refuse transfer station. Construction of a new refuse transfer station in an appropriate location should be a prerequisite or concurrent requirement for development of HoKua Place.

The County does not have the capacity to manage solid waste effectively. All new developments, especially those looking to rezone agricultural land to urban, should either cover the additional waste management costs for the services they will require or have in place, policies, plans and adequate space within their development to minimize those impacts. HoKua Place's plan to have a collection system for recyclables is a good start but does not do enough to mitigate Kauaʻi's already significantly impacted solid waste infrastructure.

Current County recycling efforts are managed through series of inefficient and costly drop-off locations. The material is then processed through a laborious hand sort at a local recycler. The process limits the volumes and quality of material that can be diverted and inhibit residential participation. The current County Integrated Solid Waste Management Plan call for the construction of a modern, state of the art materials processing facility and the implementation of residential curbside collection. Hokua Place should be required to proportionately participate in the development and construction of that facility.

<u>Q. How would redistricting agricultural lands into the urban district impact solid waste issues?</u>

A. If these agricultural lands are redesignated as "urban," the land use policies and future growth for the area between Kuhio Hwy and the bypass will be disturbed. It is essential to the rethink solid waste and wastewater infrastructure for the area prior to up zoning additional land. Until infrastructure and management/ oversight are in place, intensifying development in this area is very risky. Although redistricting the agricultural land at HoKua Place site won't break the back of the system it will open the way for more development, which could severely impact environmental services in the Kapaa / Wailua area.

<u>Q. Does this conclude your testimony?</u>

A. Yes.

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EDUCATION

• University of California at Berkeley, College of Engineering: Civil Engineering (1961-1964)
• East Los Angeles Community College: Architecture (1964-1965)
• University of California at Berkeley, College of Environmental Design: Architecture (1965-1969)
• Kauai Community College: Various courses in Environmental Issues, Alternative Energy Systems, Personal Computers and PC Software (1972-1989)
• Chadwick University, Alabama (correspondence): Various courses in Environmental Management (1995 - 1999)

PROFESSIONAL TRAINING

• American Management Association (AMA): Project Management, Scheduling and Control (1986)
• University of Wisconsin/Extension, College of Engineering/Continuing Education:
  The Design and Management of Material Recovery Facilities (January, 1994)
  Correspondence Courses: Solid Waste Composting (1990), Solid Waste Recycling (1991), Collection and Transfer of Solid Waste and Recylables (1994), Waste to Energy Systems (1995), Solid Waste Landfills - Design and Operation (1995).
• Hawaii State Department of Health: MSW Landfill Operators (MOLO) Training (1994, 1995 & 1996)
• Solid Waste Association of North America (SWANA):
  Planning and Managing Integrated Solid Waste Management Systems (August, 1994)
  Processing Recyclables and Composting Operations (August, 1994)
  Managing Municipal Solid Waste & Recycling Collection Systems (September, 1996)
  Manager of Landfill Operations (MOLO) (May, 1999)
  Landfill Gas System Design and Operations (Sept, 2004)

PROFESSIONAL CERTIFICATIONS

• Solid Waste Association of North America (SWANA): Manager of Landfill Operations (MOLO)
• SWANA: Manger, Integrated Solid Waste Management Systems
• SWANA: Manager, Municipal Solid Waste Collection Systems
• SWANA: Manager, Municipal Solid Waste Recycling Systems

PROFESSIONAL RECOGNITION

• **Hawaii Society of Professional Engineers (Maui Chapter) 2004 Project of the Year**: Phase IV - Central Maui Landfill Entry Facility, including a new residential recycling drop-off center.
• **Solid Waste Association of North America (SWANA) Silver 2004 Solid Waste Management Excellence Award:** Saipan Integrated Solid Waste Management

System, including a new fully Federally compliant landfill, refuse transfer station, and recycling processing facility.

• **SWANA Gold 2004 Composting Excellence Award**: Maui County / EKO Systems Inc. / Pacific Biodiesel Co-composting Project, including a 40,000 ton per year co-composting facility, and an integrated operation converting cooking oil and greasetrap waste into bio-fuels.

PROFESSIONAL AND COMMUNITY SERVICE ORGANIZATIONS

- Solid Waste Association of North America (SWANA)
- National Recycling Coalition (NRC)
- Sierra Club of Hawaii
- Rotary Club of Hanalei Bay
- Maui Recycling Group
- Keep North Shore Beautiful (Keep America Beautiful affiliate)
- Zero Waste Kauai

EMPLOYMENT EXPERIENCE

County of Kauaʻi, Dept of Public Works

Waste Diversion Program Advisor / MRF Project Manager – March 2011 – present

- PAYT Ordinance
- Business Recycling Ordinance
- C&D Diversion Ordinance
- Materials Recovery Facility – Conceptual Design and Planning

Zero Waste Kauai, Kauai

- Founder, Zero Waste Kauai 2006
- Coordinated and presented Kauai Max 3R Conference and Kauai County Council Zero Waste Workshop (Aug 2007)
- Developed Zero Waste Event Manual (2009)
- Developed and Managed Kauai Business Recycling Assistance Grant (2015)
- Advisory Board, Zero Waste USA

Wagner Engineering, Hanalei

Party Chief, Survey - Feb 2006 - Aug 2008

- Construction and boundary survey
- Topographic, shoreline and flood elevation survey
- Project oversight and monitoring

Solid Waste Solutions

Principal, Environmental Consultant - July 2004 to present

- Development of an Integrated Redemption Network for County of Maui
- Proposal for Oma'oma'o Molokai, for the operation of a community recycling facility at the Molokai Landfill.
- Assised Maui County Recycling Office in the design and implementation of a 100 tpd Material Recovery Facility.
- Disaster Response Coordination, Solid Resources, Collier County Florida. Assistant Project Manager, Hurricane Cleanup.
- State Coordinator, America Recycles Day

Department of Public Works and Waste Management, County of Maui
Chief, Solid Waste Division - Nov 2001 to July 2004

- Managed a staff of 69 including the operation of 4 Municipal Solid Waste Landfills, the Olowalu refuse transfer station, refuse collection from over 22,000 single family residences, the operation of 7 recycling drop-off centers collecting nearly 2,500 tons of residential recyclables each year, and the operation of the largest biosolids co-composting facility in the state.
- Implemented the first and second Phases of automated refuse collection, automating collection for nearly 8,000 residences.
- Co-ordinated successful negotiations with the United Public Workers union amending the current refuse collection contract to allow for automated routing
- Negotiated permitting requirements for the new lined landfill at Central Maui.
- Completed the design and initiated construction of a new landfill entry facility, including recycling drop-off and refuse transfer capabilities.
- Implemented the processing of over 5,000 tons of stockpiled scrap metal from the island of Molokai.
- Initiated the design and construction of a 25 ton per day Material Recovery Facility.

Department of Public Works, Commonwealth of the Northern Marianas:
Director, Division of Solid Waste Management - 1999 to 2001

- Established the Division of Solid Waste Management within the Department of Public Works including the implementation of Saipan's first tipping fees.
- Implemented a wide range of pilot recycling projects including, the on-island diversion of scrap tires, the recycling lead acid batteries, and the regular separation and chipping of greenwaste
- Developed the Saipan Integrated Solid Waste Management Plan including the development of a Conceptual Facilities Plan for the island.
- Design and construction oversight of the Saipan Integrated Solid Waste Management System (SISWMS) which will include, when completed, a new federally compliant lined landfill, a 35 ton per day Waste to Energy incinerator, a 100 ton per day refuse transfer station, and a 25 ton per day materials recycling facility.
- Legislation and Regulations:
  - Solid Waste Tipping Fee Regulations (1999)
  - Omnibus Advance Disposal Fee Act (1999)
  - Beverage Container Tax Modification (2000)
  - CNMI Solid Waste Management Regulations (DEQ - 1999 / 2000)

Department of Health, State of Hawaii:
Solid Waste Coordinator - 1991 to 1999

- Established the Office of Solid Waste Management, received program approval from the Environmental Protection Agency.
- Implemented the State Integrated Solid Waste Management Act
- Revised the State Solid Waste Management Control Regulations (Title 11 Chpt 58.1 HAR) in compliance with RCRA Subtitle D (40 CFR 258), including the development of specific functional standards for non-landfill options such as MSW incinerators, recycling and composting facilities, and special waste management.
- Legislation:
  - Solid Waste Management Authority - 1992
  - Waste Disposal Fee Surcharge - 1993

Scrap Tire Recycling - 1993
County Used Oil Recovery Fund - 1993
Glass Advance Disposal Fee - 1994
Clean Hawaii Center - 1994
State Recycling Coordinator - 1995
Waste Disposal Fee Surcharge Increase - 1996
Criminal Dumping Provision - 1996

• Promoted the establishment of numerous composting projects throughout the State including Oahu's first major greenwaste diversion program and the State's first sewage sludge composting operation on Maui.
• Provided technical and regulatory support for the expansion of recycling processing capabilities on all islands including the establishment of glass processing operations on Maui and Hawaii and a plastic lumber production facility on Maui.
• Developed standards for and assisted in the implementation of the first three petroleum contaminated soil remediation facilities in the State.
• Assisted the County of Kauai in the implementation of “Operation Garden Sweep”, a program aimed at clearing the debris resulting from Hurricane Iniki while encouraging the maximum in source separation.
• Developed the conceptual State Disaster Debris Management Plan.
• Federal Grants:

Pollution Prevention Incentives for States (PPIS - USEPA), 1993-95: Hawaii Materials Exchange (HIMEX), Recreational Boaters Guide to Waste Management, Small Scale Composting ($186,000).
Residential Unit Pricing (USEPA), 1995-96: Workshops on variable rates for residential waste collection ($10,000).
PPIS, 1996-1998: Restaurant Waste Minimization Guidebook ($56,000).
Jobs Trough Recycling (USEPA), 1997-1999: Construction Demolition Salvage Exchange Facility ($200,000 - with DBEDT)
Disaster Debris Preparedness Plan (FEMA), 1998-2000: Development of a Statewide Disaster Debris Management Plan ($275,000).

Department of Public Works, County of Kauai:
Solid Waste Coordinator - 1989 to 1991

• Established the County's first Solid Waste Program.
• Planned and implemented the design and construction of the Lihue Refuse Transfer Station.
• Coordinated the design of the Koloa Refuse Transfer Station.
• Coordinated the development of a RCRA D closure plan for Halehaka Landfill.
• Planned, developed, and implemented Kauai’s first pilot drop-off recycling project.
• Planned, developed, and implemented Kauai’s first pilot greenwaste composting project
• Draft County Integrated Solid Waste Management Plan.
• Developed and Implemented the State’s first Residential DIY used oil recovery program.

Princeville Development Corporation, Hanalei Kauai:
Construction Project Manager - 1987 to 1989

• Planning, design and construction of various capital improvement projects including: the Princeville Airport Expansion (design), the Makai Club Golf Cottages upgrade (design and const), the C.E.O. residence remodeling (design and const), the Shereton

Hotel managers residence remodeling (design and const), the Prince Golf Course interim clubhouse construction (design and const).

• Continued oversight of the resort's facilities management program.

Princeville Development Corporation: Hanalei, Kauai
Facilities Manager - 1985 to 1987

• Management of various corporate properties including: the Princeville Shopping Center, the Makai Golf Course Clubhouse, the Makai Club Condominiums, the Makai Golf Cottages, the Princeville Airport.

• Supervision of a five man maintenance crew: Included responsibilities for carpentry, electrical, plumbing and air conditioning maintenance of the shopping center, clubhouse, condominiums and cottages, and airport.

• Supervision of a six person custodial crew: Included responsibilities janitorial maintenance on the shopping center, clubhouse, and airport.

• Planning and coordination of facilities and infrastructure for the Women's Kemper Golf Tournament, annually 1986 through 1989. Included electrical and communications systems, shelter, hospitality, and custodial services.

Princeville Development Corporation, Shereton Princeville Hotel:
Field Engineer, Quality Control Inspector - 1984 to 1985

• Inspection and testing of all structural concrete installation
• Inspection and approval of all construction and subcontractor work
• Approval and final acceptance of all finish construction
• Coordination of owners furnishing, fixture, and equipment installation.

Department of Public Works, County of Kauai:
Building Inspector - 1984

• Performed construction inspection and assured code compliance of new construction (residential, commercial and resort) on the east and north sides of the island of Kauai.

Architectural Energy Systems, Kapaa Kauai:
Owner, Energy Systems Consultant - 1980 to 1986

• Consultation, Planning, Design, Construction Supervision: Training services in the area of small scale energy technologies (solar thermal, solar photovoltaic, hydroelectric, bioconversion, and passive architectural systems) on the island of Kauai and the former U.S. Trust Territory of Micronesia.

• Consultation, Design and Installation: Two solar photovoltaic electrical generation systems, Moloaa (4.0kw), and Anahola (2.5kw), Kauai. 1985 & 1987

• Design and Construction Drawings: Two micro-hydroelectric systems, Ponape (10kw) and Kosrae (25kw), Federated States of Micronesia. 1982.

• Assessment of Small Scale Hydroelectric Potential: Federated States of Micronesia and The Republic of Belau. 1981.

• Hands on Construction Workshops: Solar hot water heating systems and solar food drying, Kauai. 1979.

Treehouse Drafting Service, Kapaa Kauai:
Owner, Design Draftsman - 1974 to 1984

• Provided consultation, design, and architectural drafting services principally in the area of single family residences and small commercial facilities.

Kauai Economic Opportunity, Lihue Kauai:
Energy Coordinator - 1975 to 1976

- Administered the local Federal Low-Income Energy Program and provided outreach and educational services in the area of self-help alternative energy systems.

Hawaii Community Design Center / Kauai Center, Kapaa, Kauai:
Vista Volunteer, Design Draftsman - 1974 to 1975

- Provided consultation, planning, design, and architectural drafting services to low-income residents. Coordinated the construction of self-help single family housing.

The One Ring, Kapaa Kauai:
Owner, Jewelry Designer - 1972 to 1976

- Design of custom gold and silver jewelry, sold through outlets on Kauai and Oahu.
- Instructor in jewelry design at Kauai Community College.

Morrison Knudsen Co, Princeville at Hanalei, Kauai:
Instrumentman, Survey - 1970 to 1972

- Performed road and utility staking, boundary survey, and construction layout during the development of a 1000 acre resort development on Kauai.

REFERENCES:

Allison Fraley, Solid waste Programs Coordiantor, County of Kauaʻi (808-241-4837)
Pat Gegen, Chair, Zero Waste Kauaʻi (808-635-2081)
Ron Wagner, Wagner Engineering, Hanalei, Kauai (808-822-5203)
Dana Bekeart, Professor of Humanities, University of Hawaii, Kauai (808-822-7842)
Pete Grogan, International Paper, Federal Way WA (253-732-3871)
Patricia Young, USEPA, Pacific Islands Office, San Francisco (415-972-3775)
Richard Gertman, Environmental Planning Consultants, San Jose CA (408-249-0691)
David Goode, Former Director, Maui County Department of Public Works (808-572-3011)
Ruebens Fonseca, EKO Composting Systems, Maui (808-572-8844)
Steve Chang, Manager, Solid and Hazardous Waste Branch, State of Hawaii (808-586-4226)

Gmail

Bianca Isaki <bianca.isaki@gmail.com>

UIPA re: capacity of the Kekaha landfill

Allison Fraley <AFraley@kauai.gov> Tue, Jan 19, 2021 at 9:19 AM
To: "bianca.isaki@gmail.com" <bianca.isaki@gmail.com>
Cc: Shirley Estenzo <sestenzo@kauai.gov>, Sherri Yasutake <syasutake@kauai.gov>

Aloha Ms. Isaki,

My apologies for the delayed reply.

The expected life of the Kekaha Landfill is currently 7 years. At this time we are evaluating the feasibility of vertical expansion of the landfill, and also assessing other options for future disposal capacity outside of Kekaha landfill.

Sincerely,

Allison Fraley

Acting Solid Waste Chief

County of Kaua'i Solid Waste Division

4444 Rice Street, Suite 295

Lihue, HI 96766

Phone: (808) 241-4837

www.kauai.gov/recycling

From: Public Works - voicemail account
Sent: Tuesday, January 19, 2021 9:00 AM
To: Allison Fraley <AFraley@kauai.gov>; Sherri Yasutake <syasutake@kauai.gov>
Cc: Shirley Estenzo <sestenzo@kauai.gov>
Subject: FW: UIPA re: capacity of the Kekaha landfill

Good Morning,

Fowarding for your handling.

Thank you,

Alison

From: Bianca Isaki <bianca.isaki@gmail.com>
Sent: Monday, January 18, 2021 9:32 AM
To: Allison Fraley <AFraley@kauai.gov>; Public Works - voicemail account <publicworks@kauai.gov>
Subject: UIPA re: capacity of the Kekaha landfill

CAUTION: This email originated from outside the County of Kauai. Do not click links or open attachments even if the sender is known to you unless it is something you were expecting.

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2021.01.18 UIPA kauai solid waste.pdf
222K

EXHIBIT "I-50"

Witness Statement of Adam Asquith, Ph.D.

February 10, 2021

Q. Please state your name and place of residence.

A. My name is Adam Asquith. I am a resident of Kauaʻi County and live at 4654 Hauaala Road Kapaʻa, Hawaiʻi 96746.

Q. Please discuss your skills, experience, and training background in areas relevant to your opinions on the proposed redistricting of 96 acres of agricultural land for the HoKua Place project?

A. I have a master's Degree in biology and a doctoral degree from Oregon State University. For the past 30 years, I've been working in Hawaiʻi. I worked as a research, conservation and management biologist for the University of Hawaiʻi and the U.S. Fish and Wildlife Service for 13 years. I was an Extension Specialist for University of Hawaiʻi Sea Grant for 13 years. I have been a commercial taro farmer for 20 years. I established and operate 100+acre farms, farming and managing fifteen other farmers. I have served as a board member on several nonprofit organizations, including the Kauaʻi County Farm Bureau and East Kauaʻi Water Users Cooperative.

I have taken a keen interest in water resource and development issues in Kauaʻi. Some years ago, I prepared a presentation to the Kauaʻi County Council to seek their support for designating a water management area in South Puna.

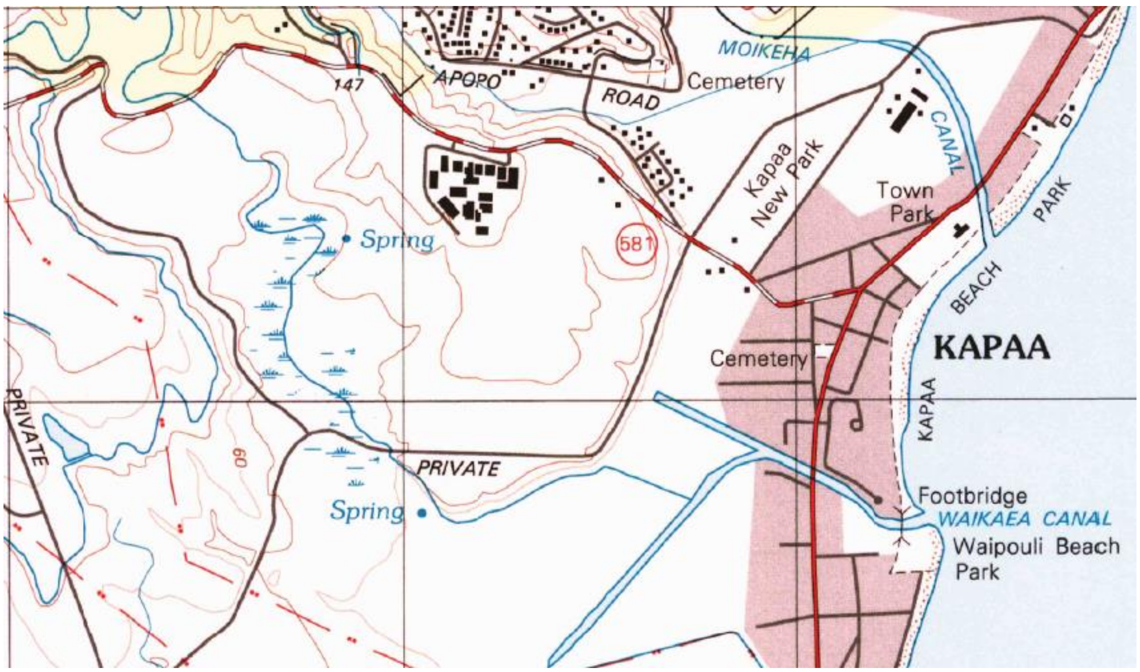
Q. Would the proposed redistricting of 96 acres of agricultural land for the HoKua Place project impact the presentation and maintenance of valued cultural resources and activities, and, historical, or natural resources, including water resource uses?

A. Yes. The traditional and customary practice of gathering is active on and around the property. This occurs in the form of hunting and harvesting pigs for food. I am aware of at least four native Hawaiians who regularly, or occasionally, use the area to acquire food this way. I have directly observed native Hawaiians harvest pigs from the property and feed their families with the gathered resource. This protected right also occurs on the surrounding agricultural properties with different habitat and different management. The boundary amendment and subsequent development would curtail this protected activity and extinguish the constitutionally protected practices that these practitioners are currently exercising on this property.

There are also water resources on the property that would be impacted. These are the stream, springs and at least one other well. The stream that runs adjacent to the property has gone by several names over the years. There is no name given for this stream on USGS maps, but the USGS database on water monitoring shows two stations on this stream: No. 1607600 as Kuhinoa

EXHIBIT "I-51"

Weir on Kaehulua Stream, and No. 1607400 as Kainahola Weir on Kaehulua Stream. Perhaps from the name of this upper weir, some recent State documents and reports from the East Kauaʻi Water Users Cooperative refer to this stream as Kainahola Stream. Other studies such as those by the Coral Reef Assessment and Monitoring Program of Hawaiʻi (CRAMP), have referred to this stream as Waikaea, from the makai drainage canal.[1] The most appropriate name for this stream is that given to it in the kamaʻāina testimony for Land Commission Awards (LCAs) Nos. 3971 and 3599, and that is Hahanui Stream. This stream has is origins entirely in the Koloa volcanic series, being cut off from the Na Pali volcanics by Makaleha and Moalepe streams. As such, it is entirely fed by ground water and springs. It is a perennial stream that historically fed lo'i kalo documented in the LCA Nos. 3971 and 3599, and undocumented loʻi further makai.



Expanded portion of Exhibit No. I-101, U.S. Geological Survey, Kapaʻa Quadrangle Hawaii-Kauai Co., 7.5-Minute Series (Topographic) (Mar. 31, 1999).

It is unclear if the project intends to place the working well in the same area as the test well (State Well No. 0419-05). This should be clarified. There are at least three springs within 1,000 feet of the test well, one mauka on the subject parcel adjacent to LCA 3599 and one just makai of the Kapaa bypass road as indicated on the USGS maps from 1971 and 1999. *See* Exhibit Nos. I-101, I-102. Another spring forms the makai boundary of LCA 3971 as described in kamaʻāina testimony.

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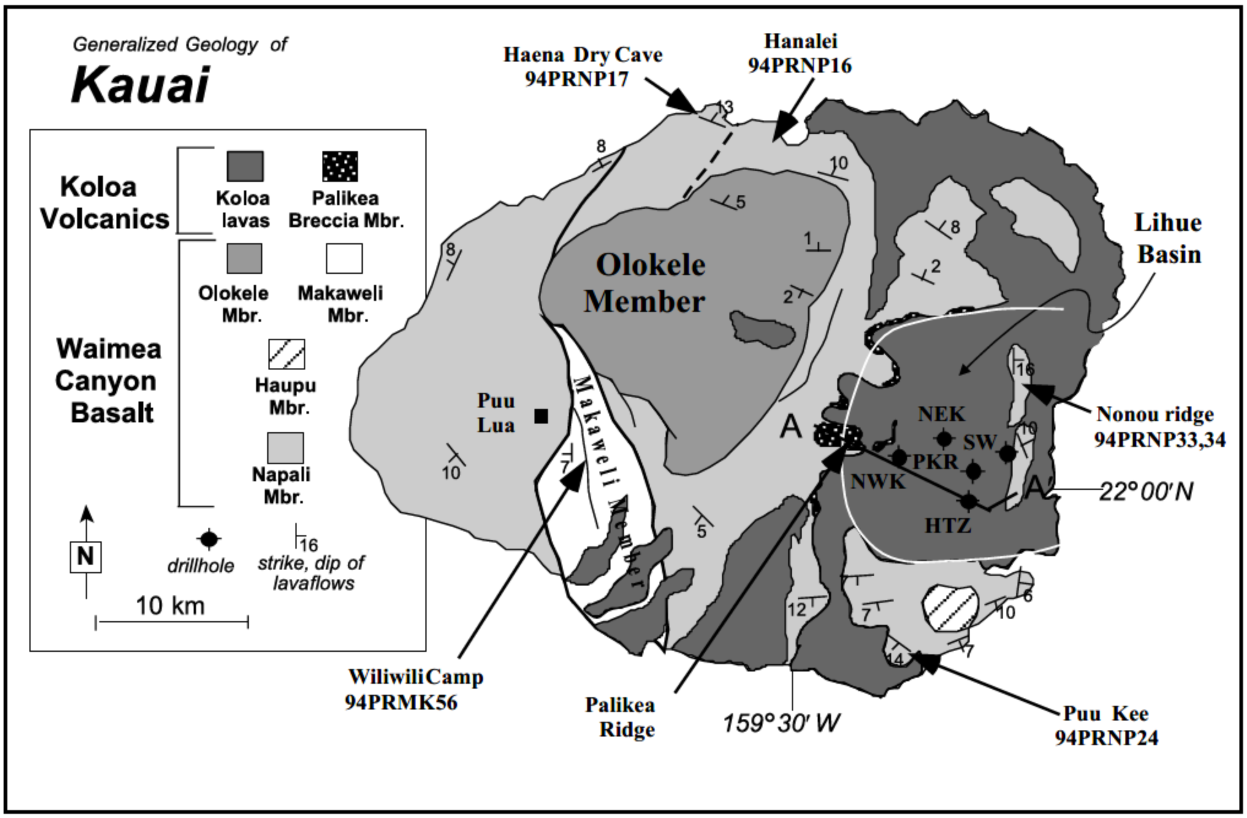
[1] *See* Coral Reef Assessment and Monitoring Program, Kauaʻi Island, Kawaihau region, Waiakea watershed (accessed Jan. 30, 2021) *available at*: http://cramp.wcc.hawaii.edu/Watershed_Files/kauai/WS_Kauai_kawaihau_waikaea.htm.

The Calvary Chapel Church has installed a well (No. 2-0419-009) just downstream of the test well and near the makai spring. The church uses the well for its drinking water.

Both Hahanui Stream, the springs, and the well are highly likely to be negatively impacted by the proposed project's well. We know this from the work that the USGS has done on the ground water in the southern Lihue Basin. *See* Exhibits I-52, I-53, I-54. These are the same volcanic substrates as the proposed project is located in. These volcanics have a unique hydrology, without typical discreet aquifers.



Generalized geologic map of Kauaʻi showing the primary lithologies and locations of the drill holes and other sample locations in and around the Līhuʻe basin. *Source:* P. Reiners et al, "Structural and petrologic evolution of the Lihue basin and eastern Kauai, Hawaii," 111: 5 *GSA Bulletin* 674, 675 fig.2 (May 1998).

In 2002, the U.S. Geological Survey (USGS) conducted modeling of the southern Līhuʻe basin to learn about the effects of proposed groundwater withdrawals on streamflow.[2] USGS modeling by shows that all ground water in this system is connected, and groundwater withdrawal causes an equally proportionate loss on nearby streams and springs. USGS concluded:

[2] S. Izuka & D. Oki, U.S. Geological Survey, "Numerical Simulation of Ground-Water Withdrawals in the Southern Lihue Basin, Kauai, Hawaii," Water-Resources Investigations Rep. 01-4200 (2002).

> The steady-state simulations indicate that with respect to stream base flow, the effects of the projected withdrawal increases will be greatest on streams nearest the location of the proposed wells. Redistributing withdrawal can change the effect on individual streams, but because streams are so numerous in the southern Lihue Basin, it is difficult to shift the net effect away from streams as a whole. Although the net effect on streams cannot be substantially reduced, the proportional effects can be partially mitigated by shifting ground-water withdrawal away from streams with low base flow and toward streams with high base flow. [3]

While the applicant's drilling consultant claims that the test well flow is from a discreet aquifer, CWRM disagreed with this interpretation, consistent with the USGS data. CWRM has also indicated that before approval of a well, they would require the applicant to conduct additional pumping tests to evaluate aquifer capacity. Exh. I-97 at PDF 32 (CWRM records for Well No. 0419-05, Letter from K. Kawahara, CWRM Deputy Director to M. Frandsen, High Plains Drilling, Abandonment and Permanent Sealing Required for Well No. 0419-05) (Jan. 5, 2009)). Such tests should also evaluate the effects on the stream flow, spring flow, and the makai well capacity. The burden is on the applicant, HG Kaua'i Joint Venture LLC (applicant) to actually demonstrate that the proposed well would function contrary to existing data, accepted models and CWRM's concerns. Demonstration of such benevolence on the water resources should be required before approval of any boundary amendment. Finally, the applicant may already have impacted the resources with a faulty well bore and failure to seal the well as ordered by CWRM. The applicant should demonstrate good standing and compliance with CWRM prior to any boundary amendment.

<u>Q. Would the proposed redistricting of 96 acres of agricultural land for the HoKua Place project impact the maintenance of other natural resources relevant to Hawaii's economy including, but not limited to agricultural resources?</u>

A. Yes. The boundary amendment would remove valuable and necessary farming lands from future use. Most of the subject area is identified as "Prime" agricultural land under the ALISH assessment. There appears to be about 50 acres of flat (no more than 12% grade), tillable grade B soils that are excellent or farming. Virtually all the farmable area in this parcel would be lost under the proposed project, with the proposed agricultural activity (grazing) being relegated to the sloping, non-Prime lands.

Through the loss of these farmable lands, the proposed amendment would also negatively impact Kauai's ability to generate sufficient food for our residents. The amendment proposal

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[3] S. Izuka & D. Oki, at 33.

admits that we do not produce sufficient food on Kauai to feed ourselves, but it punts the issue by stating that food can be produced on someone else's agricultural land. That is, of course, until those owners want a reclassification gift also. This mentality creates a rush to the trough of entitlement feeding so that you are not stuck with land that is required for food production. A more reasonable and balanced approach, and one that is actually consistent with the intent of land use laws and Kauai planning goals, would be to simply require that food production capacity be preserved on the remaining agricultural portion of the property sufficient to meet the needs of the residential development portion. The goat idea proposed in the Agricultural Plan is a nonstarter because of the grossly inefficient land use of grazing for food production. Let's say you harvest your goats at 60 lbs and you get dressed weight of 30 lbs. That would provide about one ounce of meat daily to an estimated 2,300 residents of the property. Or, according to the agricultural plan for the HG Kaua'i Joint Venture, LLC property, each residential household would be able to share one goat per year for consumption. In the County of Kauai's analysis for the Important Agricultural Lands (IAL) requirements, it determined that grazing is so inefficient, that it would take ALL the agricultural lands on Kaua'i to acquire our meat needs from this activity. The IAL study determined that without grazing for meat production, each person needs 0.3 acres for their food needs. This means that if the 100 acres were actually put in food production, it could support just around 100 households. That housing could easily be built on the non-prime lands, removing the inherent conflict between development and food production. Let me reiterate that while goat grazing is certainly agriculture, and I myself am a goat farmer, preserving agricultural to grazing on remaining lands, in no way addresses our community's ability to feed itself.

<u>Q. Do you have any other comments on the suitability of the proposed HoKua Place project for this location?</u>

A. Yes. I reviewed the applicant's "Agricultural Suitability for HoKua Place" dated June 2018, which is Exhibit C.1 to its final environmental impact statement and have the following comments.
Location: The applicant claims the location is not suitable for agriculture because it is too close to the school. This claim needs to be further examined. Until recently our schools had active agricultural programs, with farming on school grounds. Today teachers desperately try to find bus money to transport students to farms for field trips. Virtually all schools still have gardens on campus.
Labor: The HoKua Place application proffers the falsehood that we do not lack farm land but farmers. Nothing could be further from the truth. My experience is that when agricultural land is actually offered for farming, people beat down the door to get in. Fallow agricultural land banked

for two generations without making it available for farming, and then claiming nobody wants to farm it, is a self-fulfilling prophecy.

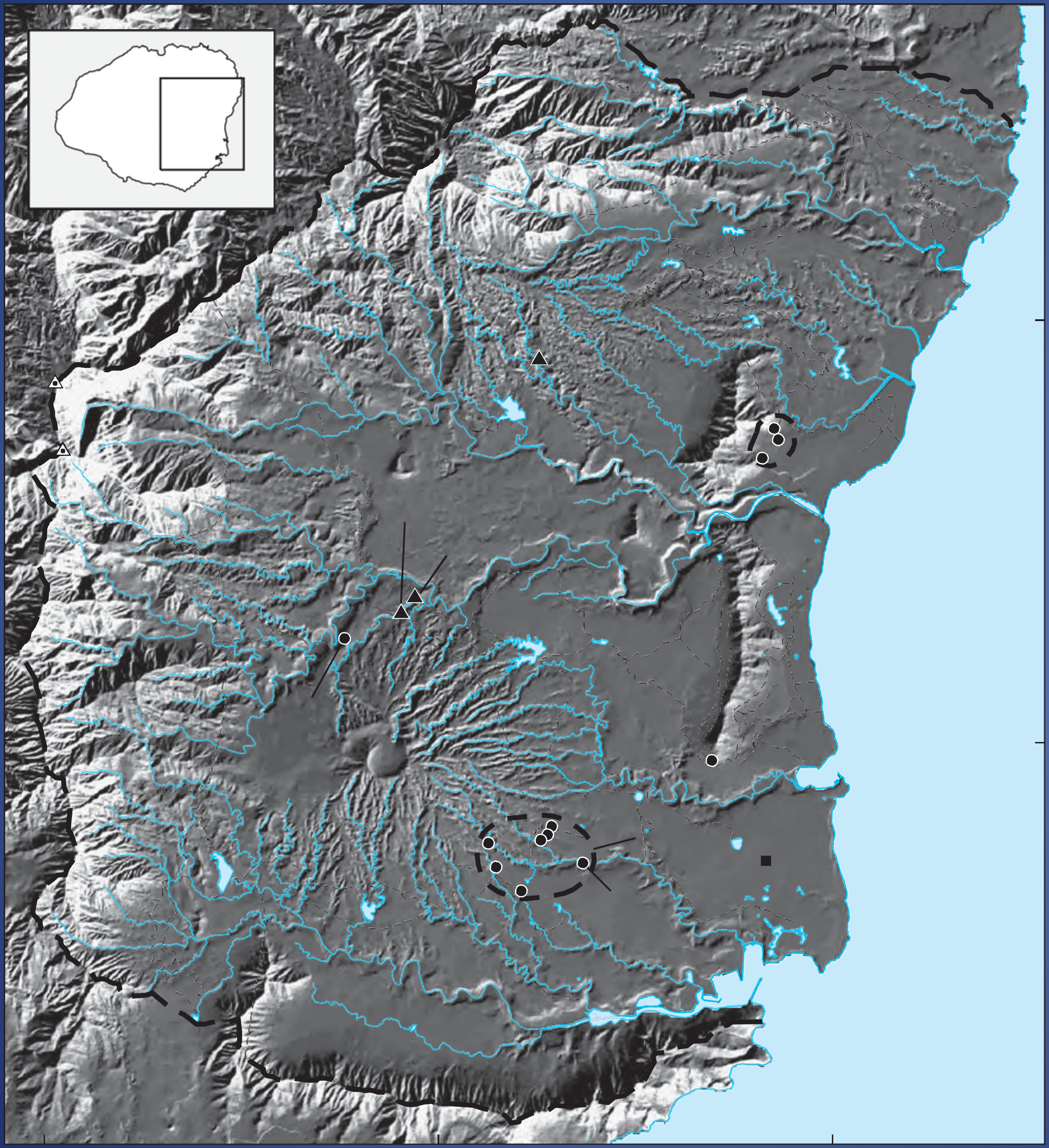
Infrastructure Costs: The HoKua Place proposal ignores that there is agricultural water delivered to the stream and the property from $19.24m in taxpayer funded infrastructure in the East Kaua'i irrigation system. *See* Exh. I-61 at 244 (CWRM Agricultural Water Use Development Plan Update)

The only part of this document that I think is accurate is found on Page 106, where it states that the traffic problem on Kauai is so bad that it significantly increases the difficultly and cost of getting crops to market. Indeed, thus increasing the traffic problem with an additional 769 units would further impact current and future agricultural production on this and other properties.

<u>Q. Does this conclude your testimony?</u>

A. Yes.

Adam Asquith, Ph.D.



Puna

Aia I Hea Ka Wai a Kane ?

2003
(Garden Island article)

- The DOW needs the water as much as Grove Farm does, because three Lihu'e wells have run dry, said Ed Tschupp, DOW manager and chief engineer.
- The DOW has four new wells in the Lihu'e area nearing completion, with two to be done by the middle of this year, and the other two finished by year's end, he said.
- Consultants are looking at the feasibility of drilling existing wells deeper. The Lihu'e area's hard rock means less well water, but more surface water, he said. The end of sugar irrigation over two years ago has meant less percolation of water to replenish the wells, Tschupp explained.

Water for Our Future

In the next few weeks, the Department of Water will be starting to use a new source of water. For our Līhu'e, Hanamā'ulu and Puhi customers, the water that will be flowing out of your tap will start to come from the mountain streams above Wailua and Hanamā'ulu. Before this surface water makes it into your home, it will be purified using advanced membrane filtration technology. This high-quality water produced through the microfiltration process will meet all of the stringent Federal and State drinking water standards.

Your water will be safe to drink.

Q. Where is my water coming from?

A. Right now, your water is pumped from underground aquifers (groundwater) that store water, originating from rainfall, that percolated through the soil and rock. Surface water comes more directly from rainfall in the watershed. Rainfall runs off the land, making its way into streams or rivers. The new source of water that Līhu'e, Hanamā'ulu and Puhi customers will receive originates from rainfall along the slopes of Mt. Wai'ale'ale, and flows from the upper reaches of the watershed into the Wailua River.

Q. How does the water get to my home?

A. Water from the mountain is diverted via the plantation-era waterworks and ditch system that supplies the Kapaia Reservoir (Tanaka Pond). This water will be pumped from the pond to a new, environmentally friendly Water Purification Facility, where it will be drawn through a microfiltration treatment system to remove any silt, microscopic particles and contaminants. After filtration, the water is further treated with chlorine and then pumped to an enclosed tank from which the treated water will flow by gravity to the water system and into your home.

Also, any system that you select should carry National Sanitation Foundation (NSF) certification.

We can help you find a solution. Call us at **245-5455**.

Q. Why is the Department of Water using surface water?

A. Our current groundwater sources in Līhu'e, Hanamā'ulu and Puhi are losing capacity, and new wells do not provide sufficient additional water for the current and future needs of the community. In order to support future generations of Līhu'e, Hanamā'ulu and Puhi residents, we need to find an alternate water source. Our current groundwater sources will not sustain us for the long-term. Not having enough water prevents growth and contributes to the lack of affordable housing.

Q. Will I have to pay more for surface water?

A. No. Your water rates will not increase due to the Department using a surface water source instead of groundwater.

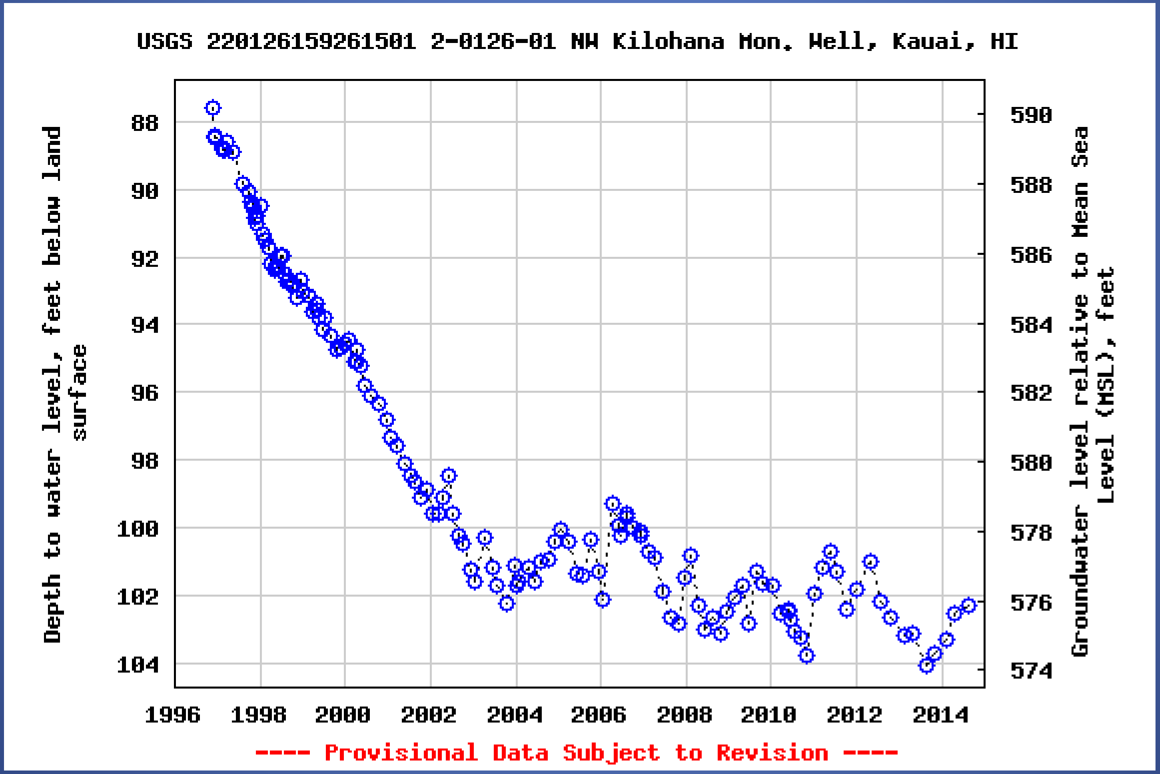
Q. Is this the first time that the Department of Water is distributing surface water to residents?

A. No. In the past, the Department relied on surface water as a water source in many areas of the island, however, the water treatment technology was old-fashioned, and groundwater from wells required less treatment, gradually replacing the use of surface water island-wide. Today's treatment technology is far superior to the technology last used by the Department prior to Hurricane Iniki. Historically, our dependence on surface water goes back to the earliest settlement of Kaua'i by the first Hawaiian people. Ancient Hawaiians saw streams as one of their most important resources. In fact, *wai* (fresh water) was considered to be sacred.

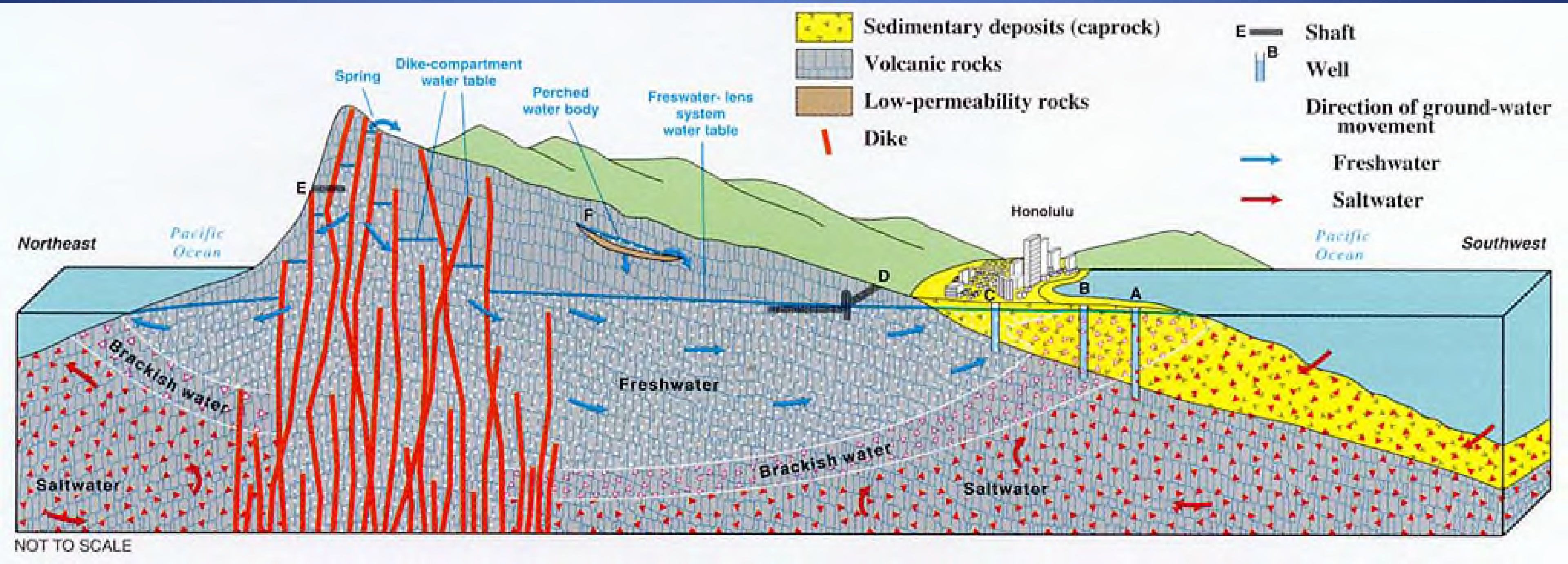
Q. I still have questions. Who can I talk to for more information?

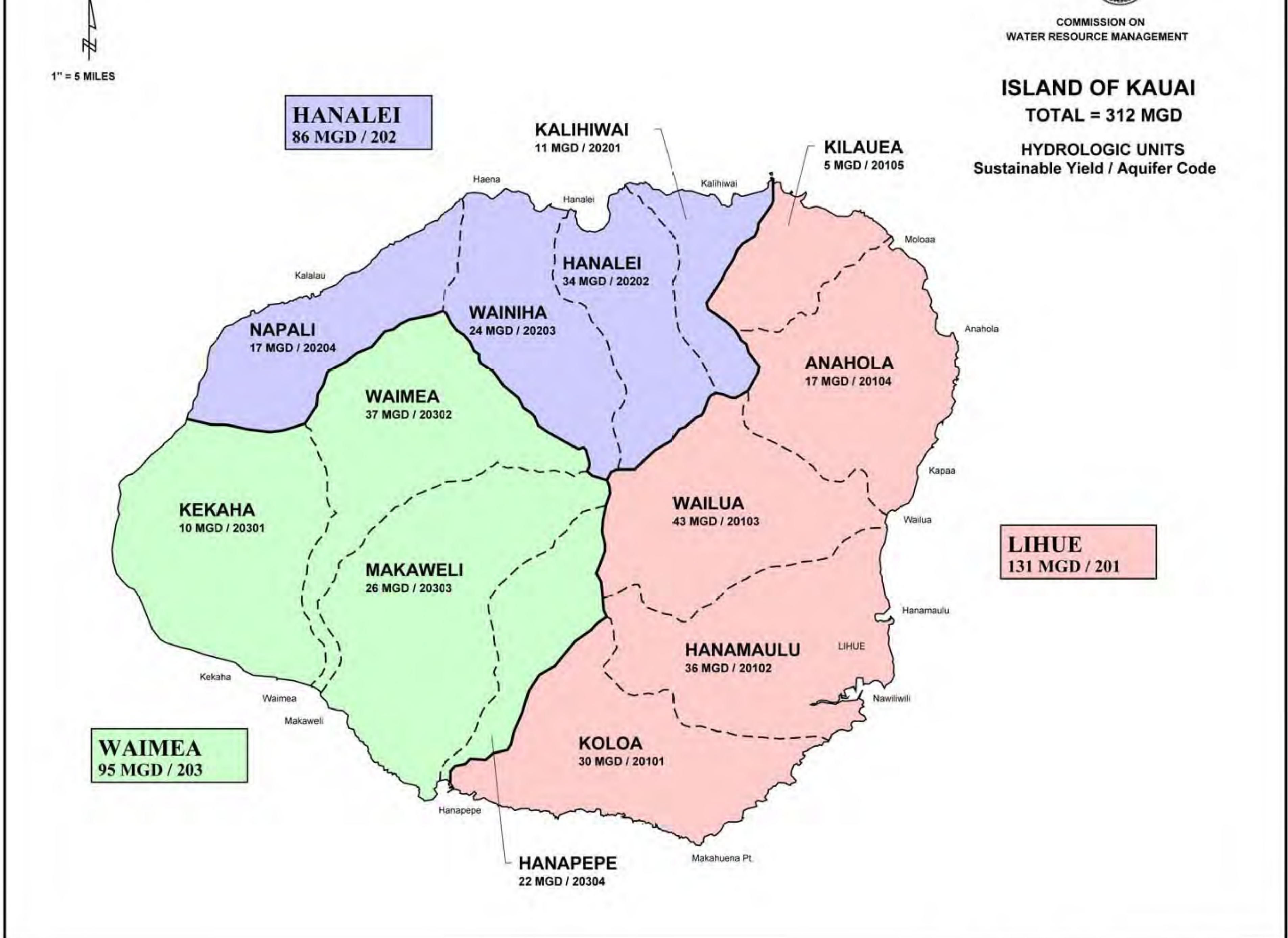
A. If you have any further questions about surface water or want more information, you can call the Department of Water at **245-5455**.

USGS Website NW Kilohana Well

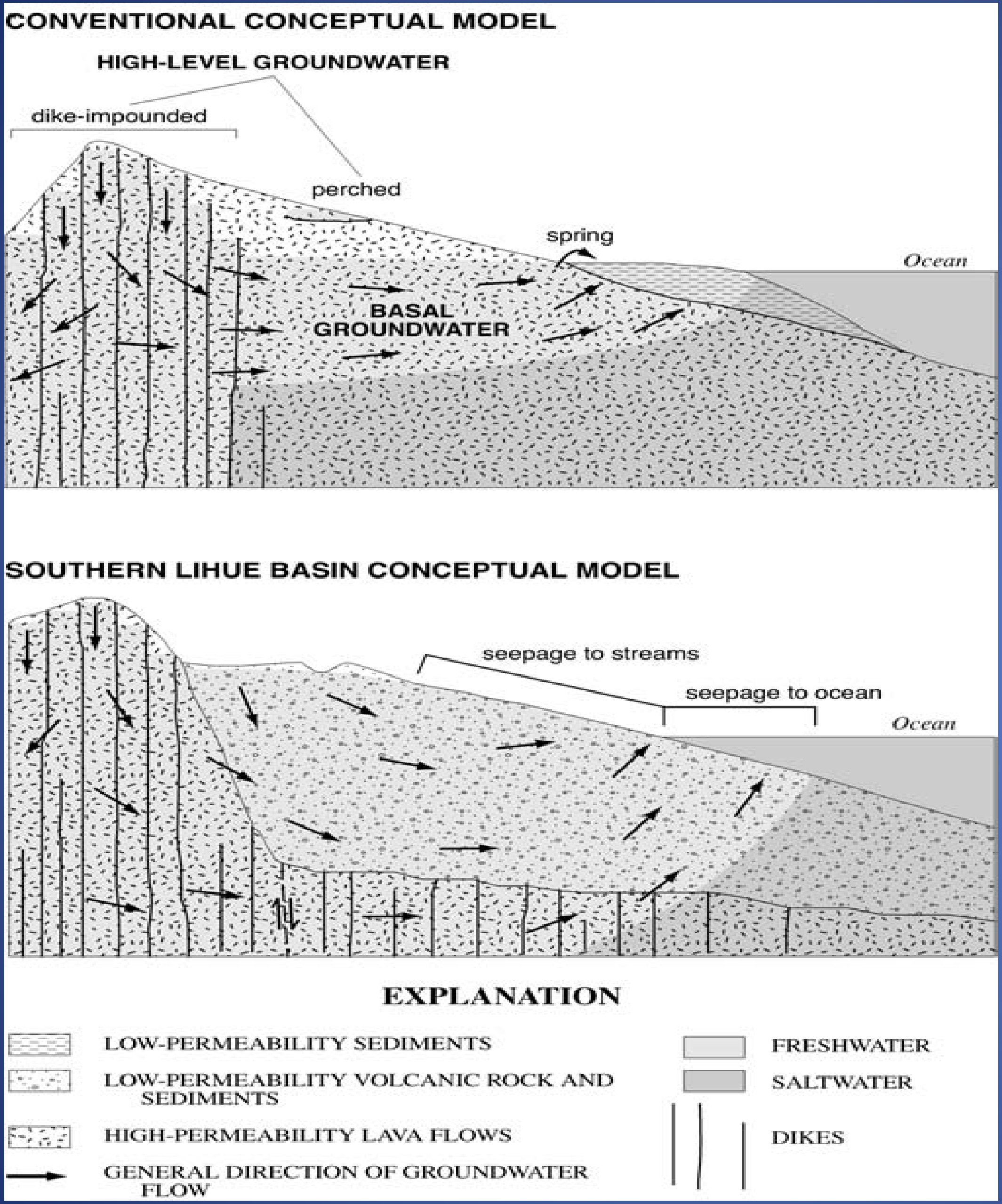


- The “basal” and “high-level” classifications of the conventional conceptual model do not account for the mode of occurrence of groundwater in the southern Lihue basin
- (Izuka and Gingerich 2002)





Map Projection: Universal Transverse Mercator


CONVENTIONAL CONCEPTUAL MODEL
HIGH-LEVEL GROUNDWATER
dike-impounded
perched
spring
Ocean
BASAL GROUNDWATER
SOUTHERN LIHUE BASIN CONCEPTUAL MODEL
seepage to streams
seepage to ocean
Ocean
EXPLANATION
LOW-PERMEABILITY SEDIMENTS
LOW-PERMEABILITY VOLCANIC ROCK AND SEDIMENTS
HIGH-PERMEABILITY LAVA FLOWS
GENERAL DIRECTION OF GROUNDWATER FLOW
FRESHWATER
SALTWATER
DIKES

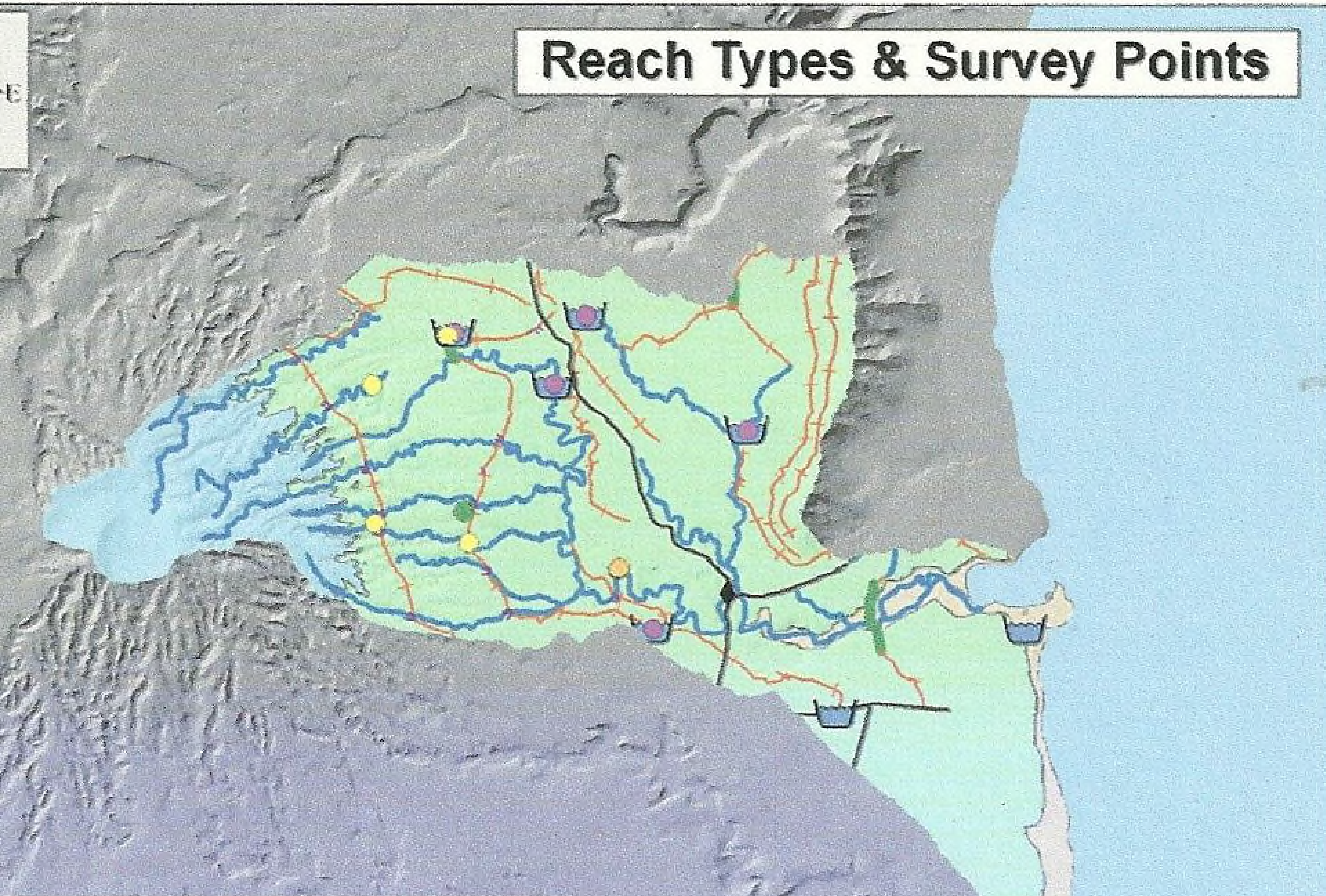
Why the Sustainable Yield Estimate Does not Match Observations

- Comparison of the base-flow and recharge estimates for the southern Lihue Basin indicate that groundwater discharge to streams constitutes at least 75% of the estimated 4.76 m3/s of recharge the southern Lihue Basin receives. (USGS 2002)
- Wells “compete” with streams for rainfall recharge

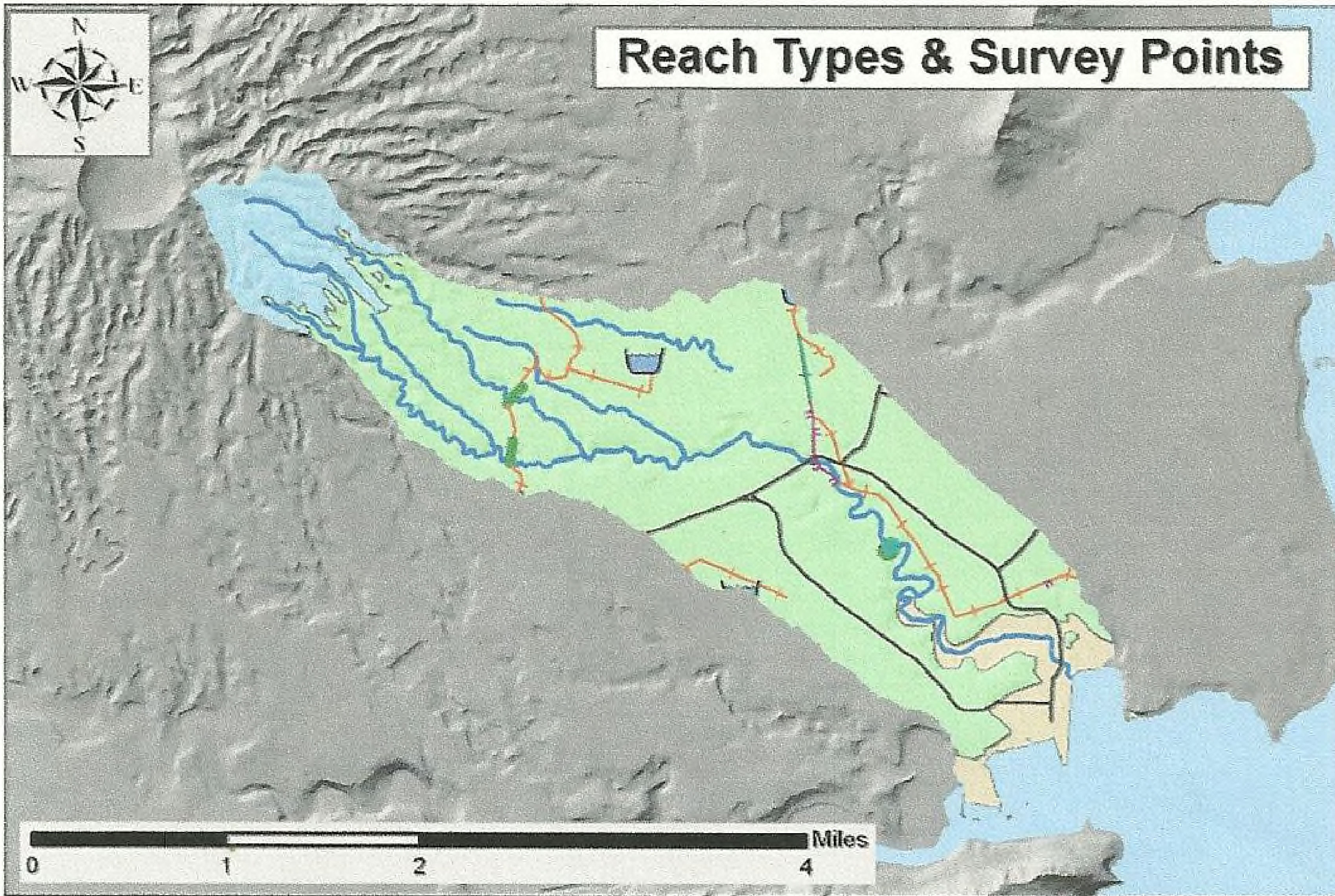
- In a sense, streams that incise the upper aquifer act as drains that shape the water table and are probably the principal reason that water levels in the rest of the basin remain below the ground surface.
- The model and stream gauge data analysis both show that most of the groundwater flowing through the southern Lihue Basin discharges to streams rather to the ocean.

USGS study of the effect of ground water pumping of certain wells on stream flow in south Puna

		Pumping Rates mgd			
Stream	**0.4**	**0.8**	**0.8**	**1.16**	**1.16**
		Flow reductions			
S Wailua	0.14	0.17	0.2	0.3	0.3
Hanamaulu	0.27	0.34	0.4	0.6	0.63
Nawiliwili	0.01	0.19	0.14	0.2	0.15
Huleia	0	0.09	0.06	0.09	0.06
Total	**0.42**	**0.79**	**0.8**	**1.14**	**1.13**

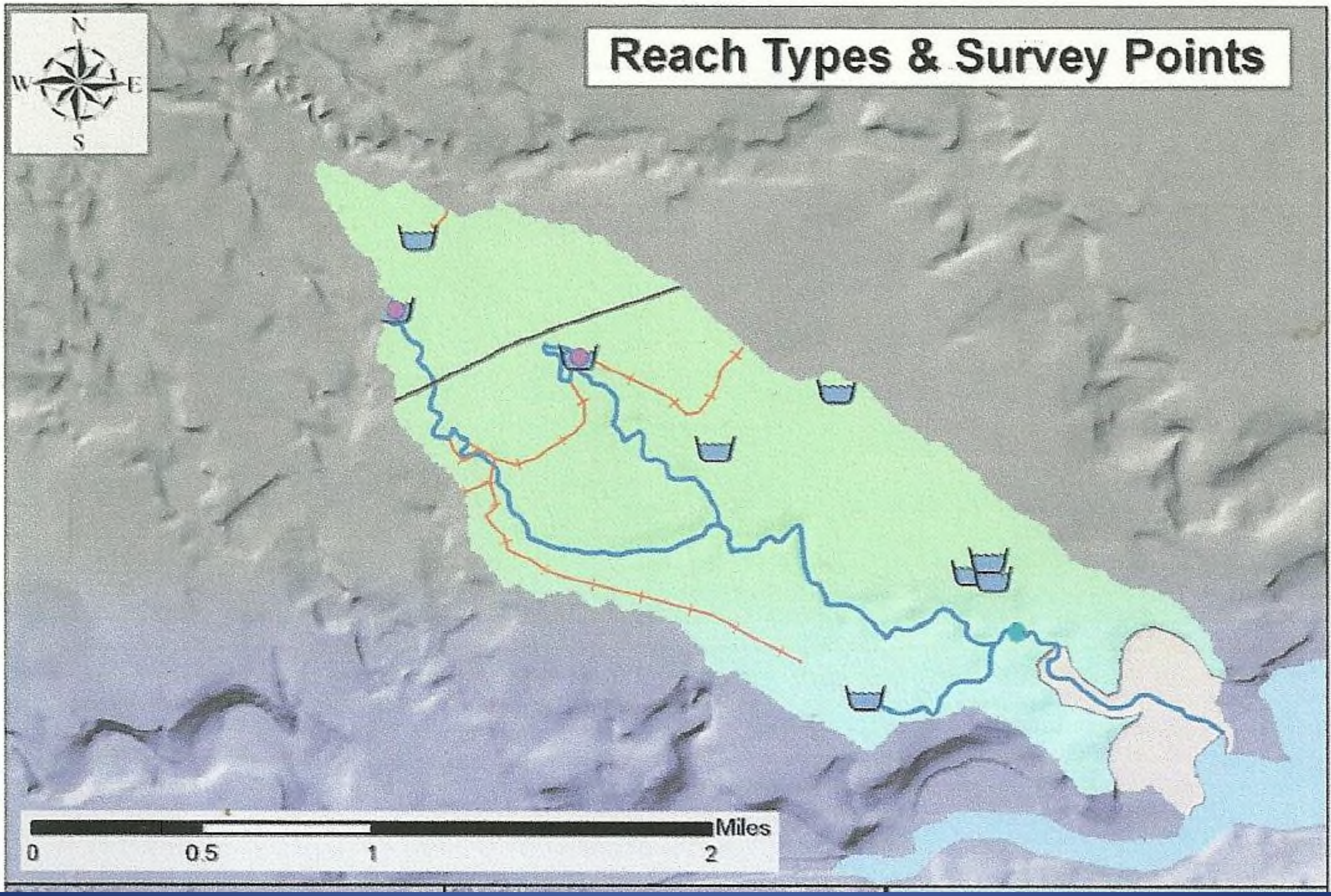

Reach Types & Survey Points

Nāwiliwili, Kaua'i



DAR Watershed Code: 22014

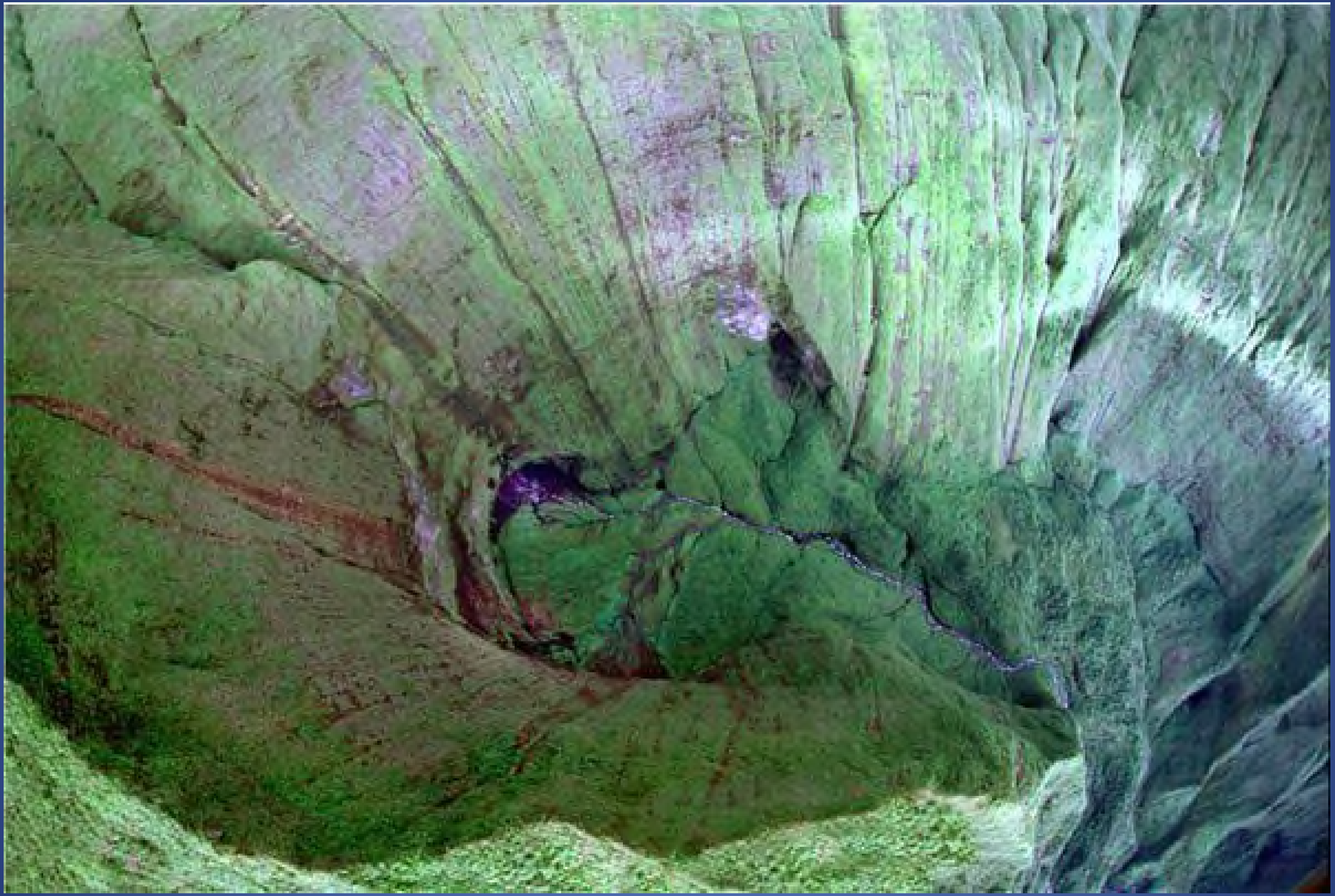
Pū'ali, Kaua'i



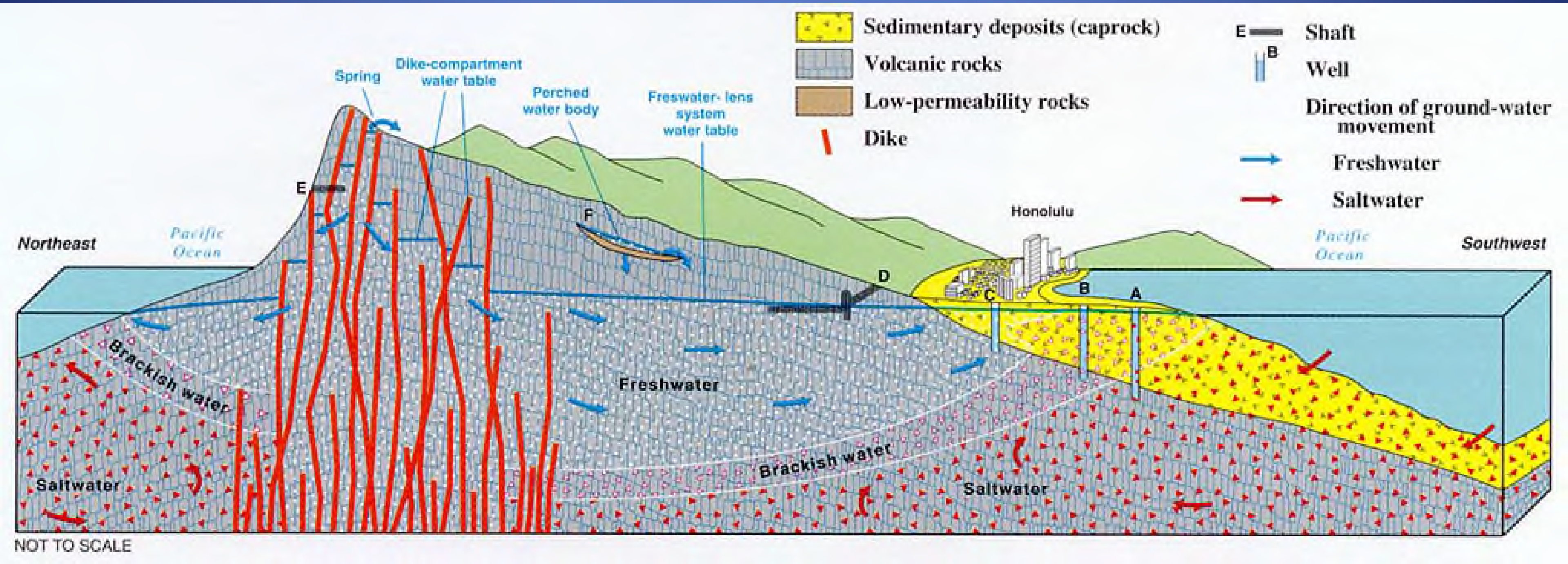
Grove Farm Waiahi Surface Water Treatment Plant

Application: First surface water treatment plant in Kauai, Hawaii
Capacity: 3 MGD (11,456 m3/day) with a 1 MGD (3,800 m3/day) redundant train
Location: Kauai, Hawaii, United States
Commissioned: December 2005

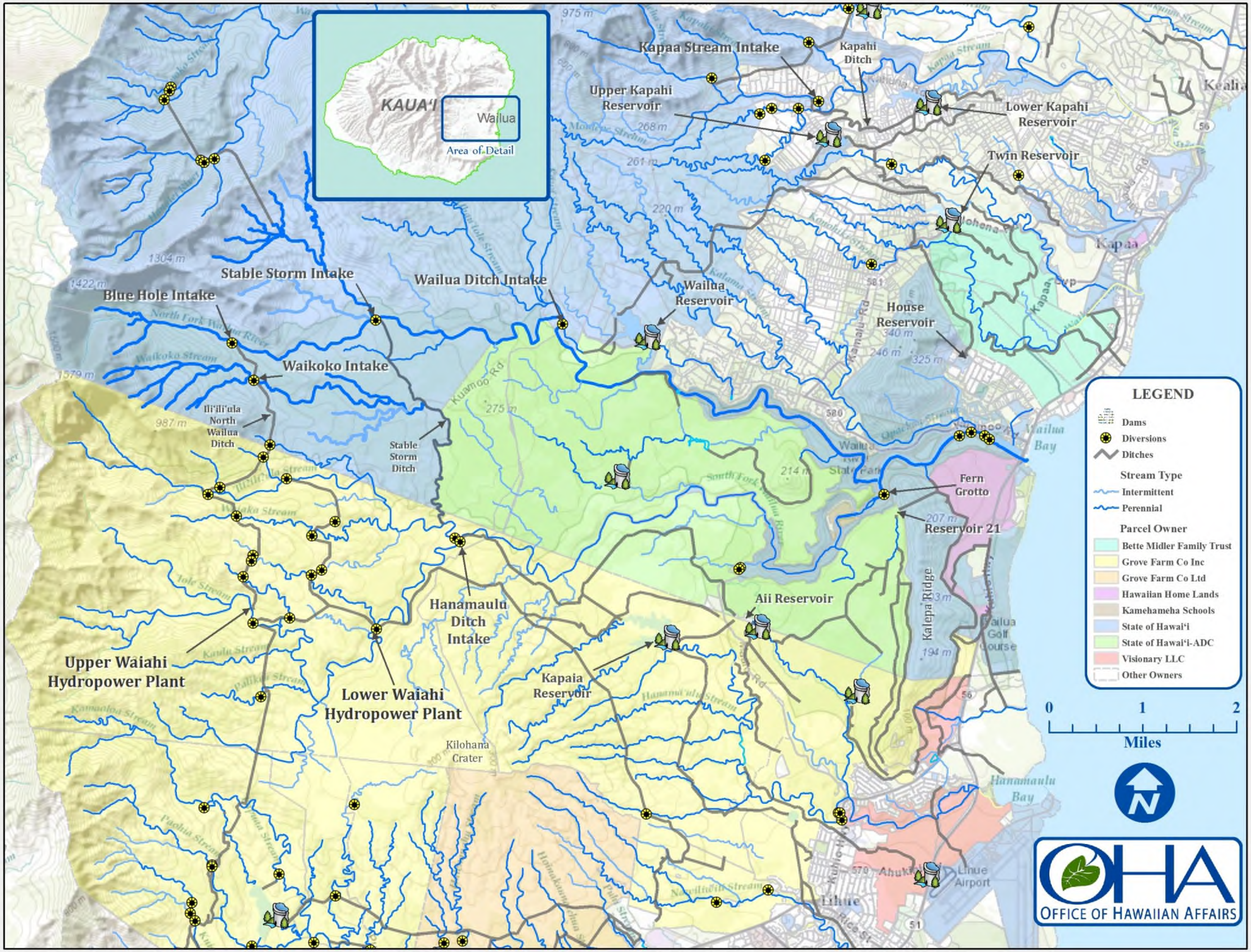
Maika’i Kaua’i, Hemolele i ka Malie



- The are the waters that the Horizontal Well project proposed to tap.



DOW Horizontal Drilling



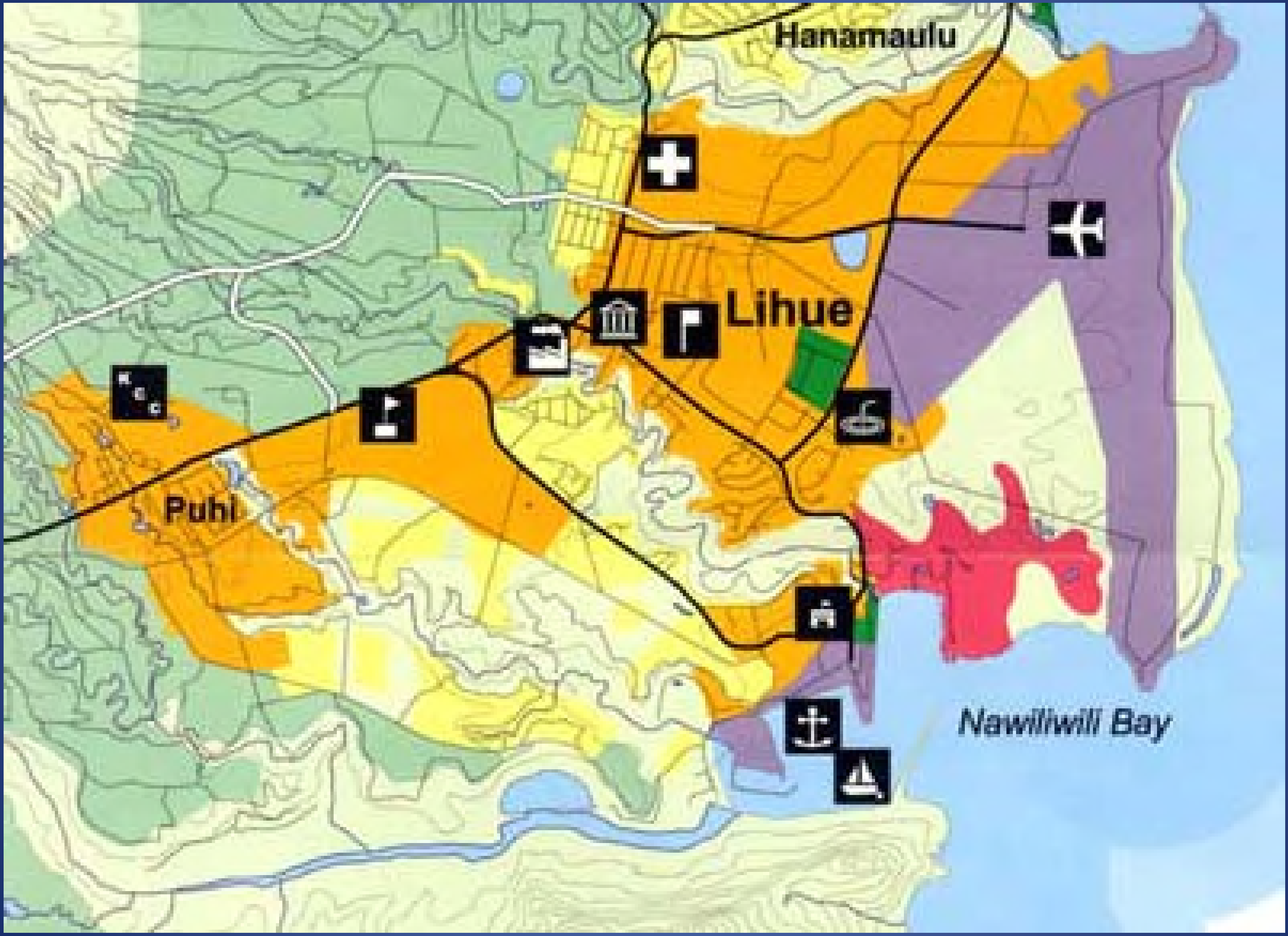
KAUA'I
Wailua
Area of Detail
Kapaa Stream Intake
Kapahi Ditch
Upper Kapahi Reservoir
Lower Kapahi Reservoir
Twin Reservoir
Kealia
Kapaa
Stable Storm Intake
Wailua Ditch Intake
Wailua Reservoir
House Reservoir
Blue Hole Intake
North Fork Wailua River
Waikoko Stream
Waikoko Intake
Ili'ili'ula North Wailua Ditch
Stable Storm Ditch
Kuamoo Rd
Wailua Bay
Fern Grotto
Reservoir 21
South Fork Wailua River
Aii Reservoir
Kalepa Ridge
Wailua Golf Course
Hanamaulu Ditch Intake
Upper Waiahi Hydropower Plant
Lower Waiahi Hydropower Plant
Kapaia Reservoir
Kilohana Crater
Hanamaulu Bay
Lihue Airport
Lihue
LEGEND
Dams
Diversions
Ditches
Stream Type
Intermittent
Perennial
Parcel Owner
Bette Midler Family Trust
Grove Farm Co Inc
Grove Farm Co Ltd
Hawaiian Home Lands
Kamehameha Schools
State of Hawai'i
State of Hawai'i-ADC
Visionary LLC
Other Owners
0
1
2
Miles
N
OHA
OFFICE OF HAWAIIAN AFFAIRS

KIUC Diversion of Wailua River

Wailua River, above diversion

Wailua River, below diversion

Huleia River
Kahili – Kilohana water


Hanamaulu
Lihue
Puhi
Nawiliwili Bay

Grove Farm Waiahi Surface Water Treatment Plant

Application: First surface water treatment plant in Kauai, Hawaii
Capacity: 3 MGD (11,456 m3/day) with a 1 MGD (3,800 m3/day) redundant train
Location: Kauai, Hawaii, United States
Commissioned: December 2005

Waiahi hydroelectric plants

Hanama'ulu Ditch tourism $$$

Kaiapa Reservoir

Agriculture

Allows Urban-Commercial-Residential Buildout

Sewage Treatment and commercial recreation

Projected Growth

- In the Hanamāʻulu Aquifer, water use is expected to increase by at least 35% between 2020 and 2050. (Hawaiʻi Water Plan 2020, 4-8)..
- This 35% upsurge, however, is based on year 2000 population estimates. In 2012, Kauaʻi's population was only 480 persons below the Water Plan 2020's estimated population for 2020. Id. at 4-2.
- Therefore, the 2020 Plan underestimates both population growth and water demand, but the Plan's 35% increase estimate is a useful floor for evaluating water use given that the current population has likely eclipsed the year 2020 estimate.

What is the County's Role?

- It is important to note that all the current uses are technically legal and legitimate under State law.
- Typically, water issues are the exclusive jurisdiction of the State as a public trust.
- But in this case the County is a major player as it has focused development in an area that has ground water problems and is purchasing stream water or will soon operate the system that uses the stream water.

What should the County be thinking about?

- The County has multiple roles: water user, developer, promoter of business, and protector of the public trust.
- As in many issues, the County must strive to achieve a balance, or in olelo, “pono””
- Fortunately, the State has a mechanism that allows for a balanced outcome of water use, if the County recognizes the problem and embraces a solution.

Summary

- We do not know how much ground water we are pumping from south Puna
- Reported pumping is only a fraction of estimated Sustainable Yield. But this is inconsistent with actual observations, actions, and official statements
- We now understand this is because ground water in south Puna behaves differently than the assumptions in the CWRM model so the SY number is almost irrelevant
- Water levels in wells are dropping
- Well pumping is reducing stream flows
- The County has resorted to using streams for drinking water to support new development
- Neither ground water usage or stream usage is being fully reported to the State
- Reducing stream flows effects the environmental, cultural and social rights of other users

Compelling Logic

- Either we have a problem with ground water in south Puna, which justifies our extreme action of the use of stream water and the associated impacts, which justifies the need for Ground Water Management area designation
-
- Or,

- Despite the data and statements, We do not have a problem and we are taking water from streams for development without justification or assessment of its impact on other users and the environment

Aia I Hea Ka Wai a Kane e Hele Ana ?

A thick lens of fresh groundwater in the southern Lihue Basin, Kauai, Hawaii, USA

Scot K. Izuka · Stephen B. Gingerich

Abstract A thick lens of fresh groundwater exists in a large region of low permeability in the southern Lihue Basin, Kauai, Hawaii, USA. The conventional conceptual model for groundwater occurrence in Hawaii and other shield-volcano islands does not account for such a thick freshwater lens. In the conventional conceptual model, the lava-flow accumulations of which most shield volcanoes are built form large regions of relatively high permeability and thin freshwater lenses. In the southern Lihue Basin, basin-filling lavas and sediments form a large region of low regional hydraulic conductivity, which, in the moist climate of the basin, is saturated nearly to the land surface and water tables are hundreds of meters above sea level within a few kilometers from the coast. Such high water levels in shield-volcano islands were previously thought to exist only under perched or dike-impounded conditions, but in the southern Lihue Basin, high water levels exist in an apparently dike-free, fully saturated aquifer. A new conceptual model of groundwater occurrence in shield-volcano islands is needed to explain conditions in the southern Lihue Basin.

Résumé Dans le sud du bassin de Lihue (Kauai, Hawaii, USA), il existe une épaisse lentille d'eau souterraine douce dans une vaste région à faible perméabilité. Le modèle conceptuel conventionnel pour la présence d'eau souterraine à Hawaii et dans les autres îles de volcans en bouclier ne rend pas compte d'une lentille d'eau douce si épaisse. Dans ce modèle conceptuel, les accumulations de lave dont sont formés la plupart des volcans en bouclier couvrent de vastes régions à relativement forte perméabilité, avec des lentilles d'eau douce peu épaisses. Dans le sud du bassin de Lihue, les laves remplissant le bassin et les sédiments constituent une région étendue à faible conductivité hydraulique régionale, qui, sous le climat humide du bassin, est saturée presque jusqu'à sa surface; les surfaces piézométriques sont plusieurs centaines de mètres au-dessus du niveau de la mer à quelques kilomètres de la côte. On pensait jusqu'à présent que des niveaux piézométriques aussi élevés dans des îles de volcans en bouclier n'existaient que dans le cas de nappes perchées ou de blocage par un dyke, mais dans le sud du bassin de Lihue, des niveaux piézométriques élevés existent dans un aquifère apparemment sans dyke et complètement saturé. Un nouveau modèle conceptuel de présence d'eau souterraine dans les îles de volcans en bouclier est nécessaire pour expliquer les conditions observées dans le sud du bassin de Lihue.

Resumen Se ha determinado la existencia de un espeso lentejón de aguas subterráneas dulces en una extensa región de baja permeabilidad situada al sur de la cuenca de Lihue, en Kauai (Hawaii, Estados Unidos de América). El modelo conceptual convencional de las aguas subterráneas en Hawai y en otros cinturones de islas volcánicas no considera la existencia de lentejones tan gruesos de agua dulce. En dicho modelo, las acumulaciones de flujos de lava que constituyen la mayoría de los cinturones volcánicos se desarrollan en grandes áreas de permeabilidad relativamente baja y con pequeños lentejones de agua dulce. En el sur de la cuenca de Lihue, las lavas de relleno y los sedimentos forman una región extensa de baja conductividad hidráulica regional que, con el clima húmedo de la zona, está saturada hasta prácticamente la superficie del terreno, mientras que el nivel freático se encuentra centenares de metros por encima del nivel del mar a pocos kilómetros de la línea de costa. Se creía hasta ahora que, en los cinturones de islas volcánicas, tales niveles sólo tenían lugar en acuíferos colgados o en condiciones de confinamiento por diques, pero, al sur de la cuenca de Lihue, se dan en acuíferos completamente saturados que no están limitados por diques. Se necesita un nuevo modelo conceptual de las aguas subterráneas en cinturones de islas volcánicas para explicar las condiciones halladas en la cuenca meridional de Lihue.

Keywords Coastal aquifers · Volcanic aquifers · Conceptual models · Island hydrology · Hawaii

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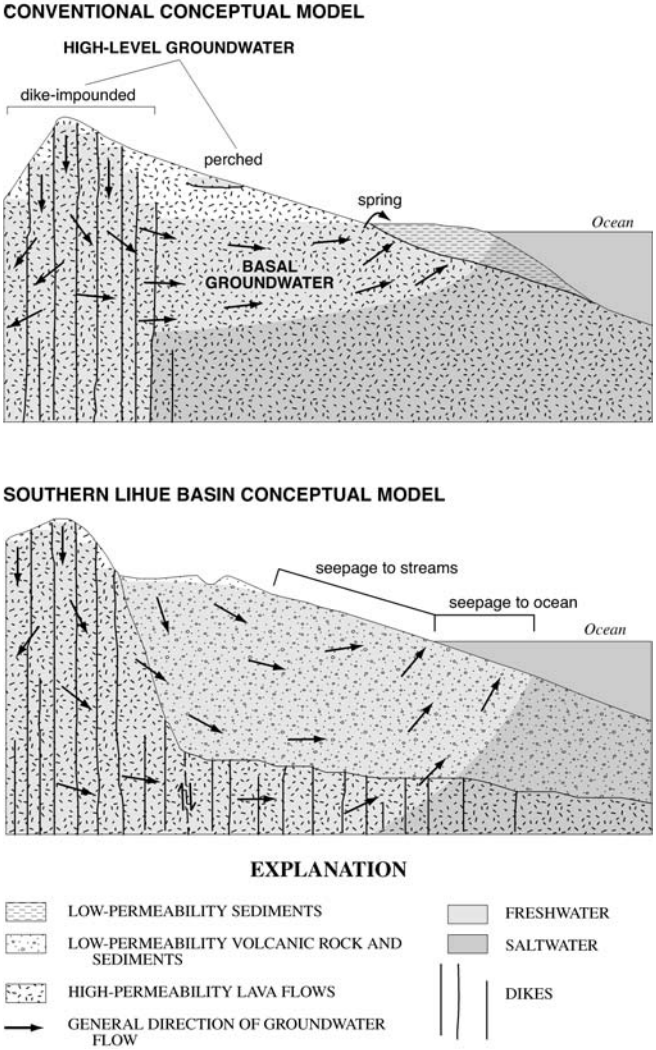

Fig. 1 Diagrammatic cross sections representing conventional conceptual model of groundwater flow in shield-volcano islands, and conceptual model of groundwater flow in the southern Lihue Basin, Kauai, Hawaii

Introduction

Much of the groundwater in an oceanic island forms a lens-shaped body of freshwater overlying saltwater, as shown in Fig. 1. The freshwater lens is buoyed by the density difference between saltwater and freshwater. In the freshwater body, water flows downward in inland parts of the aquifer where recharge is highest, horizontally to the coast, then upward near the coast where groundwater discharges to streams and the ocean. Geologic structure, climate, and size of the island are among a number of factors that impart unique characteristics to each island's groundwater system.

The existence of a freshwater-over-saltwater system was recognized in the shield-volcano islands of Hawaii, USA in the early part of the twentieth century, and by about the middle of the century, the fundamentals of a conceptual model explaining the general modes of occurrence of fresh groundwater had been developed (Lindgren 1903; Meinzer 1930; Stearns and Vaksvik 1935; Stearns 1940; Palmer 1942). This conceptual model, referred to as the "conventional conceptual model", has remained the primary model for groundwater occurrence in Hawaii and has guided groundwater development to the present. However, application of the conventional conceptual model to explore for and manage groundwater in parts of some shield volcanoes, such as the southern Lihue Basin on Kauai, has not been successful because the specific hydrologic characteristics of these areas are not accounted for in the conventional conceptual model.

As shown in Fig. 2, the southern Lihue Basin is the southern part of the Lihue Basin, a large semicircular depression in the southeast quadrant of Kauai, the fourth-largest island (1,432 km^2) in the tropical, north-Pacific Hawaiian Archipelago. The southern Lihue Basin comprises the198-km^2 area south of the South Fork Wailua River and north of Haupu Ridge. Geologists have long been aware that the southern Lihue Basin differs geologically from other areas of the Hawaiian islands (Stearns 1946; Macdonald et al. 1960), but the hydrologic implications of the geological differences were not fully recognized in part because Kauai lacked the volume of hydrologic data that was available for more heavily developed islands such as Oahu (on which much of the conventional conceptual model is based). Recent hydrologic studies, including monitor-well drilling and testing, analysis of groundwater discharge to streams, and numerical groundwater modeling (Izuka and Gingerich 1997a, 1997b, 1997c, 1997d, 1998; Gingerich and Izuka 1997a, 1997b; Gingerich 1999), provide compelling evidence that the hydrology of the southern Lihue Basin differs substantially from the conventional conceptual model that has long stood as the paradigm for groundwater occurrence in Hawaii and other shield volcano islands in the Pacific. The purpose of this paper is to present a new conceptual model of groundwater occurrence for the southern Lihue Basin that is consistent with the results of recent studies.

The Conventional Conceptual Model of Groundwater Occurrence in Shield-Volcano Islands

The bulk of a shield volcano is built of many thin basaltic lava flows. Throughout most of this basaltic pile, horizontal hydraulic conductivities (K_h) are hundreds of meters per day, water levels are no more than a few meters above sea level, and the water table slopes gently seaward. In some areas, low-permeability, near-vertical, sheet-like dikes intrude the lava flows and act as hydraulic impediments that impound water within the lava flows and raise water levels to as much as several hundred meters above sea level. Isolated, near-horizontal structures of low vertical permeability, such as ash and soil layers, may create small, perched bodies of water within the otherwise-unsaturated part of basalt lava flows.

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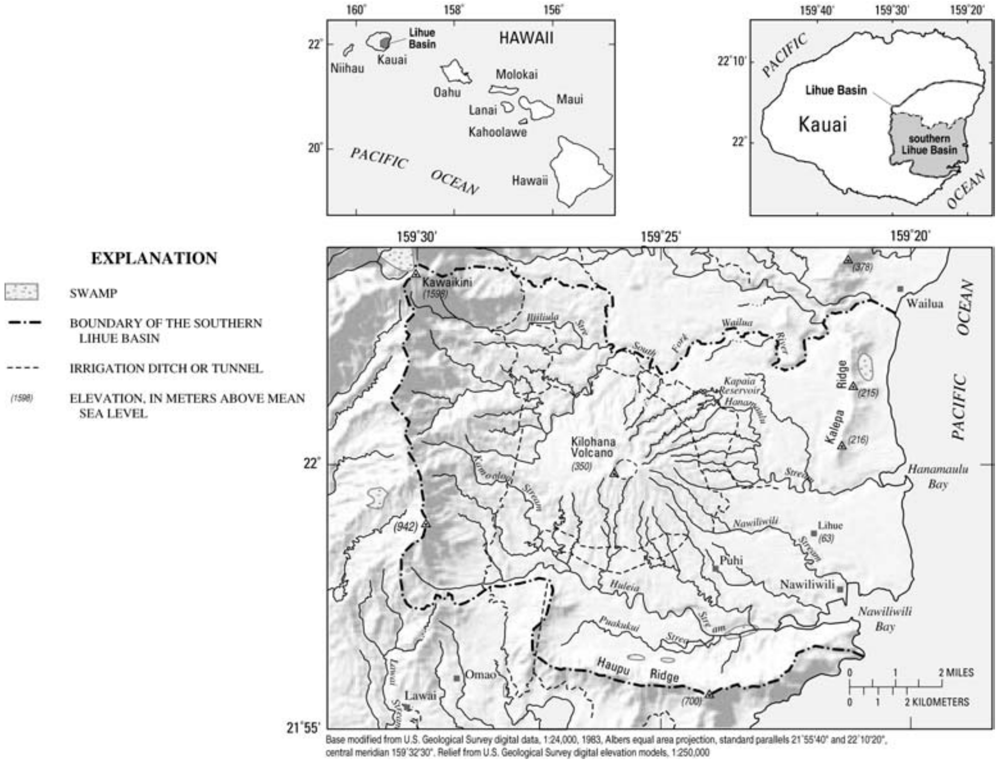

Fig. 2 Location of the southern Lihue Basin, Kauai, Hawaii

In the conventional conceptual model, groundwater in shield-volcano islands is classified as either basal or high-level groundwater (Fig. 1). The term "basal water," as first used by Meinzer (1930), refers to the groundwater that is below the lowest or "main" water table. Meinzer's definition further requires that the basal water beneath the main water table completely saturates the aquifer, and thereby distinguishes basal groundwater from perched groundwater, which by definition must be underlain by an unsaturated aquifer. In shield volcano islands, the largest basal groundwater bodies exist in high-permeability, dike-free, lava-flow aquifers. On the Hawaiian island of Oahu, a wedge of low-permeability coastal sediments creates a semiconfining unit known locally as caprock, which impedes coastal discharge and causes heads in the basal water to rise. Even so, basal water levels on Oahu are less than 15 m above sea level (Hunt 1996). Basal water bodies in islands with no caprock or thinner caprock than Oahu have lower water tables (Meinzer 1930).

High-level groundwater includes perched groundwater as well as groundwater impounded by dikes. Whereas perched groundwater is underlain by unsaturated rock, dike-impounded groundwater bodies may be fully saturated from the water table to sea level. No particular water level distinguishes high-level groundwater from basal groundwater; the distinction is made primarily on the basis of associated geologic structures. Even without definitive evidence of associated geologic structures, however, some groundwater bodies have been assumed to be high level because their water levels were higher than previously identified basal groundwater systems. Most of these enigmatic high-level groundwater bodies were presumed to be impounded by unseen low-permeability, vertically oriented, structures such as dikes or buried ridges (Stearns 1940; Oki 1998, 1999).

If the high water levels were not in an area presumed to have dikes, it was often presumed to be perched. Macdonald et al. (1960) presumed that high-elevation springs, gaining streams, and water-development tunnels in the Lihue Basin were fed by perched groundwater bodies. This presumption, however, was made at a time when few vertical wells existed in the southern Lihue Basin (except in the surrounding ridges), and with few indications of regional aquifer permeability. Since then, numerous wells having low specific capacity were drilled, which indicated that the aquifer beneath much of the southern Lihue Basin has much lower permeability than other shield volcanoes.

Hydrogeology of the Southern Lihue Basin

Precipitation in the southern Lihue Basin is heaviest where the prevailing northeasterly trade winds encounter the windward flanks of Kauai's central mountains, forcing warm, moist air into the cool, higher elevations, as shown in Fig. 3. Average annual rainfall ranges from about 1,270 mm/year in low-lying coastal areas to more than 11,000 mm/year near the crest of Kauai's central mountains (Giambelluca et al. 1986).

A prominent feature in the southern Lihue Basin is the broad dome of Kilohana Volcano. The crater at the summit of Kilohana Volcano has a marsh, and numerous

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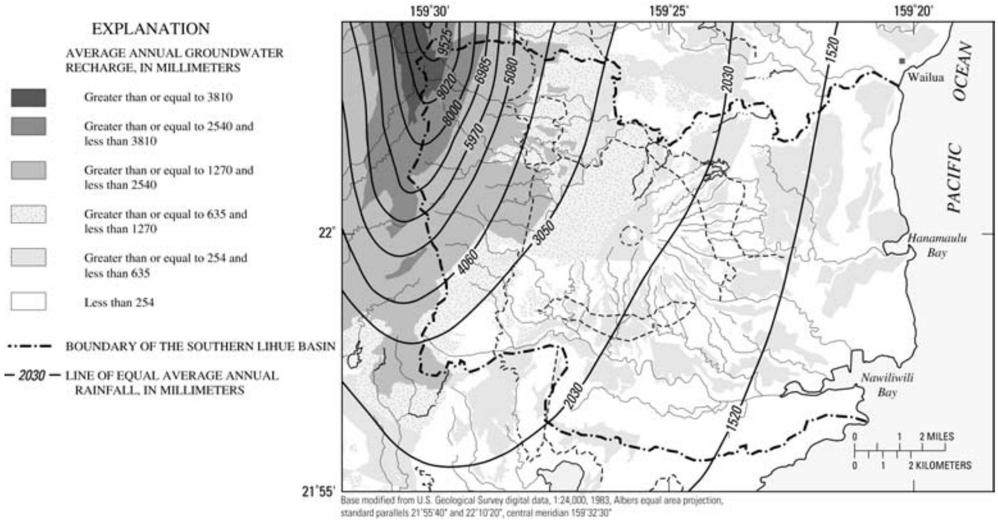

Fig. 3 Rainfall and recharge in the southern Lihue Basin, Kauai, Hawaii (from Giambelluca et al. 1986; Shade 1995)

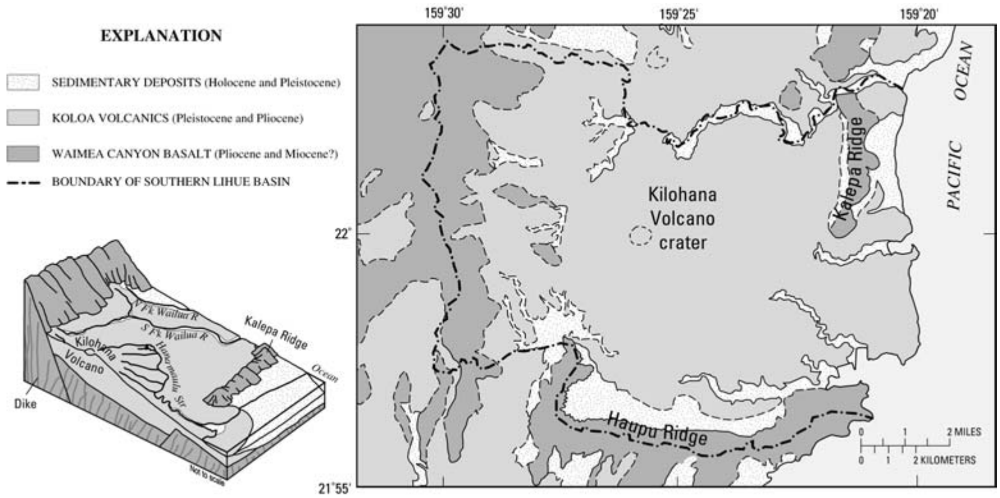

Fig. 4 Geology of the southern Lihue Basin, Kauai, Hawaii (modified from Macdonald et al. 1960)

perennial streams drain from the flank of the volcano. The marsh and perennial streams indicate that the groundwater table is at or near the surface for most of the area of the volcano. During most of the twentieth century, including the period during which the data for this study were gathered, much of the gently sloping land in the southern Lihue Basin was used for sugarcane cultivation. The sugar industry built and maintained ditches and reservoirs that not only diverted and stored stream flow within the basin for irrigation, but also brought water in from and took water out to adjacent basins. The natural drainage pattern of the southern Lihue Basin had thus been modified into a network of natural stream channels crossed by agricultural ditches.

Geologic Structure and Hydraulic Properties of the Rocks

According to previous geologic investigations (Stearns 1946; Macdonald et al. 1960; Krivoy et al. 1965; Clague and Dalrymple 1988; Langenheim and Clague 1987; Moore et al. 1989; Holcomb et al. 1997; Reiners et al. 1999), Kauai was built during the Pliocene by mid-plate, hot-spot volcanism which created one or more large shield volcanoes. Subsequent erosion and faulting created large valleys, canyons, and other depressions, including the Lihue Basin. These depressions were later partially filled with hundreds of meters of sediments as well as lava flows from rejuvenated volcanism during the Pliocene and Pleistocene.

The consolidated rocks of the southern Lihue Basin are divided into two geologic formations separated by an erosional unconformity. As shown in Fig. 4, the older and more voluminous Waimea Canyon Basalt forms the basement as well as the ridges and mountains surrounding the basin. Resting unconformably on the Waimea Canyon Basalt is the formation known as the Koloa Volcanics, a heterogeneous unit of variably weathered, thick, massive lava flows, pyroclastic deposits, and intercalated sediments that fill depressions in the Waimea Canyon Basalt (Macdonald et al. 1960; Langenheim and Clague 1987). The thickness of the Koloa Volcanics ranges from zero to more than 150 m (Macdonald et al. 1960; Reiners et al. 1999). Small volumes of sediments

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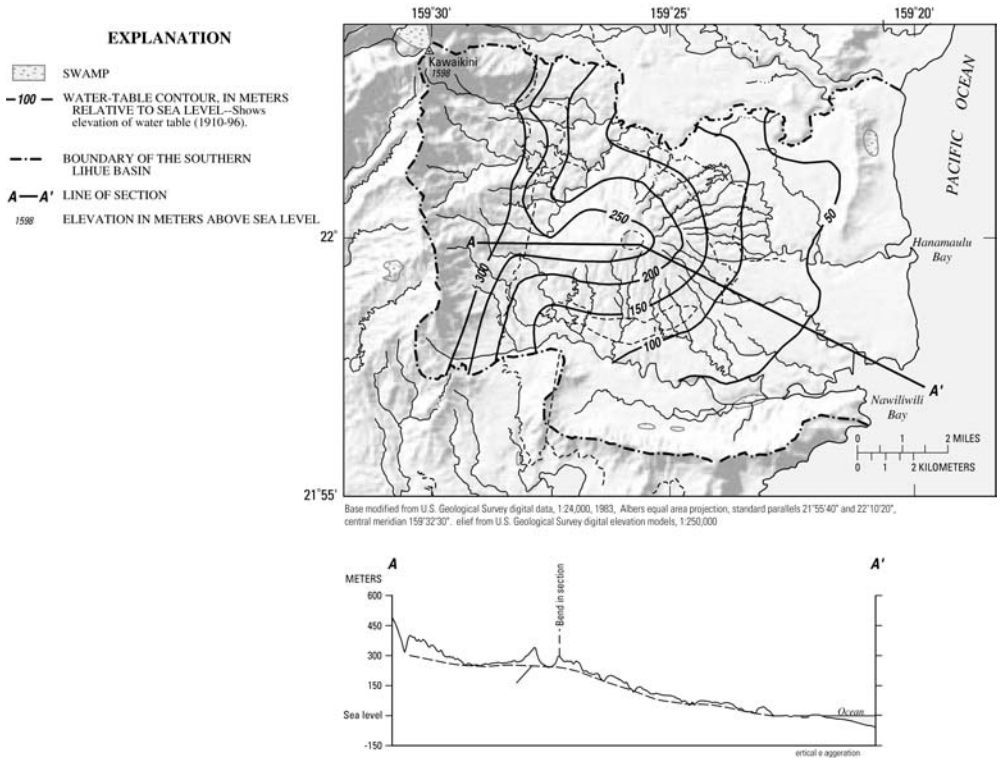

Fig. 5 Water-table map and profile generalized from data from 1910 through 1996 for the southern Lihue Basin, Kauai, Hawaii (modified from Izuka and Gingerich 1998)

of Pleistocene and Holocene age lie at the surface, but have relatively minor hydrologic significance.

Throughout most of Kauai, the Waimea Canyon Basalt consists mainly of thin lava flows, but in the southern Lihue basin, the lava flows are intruded by near-vertical, sheet-like volcanic dikes (Macdonald et al. 1960). Dikes reduce the K_h of the intruded lava flows. An aquifer test of the dike-intruded Waimea Canyon Basalt on the southern edge of the southern Lihue Basin on Haupu Ridge indicates a K_h of 5.2 m/day (Gingerich 1999), but this estimate is for rocks only in the immediate vicinity of the well. The regional bulk K_h of the dike-intruded Waimea Canyon Basalt is probably lower because of dikes that lie beyond the reach of the aquifer test (Izuka and Gingerich 1998). The K_h of the thick, dense, lava flows and intercalated sediments of the Koloa Volcanics varies widely in the southern Lihue Basin, but areas of high K_h are rare and of limited extent. Aquifer tests indicate that K_h ranges from about 0.02 m/day to about 40 m/day (Gingerich 1999), but the regional K_h is less than 0.3 m/day (Izuka and Gingerich 1998).

Groundwater Levels

Water-level elevations in wells are near sea level at the coast but increase steeply with distance inland. Many wells in the southern Lihue Basin have water levels more than 100 m above sea level, even when the wells penetrate more than a 100 m below sea level, which indicates that the high water levels are part of a groundwater system that is not perched, as previously thought. Figure 5 shows a water-table map compiled by Izuka and Gingerich (1998) using water-level data from wells, springs, seeps, and marshes. Because the map was compiled from water-level data collected over several decades, it does not represent any instant in time, and short-term temporal variations in the water table may not be accurately depicted. However, the map gives a view of the regional water table generalized over time, and shows that steep horizontal head gradients are characteristic throughout much of the southern Lihue Basin. The steep gradients are consistent with the low K_h characteristic of the Koloa Volcanics. Gradients are steepest where streams incise the aquifer and flatter where few streams drain the groundwater. In a sense, streams that incise the upper aquifer act as drains that shape the water table and are probably the principal reason that water levels in the rest of the basin remain below the ground surface.

Groundwater Recharge

Shade (1995) used a water-budget model to compute recharge on Kauai based on conditions that existed in 1990, and estimated that the southern Lihue Basin receives about 4.76 m^3/s of groundwater recharge, as shown in Table 1. Near the northwest corner of the southern Lihue Basin (Fig. 2), recharge exceeds 3,810 mm/year, whereas in the coastal areas, recharge is less than 254 mm/year (Fig. 3). In drier areas, the recharge distribution departs from the rainfall distribution because of infiltration of excess irrigation water and variations in soil-moisture storage capacity.

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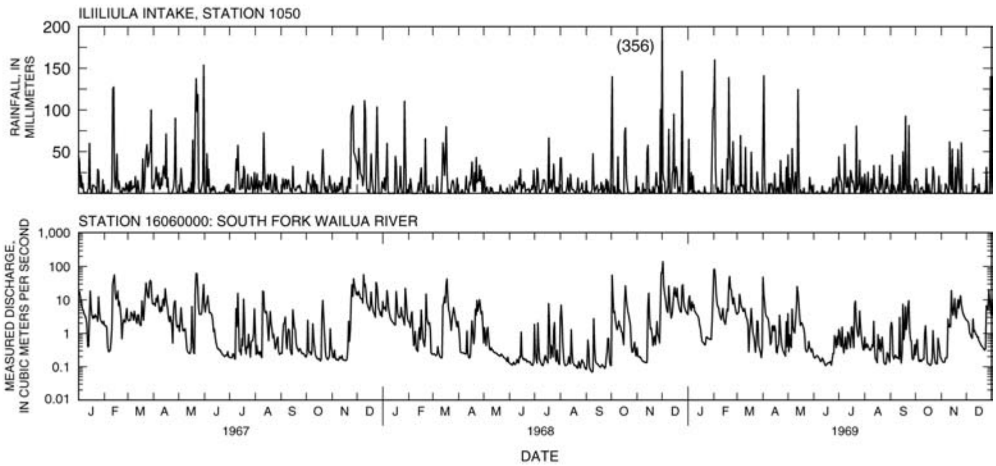

Fig. 6 Rainfall and hydrograph from typical stream in the southern Lihue Basin Kauai, Hawaii

Table 1 Summary of groundwater flows (mass balance) in the southern Lihue Basin, Kauai, Hawaii

	Estimate		Model-simulated flow[a] (m^3/s)
	Period to which estimate applies	Flow (m^3/s)	
Recharge	1990	4.76[b]	4.76
Groundwater withdrawal	1993	0.17	0.17
Discharge to streams and rivers	1913–1970	3.58 to 4.40[a]	3.19
Subsurface flow out of basin (includes flow to adjacent groundwaterareas and discharge to ocean)	Not applicable	0.19 to 1.01	0.68

[a] From Izuka and Gingerich (1998); [b] From Shade (1995)

To estimate recharge in the southern Lihue Basin, Shade (1995) used a monthly water budget, which can substantially over or underestimate recharge, and did not include contribution from fog condensation. Izuka and Oki (2002) evaluated the uncertainty resulting from Shade's methods and determined that the recharge estimates have an uncertainty ranging from at least –13 to +1.6%. Although uncertainty exists, Shade's recharge estimates indicate that groundwater recharge in the southern Lihue Basin is substantial.

Groundwater Withdrawal

Groundwater in the southern Lihue Basin is withdrawn by conventional vertical wells as well as water-development tunnels that were bored horizontally into stream banks to intercept some of the natural groundwater discharge to the streams. Izuka and Gingerich (1998) estimated groundwater withdrawal from wells and tunnels in the southern Lihue Basin to be about 0.17 m^3/s (Table 1) based on data obtained from the Hawaii State Commission on Water Resource Management in 1993, but acknowledged that this number may represent only about 70% of the actual withdrawal because not all wells had meters.

Because the southern Lihue Basin is defined on the basis of topographic features, not groundwater barriers or divides, effects from withdrawals theoretically have the potential to cross basin boundaries. However, groundwater withdrawal from the area to the north is relatively small and unlikely to cause effects that can cross the groundwater barrier presented by the South Fork Wailua River. No such barrier exists to the south and east of the southern Lihue Basin, therefore it is possible that some of the 0.58 m^3/day that was being withdrawn from wells immediately to the southwest of the southern Lihue Basin originates from recharge within the basin.

Groundwater Discharge to Streams and the Ocean

Groundwater flowing through the southern Lihue Basin discharges subaerially at springs and along streams and rivers, as well as directly to the ocean via coastal and submarine seepage. As shown in Fig. 6, hydrographs from stream gages in the Lihue Basin show flashy discharge peaks coincident with rainfall, but between the peaks, substantial base flow (i.e., groundwater discharge) persists in the streams.

Hydrograph-separation analyses used to estimate base flow from stream-gage data indicate that the total base flow for the gaged reaches of major streams (South Fork Wailua River, Hanamaulu Stream, and Huleia Stream), averages 3.58 to 4.40 m^3/s, as shown in Tables 1 and 2; the total base flow from all streams in the basin is probably higher because base flow in ungauged reaches were not included in this total. Because of the limits imposed

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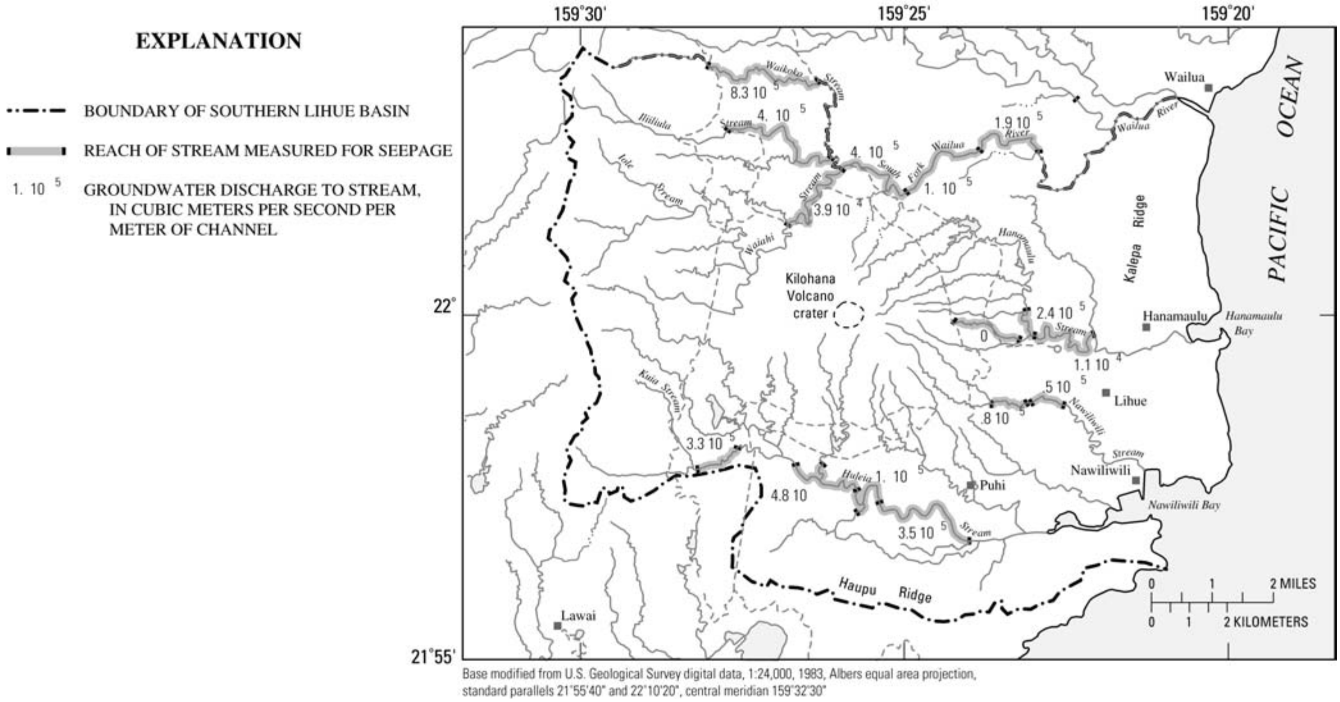

Fig. 7 Groundwater discharge (in m^3 s^{-1} $m^{-1}$of channel), from instantaneous discharge measurements, to selected streams in the southern Lihue Basin, Kauai, Hawaii

Table 2 Groundwater discharge to selected streams and rivers in the southern Lihue Basin, Kauai, Hawaii (from Izuka and Gingerich 1998)

Stream/river	Estimated groundwater discharge from analysis of stream-gauge data		Model-simulated groundwater discharge (m^3/s)
	Period used in analysis	Groundwater discharge (m^3/s)	
South Fork Wailua River	1913, 1918	2.49 to 3.26	2.44
Hanamaulu Stream	1911–1913	0.14 to 0.20	0.17
Huleia Stream	1968–1970	0.95	0.53
Nawiliwili Stream		No data	0.05

by the availability of stream-gauge data, these base-flow estimates do not represent a concurrent period of time, but temporal variations in base flow are likely to be small relative to the large persistent base flows characteristic of the streams in the southern Lihue Basin. The persistence of base flows is evident in recent direct, instantaneous (i.e., not estimated from gauge data) base-flow measurements, as shown in Fig. 7. The measurements indicate that most reaches of rivers and streams, even those without gauges or those having small drainage areas, continue to receive substantial groundwater discharge consistent with the base flows estimated from stream gauge data.

Comparison of the base-flow and recharge estimates for the southern Lihue Basin indicate that groundwater discharge to streams constitutes at least 75% of the estimated 4.76 m^3/s of recharge the southern Lihue Basin receives. Although small amounts of groundwater may cross basin boundaries, and uncertainties in the recharge and base-flow estimates impart some imprecision in the mass-balance computations, the data indicate that most of the water recharging the southern Lihue Basin aquifer is eventually discharged subaerially to streams rather than directly to the ocean (Table 1).

A Conceptual Groundwater Model for the Southern Lihue Basin

Many of the observed hydrogeologic characteristics of the southern Lihue Basin are not consistent with the conventional conceptual model of groundwater occurrence in shield-volcano islands. The groundwater system in the southern Lihue Basin is characterized by flow through low-permeability rocks, which produces a thick freshwater lens and steep head gradients, and causes the water table to rise from near sea level at the coast to hundreds of meters above sea level a few kilometers inland (Figs. 1 and 5). In most places, the water table lies only a few meters below the ground surface. The draining of the aquifer by streams shapes the water table, and groundwater discharge through streams and springs con-

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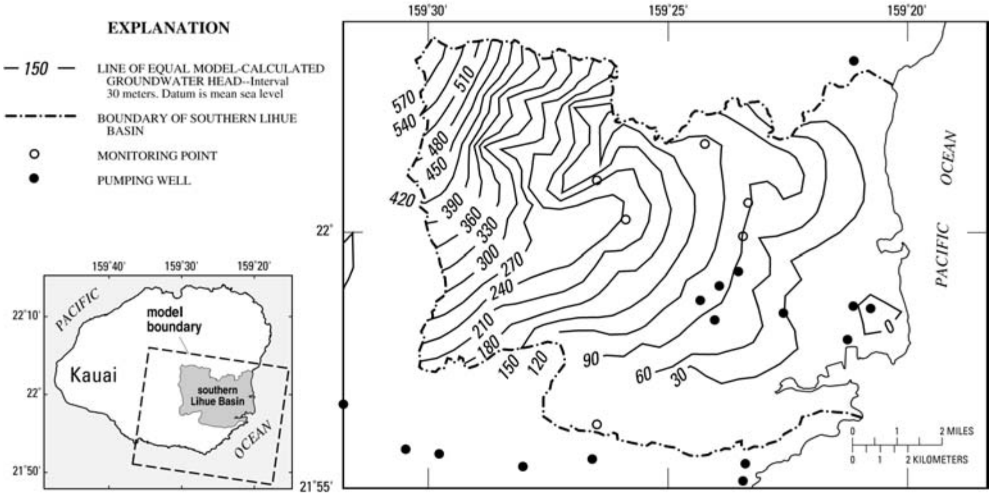

Fig. 8 Distribution of simulated head in the steady-state numerical groundwater model of the southern Lihue Basin, Kauai, Hawaii (modified from Izuka and Gingerich 1998)

stitutes the main path for natural outflow from the aquifer; a lesser amount discharges at or beyond the coast.

In contrast, aquifers containing basal groundwater on Oahu have hydraulic conductivities one to several orders of magnitude higher than those in the southern Lihue Basin (Soroos 1973). The "basal" and "high-level" classifications of the conventional conceptual model do not account for the mode of occurrence of groundwater in the southern Lihue basin, where water levels may be hundreds of meters above sea level, not because of perching or dike impoundment, but because of low regional permeabilities in an aquifer in a moist climate. The conventional conceptual model for groundwater occurrence in shield-volcano islands does not account for an extensive region of low-permeability such as that formed by the Koloa Volcanics in the southern Lihue Basin.

Quantitative Consistency of the Southern Lihue Basin Conceptual Model

The conceptual model of groundwater occurrence in the southern Lihue Basin described here differs substantially from the conventional conceptual model, but the southern Lihue Basin conceptual model is consistent with the stream-flow, aquifer hydraulics, and water-level data. Izuka and Gingerich (1998) developed a numerical model of the southern Lihue Basin that shows that the conceptual model is also quantitatively consistent with the observed data. The reader is referred to Izuka and Gingerich (1998) for details of the model construction; a synopsis of the model description is given here.

Izuka and Gingerich (1998) developed a steady-state model using the finite-difference modeling program SHARP (Essaid 1990), which allows simulation of coupled freshwater and saltwater flow. The model encompassed not only the Lihue basin, but also adjacent parts of Kauai and offshore areas, as shown in Fig. 8, so that the no-flow boundaries required at the periphery of the model would coincide with natural no-flow boundaries or groundwater divides. The model had two layers and nearly 5,000 elements, each representing an area of 0.37 km^2. Each element was assigned hydraulic properties consistent with available data on geologic structure and results from aquifer tests in the southern Lihue Basin, or estimates of hydraulic properties from similar aquifers in Hawaii (Soroos 1973; Souza and Voss 1987; Hunt 1996; Gingerich 1999).

The resulting model-simulated water levels are generally consistent with observed groundwater levels in the southern Lihue Basin. Comparison of Figs. 5 and 8 shows that despite minor differences that can be attributed to the limits imposed by model discretization, the model reproduces major characteristics of the water-table map such as the high groundwater levels and the depression of the water table where streams incise the aquifer. The numerical groundwater model shows that low hydraulic conductivities consistent with field-test data in the southern Lihue Basin will result in steep horizontal groundwater gradients and water levels that are hundreds of meters above sea level in a fully saturated (not perched) system. The model-simulated base flows are also consistent with observed base flow estimates from analysis of stream-gage data from the southern Lihue Basin (Tables 1 and 2). The model and stream-gauge data analysis both show that most of the groundwater flowing through the southern Lihue Basin discharges to streams rather to the ocean.

Conclusions

The groundwater system in the southern Lihue Basin is characterized by flow through low-permeability rocks, which produces a thick freshwater lens, steep head gradients, and a water table that rises from near sea level at the coast to hundreds of meters above sea level a few kilometers inland. In most places, water saturates the ground nearly to the surface. Subaerial groundwater discharge through streams shapes the water table and constitutes the main path for natural outflow from the aquifer; a lesser amount discharges at or beyond the coast.

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These characteristics of the groundwater system in the southern Lihue Basin differ from the conventional conceptual model for groundwater occurrence on shield-volcano islands. Neither the conventional basal-groundwater conceptualization, in which water tables are everywhere less than 15 m, nor the conventional high-level-groundwater conceptualization, in which water is either impounded by dikes or perched, adequately explains groundwater occurrence in the southern Lihue Basin, where water levels may be hundreds of meters above sea level without being perched or impounded by dikes. The conventional conceptual model does not account for the large region of low-permeability rock formed by the accumulation of thick, dense, lava flows and intercalated sediments in the southern Lihue Basin.

Acknowledgements This study was funded through a cooperative agreement between the County of Kauai Department of Water and the US Geological Survey.

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Effects of Irrigation and Rainfall Reduction on Ground-Water Recharge in the Lihue Basin, Kauai, Hawaii

By Scot K. Izuka, Delwyn S. Oki, and Chien-Hwa Chen

Prepared in cooperation with the
County of Kauai Department of Water

Scientific Investigations Report 2005-5146

U.S. Department of the Interior
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Contents

Effects of Irrigation and Rainfall Reduction on Ground-Water Recharge in the Lihue Basin, Kauai, Hawaii

By Scot K. Izuka, Delwyn S. Oki, and Chien-Hwa Chen

Abstract

Recent declines in water levels and productivity in some wells and tunnels in the Lihue Basin, Kauai, Hawaii, have raised concerns about the future reliability of ground-water sources. The trend of declining water levels coincides not only with increases in ground-water development, but also with decreases in applied irrigation and periods of lower-than-average rainfall. Water-balance computations indicate that the sugarcane industry had, at its peak, artificially increased recharge by about 25 percent over natural conditions. Periods of decreased precipitation and irrigation, concurrent with declines in observed ground-water-levels, caused substantial reductions in ground-water recharge relative to periods of normal rainfall and full irrigation. Simulations of recent decreases in irrigation, a recent drought, and hypothetical future scenarios of droughts and irrigation cessation indicated basin-wide recharge decreases of 7 to 83 percent relative to the condition of normal rainfall and full irrigation.

For the period during the observed decline in ground-water levels, the water-balance simulations indicate that the effect of the recent drought was greater than the effect of reduced irrigation. Effects of droughts, however, are temporary conditions that will eventually be mitigated by wet periods, whereas loss of irrigation in the Lihue Basin may be permanent and have a greater long-term effect. Effects of irrigation also may appear to be small relative to basin-wide recharge, but the effects of irrigation changes are concentrated in former irrigated sugarcane fields, and many wells with recent declining water levels are near these former sugarcane fields.

Introduction

The Lihue Basin (fig. 1) is the location of the seat of government and much of the industry on the island of Kauai. Nearly one-half of Kauai's population of 58,000 lives in the Lihue Basin (U.S. Census Bureau, 2005). Nearly all public drinking water supplied by the County of Kauai Department of Water (Kauai DOW) in the Lihue Basin comes from wells and tunnels that develop ground water from a volcanic-rock aquifer, much of which has low regional permeability (Izuka and Gingerich, 1998). The few high-producing wells and tunnels that exist are critical to public water supply in the Lihue Basin. Declining water levels and productivity in some of these high-producing wells and tunnels in recent years have raised concerns about the future reliability of ground-water sources. For example, productivity of the Garlinghouse Tunnel, a major source of drinking water, has decreased by about 50 percent since the 1980s. Water levels in other wells in the Kilohana-Puhi area and near Nonou Ridge, which include the most productive wells in the Lihue Basin, also have shown recent trends of declining water levels (fig. 2). Water levels in some non-pumped wells several miles from active production wells also show recent declines.

A number of natural and anthropogenic factors are approximately concurrent with the declining ground-water levels. For example, production in the Garlinghouse Tunnel decreased soon after construction of the other Kilohana-Puhi wells upgradient of the tunnel. The decrease in ground-water production from the tunnel, however, also was concurrent with extended periods of below-average precipitation, and a reduction in irrigation when the sugarcane industry converted to more efficient irrigation methods and later ceased operations. These events may have exacerbated the decline in ground-water levels by reducing ground-water recharge. To assess the effects of reductions in irrigation and rainfall on ground-water recharge in the Lihue Basin, the U.S. Geological Survey (USGS), in cooperation with the Kauai DOW, undertook a study to compute recharge for conditions that existed prior to and during the period of observed ground-water level decline, as well as for conditions that are plausible for the near future.

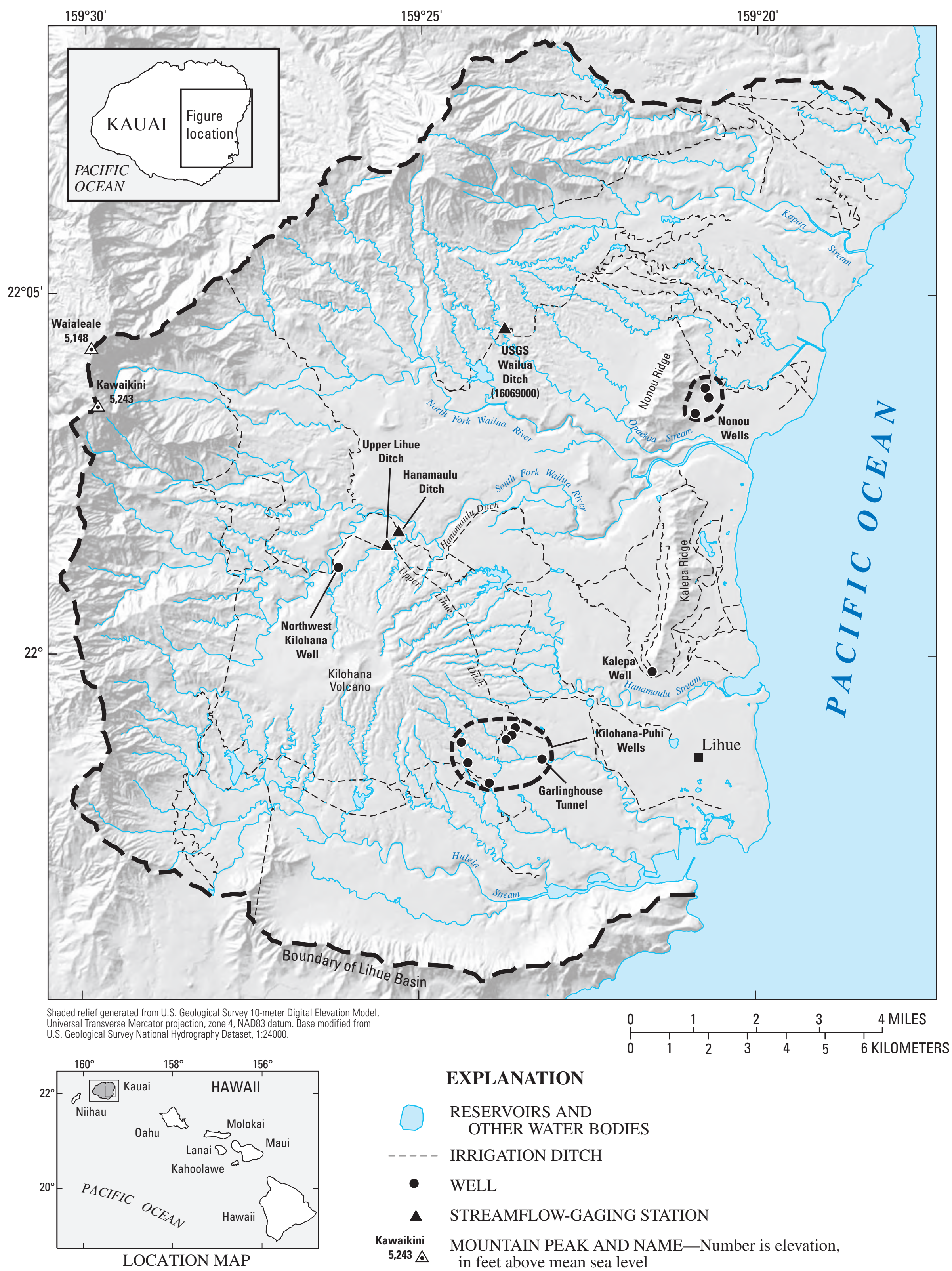


Figure 1. The Lihue Basin, Kauai, Hawaii.

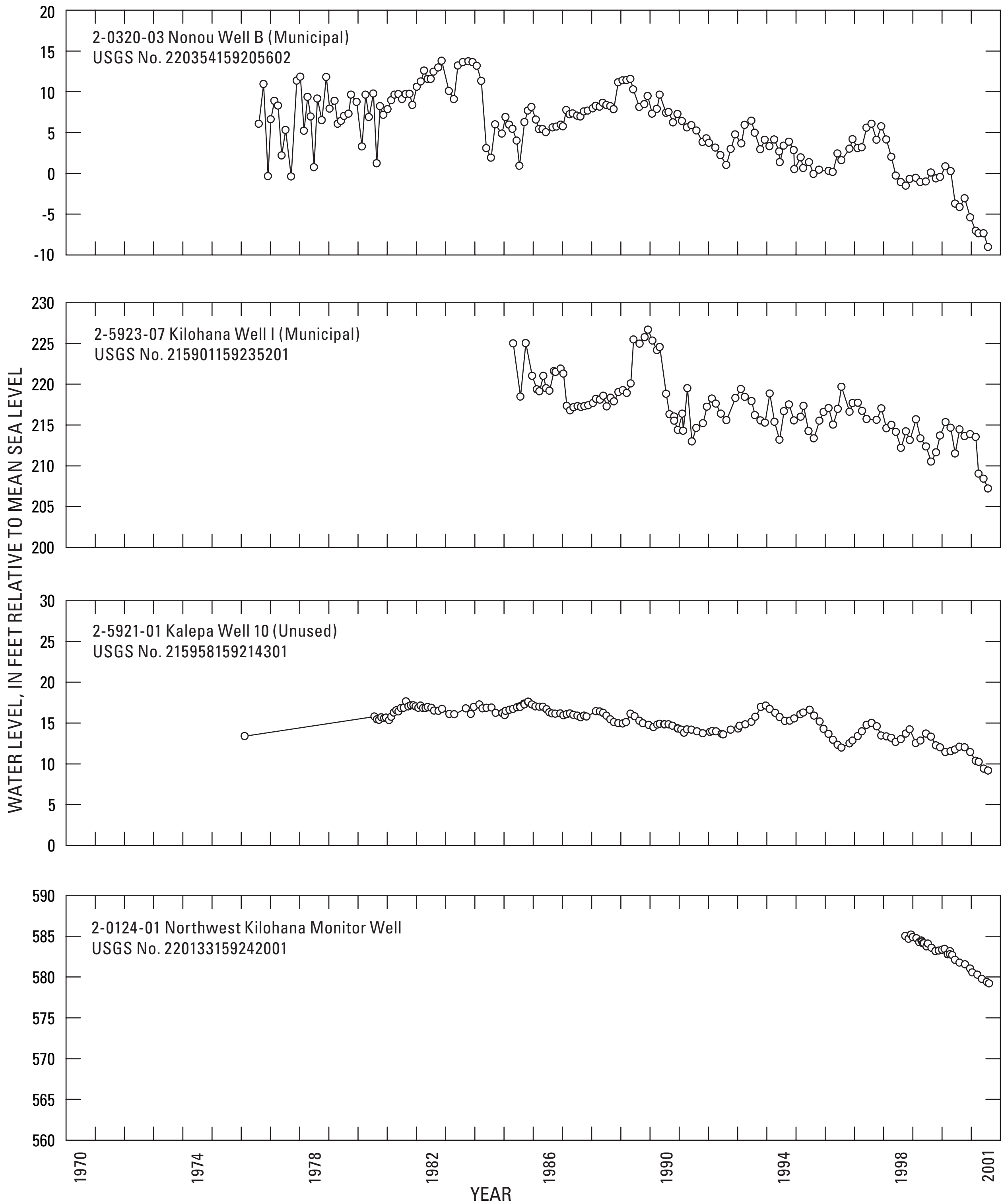


Figure 2. Water levels in selected wells in the Lihue Basin, Kauai, Hawaii.

Purpose and Scope

This report describes the effects of land-use changes, irrigation reduction, and drought on ground-water recharge in the Lihue Basin. Because the original motivation for the study was concern about the declining ground-water levels observed in some wells, the report begins with a comparison of ground-water levels to factors that affect those water levels, but the comparisons are limited to general trends. This report focuses on water-balance computations and resulting ground-water recharge estimates, and their implications for the effects of land-use changes, irrigation reduction, and drought on ground-water recharge in the Lihue Basin.

Acknowledgments

Edward Tschupp, current Manager and Chief Engineer, Ernest Lau, former Manager and Chief Engineer, and the staff of the Kauai DOW provided critical support and assistance for this study. Michael Furukawa (Grove Farm Inc. and the Lihue Land Company) and Dorothy Beckeart (formerly of Amfac Sugar – Lihue Plantation Company) assisted in accessing sugarcane plantation records and providing general information on irrigation practices. Neal Fujii and Kevin Gooding at the Hawaii State Commission on Water Resource Management (CWRM) provided data on ground-water development and withdrawals. Kevin Kodama, National Weather Service (NWS), provided rainfall data and analysis of the standard-precipitation index for the Lihue Airport. Richard A. Fontaine, Connie M. Hoong, Michael T. Moreo, and Jeff A. Perreault of the USGS contributed to the preparation of this report.

Description of Lihue Basin

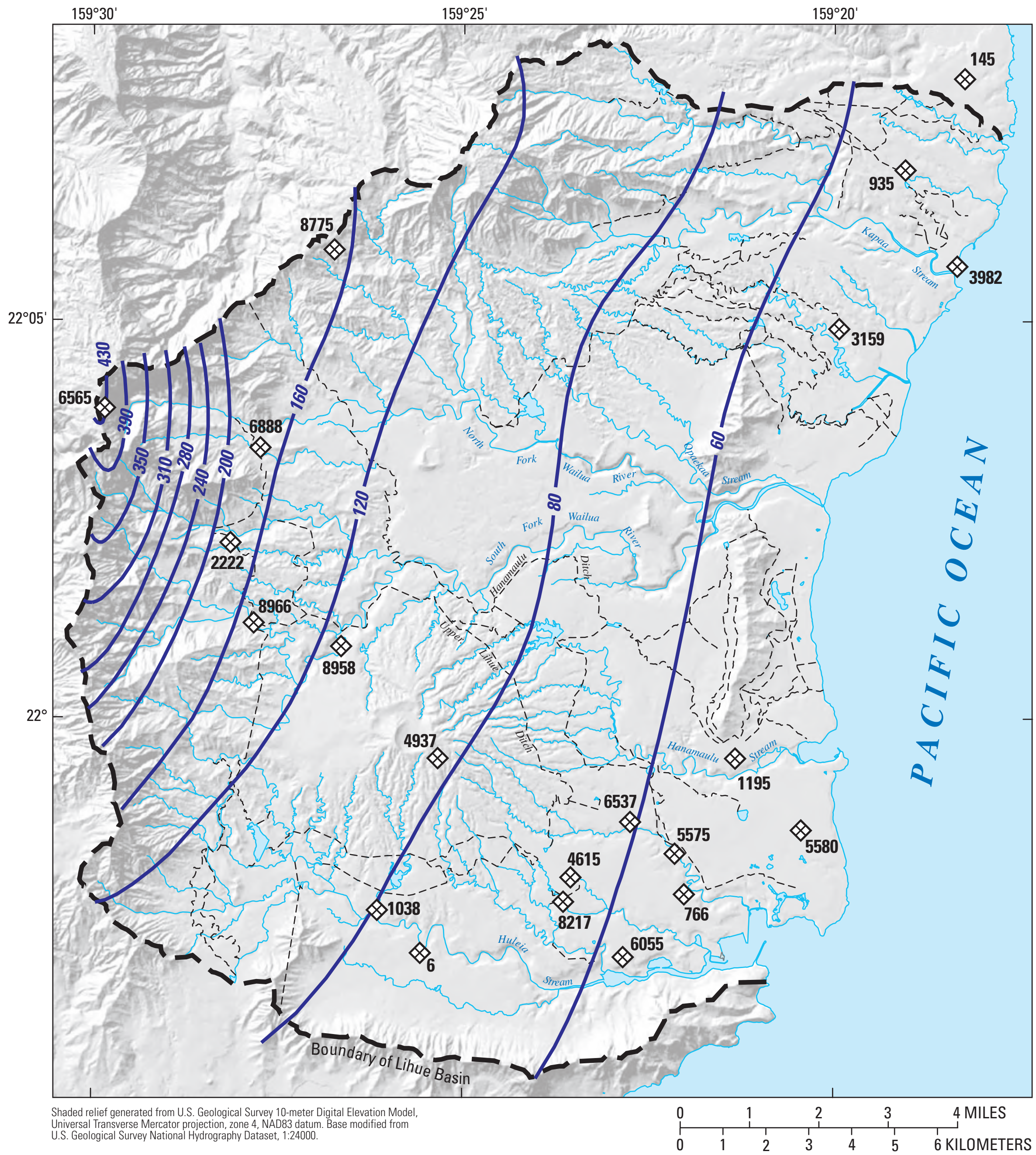
The Lihue Basin is a large semicircular depression in southeastern Kauai, a 553 mi^2 island in the tropical-Pacific Hawaiian Archipelago (fig. 1). The basin is encircled by mountains, some of which are several thousand feet in elevation, to the north, west, and south, and by the Pacific Ocean on the east. Kilohana Volcano, a broad, dome-shaped volcanic structure, covers much of the southern part of the Lihue Basin and rises to an elevation of 1,149 ft. A few smaller ridges and hills also lie within the basin. The natural drainage pattern in the Lihue Basin consists of numerous streams that coalesce into a few principal water courses, including Kapaa Stream, Wailua River, Hanamaulu Stream, and Huleia Stream.

Rainfall distribution in the basin is influenced by the orographic effect (fig. 3). Precipitation is highest where the prevailing northeasterly trade winds encounter the windward flanks of the hills and mountains, forcing warm, moist air into the cool, higher elevations. Mean annual rainfall ranges from about 50 in. at low-lying coastal areas to more than 430 in. at the crest of the mountains forming the western margin of the basin (Giambelluca and others, 1986).

From the late 19th century through the 20th century, much of the land in the Lihue Basin was used for sugarcane agriculture (Wilcox, 1996). Sugarcane plantations built numerous ditches and reservoirs to transport and store water for irrigation. The ditches and reservoirs not only redistributed water within the Lihue Basin, but also brought water in from, and took water out to, adjacent basins. As a result, surface-water drainage in the Lihue Basin consists of a complex network of natural drainage channels, irrigation ditches, and reservoirs. The sugarcane industry in Hawaii began to decline in the 1970s, and at the end of 2000, the last sugarcane plantation in the Lihue Basin closed. Some of the land formerly used for sugarcane cultivation has been urbanized or converted to diversified agriculture.

Hydrogeology

Current understanding of the complex geology of the Lihue Basin has been developed and revised on the basis of studies spanning several decades (Stearns, 1946; Macdonald and others, 1960; Langenheim and Clague, 1987, Clague and Dalrymple, 1988; Moore and others, 1989; Holcomb and others, 1997; and Reiners and others, 1998). These studies indicate that the Lihue Basin is a large depression formed by erosion and faulting of the large, basaltic shield volcanoes that formed Kauai (fig. 4). The basin is partly filled with sediments as well as lava flows and other igneous rocks from later, scattered rejuvenated volcanism. Rocks of the large shield volcanoes are known as the Waimea Canyon Basalt, which is of Pliocene age. Overlying rocks from the later rejuvenated volcanism and sedimentary deposits that partly fill the Lihue Basin are known as the Koloa Volcanics, which is of Pliocene-Pleistocene age. The Waimea Canyon Basalt forms the ridges surrounding the Lihue Basin as well as a few small ridges and hills within the basin. The Koloa Volcanics covers most of the floor of the basin and is more than 1,000 ft thick in some places. The Nonou wells penetrate into the Waimea Canyon Basalt at the base of Nonou Ridge; the Kilohana-Puhi wells penetrate the Koloa Volcanics. The Kalepa well is in the Waimea Canyon Basalt that forms Kalepa Ridge.



Shaded relief generated from U.S. Geological Survey 10-meter Digital Elevation Model, Universal Transverse Mercator projection, zone 4, NAD83 datum. Base modified from U.S. Geological Survey National Hydrography Dataset, 1:24000.

EXPLANATION

RESERVOIRS AND OTHER WATER BODIES

IRRIGATION DITCH

120 LINE OF EQUAL MEAN ANNUAL RAINFALL, IN INCHES

6 RAIN GAGE AND NATIONAL WEATHER SERVICE NUMBER

Figure 3. Mean annual rainfall in the Lihue Basin, Kauai, Hawaii. (Modified from Giambelluca and others, 1986.)

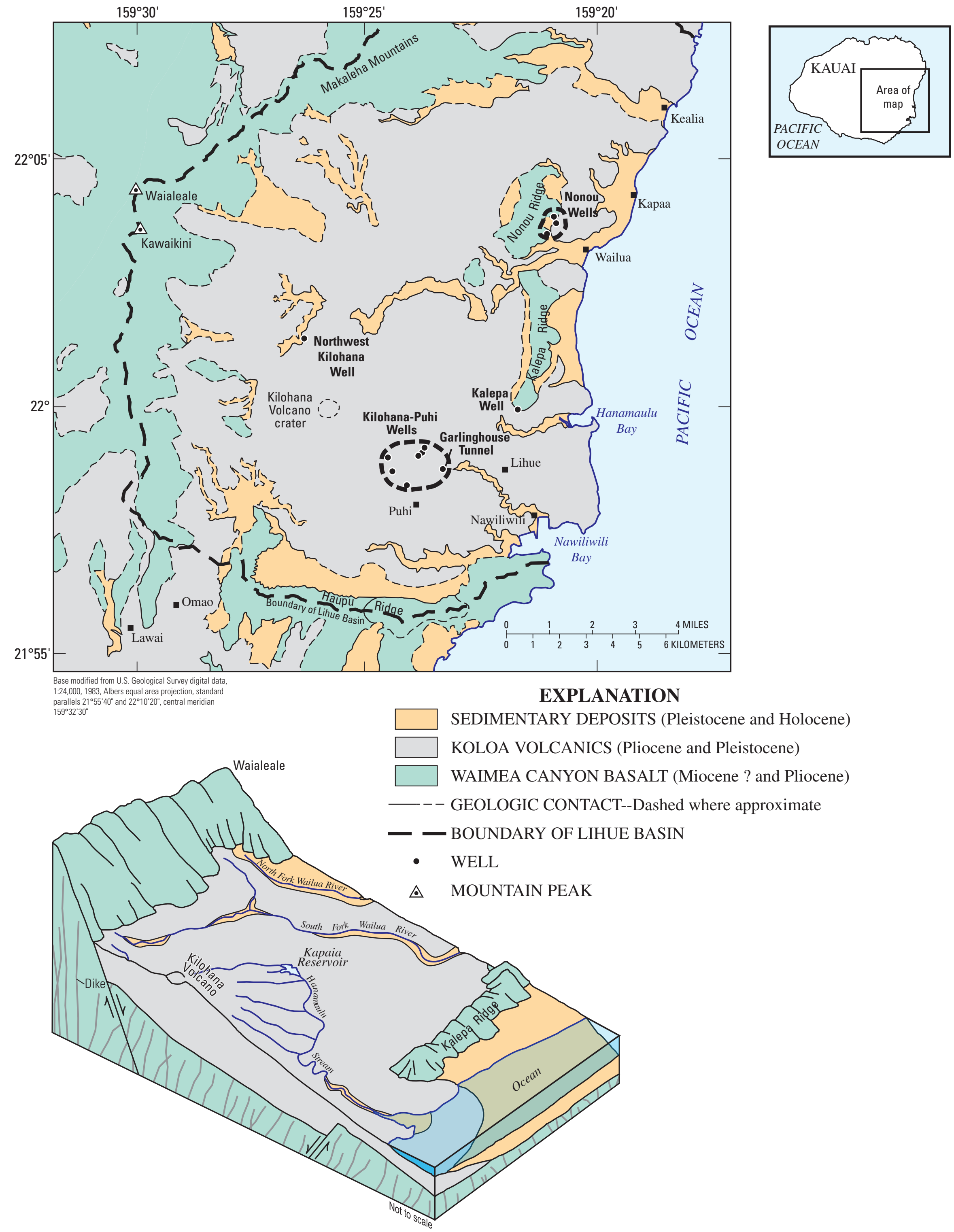


Figure 4. Geologic map and block diagram of the Lihue Basin, Kauai, Hawaii. (Modified from Macdonald and others, 1960; and Izuka and Gingerich, 2003.)

Changing water levels in wells are a manifestation of regional and local processes. Fresh ground water in the Lihue Basin, as in other coastal regions, forms a lens that overlies saltwater (fig. 5) (Izuka and Gingerich, 2003). This freshwater lens is mostly unconfined. Water from inland areas of recharge (mostly from infiltration of rainfall and irrigation water) flows toward discharge areas at streams, the coast, or pumped wells. The freshwater lens may attain a state of long-term dynamic equilibrium in which recharge equals discharge, but changes that affect recharge (such as droughts or changes in irrigation) and changes in discharge (such as changes in pumping rates at wells) can cause the lens to increase or decrease in size, thus water levels rise and decline in wells on a regional scale. Processes that can affect water levels at a local scale include the formation and spread of a cone of depression around a well when it is pumped, and local mounding caused by intensified recharge in a small area, as might be associated with the use of inefficient irrigation methods. Local processes commonly affect water levels on a shorter time scale than regional processes, but in either case, how quickly the effects occur depends in large part on geologic structure and hydraulic properties of the aquifer.

In the Lihue Basin, both the Waimea Canyon Basalt and the Koloa Volcanics are geologically complex, thus water levels in wells separated by only a short distance can be substantially different. The Waimea Canyon Basalt is one of the most permeable and productive aquifers on Kauai, but in the Lihue Basin, the formation is intruded by near-vertical sheets of dense, low-permeability volcanic dikes that reduce overall permeability (figs. 4 and 5). The Koloa Volcanics in the Lihue Basin is a thick (more that 1,000 ft in places) accumulation of heterogeneous rocks having low regional permeability and steep vertical and horizontal hydraulic-head gradients, but smaller areas of locally high permeability are within the formation (Izuka and Gingerich, 1998).

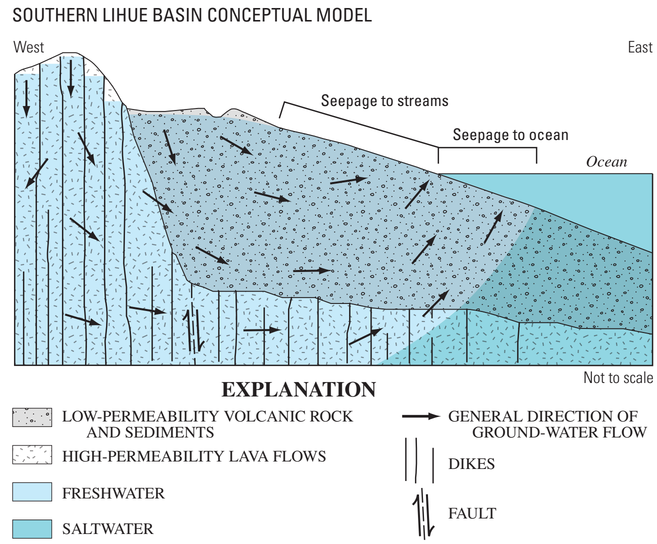


Figure 5. Diagram of conceptual model of ground-water occurrence in the Lihue Basin, Kauai, Hawaii. (From Izuka and Gingerich, 2003.)

Trends in Ground-Water Levels, Ground-Water Withdrawal, Irrigation, and Rainfall

Ground-water sources in the Lihue Basin include both conventional vertical wells and water tunnels (large-diameter horizontal galleries bored at the level of the water table). Two important ground-water production areas in the basin are the Nonou wells at the base of Nonou Ridge, and the Kilohana-Puhi wells on the southeast flank of Kilohana Volcano (fig. 1). Wells in both of these areas have shown recent water-level declines (fig. 2). In some cases, the declining water levels have affected well and tunnel production. For example, at the Garlinghouse Tunnel, one of the most productive sources of public water in the area of the Kilohana-Puhi wells, two pumps could be operated continuously prior to 1970, yielding about 1,500 gal/min for extended periods. By the 1990s, however, only one pump could be operated (at about 800 gal/min) without causing water levels to decline to the level of the pump intake. Water levels in some non-pumped monitor wells that are far from pumped wells also show recent declines. For example, water levels declined at the unused Kalepa well and the Northwest Kilohana monitor well (2.3 and 3.7 mi from the Kilohana-Puhi wells, respectively) (fig. 2).

The observed decline in ground-water levels in the Lihue Basin may be related to regional or local response of the ground-water system to (1) increasing ground-water withdrawals, (2) reductions in irrigation, and (3) below-average rainfall.

Increasing ground-water withdrawals.—Ground-water records at CWRM include wells in the Lihue Basin that date back to the 1890s, but records of ground-water withdrawals are not complete. An indication of historical ground-water production can be seen, however, in the number of wells listed as being in use. The number of wells in use increased sharply after 1960 (fig. 6). In the Lihue Basin, ground-water levels may take decades to adjust to increasing ground-water withdrawals (Izuka and Oki, 2002). Therefore, wells that began pumping in the 1970s–90s (such as all of the Kilohana-Puhi wells except the Garlinghouse Tunnel) and 1960s–80s (such as the Nonou wells) may have continued to affect ground-water levels through 2000.

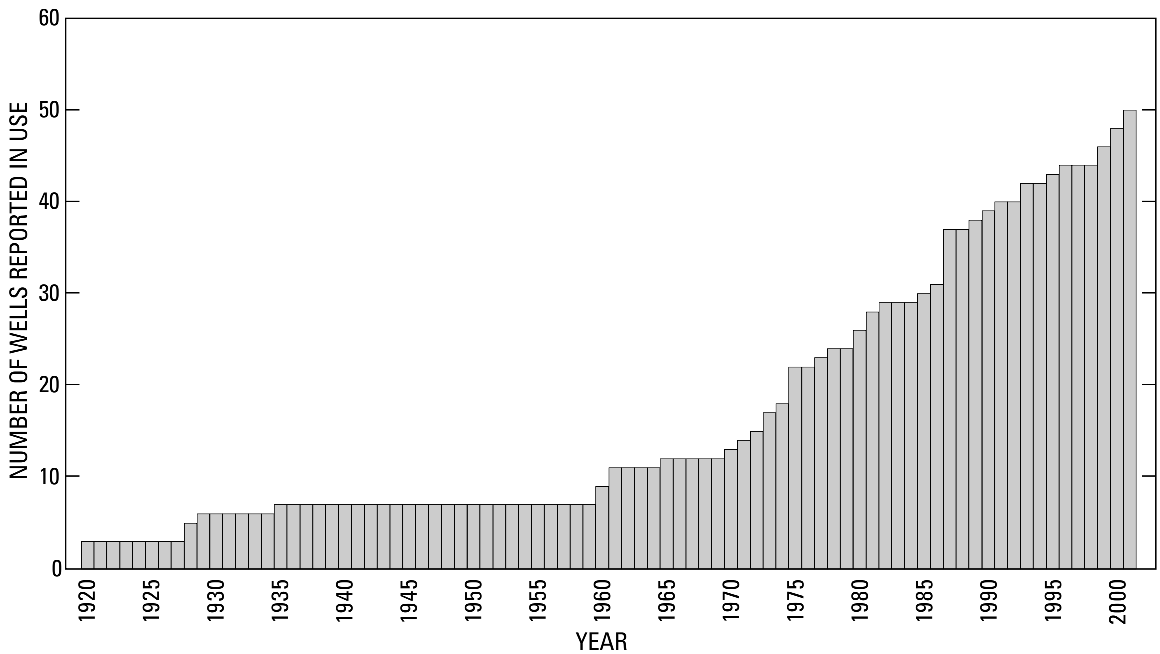


Figure 6. Growth in the number of production wells in the Lihue Basin, Kauai, Hawaii. (Based on data from the Hawaii State Commission on Water Resource Management, 2001.)

In both the Nonou and Kilohana-Puhi wells, short-term variations in water levels correspond inversely with rates of ground-water withdrawal (fig. 7). The Nonou wells show this correspondence clearly—when the pumping rates increase, water levels decline. Even so, ground-water withdrawals cannot account entirely for the overall trend of declining ground-water levels. The theoretical curve describing the decline of water levels with time in response to pumping a well, assuming the pumping rate is constant, is concave upward, becoming less steep with time. The observed ground-water decline in both the Kilohana-Puhi and Nonou wells, however, is concave downward, becoming increasingly steep with time (fig. 7). The concave-downward water-level trend also is seen in the Kalepa well, which is not being pumped and is not near any production wells (fig. 2). Withdrawal from wells certainly had an effect on local ground-water levels in the Kilohana-Puhi and Nonou wells, but other factors may have contributed to the observed water-level decline seen in the Kalepa well. The combined effects of withdrawal from numerous wells may have caused a regional depletion of water in the aquifer, and recharge may have been reduced by changes in irrigation and rainfall.

Changes in irrigation.—At its peak, the sugarcane industry in the Lihue Basin diverted tens of billions of gallons of water annually from streams for irrigation. The trends in irrigation water use for sugarcane fields near the Kilohana-Puhi wells can be seen in flows monitored by Lihue Plantation Company streamflow-gaging stations on the Hanamaulu and Upper Lihue Ditches; trends in water used to irrigate fields near the Nonou wells are indicated by the flow in the USGS Wailua Ditch streamflow-gaging station (number 16069000) (fig. 1). Water levels in wells show an overall correspondence with flows in ditches bringing water to fields near the wells (fig. 8). The general trend of declining water levels in the Kilohana-Puhi wells between 1985 and 2000 is approximately concurrent with a decline in flows in the Upper Lihue and Hanamaulu Ditches. Water levels at the Nonou wells and flows in the Wailua Ditch both show a general rise from 1975 to 1985 and decline from 1985 to 2000, although the ground-water-level pattern lags ditch flow by about 1.5 years. This correspondence indicates that ground-water levels may be linked to irrigation rates.

Sugarcane in the Lihue Basin was grown both with and without irrigation (figs. 9 and 10). Fields at higher elevations received enough rainfall and irrigation was not necessary. At the lower elevations, sugarcane fields were irrigated primarily by furrow methods prior to the 1980s, and a mix of furrow and drip methods from the mid-1980s through 2000. Drip irrigation was introduced to increase irrigation efficiency. Estimates for drip-irrigation efficiency (the ratio of water consumed by the crop to water applied to the field) for sugar plantations in Hawaii range from 80 to 95 percent, whereas estimates for furrow irrigation range from 30 to 70 percent (Dale, 1967; Fukunaga, 1978; Gibson, 1978; and Yamauchi and Bui, 1990).

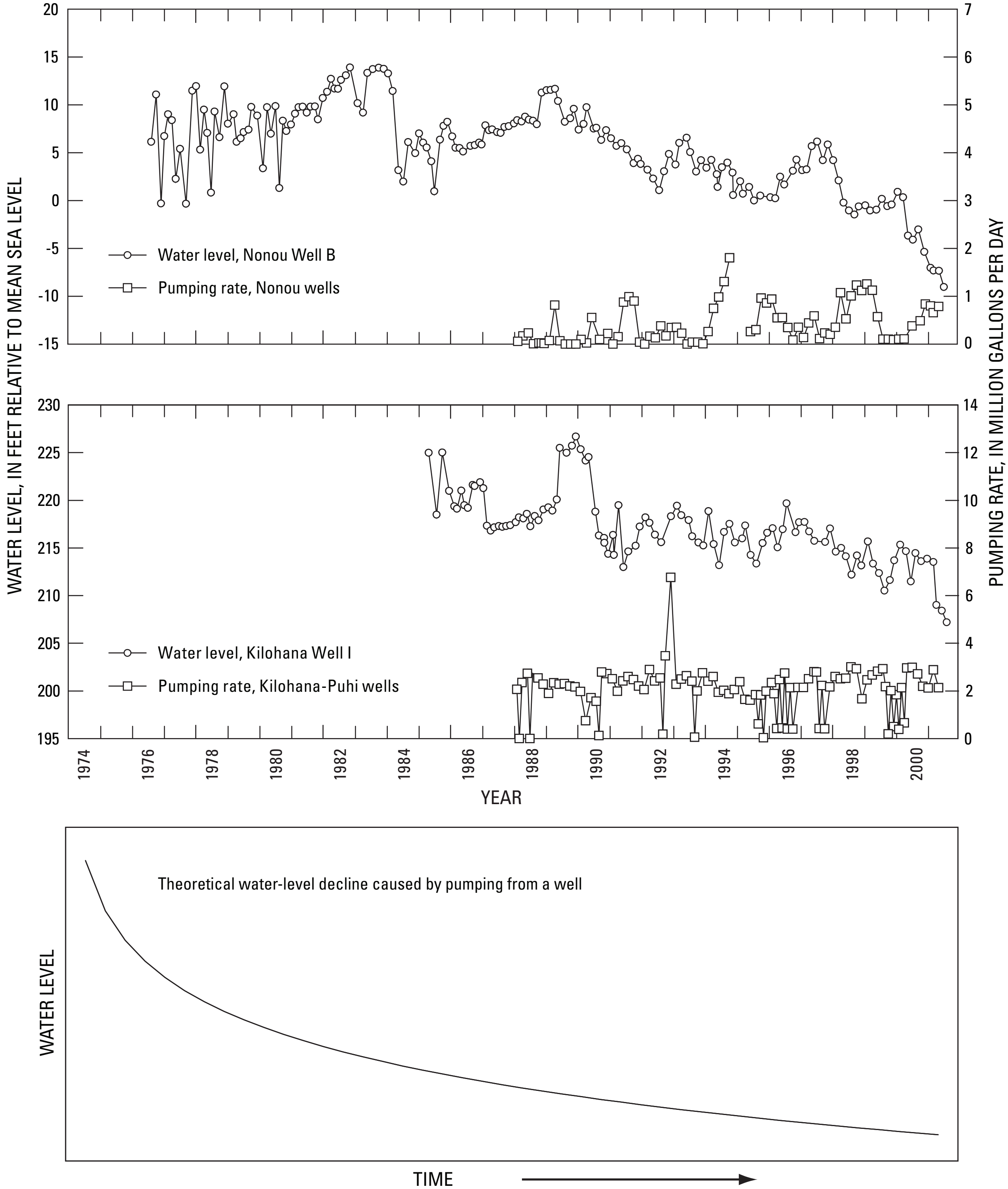


Figure 7. Pumping rate and water levels in the Nonou and Kilohana-Puhi wells, Kauai, Hawaii. (Pumping data provided by N.S. Fujii, Hawaii State Commission on Water Resource Management, written commun., 2001.)

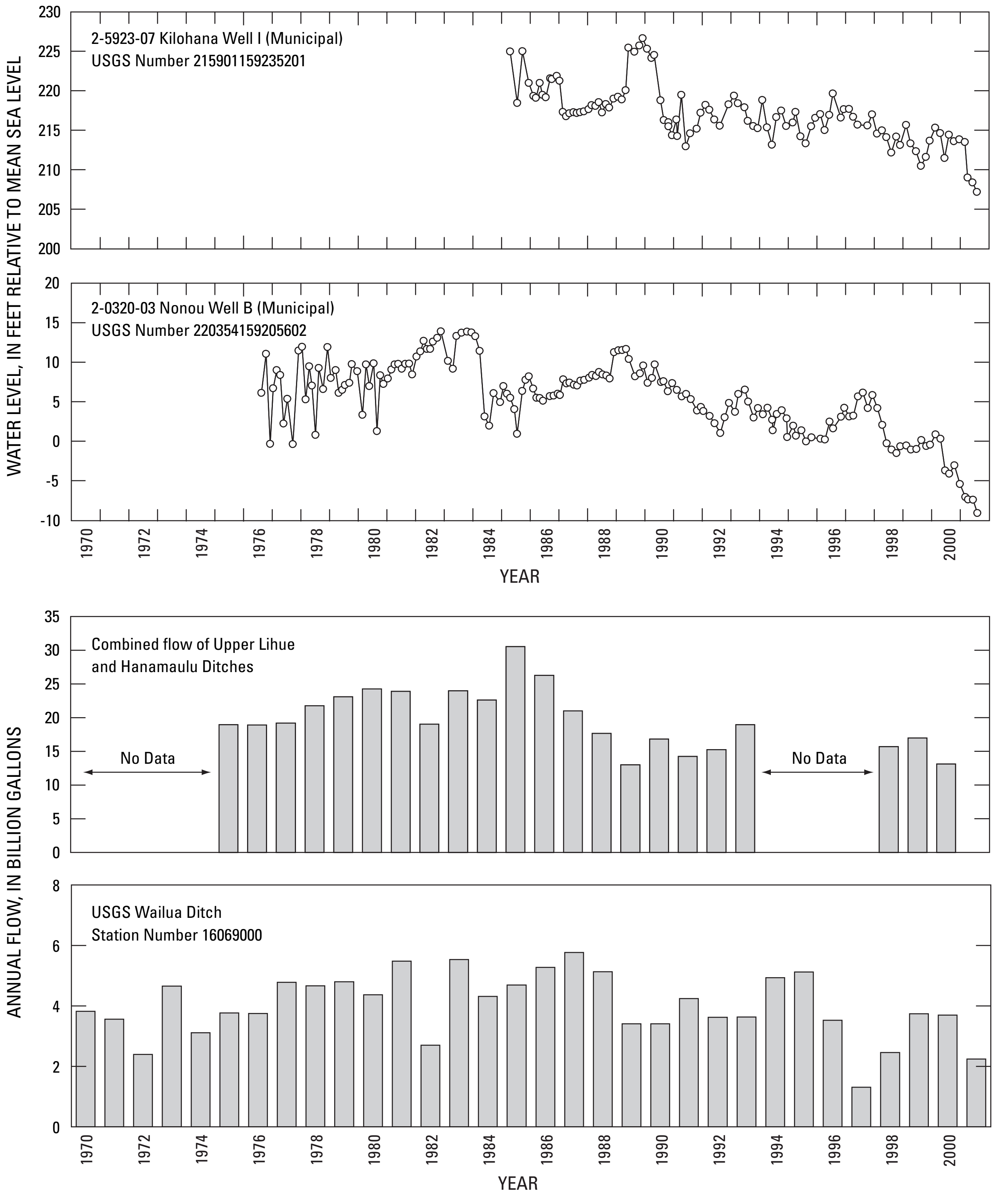


Figure 8. Ground-water levels and irrigation-ditch flow in the Lihue Basin, Kauai, Hawaii. (Data for the Upper Lihue and Hanamaulu Ditches are from records of the Lihue Plantation Company.)

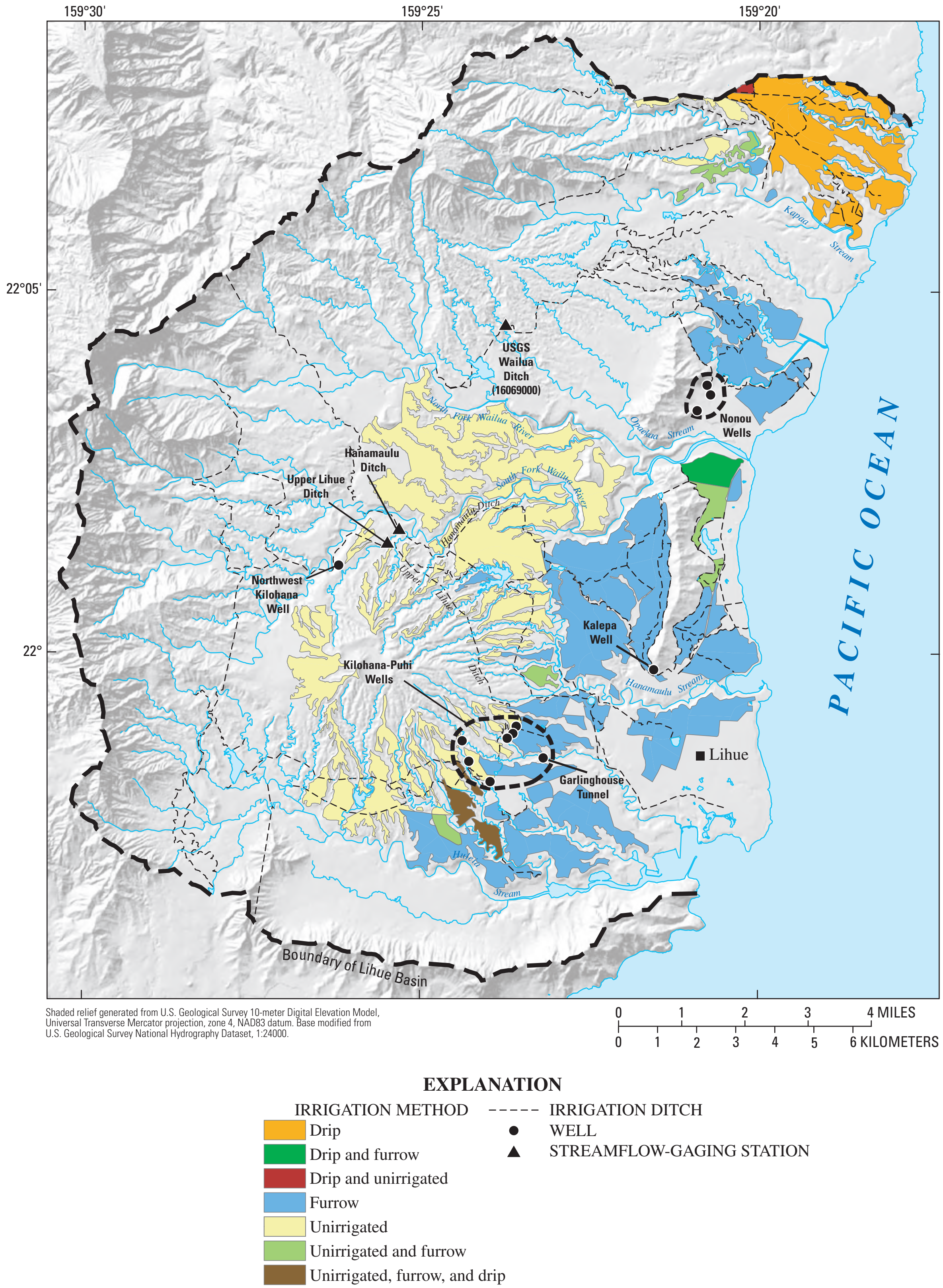


Figure 9. Sugar-plantation fields in 1981 in the Lihue Basin, Kauai, Hawaii. (Field outlines modified from maps in State of Hawaii, 1991; irrigation classification for 1981 from records of the Lihue Plantation Company.)

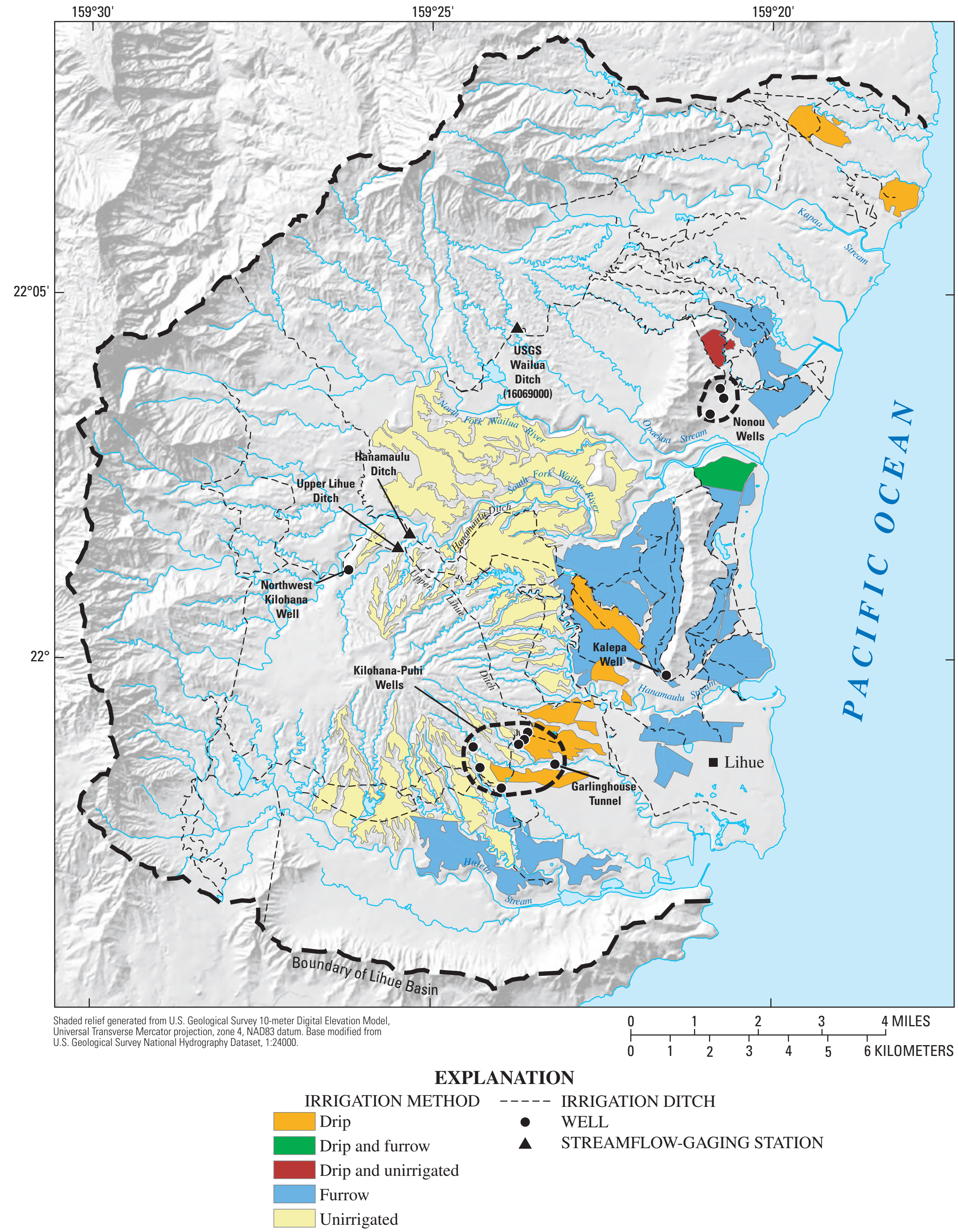


Figure 10. Sugar-plantation fields in 1998 in the Lihue Basin, Kauai, Hawaii. (Field outlines modified from maps in State of Hawaii, 1991; irrigation classification for 1998 from records of the Lihue Plantation Company.)

The conversion from furrow to drip irrigation was not widespread in the Lihue Basin, but sugarcane fields immediately adjacent to the Kilohana-Puhi wells were converted to drip irrigation beginning in the early 1990s (figs. 9 and 10). Concurrent with the conversion was a steep decline in water levels at the Kilohana wells. The rate of water-level decline steepened even more, however, beginning in about 1998, several years after the conversion was completed (fig. 8).

Only a small part of the sugarcane fields near the Nonou wells was converted from furrow to drip irrigation, but in the mid to late 1990s, some of the area was completely taken out of sugarcane production (figs. 9 and 10). This reduction in sugarcane production near the Nonou wells coincides with observed declines in ground-water levels (fig. 8).

Variations in rainfall.—Rain-gage records for the Lihue Basin extend back to the late 19th century, but not all rain gages have long, continuous records. The rainfall records at the USGS rain gage on Mt. Waialeale and the NWS rain gage at the Lihue Airport were used to evaluate trends because they are among the longest, most complete records in the Lihue Basin. The Lihue Airport rain gage also is one of the rain gages that the NWS uses to monitor droughts in Hawaii.

Annual rainfall totals at the rain gages on Mt. Waialeale and at the Lihue Airport were below average during most of the 1990s, especially from 1995 through 2002 at Mt. Waialeale and from 1998 through 2002 at the Lihue Airport (fig. 11). Periods of below-average rainfall also occurred in the 1970s and 1980s. The periods of below-average rainfall in the 1980s and 1990s coincide with the period of observed declines in ground-water levels in the Lihue Basin. The apparent water-level decline in the Northwest Kilohana Well (fig. 2), which is far from production wells and irrigated sugarcane fields, indicates decreased rainfall is at least partly the cause of water-level declines in the Lihue Basin.

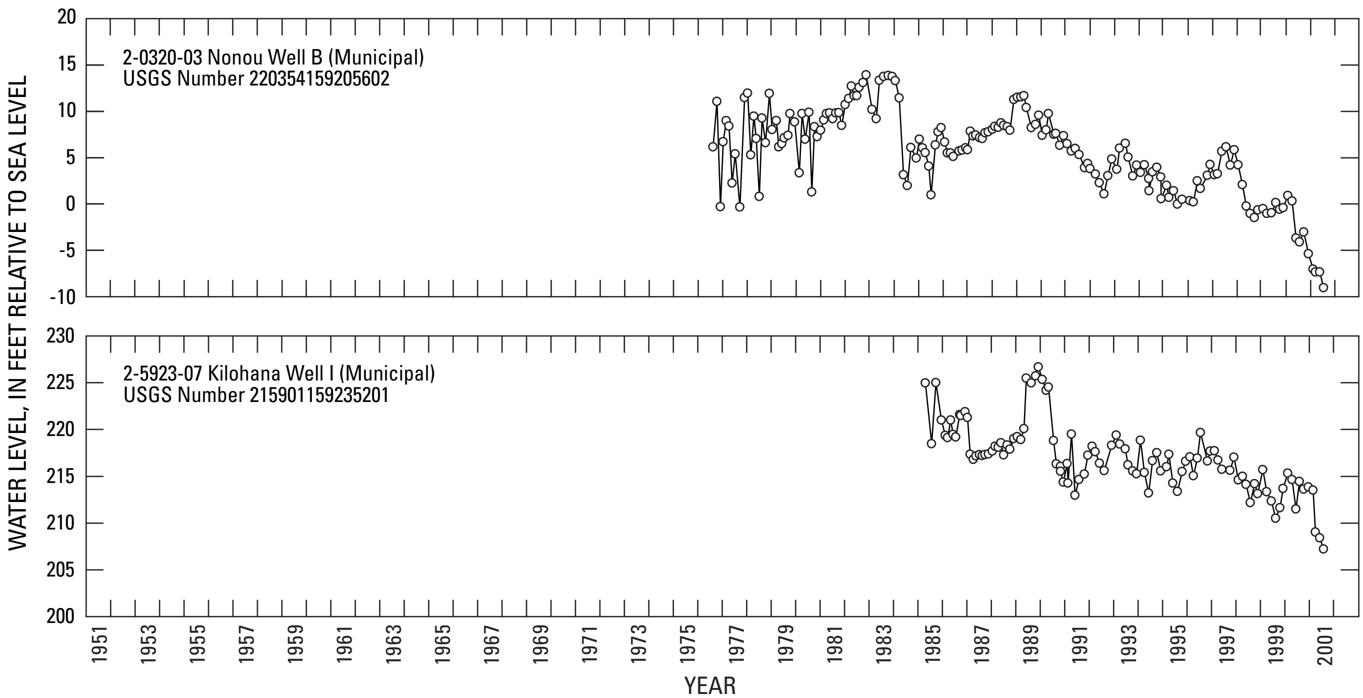
Changes in Ground-Water Recharge

Recent declines in water levels observed in some wells in the Lihue Basin correspond with increased ground-water withdrawal, reduced irrigation, and periods of below-average rainfall. Whereas increasing ground-water withdrawal will certainly and directly lower water levels to some degree, reduction of irrigation and periods of low rainfall can affect water levels indirectly by reducing ground-water recharge. To quantify the effects irrigation and rainfall may have on ground-water recharge, a water-balance model of the Lihue Basin was developed and used to simulate several scenarios representing historical conditions prior to and during the period of observed water-level decline, and for hypothetical conditions that could develop in the near future. The scenarios examined three different land-use conditions: (1) conditions that existed in 1981, when sugarcane cultivation occupied 16,600 acres in the Lihue Basin and most fields used furrow irrigation; (2) conditions that existed in 1998, when the area used for sugarcane cultivation had declined by 25 percent from 1981 and some fields were converted from furrow to drip irrigation; and (3) a hypothetical condition in which there is no irrigation. For each of the land-use conditions, four rainfall conditions were examined, including a base case using historical mean rainfall, and three drought conditions (described in a later section).

Estimating Ground-Water Recharge

Ground-water recharge in this study was estimated using a modification of the mass-balance method of Thornthwaite and Mather (1955) (see appendix A for details). The method operates on the premise that part of the water that falls on the land surface as rain runs off to the ocean via streams while the remainder infiltrates the soil. In the Lihue Basin, fog and irrigation also add to the amount of water in the soil. Water is temporarily stored in the soil where it is subject to evapotranspiration (fig. 12). Recharge to the aquifer occurs when more water infiltrates than can be held in the soil given its water-storing capacity, antecedent water content, and losses from evapotranspiration. The excess infiltrated water is then passed to the aquifer underlying the soil. The method thus constitutes a balance of input (precipitation and irrigation), output (runoff, evapotranspiration, and recharge), and water storage in the plant-soil system. In the water balance, the water-storage capacity of the soil is determined by the thickness of the soil within the root zone (root depth) and the available water capacity of the soil.

Timing of the input, output, and storage of water also affects computed recharge. If precipitation is frequent, evapotranspiration has less time to deplete the water stored in the soil, hence soil moisture may be kept near the water-storage capacity of the soil and even a small amount of infiltration may result in recharge to the aquifer. If precipitation is infrequent and evapotranspiration has a long time to reduce the antecedent soil moisture, even a large precipitation event may result in small volumes of recharge. In this study, the water-balance was computed on a daily basis, which is more accurate than computing on a monthly or longer basis because it allows more realistic simulation of short-duration events such as daily irrigation and episodic rainfall. The water balance was computed by stepping through consecutive days, using the ending soil moisture for one day as the antecedent soil moisture for the next day. The analysis required assuming initial soil-moisture conditions, but by computing the water balance for thousands of consecutive days (in this study, the equivalent of 50 years), the water balance converged on a long-term average recharge value.



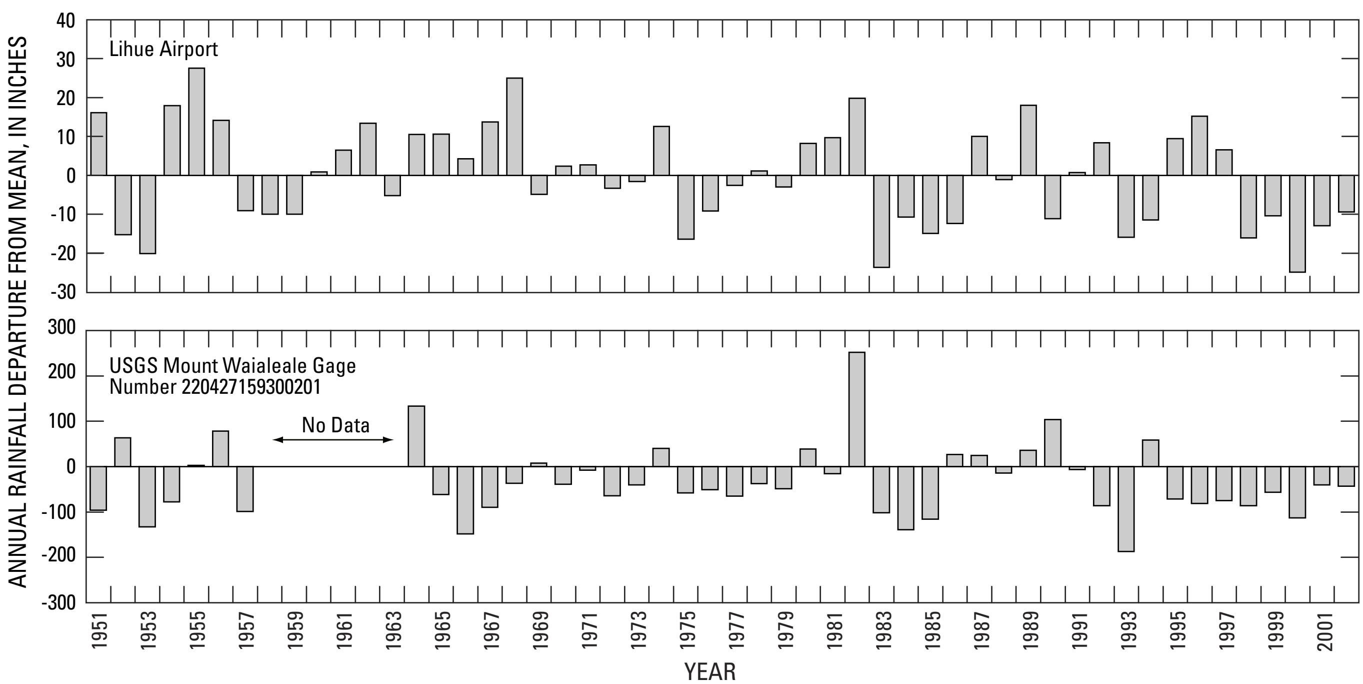


Figure 11. Ground-water levels and rainfall in the Lihue Basin, Kauai, Hawaii.
Mean annual rainfall for each rain gage determined on entire period of record, which is 1912 to 2002 for Mt. Waialeale and 1951 to 2002 for the Lihue Airport. (Rainfall data for the Lihue Airport for 1951 to 2001 from National Climatic Data Center, 2002; for 2002 from K. Kodama, National Weather Service, written commun., 2004; other data from the U.S. Geological Survey.)

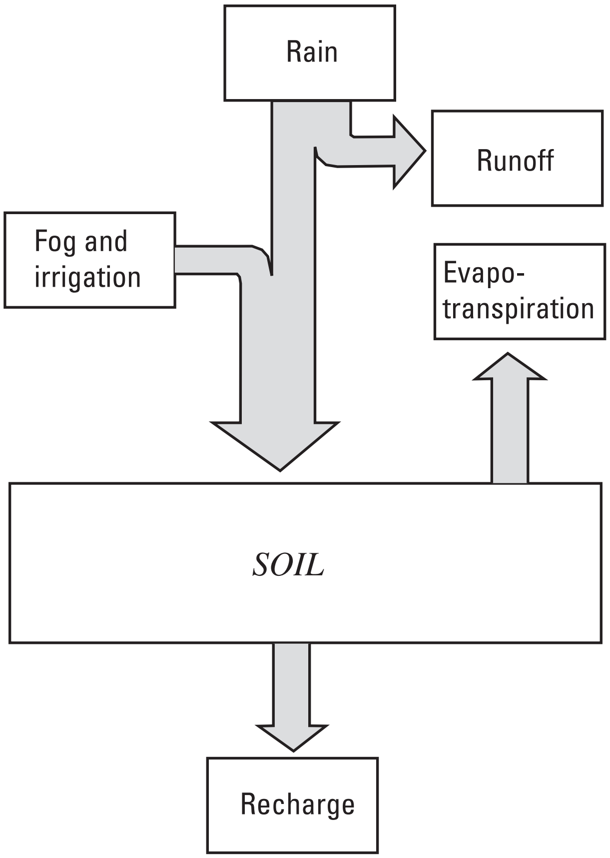


Figure 12. Water-balance flow chart showing water input (rain, fog, and irrigation minus runoff) and loss (evapotranspiration and recharge) from the plant-soil system.

Although the water-balance computes the water budget over a 50-year period, the computation is not intended to show how recharge varied over the 50-year period (that is, it is not a transient simulation). Each scenario is a steady-state simulation for a given set of conditions, assuming that those conditions persisted long enough for recharge to have achieved a steady state. Only the recharge at the end of the 50 years is considered valid. The sole purpose of stepping through daily water-balance computations for 50 years is to allow time for recharge to achieve a steady state for the conditions being simulated.

The water-balance was computed for the entire Lihue Basin (fig. 1). The daily water balance was computed for subareas within the basin having homogeneous precipitation, sugarcane cultivation and irrigation, runoff, and evapotranspiration characteristics. These areas were defined by merging geographic-information-system (GIS) spatial datasets (coverages) created from published and unpublished maps and other data (see appendix A).

Factors Affecting Ground-Water Recharge

Spatial and temporal variations in precipitation, irrigation, runoff, and evapotranspiration affect ground-water recharge. Each of these factors constitutes a parameter in the water-balance computations of recharge. Some parameters may have considerable uncertainty associated with them because a range of values are plausible, although one of the values in the range is usually considered most plausible. This section describes only the most plausible values selected for the water-balance computation; parameter uncertainty (i.e. plausible values other than the ones used) and its implications on recharge computations are discussed in a later section of this report.

Precipitation

Rainfall.—In this study, the daily rainfall distribution required for the water-balance computations was synthesized from the mean monthly rainfall distribution maps of Giambelluca and others (1986). These maps depict mean monthly rainfall as lines of equal rainfall, based on rain-gage data from 1916 to 1983. To convert lines on the maps to the areal rainfall distribution needed for the water-balance computation, areas between adjacent rainfall lines were assigned a mean monthly value equal to the average values of the two lines. In areas that were bounded by only one rainfall line (such as near the coast) or completely encircled by a single rainfall line (such as near the peaks of mountains), the mean value of rain gages within the area was assigned. If no rain gages were within a given area, the area was assigned the average of the value of the existing rainfall line and the value of the line that would logically have been next in the sequence of existing lines on the map.

The daily rainfall needed for the water-balance computation was synthesized from the mean monthly rainfall using the method of fragments (see Oki, 2002, for example). In this method, month-by-month patterns of daily rainfall (fragments) derived from the records of selected individual rain gages were imposed on the mean monthly rainfall distribution (fig. 13). In this study, data for fragments were obtained from daily rainfall data compiled by the National Climatic Data Center (2002, 2003) for the period from 1905 through 2001. Nineteen rain gages in the Lihue Basin had sufficient daily data for creating fragments. The fragments were created by dividing the rainfall of each day by the total for the month (fig. 13). Fragments were applied to the areas of equal mean monthly rainfall as defined by the mean monthly rainfall lines. Only fragments from rain gages lying within an area were applied to the rainfall for that area. If an area had no rain gages, fragments from the rain gages that were in the next closest area were used. Table 1 lists the areas of equal mean monthly rainfall and the corresponding rain gages from which fragments were derived.

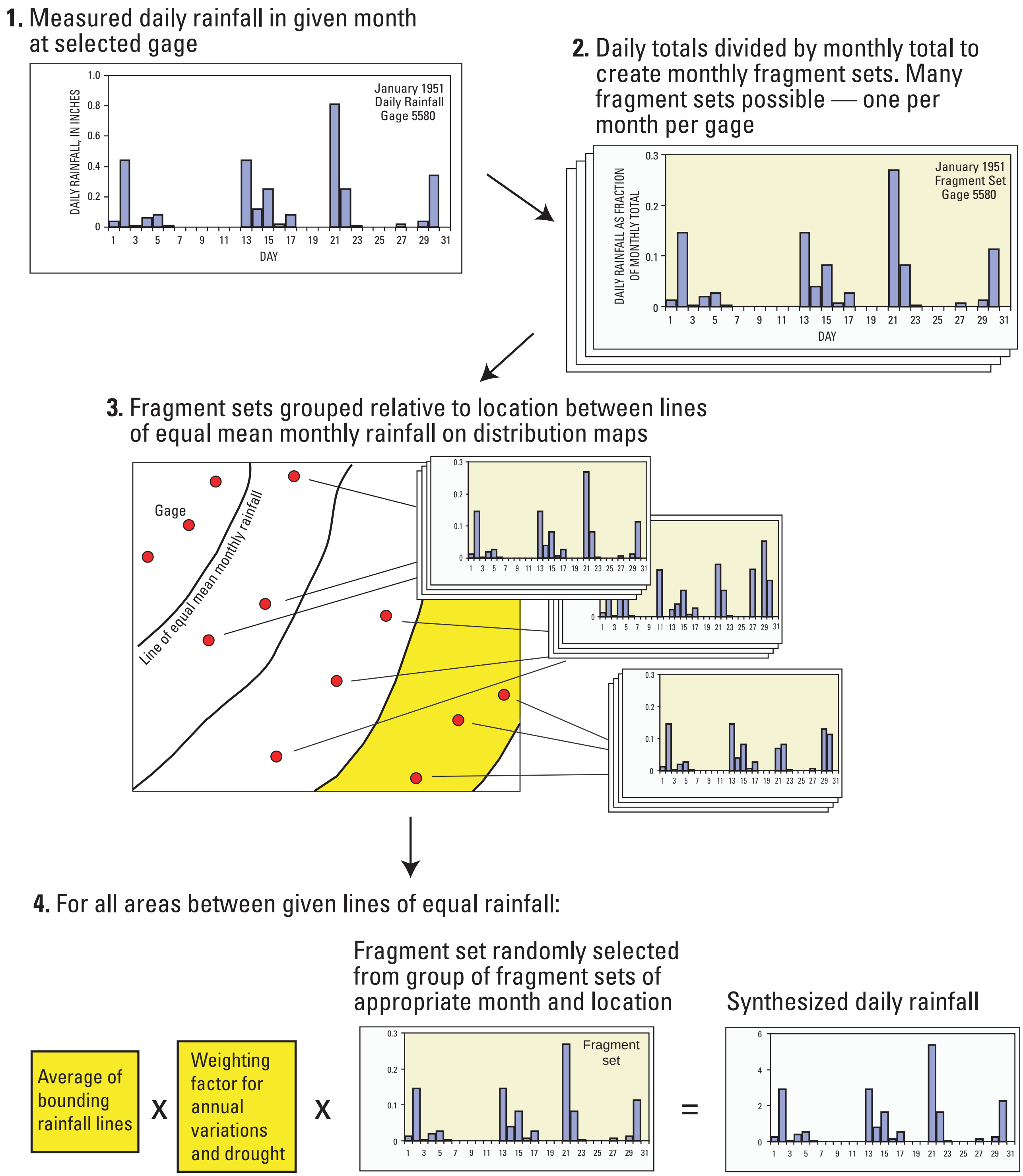


Figure 13. Synthesis of daily rainfall from mean monthly rainfall maps using method of fragments.

Table 1. Rain gages used to derive fragments for areas of equal rainfall in the water-balance computation for the Lihue Basin, Kauai, Hawaii.

[Gage numbers shown are National Weather Service rain-gage numbers (see figure 3 for locations). **Abbreviations:** OPAE, U.S. Geological Survey Opaekaa rain gage, number 220443159235601; NA, not applicable]

Bounding lines of equal mean monthly rainfall (inches)	Mean monthly rainfall in area between bounding lines (inches)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Less than 2	Average of gages in area. If no gages, then 1.5	NA	NA	NA	NA	NA	5580 0145 0935 3982	0145 0935 3982 5580	5580	NA	NA	NA	NA
2 to 3	2.5	NA	NA	NA	NA	3982	1195 3159 5575 6537 0766 6055	0145 0935 3982 5580	0145 1195 3159 0935 3982	0145 1195 3159 5580 0935 3982 0766	NA	NA	NA
3 to 4	3.5	NA	NA	NA	5580 3982	0145 1195 3159 5575 5580 0935 0766 6055	4615 8217	1195 3159 5575 0766 6537 6055	5575 6537 0766 6055	5575 6537 4615 8217 6055	3892	NA	NA
4 to 6	5.0	NA	0145 1195 3159 5575 5580 0935 3982 6537 4615 8217 0766 6055	0145 1195 5575 5580 3982 0766 6055	0145 1195 3159 5575 0935 6537 0766 4615 8217 6055	6537 4615 8217 0006	4937 1038 0006	8217 4615	0006 8217 4615	OPAE 0006 1038 4937	1195 5580 5575 3159 0145 0935 0766 6055 6537	0145 5580 0766 3982	0145 5580 3982
6 to 8	7.0	0145 1195 3159 5580 5575 0935 6537 4615 8217 6055 0766 3982	OPAE 4937 1038 0006	3159 0935 6537 4615 8217 0006	1038 0006	4937 1038	8958 OPAE	OPAE 0006 1038 4937	OPAE 4937 1038	8958	4615 8217 0006 1038 4937	5575 1195 3159 0935 6537 4615 8217 6055 0006	1195 5575 3159 0935 0766 6537 4615 8217 6055 0006
8 to 12	10.0	OPAE 8958 4937 1038 0006	8958 8966	OPAE 8958 4937 1038	OPAE 8958 4937	OPAE 8958 8966	8966 2222 6888 8775	8958	8958	8966 2222 6888 8775	8958 OPAE	OPAE 1038 4937 8958	OPAE 8958 4937 1038

Table 1. Rain gages used to derive fragments for areas of equal rainfall in the water-balance computation for the Lihue Basin, Kauai, Hawaii.—Continued

[Gage numbers shown are National Weather Service rain-gage numbers (see figure 3 for locations). **Abbreviations:** OPAE, U.S. Geological Survey Opaekaa rain gage, number 220443159235601; NA, not applicable]

Bounding lines of equal mean monthly rainfall (inches)	Mean monthly rainfall in area between bounding lines (inches)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
12 to 16	14.0	2222 6888 8966 8775	2222 6888 8775	2222 8966	8966 8775	2222 6888 8775	8966 2222 6888 8775	6888 2222 8966 8775	8966 2222 6888 8775	8966 2222 6888 8775	8966 2222 6888 8775	8966 8775	8966 8775
16 to 20	18.0	2222 6888 8966 8775	2222 6888 8775	6888 8775	2222 6888	2222 6888 8775	6565	6888 2222 8966 8775	8966 2222 6888 8775	6565	8966 2222 6888 8775	2222 6888	2222 6888
20 to 24	22.0	6565	2222 6888 8775	6888 8775	2222 6888	2222 6888 8775	6565	6565	8966 2222 6888 8775	6565	6565	2222 6888	2222 6888
24 to 28	26.0	6565	6565	6565	6565	6565	6565	6565	6565	6565	6565	6565	2222
Greater than 28	Average of gages in area. If no gages, then 30.0	6565	6565	6565	6565	6565	6565	6565	6565	6565	6565	6565	6565

For the base-case scenarios, the mean monthly rainfall was multiplied by a weighting factor to account for annual rainfall variations (fig. 13). The weighting factors were derived from the 50-year period, beginning in 1950, of the historical rainfall record at the NWS rain gage at the Lihue Airport. The factors were computed by dividing the annual rainfall for a given year by the mean annual rainfall for the period 1950 to 2001. For drought scenarios, lower-than-average weighting factors were used (computation of weighting factors for droughts is discussed in more detail in a later section).

An example computation helps illustrate the computation of daily rainfall using the weighting factors and method of fragments. The month of June 1960 and the area having mean monthly rainfall of 5.0 in. is used in this example. For this area and time, the value of 5.0 in. is multiplied by the weighting factor for 1960 (the factor is 1.021, indicating that rainfall in 1960 was slightly higher than average) yielding an estimated monthly value of 5.105 in. of rainfall in June 1960. A rainfall fragment set (fragments based on one June) is then randomly selected from among the fragment sets computed for June from rain gages within the 5.0-in. rainfall area (as seen in table 1, those rain gages are 4937, 1038, and 0006). The daily rainfall pattern represented by the fragment set is then imposed on the estimated June 1960 value by multiplying it by the fragment set.

Fog drip.—Fog is water that exists in the liquid phase but in droplets too small to fall as rain. Some of this water is intercepted by plants and drips or flows along branches and stems to the ground, thus adding to the overall water balance of the soil. The sparse fog data for Hawaii is commonly expressed as a ratio of fog to concurrent rainfall. This ratio is used to estimate fog precipitation in areas having rainfall but no fog data, such as the Lihue Basin. The fog-to-rain ratio varies, however, with elevation, seasons, topography, and climate regimes, so it is important that the fog-to-rain ratios used are reasonably representative of conditions in the Lihue Basin. In Hawaii, maximum fog development coincides with the position of the tropical temperature inversion (usually at about 6,600 ft), but fog may develop at elevations as low as about 2,000 ft (Juvik and Ekern, 1978).

For this study, fog contribution was added to all areas in the Lihue Basin at elevations above 2,000 ft (fig. 14). Juvik and Ekern (1978) reported a fog-to-rain ratio of 0.28 for the Kulani Camp Station (on Mauna Loa, on the island of Hawaii), which has a windward orographic climate regime comparable to that in the Lihue Basin. The Lihue Basin has a maximum elevation of 5,208 ft, which is comparable to the elevation of the Kulani Camp Station (5,183 ft), but most of the fog zone in the Lihue Basin is at a lower elevation than the Kulani Camp Station, and lower than the level of maximum fog development at the tropical temperature inversion. In the water-balance computation for this study, a single fog-to-rain ratio of 0.18 was used for all areas higher than 2,000 ft elevation. This value was selected on the assumption that the fog-to-rain ratio in the Lihue Basin ranges from zero at 2,000 ft to about 0.3 at the highest elevation, and that areas above 2,000 ft elevation probably have a mean fog-to-rain ratio about midway between 0 and 0.3.

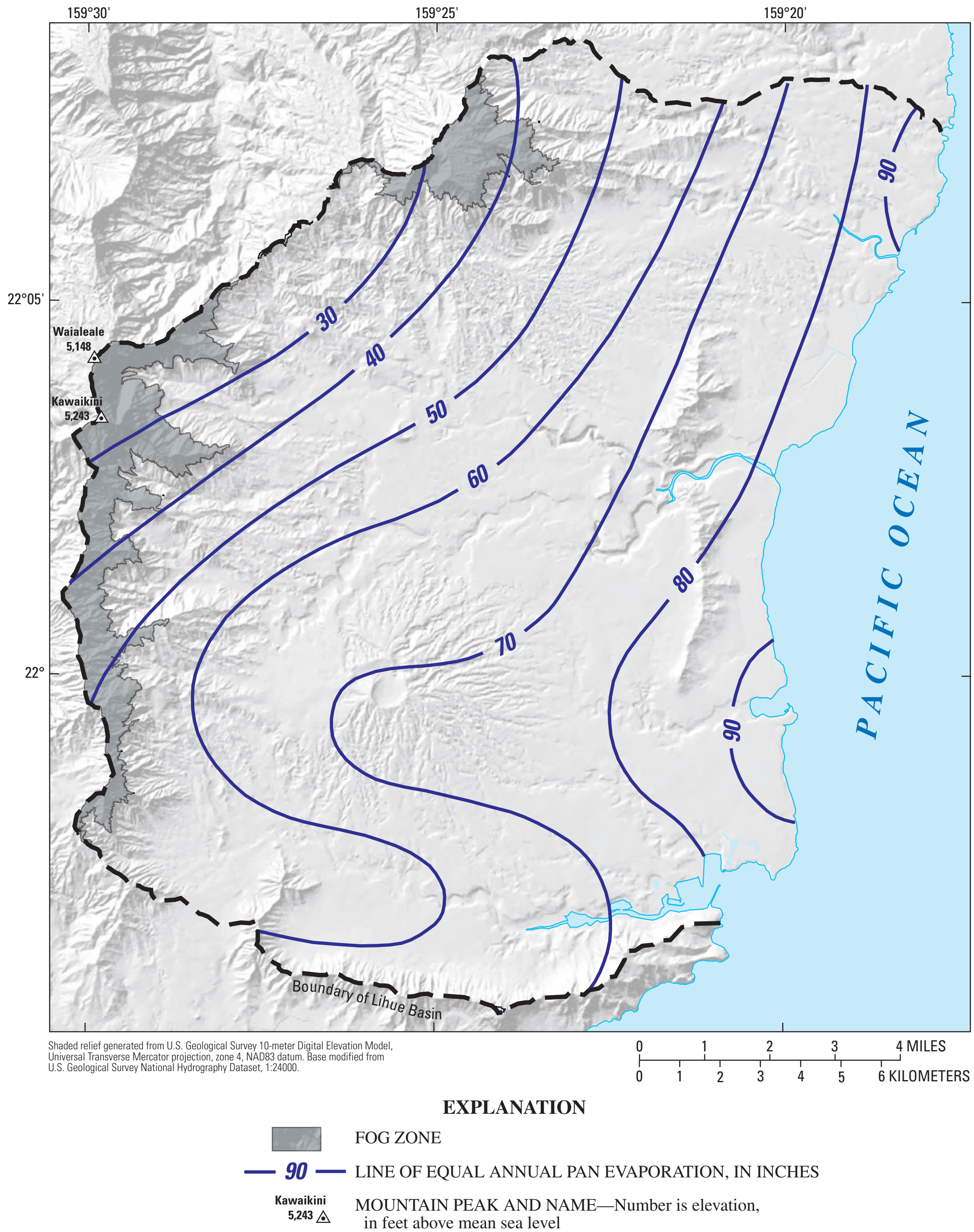


Figure 14. Distribution of mean annual pan evaporation (modified from Ekern and Chang, 1985) and area of fog contribution in the water balance for the Lihue Basin, Kauai, Hawaii.

Sugarcane Cultivation and Irrigation

Timing of irrigation application.—The typical sugarcane growing cycle in the Lihue Basin was 24 months. In a field that was irrigated, water was applied during only part of the cycle. The sugarcane was irrigated throughout the first 20 months of the cycle, which constituted the growing period. Over a period of about 40 days just before the end of the growing period, irrigation was reduced gradually until at the end of the growing period, the sugarcane received no irrigation water. The growing period was followed by a 50-day ripening period without irrigation, after which the sugarcane was harvested. After harvest, the field lay fallow for about 2 months while it was prepared for the next crop. In the water balance, the growing cycle was simplified to eliminate the need to simulate the gradual reduction of irrigation during the last 40 days of the growing period prior to ripening (table 2).

Plantations planned the growing cycles of the fields so that about one-half of the fields would be harvested in alternating years. To simulate this practice in the water-balance calculation, the fields were randomly divided into two groups such that half of the area of active cultivation began the 24-month cycle at the start of the computation period, and the other half started the irrigation cycle 12 months later.

In furrow-irrigated fields, water was periodically diverted from irrigation ditches to flood furrows dug in the crop fields. In an idealized irrigation schedule, each furrow-irrigated field would be flooded once every 14 to 16 days. In drip irrigated fields, water carried in hoses or pipes was dripped slowly into soil near the roots of the sugarcane. Ideally, water would be applied frequently in small amounts, but in practice, water was applied to drip-irrigated fields for two to three consecutive days each week, with no water applied during the remainder of the week. For the water-balance calculation, sugarcane fields were identified as having either drip, furrow, or no irrigation, and in some cases, combinations of these, based on plantation records (figs. 9, 10). Water was applied to furrow-irrigated fields on days 1 and 15 of each month, and to drip-irrigated fields on days 1, 2, 3, 8, 9, 10, 15, 16, 17, 22, 23, 24, and 28 of each month.

Table 2. Irrigation rates during periods in the growing cycle of sugarcane in the water-balance computation for the Lihue Basin, Kauai, Hawaii.

Period	Irrigation	Actual duration (days)	Duration in water-balance analysis (days)
Growing	Full	580	608
Last 40 days of growing [1]	Gradual reduction	40	0
Ripening	None	50	61
Fallow	None	60	61
Total number of days in cycle		730	730

[1] Not simulated in water-balance computation

Amount of water applied: furrow versus drip irrigation.—The water-balance computation requires mean monthly volumes of applied irrigation water per unit area of drip-irrigated fields (Q_D) and furrow-irrigated fields (Q_F). For this study, the distribution of sugarcane fields and the irrigation method used at each field was determined from records acquired from the Lihue Plantation Company after they had ceased operation in 2000. Records of how much irrigation water was actually applied to each field were not available, but a time-averaged estimate of Q_D and Q_F could be computed from monthly irrigation-ditch flow data. For this estimate, all water measured at the streamflow-gaging stations on ditches was assumed to have been actually applied to the fields served by the ditches (all irrigation also was assumed to have come from stream diversions; some small areas may have been irrigated with ground water, but this irrigation is insignificant compared to the amount of stream water diverted to irrigate sugarcane). In reality, some water probably was lost in transit between the gaging stations and the fields as a result of leakage and evaporation. The ditch-and-reservoir system, in a sense, has a water balance of its own, with evapotranspiration and recharge components that differ somewhat from, but are analogous to, that of sugarcane fields. The difference in the water balances of the ditch-and-reservoir system and the sugarcane fields probably have a negligible effect on the overall water balance of the Lihue Basin because the area occupied by the ditch-and-reservoir system is small. The applied irrigation per unit area within the Lihue Basin also was assumed to be virtually the same for all fields on which the same irrigation method was used. This allowed values of Q_D and Q_F to be computed based on fields having the most complete records of area in cultivation, irrigation method, and ditch flow. These values of Q_D and Q_F could then be applied to all fields in the basin, including those having insufficient data.

Because furrow irrigation is less efficient than drip irrigation, more water is applied per acre to a furrow-irrigated field than to a drip-irrigated field (assuming crop needs are the same). As discussed previously, estimates for drip-irrigation efficiency for sugar plantations in Hawaii range from 80 to 95 percent, whereas estimates for furrow irrigation range from 30 to 70 percent. The ratio of drip efficiency to furrow efficiency (R_{DF}) thus ranges from 1.1 to 3.2 (that is, a unit area of furrow-irrigated field uses 1.1 to 3.2 times more water than a drip-irrigated field). The Hawaii Sugar Planters' Association (HSPA) generally considered furrow irrigation to be about 30 percent efficient and drip irrigation to be 85 to 90 percent efficient (Michael Furukawa, oral commun., 2002), which indicates a range in R_{DF} of 2.8 to 3.0.

The quantity R_{DF} can be used to estimate monthly Q_D and Q_F from monthly irrigation ditch flows. For a given month, the total monthly irrigation (I_T) applied to a region with both furrow-irrigated and drip-irrigated fields is given by:

$$I_T = Q_D A_D + Q_F A_F \,, \quad (1)$$

where

I_T is total monthly irrigation applied to an area of mixed furrow- and drip-irrigated fields [L^3],

Q_D is monthly volume of water applied per unit area of drip-irrigated fields [L],

A_D is total area of furrow-irrigated fields [L^2],

Q_F is monthly volume of water applied per unit area of furrow-irrigated fields [L], and

A_F is total area of furrow-irrigated fields [L^2].

The value of Q_F can be expressed in terms of Q_D if the ratio of drip efficiency to furrow efficiency (R_{DF}) is known:

$$Q_F = R_{DF} Q_D \,, \quad (2)$$

where

R_{DF} is the ratio of drip efficiency to furrow efficiency [dimensionless].

Substituting equation 2 into equation 1 and solving for Q_D gives:

$$Q_D = I_T \,/ (A_D + R_{DF} A_F) \,. \quad (3)$$

Monthly values of Q_D and Q_F can thus be computed from equations 2 and 3 for any region having adequate records of monthly I_T (for example from monthly ditch-flow records), A_D , and A_F .

Relatively continuous monthly ditch-flow records exist for the Upper Lihue and Hanamaulu Ditches for the period between 1980 and 2000. These ditches supplied water to furrow- and drip-irrigated sugarcane fields between the South Fork Wailua River and Huleia Stream (figs. 9 and 10). The records of irrigation methods also are nearly complete for these fields. Monthly ditch flows for the Upper Lihue Ditch were added to those for the Hanamaulu Ditch and the composite flows used together with a value of 3.0 for R_{DF} to compute monthly Q_D and Q_F . Mean monthly Q_D and Q_F were then computed from the monthly values (table 3).

Runoff and Infiltration

The volume of water that infiltrates the soil after a period of rainfall can be estimated by subtracting the amount of direct runoff (water that flows over the land surface and shallow subsurface into the stream) from rainfall (fig. 12).

Table 3. Monthly irrigation used in the water budget for drip-irrigated (Q_D) and furrow-irrigated (Q_F) fields in the Lihue Basin, Kauai, Hawaii.

Month	Q_D (inches)	Q_F (inches)
January	2.96	8.89
February	2.77	8.30
March	3.41	10.24
April	3.83	11.50
May	4.18	12.53
June	3.67	11.00
July	4.43	13.29
August	4.41	13.23
September	3.69	11.06
October	4.09	12.27
November	3.60	10.80
December	2.96	8.89

Direct runoff for the drainage basins of some streams in the Lihue Basin can be determined from long-term gaging-station records. Flow recorded at a streamflow-gaging station includes both direct-runoff and base-flow (ground water that discharges into the stream) components from within the drainage area of the station. In this study, the direct-runoff component was separated from the base-flow component for selected streams by using the hydrograph-separation program of Wahl and Wahl (1995). The mean monthly direct-runoff values were then divided by the mean monthly rainfall (derived from the rainfall-distribution maps of Giambelluca and others, 1986) within the drainage area of each gaging station to obtain monthly ratios of runoff to rainfall. The monthly runoff-to-rainfall ratios were then used to compute infiltration in the water balance.

Runoff-to-rainfall ratios could not be computed for all areas in the Lihue Basin. The hydrograph-separation program is designed for continuous-record streamflow-gaging stations with no upstream controls such as diversions, additions, or reservoirs. Not all areas within the Lihue Basin were covered by the drainage areas of continuous-record streamflow-gaging stations, and most of the streams with gaging stations have been affected by diversions for irrigation. Direct runoff could, however, be computed for gaged streams that also have concurrent records of the water put into and taken from the stream. In these cases, the hydrograph-separation program was run on the composite hydrographs of the concurrent parts of the records of the gaging stations. Direct runoff and runoff-to-rainfall ratios were computed for the drainage areas of gaging stations 16060000 on the South Fork Wailua River, 16071000 on the North Fork Wailua River, and 16055000 on Huleia Stream (fig. 15 and table 4). Other areas in the Lihue Basin were assigned runoff-to-rainfall ratios of the nearest gaged basins.

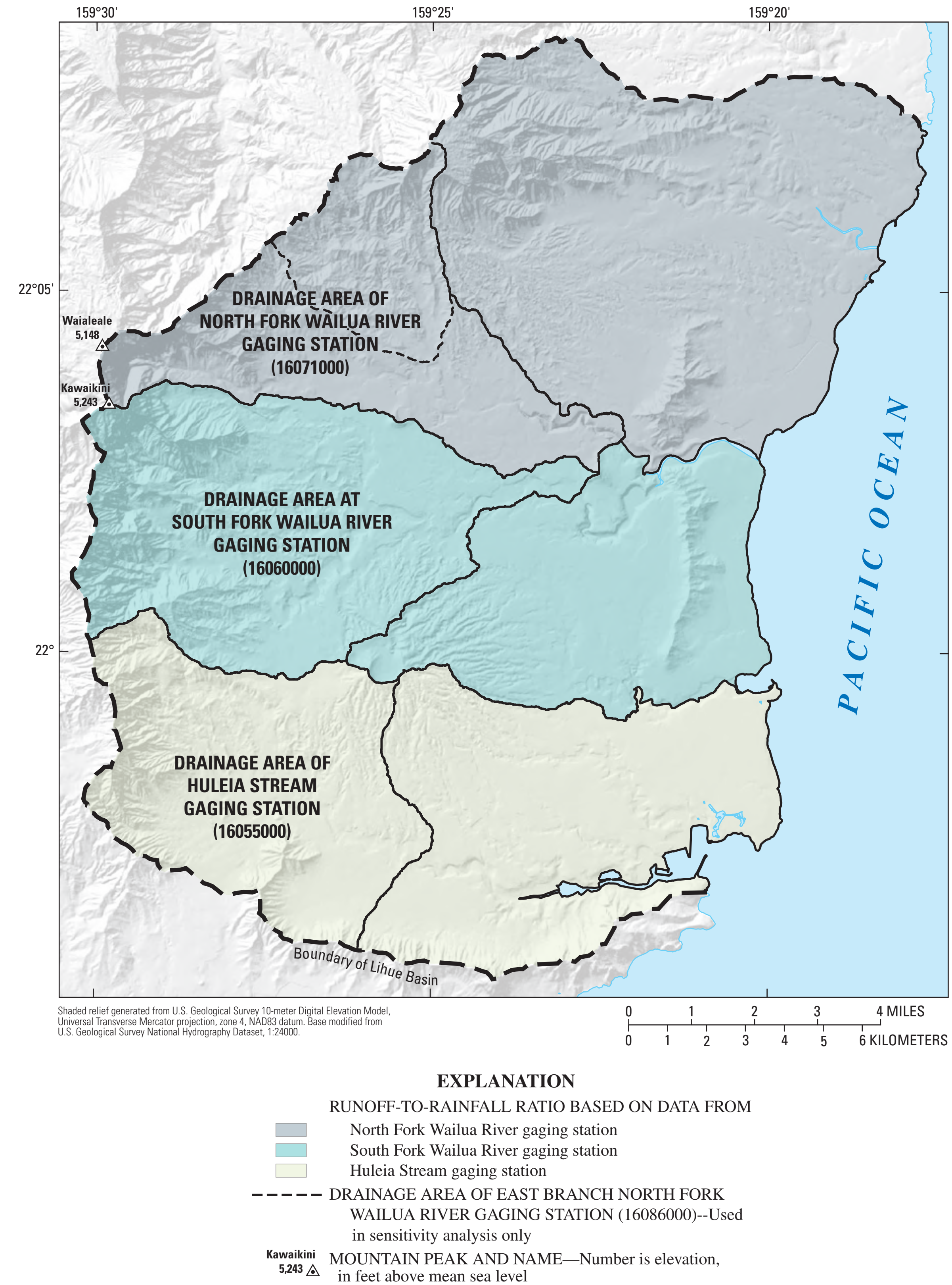


Figure 15. Areas used in the computation and assignment of runoff-to-rainfall ratios for the water balance of the Lihue Basin, Kauai, Hawaii.

Table 4. Monthly runoff-to-rainfall ratios for selected drainage basins in the Lihue Basin, Kauai, Hawaii.

[**East Branch North Fork Wailua River:** used in sensitivity tests only. **Gaging stations:** abbreviated U.S. Geological Survey gaging-station numbers. To obtain full number, append “16” before and “00” after number shown.]

	Huleia Stream	South Fork Wailua River	North Fork Wailua River	East Branch North Fork Wailua River
Gaging stations used to compute composite flow	[1]0550, 0534, 0536, 0544	[1]0600, 0570, 0580	[1]0710, 0700, 0620, 0610, 1000	[1]0680
Period of record used in computation	1968–70	1913, 1918	1966–72	1912–2004
Monthly runoff-to-rainfall ratios				
January	0.36	0.32	0.42	0.49
February	.41	.26	.33	.34
March	.40	.62	.31	.41
April	.17	.60	.37	.37
May	.24	.43	.35	.32
June	.17	.29	.31	.20
July	.11	.30	.21	.23
August	.11	.24	.21	.24
September	.12	.16	.23	.27
October	.19	.23	.17	.31
November	.41	.17	.25	.44
December	.83	.60	.52	.41
Average	.29	.35	.31	.34

[1]Indicates the gaging station that defines the drainage area of basin.

The mean monthly direct runoff values are not really mean monthly values in the strict sense. The mean monthly direct runoff for January, for example, would normally be the average of all direct-runoff means for January over the period of record, and only Januarys with complete data would be used in the average. The periods of concurrent record for most streams in the Lihue Basin are short, however, and would be even shorter if incomplete months were eliminated from analysis. Therefore, in this study, the monthly direct runoff for January was computed by averaging all direct runoff values for all January days, regardless of whether or not those days belong to complete months. This gave an average daily discharge (in cubic feet per second) for all January days; a similar computation was made for all other months. An adjustment was necessary for March at the South Fork Wailua River gaging station because available data from that station indicated that the mean monthly direct runoff was more than mean monthly rainfall. This inconsistency results because the period of concurrent record for the gaging stations used in the computation was short and included the anomalously high flows of March 11–13, 1918, with daily mean flows in excess of 2,900 ft^3/s. Because such flows are not typical and tended to skew the mean, they were eliminated from the average.

Rate of Evapotranspiration

In the water-balance analysis, evapotranspiration takes place within the soil. Potential evapotranspiration is the amount of water that would be evaporated or transpired from a well-vegetated soil if sufficient water is always available. The actual amount of water that is evaporated or transpired (actual evapotranspiration) is usually less because natural precipitation and soil-moisture storage do not always provide sufficient water for evapotranspiration at the potential rate. Even in sugarcane-growing areas where irrigation supplements natural precipitation, evapotranspiration may be less than the potential rate during ripening, harvesting, and fallow periods between crops when irrigation is reduced or completely withheld. Potential evapotranspiration is controlled by climate and the physiological water requirements of vegetation, whereas actual evapotranspiration also is affected by availability of water in the soil and soil depth.

Potential evapotranspiration.—A relatively large volume of pan-evaporation data is available for Hawaii because of monitoring conducted by sugarcane plantations, but pan evaporation may differ from potential evapotranspiration depending on vegetation type and percentage of ground area covered by the vegetation. Because the pan-evaporation data constitute the most widespread, readily available indicator of evapotranspiration, it is common in water-balance studies in Hawaii to express the uptake of water by vegetation as a ratio to pan evaporation (pan coefficient).

Research on sugarcane in Hawaii indicates that the ratio of evapotranspiration from fully grown sugarcane to pan evaporation is about 1.0 to 1.2 (Jones, 1980). Pan coefficients for other vegetation types are less well known. In a water-balance study on Oahu, Hawaii, Giambelluca (1983) considered evapotranspiration for most types of vegetation to be equal to that of fully grown sugarcane, except in persistently wet forests. In a series of water-balance computations for several areas in Hawaii, Shade (1995a, 1995b, 1997a, 1997b, 1999) used a pan coefficient of 1.0 based on published lysimeter studies in Hawaii sugarcane fields. For the Kohala Mountain on the island of Hawaii, Oki (2002) used a pan coefficient of 0.85 for all areas except wet forested areas below the fog zone.

In this study, potential evapotranspiration was derived from the map of annual pan evaporation by Ekern and Chang (1985) (fig. 14). The same methods described above for converting the lines of equal rainfall to an areal rainfall distribution were used to convert the lines of equal pan evaporation to areal evaporation distribution. Tabled monthly data in Ekern and Chang (1985) indicate that pan evaporation varies seasonally, with peaks in July–August, and lows in December–January. To better represent monthly variations, monthly weighting factors were derived from the mean monthly values and applied to the areal pan-evaporation distribution (table 5). The pan-evaporation distribution was converted to potential-evapotranspiration distribution by applying the pan coefficients. All non-agricultural areas were assigned a pan coefficient of 0.85 except for wetlands (1.0) and bare, rocky, or unconsolidated land (0.2). In agricultural areas, potential evapotranspiration (and hence pan coefficients) varies depending on the stage of growth of the crop (Allen and others, 1998). In this study, the crop cycle for sugarcane fields was divided into stages and pan coefficients for sugarcane fields were assigned as shown in figure 16 based on information in Fukunaga (1978). Evapotranspiration varies depending on whether the soil is at field capacity, nearly depleted (near the wilting point), or at some point between these conditions. In the water-balance computations used in this study, the method of Allen and others (1998) was used to model the change in evapotranspiration between field capacity and wilting point.

Availability of water in the soil.—For a given amount of infiltration, the availability of water in the soil is a function of the soil's ability to store water for uptake by plants. The maximum amount of water that can be stored in the soil and used by plants is known as the available water capacity. In the water-balance analysis for this study, the distribution of available water capacity of soils in the Lihue Basin is based on soil surveys described in Foote and others (1972) and U.S. Department of Agriculture (2001). For most types of soil, values of available water capacity were reported as ranges.

Table 5. Weighting factors used to account for the monthly variation in pan evaporation in the water-balance computation for the Lihue Basin, Kauai, Hawaii.

Month	Weighting factor
January	0.0643
February	.0661
March	.0797
April	.0850
May	.0948
June	.0974
July	.1036
August	.1024
September	.0918
October	.0831
November	.0692
December	.0626

For the water-balance computation, the median value of the range was used. For many soil types, different ranges were reported for different depths. In these cases, the water-balance computation used the depth-weighted mean available water capacity for all soil layers within the root depth. For a small number of soil types in the Lihue Basin, a value of zero was reported in the available-water-capacity data from the U.S. Department of Agriculture (2001). Because an available water capacity of zero is unrealistic, a default minimum value of 0.03 was assigned to any soil type and layer having a reported value of zero.

Soil thickness (root depth).—In the water-balance analysis, evapotranspiration from soil is assumed to take place only within the reach of roots. Root depths were estimated for various types of vegetation land cover. The distribution of vegetation type used in this study was based on a land-cover map for Kauai produced by the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center (CSC) on the basis of remote-sensing satellite imagery taken in 2000 (National Oceanic and Atmospheric Administration, 2000). The NOAA map showed 13 categories of land cover in the study area (table 6). The NOAA land-cover classification did not always agree with aerial photographs, plantation maps, and ground-based knowledge of the area. In particular, areas of active sugarcane cultivation at the time the satellite imagery was acquired were in some cases classified as "grassland" and in other cases as "cultivated land," presumably based on how the land appeared at the time of the satellite imaging. From above, recently plowed or planted fields have the appearance of actively cultivated land, whereas mature sugarcane has the appearance of grass. In areas where there were discrepancies, the areas of known active sugarcane cultivation as indicated by plantation maps and records took precedence over the NOAA classification.

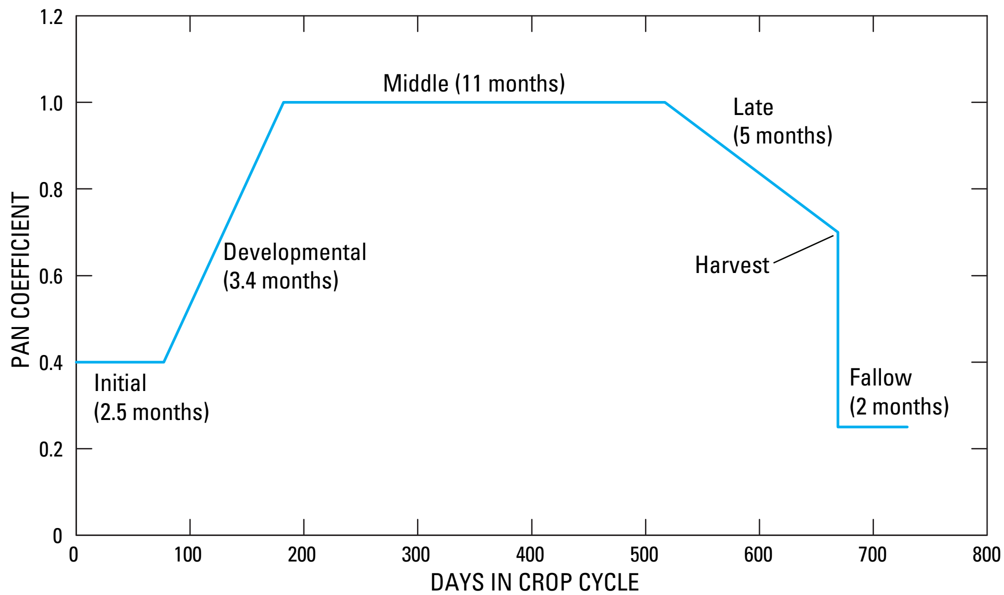


Figure 16. Pan coefficients in the water-balance computation for different growth stages of sugarcane.

In this study, sugarcane was assigned a root depth of 24 in. based on the results of Lee (1927), who found that in field studies and controlled experiments, 85 percent or more of the roots in mature sugarcane were in the uppermost 24 in. of soil (table 6). Grasslands were assigned a root depth of 20 in., which is similar to the root depth assigned to pasture lands by Oki (2002). Areas of scrub and shrub, which in the Lihue Basin are mostly sloping areas where soil thickness and vegetation growth is limited by mass wasting, were assigned a root depth of 12 in., which is consistent with values reported in Scott (1975). Vegetation in high- and low-intensity developed areas, which in the Lihue Basin consist primarily of urban and residential lands, was assumed to be short grass with a root depth of 12 in. Fifty percent of any area classified as high-intensity developed and 20 percent of any area classified as low-intensity developed were assumed to be impervious to water. Areas classified as “evergreen forest” in the NOAA map were assigned a root depth of 36 in., based on reported root depths for forest soils in Foote and others (1972). Other land-cover categories, for which root depths are unknown, were assigned arbitrary values of 6 to 16 in., but the total land area in these categories is relatively small.

Table 6. Land-cover categories, root depths, and pan coefficients used in this study.

[**Land-cover category**: Data from National Oceanic and Atmospheric Administration (2001)]

Land-cover category	Root depth (inches)	Pan coefficient
Sugarcane	24	See fig. 16
Bare land	6	0.20
Cultivated land	16	.85
Estuarine forested wetland	6	1.00
Evergreen forest	36	.85
Grassland	20	.85
High intensity developed	12	.85
Low intensity developed	12	.85
Palustrine emergent wetland	6	1.00
Palustrine forested wetland	6	1.00
Palustrine scrub/shrub wetland	6	1.00
Scrub/shrub	12	.85
Unconsolidated shore	6	.20
Unclassified	6	.85

Other Input Data

In addition to the principal data sets described above, the water-balance computation required other data that generally have a smaller influence on estimates of ground-water recharge because the data (1) pertain to only a small area in the Lihue Basin, (2) affect a minor computational adjustment in the water balance, or (3) represent starting conditions whose initial values become irrelevant as the daily water balance is computed over a period of many decades. The values assigned to these parameters in the water-balance computation for the Lihue Basin are listed in table 7.

Recharge Estimates

1981 base case.—In 1981, 16,600 acres in the Lihue Basin were used for sugarcane production (fig. 9). Most of the sugarcane fields that were irrigated used the furrow-irrigation method. In this scenario, the basin received a total water input of 750 Mgal/d, 665 Mgal/d (89 percent) of which came from rainfall, 70 Mgal/d (9 percent) from irrigation, and 15 Mgal/d (2 percent) from fog (table 8). Of this total input, 220 Mgal/d (29 percent) went to stream runoff. The estimated basin-wide recharge in this scenario was 264 Mgal/d, or about 35 percent of the total water input to the basin. The distribution pattern of recharge (fig. 17) parallels the distributions of rainfall (fig. 3) and evapotranspiration (fig. 14), with highest recharge per unit area at the inland margin of the Lihue Basin, and lowest recharge near the coast. Much of the coastal area receives 10 in/yr or less of recharge, except in areas of active sugarcane fields, where irrigation has raised recharge in most fields to more than 80 in/yr.

Table 7. Values of miscellaneous parameters in the computation of the water balance for the Lihue Basin, Kauai, Hawaii.

Parameter	Value
Starting soil-moisture storage	50 percent of capacity
Soil depth for non-vegetated areas	6 inches
Impervious surface interception capacity	50 percent
Recharge rate under surface-water bodies	12 inches per year
Percentage of pervious area in:	
High-intensity developed areas	50 percent
Low-intensity developed areas	80 percent
Depletion fraction for evapotranspiration method of Allen and others (1998)[1]	0.65 for sugarcane, 0.50 for all other types of vegetation

[1]See appendix A for explanation.

Table 8. Results of water-balance computations for various land-use and climate conditions in the Lihue Basin, Kauai, Hawaii.

[**Abbreviation:** n.r., not relevant]

Scenario	Water-balance components (million gallons per day)						Percent difference in recharge relative to	
	Rain	Fog	Irrigation	Runoff	Actual evapotranspiration	Recharge	1981 base case	1998 base case
1981 base case	665	15	70	220	266	264	n.r.	7
1998 base case	665	15	46	220	260	246	-7	n.r.
No-irrigation base case	665	15	0	220	247	212	-20	-14
1981 condition, moderately dry	419	9	70	139	229	131	-50	n.r.
1981 condition, very dry	343	8	70	113	208	100	-62	n.r.
1981 condition, extremely dry	298	7	70	99	193	84	-68	n.r.
1998 condition, moderately dry	419	9	46	139	222	114	n.r.	-54
1998 condition, very dry	343	8	46	113	199	84	n.r.	-66
1998 condition, extremely dry	298	7	46	99	184	69	n.r.	-72
No irrigation, moderately dry	419	9	0	139	205	84	-68	-66
No irrigation, very dry	343	8	0	114	182	56	-79	-77
No irrigation, extremely dry	298	7	0	99	165	41	-84	-83

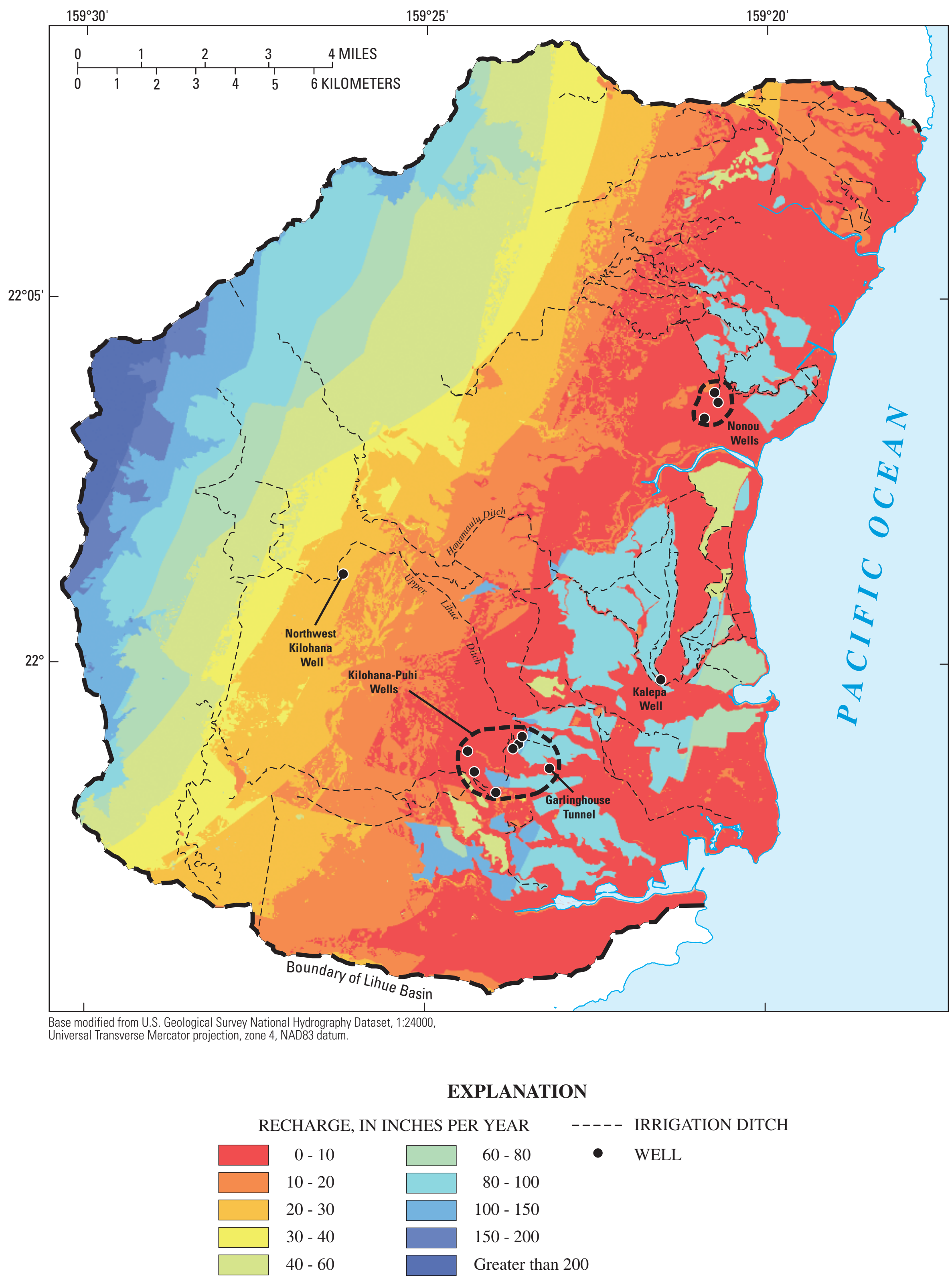


Figure 17. Distribution of estimated recharge for 1981 land-use conditions in the Lihue Basin, Kauai, Hawaii.

1998 base case.—Between 1981 and 1998, agriculture in the Lihue Basin changed in hydrologically significant ways. Plantation records for 1998 had the most complete irrigation information available for years near the closing of sugarcane operations. In 1998, the total area used for sugarcane production was 12,400 acres, about 25 percent less than in 1981 (fig. 10). Also, some sugarcane fields were converted from furrow irrigation to more efficient drip irrigation in the 1980s and 1990s. These changes resulted in a reduction in irrigation of 24 Mgal/d (relative to 1981 conditions), or about 3 percent reduction in total water input to the Lihue Basin. For the land-use conditions that existed in 1998, the water-balance analysis yielded a recharge estimate of 246 Mgal/d in the Lihue Basin, which is 18 Mgal/d less than the estimated recharge for 1981 land-use conditions (table 8). The pattern of recharge distribution for the 1998 base case (fig. 18) is similar to the distribution for the 1981 base case (fig. 17) except for differences associated with irrigation changes that took place between these times (figs. 9 and 10). Recharge is less in areas that changed from furrow to drip irrigation and in areas removed from sugarcane production.

No-irrigation base case.—Since the closure of the sugarcane industry in the Lihue Basin in 2000, other agricultural activities have replaced sugarcane in some areas, but most of the former sugarcane lands are currently unused. Although the future of agriculture in the Lihue Basin is unknown, the amount of irrigation water used in the near future probably will be substantially less than the amount used to irrigate sugarcane. In this scenario, distribution of sugarcane fields was based on 1998 land-use conditions. When the sugarcane plantations ceased operation in 2000, fields probably were left in various stages of the planting cycle, from recently harvested fallow fields to fields with mature sugarcane. It is therefore difficult to determine what the water demands (pan coefficients) would have been since the closing of the plantation, or what they will be in the future. For this reason, the water balance was allowed to cycle through the pan coefficients as if the sugarcane was still present, but irrigation was completely withheld. In the 1981 and 1998 land-use scenarios, irrigation provided 70 and 46 Mgal/d, respectively, or 9 and 6 percent of the total water input to the basin-wide water balance (table 8). With this water completely removed from the water balance, basin-wide recharge was 212 Mgal/d, which constitutes a 52 Mgal/d decrease relative to the 1981 base case and 34 Mgal/d decrease relative to 1998 base case. The pattern of recharge distribution for this scenario (fig. 19) shows that without irrigation, nearly all coastal areas, including the areas near the Nonou and Kilohana-Puhi wells, would receive recharge of 10 in/yr or less.

1981 and 1998 land-use conditions with drought.—To examine how a period of low precipitation may have affected recharge, a water balance was computed for a hypothetical case using the 1981 and 1998 land-use conditions combined with various degrees of drought. For this study, drought conditions were imposed on the water-balance computation by using a lower-than-normal annual-rainfall weighting factor. Drought conditions were defined on the basis of the 12-month standard precipitation index (SPI) (Guttman, 1999). The 12-month SPI for rainfall data from 1952 to 2003 for the Lihue Airport rain gage was computed and placed into “moderately dry,” “very dry,” and “extremely dry” categories by the NWS (Kevin Kodama, written commun., May 20, 2004). To obtain the annual rainfall weights representative of each category, the average rainfall for all 12-month periods in the category was divided by the mean annual rainfall for 1950–2001 (table 9).

The average of the 12-month periods classified as moderately dry, very dry, and extremely dry was 26.6, 21.8, and 18.9 in., respectively, which yielded weighting factors of 0.64, 0.53, and 0.46 (table 9). Using these weighting factors to compute rainfall for droughts of varying severity and applying this to 1981 land-use conditions resulted in computed recharge ranging from 131 to 84 Mgal/d (table 8). This represents a decrease of 133 to 180 Mgal/d (50 to 68 percent) relative to the 1981 base case. Using 1998 land-use conditions, the computed recharge ranged from 114 to 69 Mgal/d, or 132 to 177 Mgal/d (54 to 72 percent) less than the 1998 base case. Under moderately dry conditions, the area of the basin receiving 10 in/yr or less of recharge is about twice the size that it is under normal rainfall conditions (compare figs. 20 and 21 with figs. 17 and 18). Most furrow-irrigated areas, however, still would receive 60 in/yr or more of recharge.

Table 9. Mean rainfall for 12-month periods classified as near normal to extremely dry using the standard precipitation index (SPI) for the rain gage at the Lihue Airport, Kauai, Hawaii.

[Data and SPI analysis for 1951 through 2003 provided by Kevin Kodama, National Weather Service, written commun., May 20, 2004]

Category	Mean rainfall for 12-month periods classified in category (inches)	Weighting factor
Near normal	40.3	Not applicable
Moderately dry	26.6	0.64
Very dry	21.8	.53
Extremely dry	18.9	.46

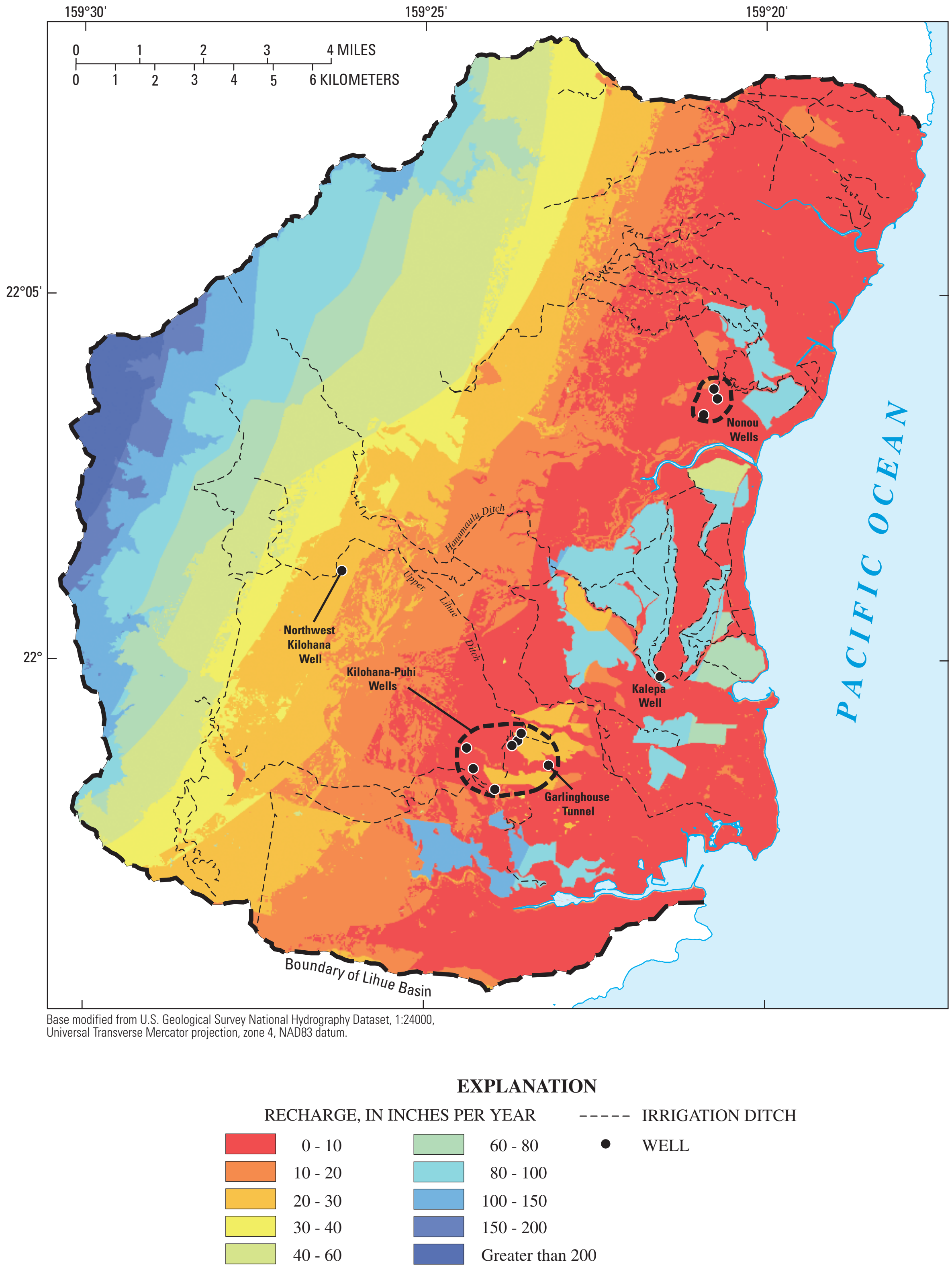


Figure 18. Distribution of estimated recharge for 1998 land-use conditions in the Lihue Basin, Kauai, Hawaii.

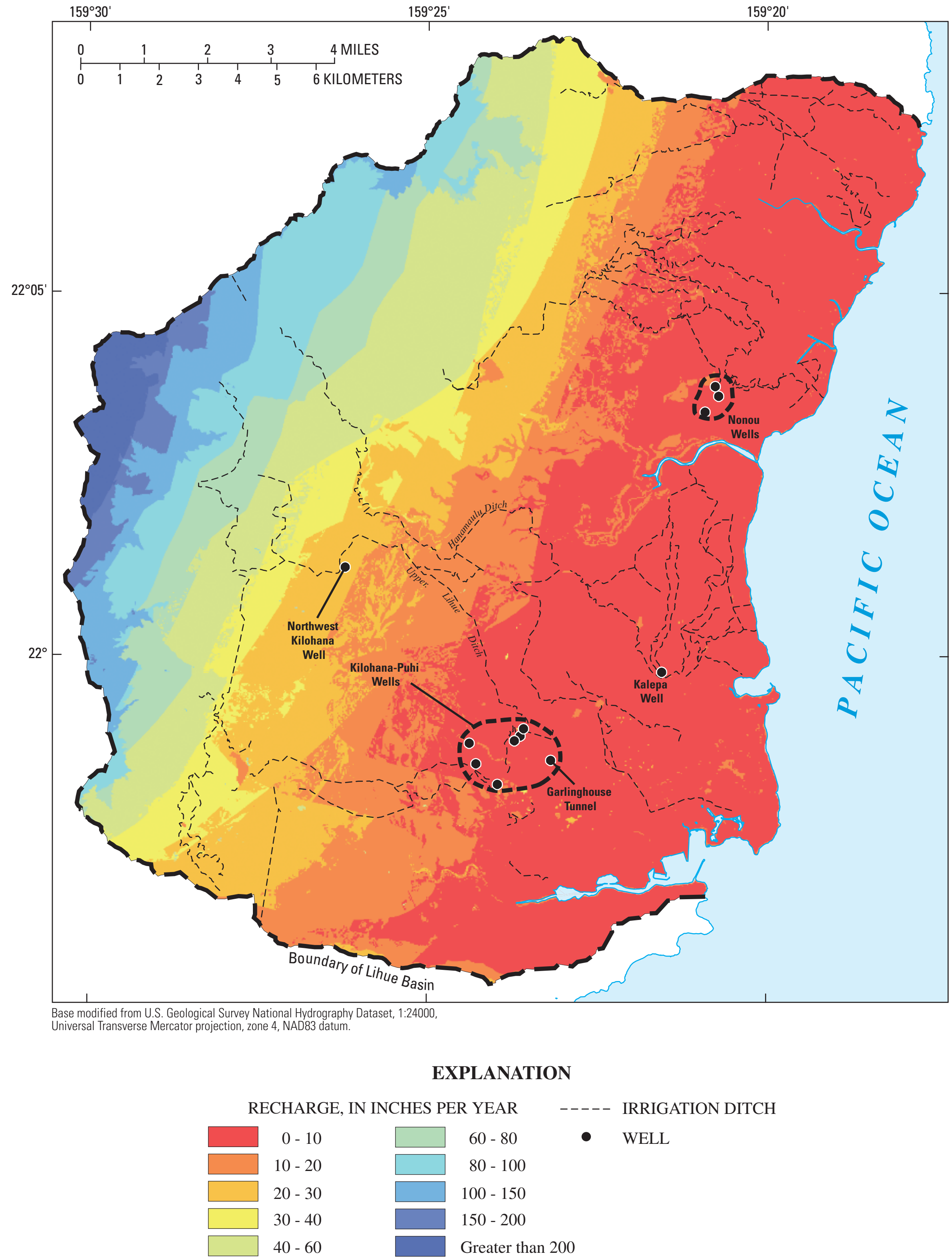


Figure 19. Distribution of estimated recharge if irrigation ceases in the Lihue Basin, Kauai, Hawaii.

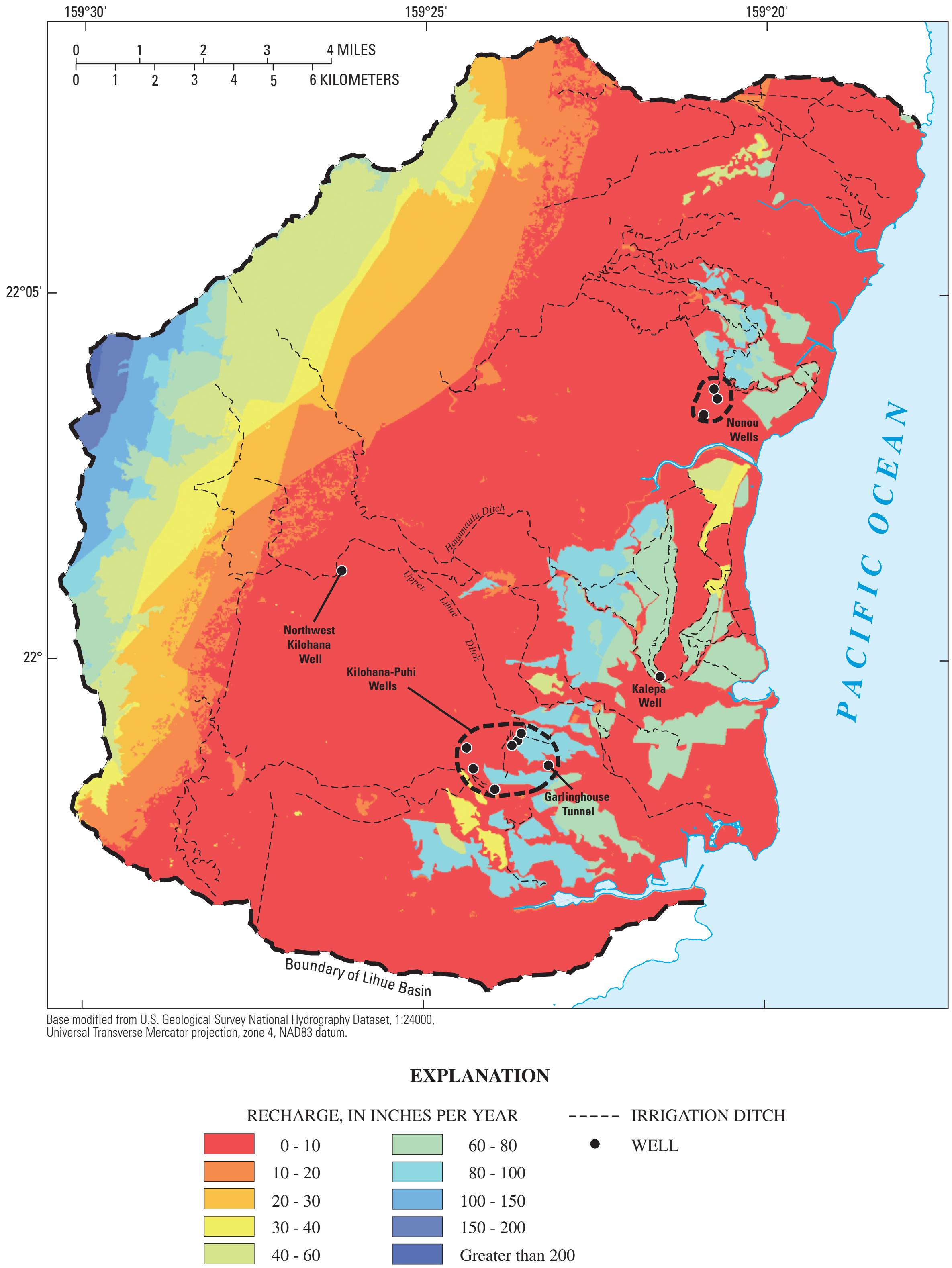


Figure 20. Distribution of estimated recharge for 1981 land-use conditions and moderately dry rainfall conditions in the Lihue Basin, Kauai, Hawaii.

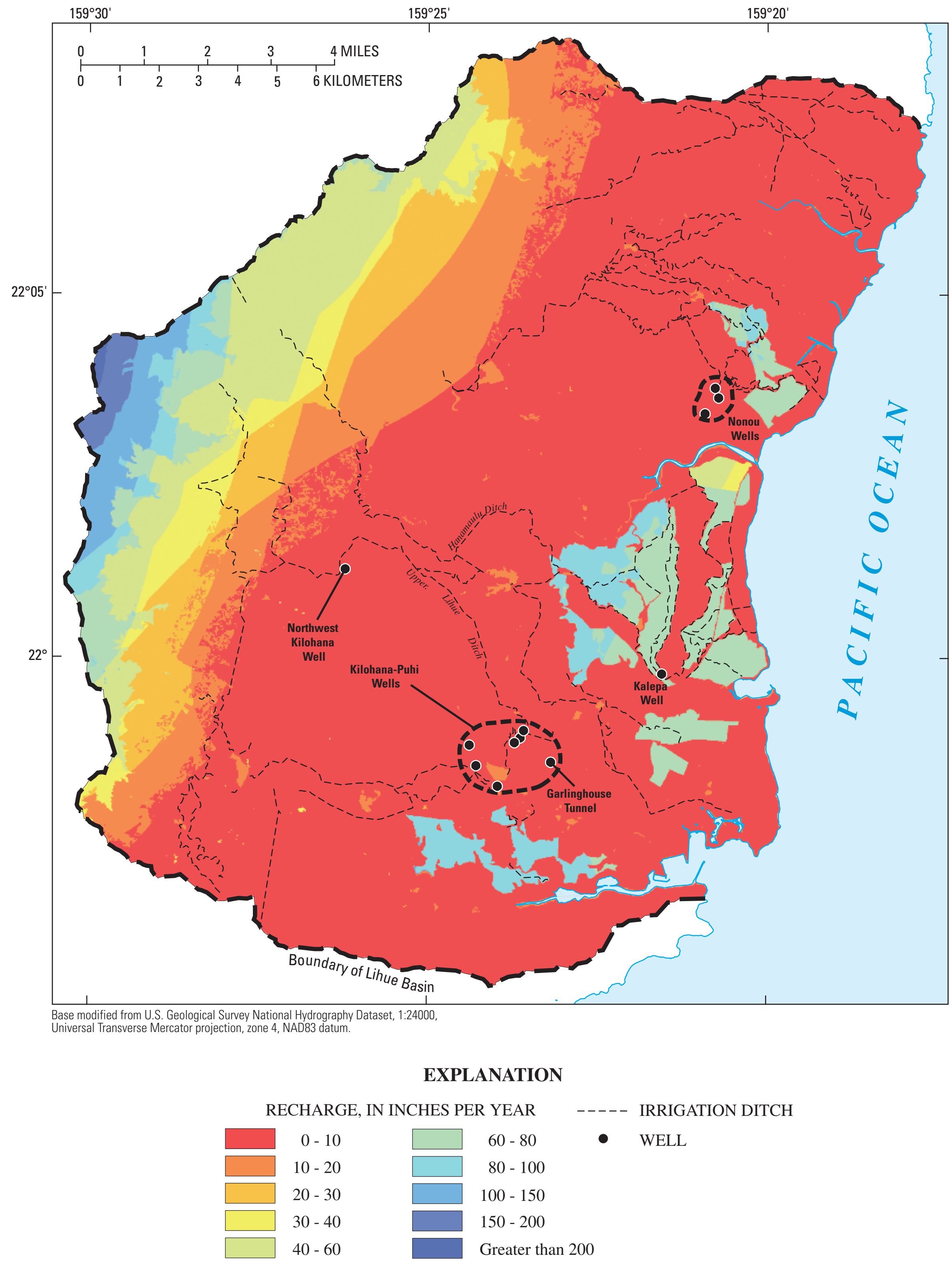


Figure 21. Distribution of estimated recharge for 1998 land-use conditions and moderately dry rainfall conditions in the Lihue Basin, Kauai, Hawaii.

Drought with no irrigation.—If drought conditions occur when there is no irrigation, the input of water to the water balance will be substantially decreased. The computed combined water-balance input assuming no irrigation and moderately dry, very dry, and extremely dry conditions was 428, 351, and 305 Mgal/d, respectively (table 8), which constitutes a 43 to 59 percent decrease in input relative to the 1981 base case and 41 to 58 percent decrease relative to the 1998 base case. Computed recharge ranged from 84 to 41 Mgal/d, which is 180 to 223 Mgal/d (68 to 84 percent) less than the recharge computed in the 1981 base case, and 162 to 205 Mgal/d (66 to 83 percent) less than the 1998 base case. The pattern of recharge distribution for moderately dry rainfall conditions when there is no irrigation shows that recharge in about two-thirds of the Lihue Basin would be 10 in/yr or less (fig. 22).

Comparison with previous recharge estimates.—The water balance of Kauai for land-use conditions that existed in 1990 was studied previously by Shade (1995a). Because the land-use conditions in 1990 were close to those of the 1998 base-case scenario of this study, an opportunity exists to compare the recharge computed by two different methods. Shade used a water-balance approach similar to the one used in this study, except that (1) the water balance was computed on a monthly basis rather than a daily basis, (2) fog drip was not considered, (3) runoff-to-rainfall ratios were computed using flow-duration analysis rather than hydrograph-separation analysis, and (4) evapotranspiration losses were subtracted from the soil water after recharge was computed. Shade also reported the results of her study by sectors that do not fit precisely the area of this study. Shade's Wailua and Hanamaulu sectors closely approximate the southern 80 percent of the Lihue Basin, but the remainder of the basin is encompassed in Shade's Anahola sector, about one-half of which extends beyond the northern boundary of the basin. For the purposes of this discussion, an adequate estimate of Shade's recharge for the Lihue Basin can be obtained by summing the recharge of the Wailua and Hanamaulu sectors, and 50 percent of the recharge for the Anahola sector.

The most striking difference between the results of the two studies is that Shade's (1995a) water balance for the Lihue Basin shows significantly lower recharge and higher runoff than the basin-wide water balance computed in this study (table 10). This difference primarily is due to the differences in the method used to compute rainfall-runoff ratios. To distinguish between base flow and direct runoff in the records of streamflow-gaging stations, Shade used a discharge corresponding to the 90th percentile on a flow-duration curve. This common practice presumes that flow that is equaled or exceeded 90 percent of the time represents the mean base flow of the stream. The 90th percentile is arbitrary, however, and does not consider that the relation between ground water and surface water in each stream basin is unique. For stream basins in which ground-water discharge constitutes a large portion of total flow, such as the streams in the Lihue Basin, base flow may be more frequent than indicated by the 90th percentile. In these cases, the 90th-percentile flow underestimates actual base flow, and in turn overestimates direct runoff. In contrast, the hydrograph-separation technique used in this study is less arbitrary because it analyzes the shape of the stream hydrograph to determine base flow, and the shape of the hydrograph reflects the unique base-flow characteristics of each stream. Other differences between Shade's approach and the approach used in this study resulted in smaller differences in recharge. Shade's resultant actual evapotranspiration is lower because evapotranspiration was subtracted after recharge was computed, which tends to overestimate recharge and underestimate evapotranspiration. Pan coefficients, root depths, and the method of computing evapotranspiration also differed between the two studies. Total input in Shade's water balance is lower because fog drip was not considered.

Table 10. Comparison of recharge estimates from this study with previous estimates.

[**Percent of total input:** Total input for 1998 base case is the sum of rainfall, fog, and irrigation; total input for Shade (1995a) is the sum of rainfall and irrigation]

	Percent of total input		
	Runoff	Actual evapotranspiration	Recharge
1998 base case	30	36	34
Shade (1995a)	48	34	19

Sensitivity Analysis

Several of the input parameters required for the water-balance computation have significant uncertainty. Values used in the computations above were considered to be the most reasonable, but for some parameters, other values or ranges of values also could be considered reasonable. In the sensitivity tests discussed below, parameters were varied individually within reasonable ranges to assess how much of a difference this would make in the recharge estimates. The parameters tested include the (1) rainfall, (2) available water capacity in soil, (3) fog-to-rain ratio, (4) ratio of drip-irrigation efficiency to furrow-irrigation efficiency, (5) runoff-to-rainfall ratio, (6) root depth, (7) pan coefficient, and (8) rainfall weights used to represent droughts (table 11). For all tests except irrigation efficiency, 1981 land-use conditions were used. For the test of the ratio of drip-to-furrow irrigation efficiency, the 1998 land-use condition was used because the conversion from furrow to drip irrigation probably had reached its maximum by this time.

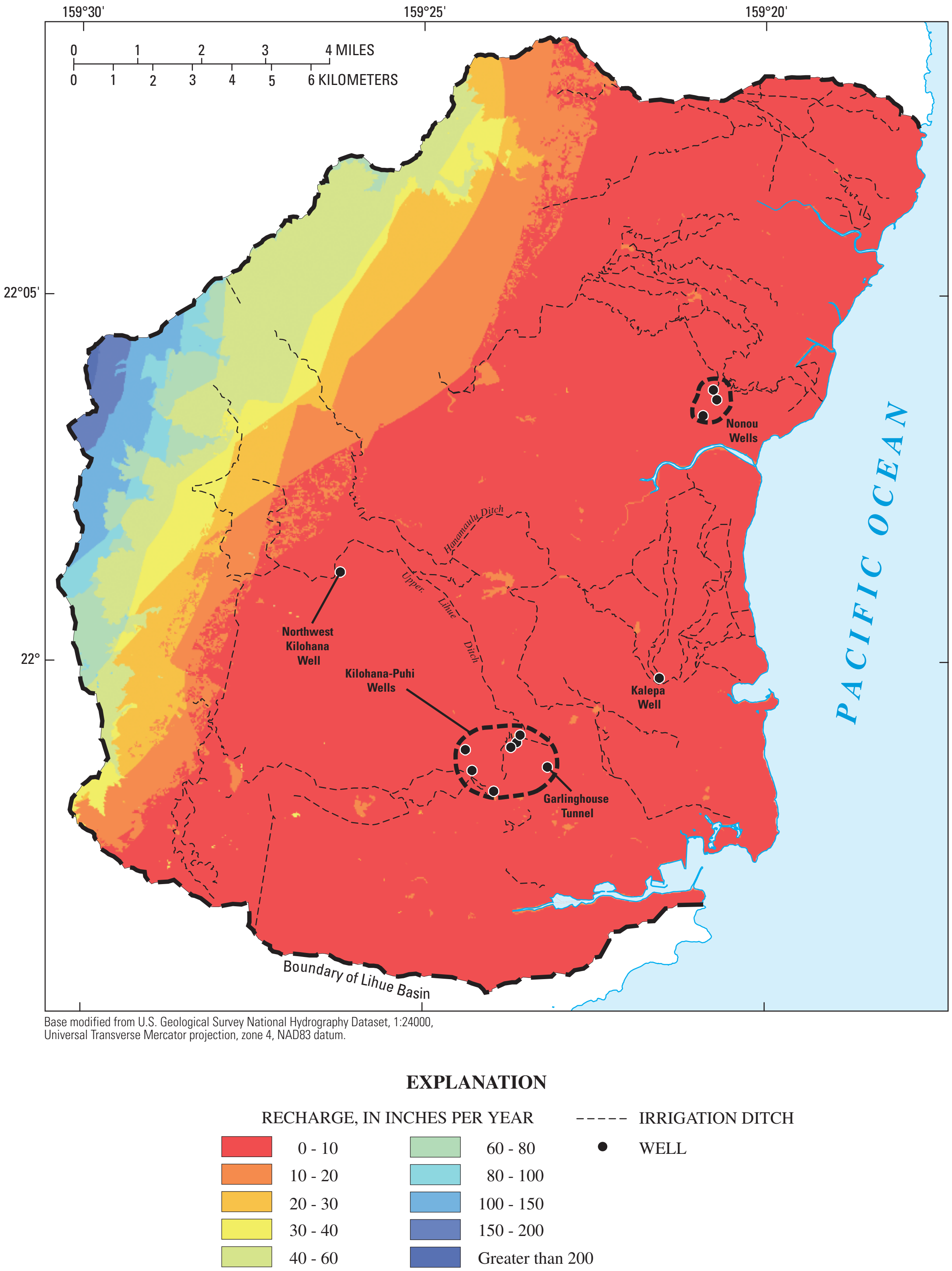


Figure 22. Distribution of estimated recharge if irrigation ceases under moderately dry conditions in the Lihue Basin, Kauai, Hawaii.

Table 11. Results of sensitivity testing for parameters used in the water-balance computation of recharge in the Lihue Basin, Kauai, Hawaii.

Parameter	Test	Water-balance components (million gallons per day)						Percent difference in recharge relative to 1981 base case except where noted
		Rain	Fog	Irrigation	Runoff	Actual evapotrans-piration	Recharge	
Rainfall	1.1 times base case	732	17	70	220	276	323	22
Available water capacity[1]	High reported value	665	15	70	220	267	263	0
	Low reported value	665	15	70	220	264	266	1
Fog-to-rain ratio	0.0	665	0	70	220	265	249	-6
	0.1	665	8	70	220	265	258	-2
	0.2	665	17	70	220	266	266	1
	0.3	665	25	70	220	266	274	4
Ratio of drip efficiency to furrow efficiency	2.0	665	15	48	220	260	247	[2]0
	1.5	665	15	49	220	260	249	[2]1
	1.0	665	15	52	220	260	252	[2]2
Runoff-to-rainfall ratio	1.5 times base cases	665	15	70	339	231	181	-31
	0.5 times base cases	665	15	70	110	280	360	36
	From gage 16068000	665	15	70	232	265	254	-4
Root depth	2.0 times base cases	665	15	70	220	275	255	-3
	0.5 times base cases	665	15	70	220	248	282	7
Pan coefficient	0.8 times base cases	665	15	70	220	229	300	14
	1.2 times base cases	665	15	70	220	294	236	-11
Rainfall weights for drought	0.84	549	12	70	182	256	194	[3]48
	0.74	483	11	70	160	244	161	[3]23

[1] High and low values reported in Foote and others (1972).

[2] Relative to 1998 base case.

[3] Relative to 1981 land use with moderately dry rainfall.

Parameters having minor effects on recharge estimates.—Varying available water capacity, fog-to-rain ratio, ratio of drip-to-furrow irrigation efficiency, and root depth within ranges that encompassed the uncertainty associated with these parameters resulted in relatively minor effects (difference of 7 percent or less relative to the base cases) on estimated recharge (table 11). To test the effect of uncertainty in available water capacity for each soil type, the maximum and minimum values reported by the U.S. Department of Agriculture (2001) were tested. The actual available water capacity is likely to be between these maximum and minimum values. Fog-to-rain ratios were tested within a range from 0.0, which represents no fog input, to 0.3, which is slightly higher than the value reported by Juvik and Ekern (1978) for the Kulani Camp Station. The Kulani Camp Station has a windward orographic climate regime and elevation comparable to the highest elevation in the Lihue Basin. Fog contribution probably decreases with elevation, thus the average fog-to-rain ratio below the highest point in the basin down to 2,000 ft probably is between 0.0 and 0.3.

As discussed previously, estimates for drip-irrigation efficiency for sugar plantations in Hawaii range from 80 to 95 percent whereas estimates for furrow-irrigation efficiency range from 30 to 70 percent. These values indicate that the ratio of drip to furrow irrigation efficiency is 1.1 to 3.2. The ratio used in the computation of the recharge presented previously was already near the maximum of this range; therefore, in the sensitivity analysis, the ratio of furrow to drip efficiency was tested over the range of 1.0 to 2.0. Root depths were tested in a range from 0.5 to 2.0 times the root depths used in the 1981 base case.

Rainfall.—Most rain gages are not completely efficient in capturing rainfall, therefore rain-gage records commonly under represent actual rainfall (Brakensiek and others, 1979). The efficiency of a rain gage depends on many factors, including design of the rain gage and the environmental conditions at the site. Giambelluca (1986) acknowledged that the data used in his report were not adjusted to account for rain-gage efficiency. The possibility therefore exists that the rainfall shown in Giambelluca's monthly rainfall maps is lower than actual rainfall. To examine how this uncertainty may affect recharge, rainfall was increased by 10 percent over the 1981 base-case scenario for the entire study area. Rainfall-runoff ratios also were adjusted to be consistent with the 10-percent higher rainfall. The resulting basin-wide recharge was 22 percent higher than the base-case scenario (table 11). Inasmuch as most rain gages collect less rain than actually falls, the base-case recharge estimate can be considered conservative.

Runoff-to-rainfall ratio.—Tests using runoff-to-rainfall ratios that were 0.5 to 1.5 times the values used in the 1981 base-case scenario showed that recharge estimates are sensitive to this parameter (table 11). However, the hydrograph-separation method used to compute direct runoff in this study is the best available method to determine runoff-to-rainfall ratios given the scope of this study because it is less arbitrary than previously used methods. Even so, potential inaccuracy may be associated with using the hydrograph-separation program on the composite of the hydrographs from the gaging stations of streams and their upstream diversions. To assess this potential, the hydrograph-separation program was used to determine the runoff-to-rainfall ratio from the record of a streamflow-gaging station on the East Branch North Fork Wailua River (16096000), which has a small drainage area but no upstream diversions (fig.15). The resulting mean monthly runoff-to-rainfall ratios are similar to those of the larger drainage basins used in this study (table 4), which supports the premise that the ratios used in this study are representative of the basin as a whole. The runoff-to-rainfall ratios for the East Branch North Fork Wailua River also were tested in the water-balance computation, and the resulting basin-wide recharge estimate differs from the base case by only 4 percent (table 11).

Pan coefficients.—As discussed previously, the pan coefficient for fully grown sugarcane, the predominant crop grown in the Lihue Basin for over a century, is about 1.0 to 1.2. The coefficient for wet forested areas could be as high as 1.3 times that of sugarcane (Giambelluca, 1983). Significant areas in the Lihue Basin would not likely have vegetation that has a pan coefficient as low as 0.5 because such coefficients are associated with low-water-demand crops such as pineapple and coffee that were not grown in the Lihue Basin. In the sensitivity tests, pan coefficients were varied by multiplying the coefficients used in the base case by factors of 0.8 to 1.2. Inasmuch as it is difficult to narrow the range of uncertainty of pan-coefficient estimates, the uncertainty translates directly to an uncertainty in the recharge estimates. The estimated basin-wide recharge resulting from the sensitivity tests differed from the 1981 base case by –11 percent when the base-case pan coefficients were multiplied by a factor of 1.2, and by +14 percent when the coefficients were multiplied by a factor of 0.8 (table 11). This uncertainty pertains primarily to the absolute estimated recharge values, but has little significance to the relative changes in recharge caused by droughts and irrigation changes.

Rainfall weighting factors for droughts.—In the water-balance computation, the difference in rainfall between drought periods and normal-rainfall periods was based entirely on the rainfall record of the Lihue Airport rain gage because it has one of the most complete records for the Lihue Basin and is one of the rain gages for which the NWS continuously updates the SPI. However, the apparent severity of a given drought may differ from one location to the next. For example, during the period 1998 to 2002, average annual rainfall at the Lihue Airport was 27 in., which is in the moderately dry SPI classification (table 9). This value is 65 percent of the average annual rainfall (41.4 in.) based on the period 1950 to 2001. In comparison, average annual rainfall for the 1998–2002 dry period at the USGS rain gage on Mt. Waialeale was 363 in., which is 84 percent of the average annual rainfall (431 in.) based on the period of record (1912 to 2002) for this rain gage. This indicates that during the drought of 1998-2002, conditions appear to have been less severe in wet areas than in dry areas. Inasmuch as Mt. Waialeale and the Lihue Airport probably represent the wettest and driest climate extremes in the Lihue Basin (figs. 1, 2), conditions throughout most of the Lihue Basin are probably intermediate between the conditions at Mt. Waialeale and the Lihue Airport. To examine the effect of the uncertainty in using the Lihue Airport rain gage in the drought analysis, two alternative drought-rainfall weighting factors were tested in the sensitivity analysis: (1) 0.84, representing the 1998–2002 dry-period data for Mt. Waialeale; and (2) 0.74, which is the average between the 0.84 from Mt. Waialeale and 0.64, the value used to represent moderately dry conditions in the drought scenarios. Tests using these weighting factors indicates that drought effects may be smaller than indicated in the previous discussions of drought scenarios (table 11), but the drought effects, relative to the 1981 base case, are still substantial.

Discussion

The recharge estimates resulting from the water-balance computations indicate that over a short term and on a basin-wide basis, the effect of changes in irrigation are small compared to effects of droughts (fig. 23). The decreases in irrigation between 1981 and 1998 constituted a change of only 3 percent in the total water input to the Lihue Basin and a 7-percent decline in basin-wide recharge (table 8). Even the complete cessation of irrigation constituted a decrease of 6 to 9 percent of total water input and resulted in a 14- to 20-percent decrease in recharge. In comparison, a drought of only moderate magnitude could reduce the short-term basin-wide water input by 34 to 37 percent, and cause recharge to decrease to less than half of recharge under normal rainfall conditions. A drought of this magnitude occurred in the period 1998 to 2002, when rainfall at the airport averaged 27 in/yr. This dry period coincides with part of the period of observed declining ground-water levels. Thus, for the period during the observed decline in ground-water levels, the water-balance simulations indicate that the effect of the recent drought was greater than the effect of reduced irrigation.

Because droughts are defined on the basis of statistical aberrations from normal or mean rainfall, however, droughts are temporary conditions that will be mitigated eventually by wet periods. Changes in irrigation, on the other hand, can be of long duration or even permanent. In the Lihue Basin, irrigation at the rates formerly provided by the sugarcane industry will probably not return in the foreseeable future. In this context, the cumulative effects of prolonged irrigation loss on recharge may have a greater effect on long-term trends in ground-water levels.

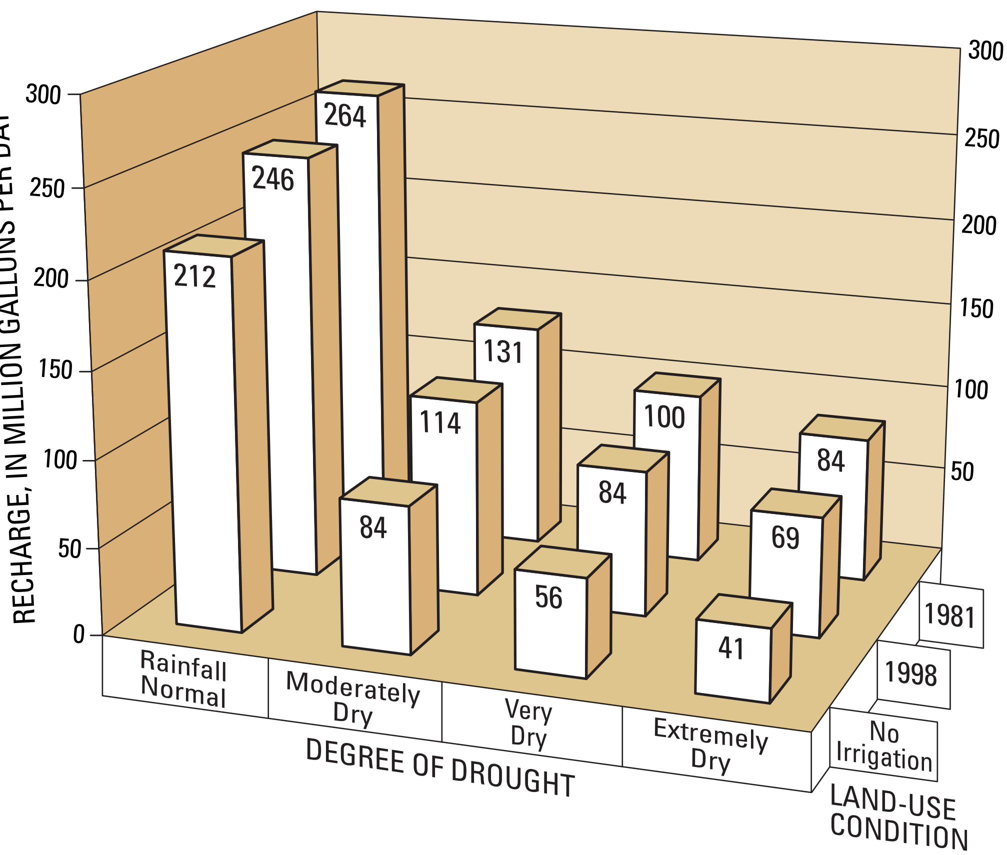


Figure 23. Summary of estimated recharge for various land-use and rainfall conditions in the Lihue Basin, Kauai, Hawaii.
Numbers on bars are recharge values, in million gallons per day.

The importance of irrigation changes on the observed decline in ground-water levels may also be obscured by the voluminous recharge of the entire basin. How irrigation changes relate to declining ground-water levels depends partly on the proximity of the irrigation to the wells. The entire 18-Mgal/d difference in recharge between the 1981 and 1998 scenarios took place in the sugarcane fields. During this time, one of the fields near the Nonou wells was taken out of sugarcane production, and much of the area near the Kilohana wells was converted from furrow to drip irrigation (fig. 10). Similarly, the 34 to 52 Mgal/d decrease in recharge between the 1981 and 1998 base-case scenarios on one hand, and the no-irrigation scenario on the other, took place entirely within the area of the sugarcane fields. Significantly, the Kilohana-Puhi wells, Garlinghouse Tunnel, and Nonou wells are all near areas that without irrigation would receive less than 10 in/yr of recharge, but with irrigation receive more than 80 in/yr of recharge (figs. 17 to 22). Irrigation changes may therefore have a larger connection to the observed decline in localized areas than the basin-wide statistics imply.

If the irrigation formerly provided by the sugarcane industry is completely stopped and a drought occurs, a substantial reduction in total water input to the basin and in basin-wide recharge would result. The water-balance computations indicate that a lack of irrigation combined with moderately dry conditions could cause recharge to decline to only a third of what it was under 1981 and 1998 irrigation levels and normal rainfall; very dry and extremely dry conditions would reduce recharge even more (fig. 23). Rainfall statistics indicate that droughts will return at some frequency, with moderately dry conditions occurring more frequently than very dry or extremely dry conditions. On the other hand, the future of irrigation in the Lihue Basin is generally unknown and is currently in a state of change. Diversified agriculture has replaced some of the sugarcane fields, but the overall extent of agriculture in the basin is much less than during the peak of sugarcane production. If the future of irrigation in the Lihue Basin can be better predicted, the water balance can be recomputed to better assess the future of ground-water recharge.

Results of the water-balance analysis indicate that recent variations in precipitation and irrigation in the Lihue Basin have caused large reductions in ground-water recharge, and that plausible scenarios of future land-use changes and drought could result in even greater reductions in ground-water recharge. Periods of low rainfall caused short-term reductions in basin-wide recharge, and irrigation changes caused local reductions in recharge. In combination these reductions in recharge could be significant to ground-water levels, particularly in areas that include important production wells surrounded by former sugarcane fields.

This study shows that significant reductions in ground-water recharge have resulted from recent dry weather and changes in irrigation, but does not specifically address how the reduced recharge translates to lowering of ground-water levels. Historical increases in ground-water withdrawal still remain a possible (perhaps even greater) cause of the observed decline in ground-water levels.

Conditions affecting recharge prior to the start of sugarcane irrigation are unknown, but the no-irrigation base-case scenario can provide a close approximation of recharge at that time. The main difference between the conditions simulated in the no-irrigation base-case scenario and the conditions that probably existed prior to the onset of sugarcane irrigation is the presence of the sugarcane itself. The no-irrigation base-case scenario assumed that sugarcane still existed in the fields and that its water consumption varied on a cyclical basis corresponding to crop growth stages. Under pre-irrigation conditions, the sugarcane fields would presumably have been covered with natural vegetation that did not undergo cycles similar to crops. Despite the differences, if the basin-wide recharge of 212 Mgal/d from the no-irrigation base-case scenario is considered an approximation of pre-development recharge, then comparison with the recharge computed for the 1981 base-case scenario indicates that the sugarcane industry had, at its peak, artificially increased recharge by 25 percent over natural conditions.

Although records of ground-water withdrawal are incomplete, previous studies and the data that do exist indicate that average ground-water withdrawal from the Lihue Basin over the last decade is a small fraction of the ground-water recharge computed in this study. Shade (1995) estimated that in 1990, ground-water withdrawals from the Hanamaulu and Wailua aquifer sectors (which lie entirely within the Lihue Basin), and the Anahola aquifer sector (which lies partly within the Lihue Basin) were 5.24, 0.75, and 2.73 Mgal/d, respectively. Summing the withdrawals for the Hanamaulu and Wailua sectors and adding one half of the withdrawal of the Anahola sector indicates a total 1990 ground-water withdrawal of about 7.4 Mgal/d for the Lihue Basin. Data at CWRM for the period January 25, 2003 to about April 28, 2004 (the actual period varies for specific wells) for wells in the Lihue Basin indicate total average ground-water withdrawal of 4.56 Mgal/d (K. Gooding, CWRM, written commun., 2004), but this number may be incomplete. Assuming that the reporting is about 75 percent complete (Izuka and Gingerich, 1998), the estimated ground-water withdrawal for the Lihue Basin would be 6.5 Mgal/d. A ground-water withdrawal rate of 7 Mgal/d constitutes only 3 percent of the basin-wide recharge for all the base-case scenarios, including the scenario in which all irrigation ceases. In the hypothetical severe-drought simulation in which irrigation ceases and conditions are extremely dry, a ground-water withdrawal of 7 Mgal/d would constitute 17 percent of the recharge, but such a condition is rare and would likely be brief.

Assessing how the reduced recharge translates to lowering of ground-water levels requires coupling the recharge estimates with the ground-water system. Incorporating the results of this study into a comprehensive analytical tool (such as a numerical ground-water model) could address specific questions such as (1) whether the timing and location of the decline in recharge is consistent with the observed decline in water levels, considering the rate of aquifer response to pumping and recharge stresses; and (2) whether ground-water withdrawals were more, less, or equally responsible as recharge decreases for the observed declining ground-water levels. A numerical model could also be used to address whether a century of irrigation in the Lihue Basin had significantly altered the ground-water levels from preexisting natural conditions. Answers to these questions can help in formulating management strategies to mitigate the problem of declining water levels in the Lihue Basin.

Summary and Conclusions

Trends in ground-water development, irrigation changes, and variations in rainfall indicate that these factors may be related to the recent decline in ground-water levels observed in the Lihue Basin. Water-balance computations indicate that periods of decreased precipitation and irrigation, concurrent with the observed ground-water-level decline, caused substantial reductions in ground-water recharge relative to periods of normal rainfall and full irrigation.

Comparison of water-balance simulations in which irrigation was completely withheld versus simulations in which irrigation was at its peak indicates that the sugarcane industry had artificially increased recharge by as much as 25 percent over natural conditions. Simulations of the decreases in irrigation between 1981 and 1998 resulted in a decrease in basin-wide recharge of 7 percent, whereas the complete cessation of irrigation resulted in a decrease in recharge of 14 to 20 percent.

Simulation of a drought of moderate magnitude, such as the dry period from 1998 to 2002, resulted in a decrease in recharge of 50 to 54 percent. Simulations of complete cessation of irrigation combined with a moderate drought decreased recharge by 68 percent relative to the 1981 base case and 66 percent relative to the 1998 base case. Complete cessation of irrigation combined with more severe droughts decreased recharge by as much as 84 percent relative to the 1981 base case and 83 percent relative to the 1998 base case. For the period during the observed decline in ground-water levels, the water-balance simulations indicate that the effect of the recent drought was greater than the effect of recent reductions in irrigation.

The cumulative effects of prolonged irrigation loss may, however, be larger than the relatively brief effects of droughts. The effects of droughts are temporary conditions that will eventually be mitigated by wet periods, whereas loss of irrigation in the Lihue Basin may be permanent. Irrigation changes may have a larger connection to the observed ground-water-level decline than the basin-wide statistics imply. Effects of reduced irrigation may be small when compared to basin-wide recharge, but the effects would have been concentrated within the area of former sugarcane fields, some of which are near wells showing declining water levels.

The water-balance analysis demonstrates that recent variations in precipitation and irrigation in the Lihue Basin have caused large reductions in ground-water recharge, and that plausible future scenarios could result in even greater reductions in ground-water recharge. Coupling the recharge estimates from this study with the characteristics of the ground-water system by use of a comprehensive tool such as a numerical ground-water model could allow better assessment of how the reduced recharge translates to lowering of ground-water levels and whether it is more, less, or equally responsible as ground-water withdrawal for causing the observed declining ground-water levels in the Lihue Basin.

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MĀLAMA `ĀINA: A CONVERSATION ABOUT MAUI'S FARMING FUTURE

A PROJECT OF THE MAUI TOMORROW FOUNDATION

Revised October 2016

Looking towards Iao Valley
Illustration by Silvia Yordanova

EXHIBIT "I-55"

Report by Permaculture Design International LLC

MAUI TOMORROW

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PREFACE

In 2015, it became apparent that sugar cultivation on Maui was likely to end soon. It also appeared at that time that - other than raising cattle and leasing land to seed growers – landowner Alexander and Baldwin, Inc. (A&B) did not have much planned in the way of agriculture in central Maui that would increase the likelihood of long term success. The existing model of importing expensive chemical fertilizers and pesticides to grow a low-priced commodity crop for export across the Pacific Ocean to compete in world markets was clearly no longer viable. Diversified agriculture had been discussed as an alternative, but that had already been attempted for decades, and had yielded only mixed results throughout Hawai`i. Given that much of A&B‘s revenue is derived from real estate development, Maui Tomorrow‘s Board of Directors was concerned that urbanization of central Maui might soon follow. The Board discussed the importance of expressing a positive, sustainable vision, and considered hiring an agronomist to find crops that could be grown profitably here on Maui while minimizing the need for toxic chemical inputs. As a result of this inquiry, we discovered much more.

Properly designed and implemented, it turns out that this large, consolidated 35,000-acre block of central Maui farmland can be used to generate multiple income streams while growing food and fuel profitably for local consumption and value-added export. Regenerative agricultural methods can rebuild our soil, while using far less water. Agricultural jobs can be saved, along with Maui's open space and rural character. There is also an exciting possibility that we can create a new, regenerative agriculture education industry. Maui can share this important knowledge – which will help sequester carbon, and thus battle climate change - with people from around the world, and thus have an impact far beyond our shores.

The first printing of Mālama `Āina: A Conversation About Maui‘s Farming Future was released in March 2016. Simultaneously, it was released online at www.futureofmaui.org. As intended, it has generated a wide variety of comments, many of which are incorporated in this revised edition. We invite people to continue to share their mana`o, so that this living document can serve as a timely and valuable resource for prospective agricultural entrepreneurs, government decision makers, and the wider community.

As stated in this report, there needs to be a more detailed examination of the costs and methods necessary to shift agricultural operations on the former sugar lands toward profitable and sustainable regenerative agriculture. To address that need, Maui Tomorrow is in the process of preparing a follow up report that will include business plans and detailed data, both of which will be essential as we examine these issues in more depth.

We invite you to join us on this vital journey.

***Aloha ` āina** - love and respect the land, make it yours and claim stewardship for it*

***Mālama ` āina** - care for and nurture the land so it can give back all we need to sustain life for ourselves and our future generations*

-Puanani Rogers, Ho`okipa Network

Beloved Maui is at a crossroads. The January 2016 announcement by Alexander and Baldwin (A&B) that Hawaiian Commercial & Sugar (HC&S) will be ending their 35,000 acre sugarcane operation has flung the door wide open to a much-needed conversation regarding what the future of farming on Maui can truly be. It's an opportunity to invite all the stakeholders into this discussion with the spirit of aloha, and draw on our collective mana`o to consider how we will plan ahead to mālama `āina - care for and nurture the land so it can sustain life for ourselves and future generations.

Maui now imports upwards of 90% of its food and energy, most of our building materials, and all of our textiles - a precarious reality for a remote island. We need many more living wage jobs, ample affordable housing, abundant and affordable local food, and clean water to provide for our 145,000 citizens and 2.6 million tourists annually.

Facing the future, we have choices - what will farming look like on Maui from this moment forward? This question is intimately tied to the wai, our precious water resources, and any answers must offer solutions that care for and restore watersheds.

Laguna Blanca, Argentina. Twelve years after transitioning to diversified regenerative farming.
http://www.tompkinsconservation.org/farm_laguna_blanca.htm

MA'O Organic Farms Hawai`i Investment Ready Program
http://social-impact.org/regional-programs/investment-ready-hawaii

The closure of the HC&S sugarcane enterprise is an opening to the next generation of diversified farm businesses. 35,000 acres of sugarcane plantation land farmed by HC&S are in question, of which 27,000 acres are designated Important Agricultural Land, and receive tax and water benefits intended to help keep large tracts of contiguous farmland intact, and make farming more affordable. **Maui's farming future is tied to this land.**

What kinds of agriculture will benefit Maui's people moving forward? For 150 years Maui agriculture has been large-scale, mono-crop, chemical dependent, and export oriented. Can a new farming model bring both economic and biological benefits? The sugarcane era is officially ending this year - citizens of Maui are concerned about the loss of jobs for so many families, and want to see Maui's agricultural legacy continue.

This report is the start of a community conversation - bringing our diverse people and businesses together to find long-term solutions that are pono. With that in mind, there are many stories that need to be told, and discussions that need to take place. This report offers a window into abundant, resilient **regenerative agriculture** - a way forward that prioritizes food crops, livestock, diverse and profitable enterprises, and can build a whole farming economy that is just and environmentally sound.

The cessation of sugar cultivation raises important questions:

- What kinds of crops will grow here well and profitably?
- Should we prioritize food crops over commodity crops, and why? Can we have both?
- How do we remediate contaminated soils and aquifers?

Portuguese sugar workers - 6,000 in 1913
https://en.wikipedia.org/wiki/Portuguese_immigration_to_

- Can we have diverse livestock operations? What would that look like?
- How many more jobs can we create with diversified regenerative agriculture?
- Does Maui have enough farmers for all these businesses?
- How can we assure long-term access to land for farmers?
- Can affordable housing be integrated into the design?
- Does regenerative agriculture use less water, and can some of that water be returned to East Maui watersheds?
- Can we and should we expand agritourism?
- What type of infrastructure do we have for "food hubs" - processing, creating value-added products, improving local distribution, and providing education for farmers?
- How can we bring all the stakeholders to the table, including A&B, in a transparent and meaningful way?
- Will A&B sell the 27,000 acres now designated as Important Agricultural Lands? If so, at what price?
- What would be the implications of alternative ownership scenarios, such as non-profit land trusts, state ownership, or some combination thereof?

This report is a snapshot of what is possible, profitable, and pono. Looking at case-studies from similar climates, there are compelling precedents and sound science the world over that support making the transition from conventional to regenerative agriculture. Each specific area will need further research and detail before proceeding.

Japanese sugarcane workers 1885
https://s-media-cache-ak0.pinimg.com/736x/84/42/80/844280dac7ef0154bde250816a634ba2.jpg

Cultivating beneficial relationships between stakeholders is the foundation for the success of any project. We look forward to hearing your stories, addressing your questions and concerns, and incorporating new ideas.

A Brief Overview of Maui's "Central Valley" and Sugarcane

The central valley of Maui, once a native dryland forest, is now a wind-swept arid landscape with intermittent streams that were once perennial. Streams such as Pulehunui, Kalialinui, Kailua, Pohakukea, Waikapu and others were free flowing until the advent of large scale grazing and logging on upper slopes. This area previously provided nēnē habitat, as evidenced by the name Pu`unēnē; nēnē are now returning to areas such as Waikapu. Most native Hawaiians traditionally lived around flowing water, where the sophisticated ahupua`a-based farming and aquaculture systems were developed. Master farmers and master fishermen grew and raised plenty of food to feed upwards of a million people across the islands.

Before the sugarcane era, the central valley was sparsely populated, and was not intensively farmed. The birth of the sugarcane industry changed the face of the central valley and all of Maui forever. Water from the northeast coast of Maui was diverted to irrigate the sugar crop, impoverishing stream ecosystems and negatively impacting communities by restricting their access to water, and hence their ability to grow traditional foods. The once-parched land flourished with this abundant water, and the sugarcane industry has dominated the local economy for almost one hundred and fifty years. Waves of immigrant workers came to seek their fortunes, worked the cane fields, and settled down to raise families.

The sugarcane industry the world over has shifted to chemical farming and systematic mechanization of jobs. On Maui, as in other places, not only has the number of industry jobs decreased steadily, but the use of more and different agricultural chemicals has contaminated the soil and the main Pa`ia aquifer, which is now polluted to the point where the water is considered unsuitable for drinking.

Pesticides, herbicides, fungicides, synthetic fertilizers, and ripening agents such as glyphosate have been applied to the soil for years, with very little independent research available to evaluate any deleterious effects on farm workers, neighbors, the groundwater, the ocean, and endemic wildlife. There are no legal obligations for HC&S to remediate the soils or the aquifers.

This style of agriculture, a monoculture crop with substantial chemical inputs, has been found to be a significant contributor to global warming - rather than sequestering carbon in healthy soil, repeated tillage and the application of nitrogen-based synthetic fertilizers release large amounts of CO_2 into the atmosphere. Records show significant amounts of pesticides have been applied to central Maui soils, and these chemicals or their derivatives have now shown up in the soil. Mechanization and global transportation of commodity crops only adds more CO_2 to the atmosphere, an externality that industrial agriculture has passed on to the citizens of the world.

Herb Kane's painting of Ka`anapali pre-contact
http://herbkanehawaii.com

Ka`anapali today
www.islandbreath.blogspot.com

HC&S has been unable to compete on the world market in recent years, and after reporting $30 million in losses in 2015, they recently announced they will be shuttering the last remaining plantation, not only on Maui, but in the State of Hawai`i. 675 planters and skilled mill workers will be laid off this year.

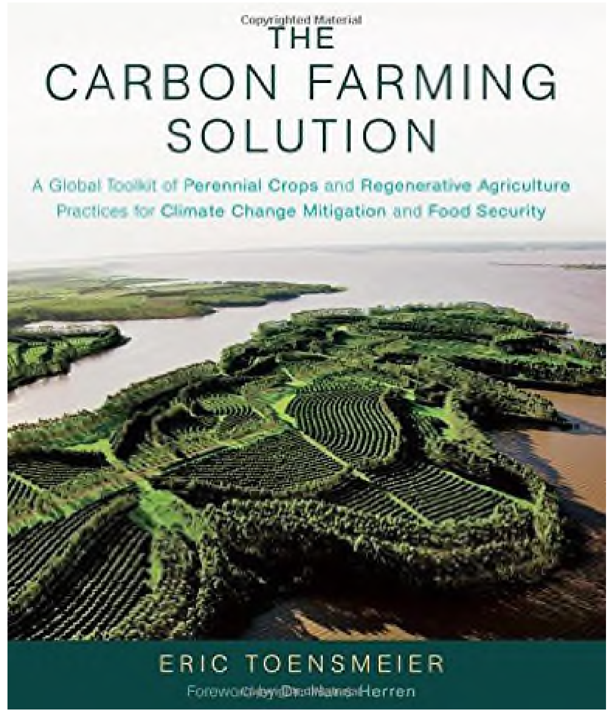
Regenerative Agriculture

Regenerative agriculture integrates specific farm management practices and site design to build ecological and economic resiliency at every opportunity. Regenerative agricultural practices significantly improve upon the USDA National Organic Standards, and are applicable at any scale.

Systematically increasing soil health is the foundation of regenerative agriculture. Building healthy soil improves crop yields and resistance to pests, and makes crops more profitable. It decreases the need for external inputs such as fertilizers and pesticides, improves the water holding capacity by adding organic matter to the soil, and dramatically increases carbon sequestration as a byproduct of the above functions. Regenerative agricultural systems are based on perennial crops with sustained yields using resources generated on-site, as compared to annual agriculture which is often dependent on tillage and external inputs.

Regenerative Agriculture Characteristics:

- Improves water and mineral cycles on agricultural lands through contour farming and soil conservation methods
- Increases effective precipitation (the percentage of rainfall which becomes available to plants and crops) by improving soil structure and proper grading of land
- Reduces water use by selecting crops that are adapted to the local climate
- Preserves and creates soil through sound soil management practices
- Reduces or eliminates soil degradation and erosion caused by tillage through the use of perennial crops
- Sequesters carbon in the soil through organic production methods, thus counteracting climate change
- Is based on increasing diversity of both agricultural crops and native species to achieve Integrated Pest Management (organic farming techniques for controlling pest predation)
- Decreases reliance on agricultural chemicals such as fertilizers and biocides
- Integrates humanely raised livestock into crop production
- Improves economic resiliency of farming operations through diversified production
- Prioritizes local distribution and value-added products to improve profit margins
- Produces nutrient-dense food products that are healthier
- Improves natural capital and ecosystem services on agricultural lands
- Uses socially just business models like cooperatives, profit sharing, and nested enterprises
- Demands more skilled labor through the diversification of farming enterprises
- Embeds a full complement of necessary agricultural and business skills in the community for generations
- Generates a significant economic multiplier effect in the community, creating real wealth well beyond the agricultural businesses



Cover of The Carbon Farming Solution, by Eric Toensmeier

Regenerative agriculture is based on sound design of the ***mainframe*** of farming operations. **This means that the site is designed to reduce or completely eliminate soil erosion from wind and rain through contour farming, proper grading of roads, and covering the soil with plants and/or mulches - the goal is to build soil, not lose it.** Infrastructural elements such as processing centers and agricultural facilities are located near each other to increase efficiency of farming operations, and systems are integrated so that there is synergy and economy of management.

The reduction of water use through the selection of appropriate crops and the increase of effective precipitation through various soil management practices is another very important facet of regenerative agricultural systems. There is a global water shortage, but this shortage is really an issue of management of our water resources as opposed to a lack of water in the environment. Common agricultural practices like tillage, which leaves soil bare, reduce soil organic matter and therefore the capacity of soil to hold and store water. One percent of organic matter added to the soil enables it to hold 8 times more water, allowing the soil to act as a sponge. Shifting to ecologically sound management practices can conservatively increase water-holding capacity of soils by up to 15% or more.

Side by side comparison of conventional grazing (left) and regenerative agriculture (right) grazing lands. http://www.abc.net.au/news/2015-09-16/6780458

Regenerative agriculture is rooted in ancient techniques and wedded to the best of modern agro-ecological technologies. Techniques such as composting and cover cropping for soil building are enhanced with our modern understanding of soil microbiology. Sophisticated rotational grazing of livestock to improve agricultural lands is now more effective with new and evolving practices such as Holistic Management and Management Intensive Grazing.

The business models and corollary social systems - the "invisible structures" - are the foundation for any successful agricultural operation that has the interests of its local community at heart. Regenerative agriculture systematically improves on select business models to build successful and profitable farming enterprises, taking into account the short and long-term health effects on land, water, agricultural workers and surrounding communities.

Maui residents have access to more information than ever before through the worldwide web. The ability to share successes and failures across the globe in real time is perhaps the most important advancement of our culture. This allows the future of Maui agriculture to incorporate improved agricultural systems from other similar climate zones as appropriate to our local culture, thus saving time and investment. A speedy transition to a diversified, sustainable farming model for the lands formerly in sugar cultivation will benefit local workers, enable local food production and enhance Maui's overall economy.

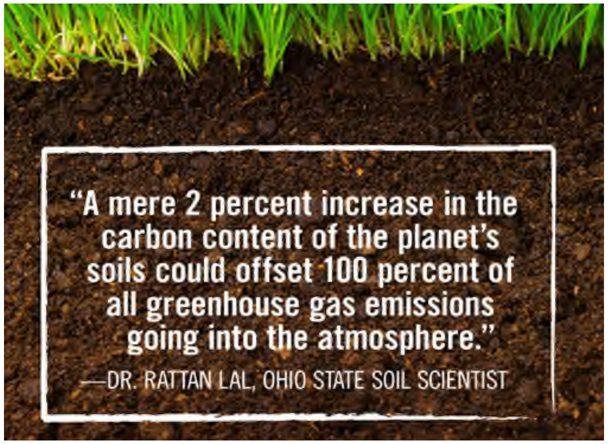
Regenerative Agriculture results:
Loess Plateau, China 1995 (top) & 2005 (bottom)

http://permaculturenews.org/2012/06/28/hope-for-a-new-era-before-after-examples-of-permaculture-earth-restoration-solving-our-problems-from-the-ground-up/

Climate Change and Regenerative Agriculture

Climate change and agriculture are strange bedfellows. Agriculture is responsible for 50% of global greenhouse gas emissions, and is one of the main contributors to climate change. Conversely, climate change negatively affects agriculture. Droughts, floods, and heat waves all have profound impacts on our food production systems leading to crop losses and food supply shortages. Resource scarcity is a leading cause of conflicts globally, as the surge of climate and economic refugees is being linked directly to competition for these resources.

Yet the problem reveals the solution. As agriculture is a major contributor to climate change, shifting our production methods to regenerative agriculture as described above can also reverse this trend. By some estimates, if all the arable land in the world increased the soil organic matter by 2%, we could reduce atmospheric carbon to pre-industrial levels.



http://ecowatch.com/2015/01/06/regenerative-organic-agriculture/

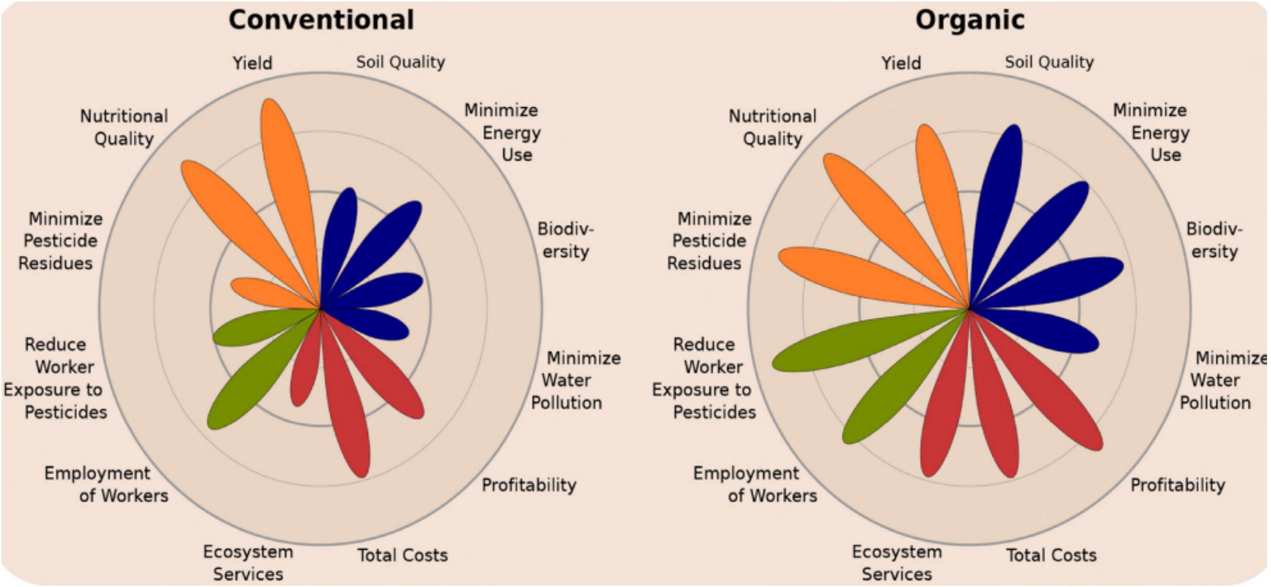
To quote a white paper by The Rodale Institute [1]:

- If management of all current cropland shifted to reflect the regenerative model, we could potentially sequester more than 40% of annual carbon emissions
- If all global pasture was managed using a regenerative model, 71% of carbon emissions could be sequestered
- Even if modest assumptions about soil's carbon sequestration potential are made, regenerative agriculture can easily keep annual emissions to within a desirable range

Andre Leu, President of the International Federation of Organic Agricultural movements (IFOAM), provides a thorough review on carbon sequestration in organic soils from diverse sources and ecosystems. These findings are corroborated by international agronomists and climate scientists; quickly converting farms to healthy soils is now a leading topic at climate change solutions forums.

(Endnotes)
1) http://rodaleinstitute.org/assets/

Carbon Farming Educational Series, Permaculture and Holistic Management for Carbon Negative Agriculture



http://beyondpesticides.org/dailynewsblog/2016/02/organic-agriculture-essential-to-a-sustainable-future/

Regenerative Agricultural Land Use Potential and Transition Strategy

From the 15th century on, Native Hawaiian chiefs governed and managed land based upon a system involving mauka-makai land divisions known as ahupua`a. This sophisticated agricultural and ecological management system included complete watersheds from mountain peak (mauka) to reef (makai), with several distinct sub-systems for food production, aquaculture, and communal land use.[1]

The ahupua`a-based management system is a regenerative system; the local environment is continuously improved, and water cycles are maintained, all the while producing abundant foods. Food production and ecosystem functionality go hand in hand, and the system is resilient in the face of drought, flood, fire, and hurricane. Skills, knowledge, and cultural identity grow from generation to generation. Today, upper portions of the watersheds are managed through collaborative watershed partnerships, while most farming land is outside that management system. The Maui Island Plan includes a policy that requires application of ahupua`a-based management to all lands within the watersheds:

All present and future watershed management plans shall incorporate concepts of ahupua`a management based on the interconnectedness of upland and coastal ecosystems/species.

Maui farmers have the opportunity to incorporate the principles of the ahupua`a system into overall land management to meet this goal and reconnect to our agricultural legacy.

Ahupua'a Agricultural Association of Hawaii (AAA)
Kauai University Web log

Retrofitting the current mono-crop system to one that borrows from the more crop-diverse ahupua`a-based management system is an excellent way forward. Agricultural land uses would change according to elevation and soil type, exposure, and proximity to infrastructure. Maui has opportunities to implement solutions that require the least change for the greatest effect; this may begin with adding tree crops and livestock to the current sugarcane operation, as outlined below.

Despite the fact that Hawai`i's climate is ideal for the production of many types of crops, there is less than a ten-day supply of food on the islands at any given time.[2] The public is rightfully concerned about our food future, and people are demanding real solutions.

The rationales for changing the HC&S operation to regenerative agriculture are many:

- Increase the number of skilled jobs in the agricultural sector
- Satisfy the demand for locally produced food and renewable energy
- Create an economically resilient agricultural operation based on diversified products
- Recharge groundwater and restore hydrological cycles on the land
- Eliminate storm water discharge of agricultural chemicals and come into compliance with the Clean Water Act
- Eliminate air pollution from cane processing and burning, spray drift of agricultural chemicals, and airborne dust
- Address public outcry against industrial farming and Genetically Modified Organisms (GMOs)
- Restore water and stream flows to native habitat and farms in East Maui
- Restore native habitats and increase biodiversity on site
- Make it pono by providing access to land for farming through Cooperatives and provide farmworker housing for local workers
- Reduce / eliminate the use of chemical fertilizers and biocides, thus allowing cleansing / remediation of our soils, aquifers, and coastal ecosystems to begin

Regenerative agriculture pays dividends

Regenerative agricultural systems can be more profitable than conventional agriculture, offering better risk-reward scenarios for agri-business and farmers.

According to a recent report by Paul McMahon of SLM partners (an asset manager that acquires and manages rural land on behalf of institutional investors) there are a number of reasons why these types of systems can deliver superior risk-adjusted returns:[4]

- **Comparable or better yields in most cases**
- **Lower operating costs because of less reliance on external inputs**
- **Enhanced natural capital, with the opportunity to increase asset values by regenerating degraded land**
- **Climatic resilience because healthy soils cope better with droughts and floods**
- **Positive environmental externalities and the chance to be paid for them, for example through carbon credits**
- **The ability to sell to higher value markets such as those for organic or grass-fed meats**
- **Higher profitability with less volatility**

Converting 35, 000 acres of industrial sugarcane to diversified organic regenerative agriculture will take many years and the final outcome will likely be very different than what we now see as most practical. We must chart our course, and be prepared to adjust as the winds and tides dictate.

Designing the 'visible structures' - the plants and animals, windbreaks and terracing - is the easy part. Designing new 'invisible structures' – the contracts and agreements, business models, fair and inclusive governance, and land access – is much more challenging; however, if done properly, the result can be transparency, inclusivity, and shared prosperity.

This transition will require an adaptive management strategy. The system must be able to respond to cultural patterns, biological indicators, and economic pressures - it must be resilient. Nature is our model, as resilient systems have evolved over eons. By mimicking natural systems we create agricultural and cultural systems that are dynamic and respond to change and external pressures without wholesale collapse.

10 year regenerative agriculture transition to tree crops using sugarcane for fodder, swales on contour for water infiltration, and aquaculture

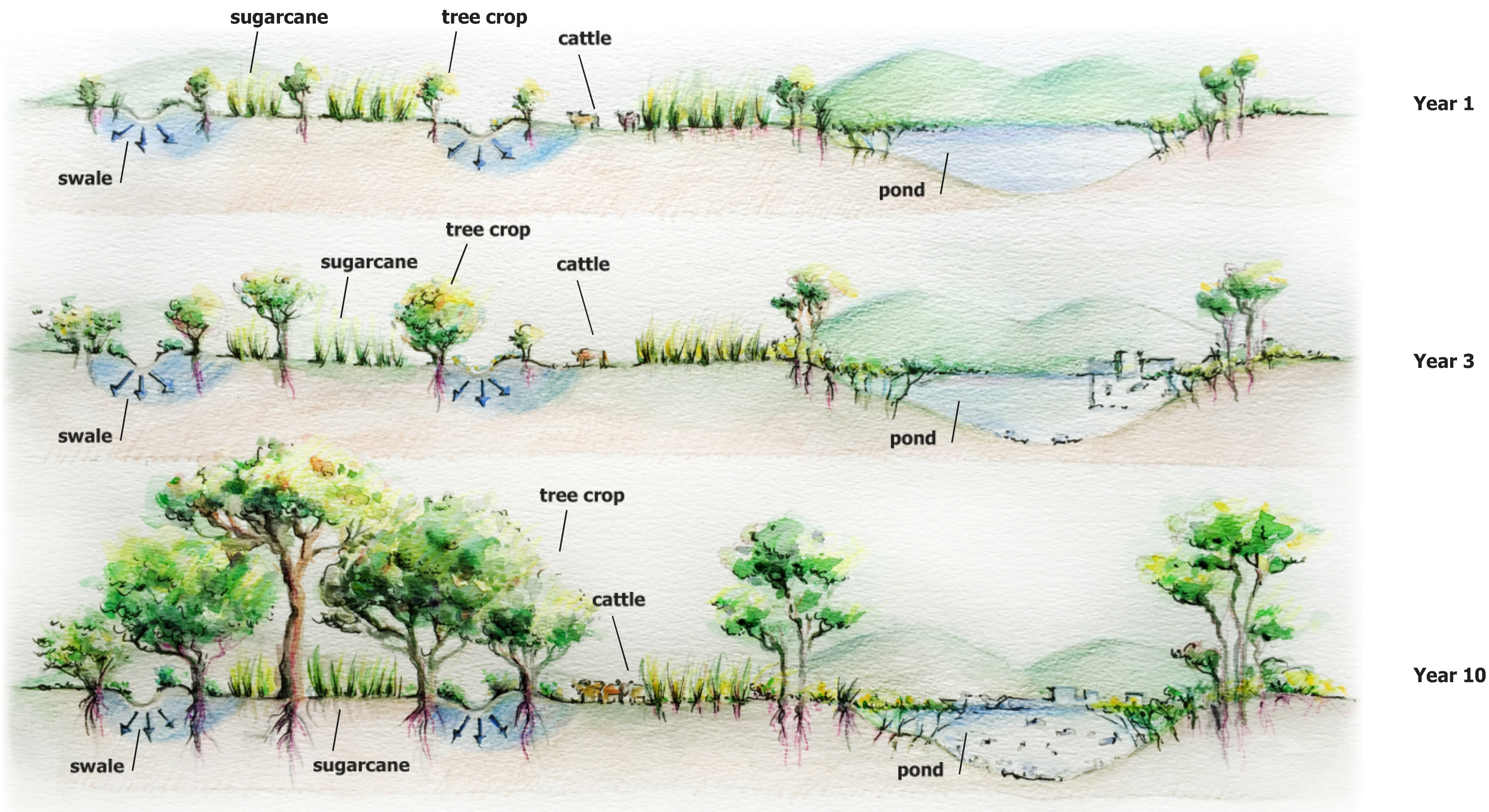
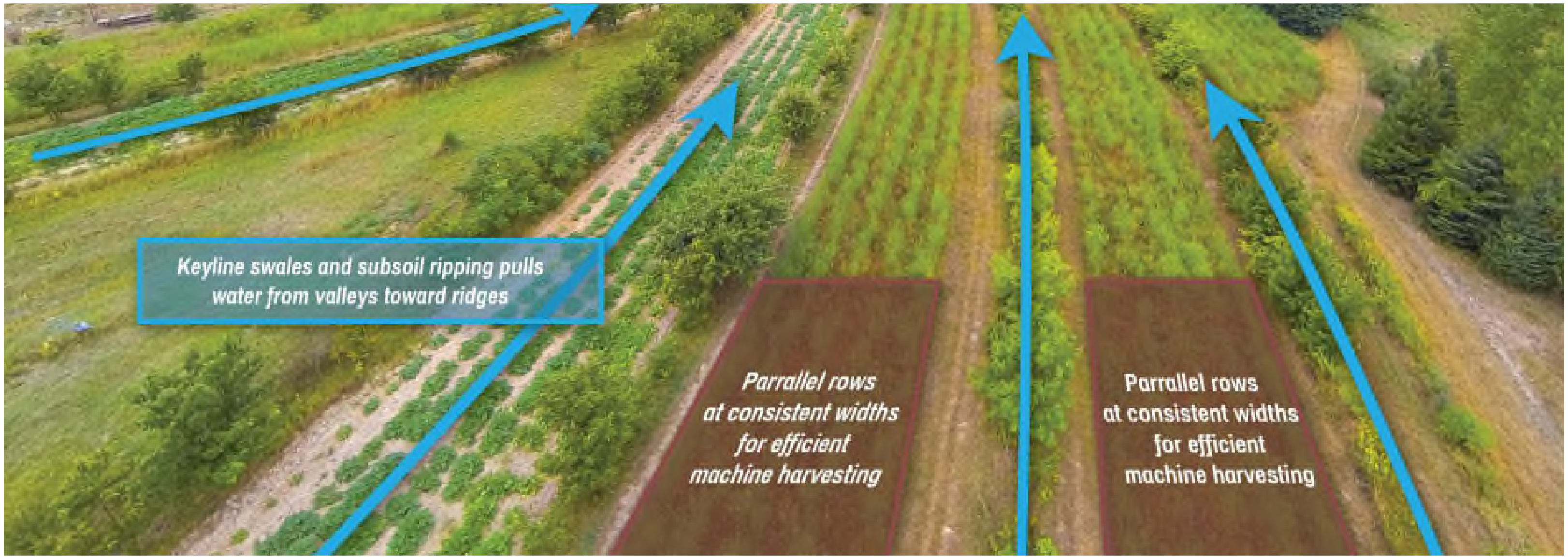


Illustration by Silvia Yordanova



Keyline Design, photo by Mark Shepard, New Forest Farm

Retrofitting Sugarcane Operations and the Transition to Regenerative Agriculture

The most sensible way to switch the HC&S plantation to regenerative agriculture would be to retrofit the current sugarcane operation. A fresh look at the intrinsic characteristics and benefits of sugarcane will help us understand how management practices could be shifted slightly to take advantage of existing infrastructure and resources currently available.

While beyond the scope of this report, a detailed Business Plan could be prepared to examine what percentage of current HC&S field and processing employees would be needed in the early years of a regenerative agriculture program to harvest and process higher value-added cane products. Further, this Business Plan could review whether HC&S's current mill on Maui could be retrofitted, and at what cost, to process these new products.

The Business Plan would analyze whether the sale of additional sugar related products could generate enough funding over some time period to cover additional employees and infrastructure costs related to future regenerative agriculture operations.

Sugarcane, or kō, is a traditional Polynesian canoe crop that has been transplanted the world over because of its very desirable characteristics and adaptation to varied soils and regions.

Sugarcane is *the* champion crop with respect to carbon sequestration and soil building.[5] It is one of the best tropical fodder crops for livestock, including cattle and swine. In its raw state, sugarcane juice is actually very nutritious. Raw cane juice is high in polyphenols, vitamins and minerals such as calcium, potassium, magnesium, manganese, and iron, along with a complete profile of essential amino-acids. It has even been found to lower cholesterol--both LDL and triglycerides, and is high in antioxidants.[6]

Sugarcane's outstanding characteristics are:

- Its perennial growth habit
- The quantity and nutritional quality of sugarcane increase with harvest interval, with optimum values being reached at a harvest interval of between 12 and 18 months. This is in marked contrast with almost all other tropical forage crops, which deteriorate in yield and quality as the interval between successive cuts is increased. For this reason, sugarcane has been called "ensilaje vivo", or living silage in many Central American countries
- The dry matter content of mature sugarcane averages 30 percent, which exceeds that of most other forage grasses (the average for Elephant and King grasses is closer to 17 percent). Thus harvest, transport and processing costs per unit dry matter are less for sugarcane than for most other forages
- There is a long tradition in sugarcane agronomy, especially in breeding, pest control and cultural practices. Admittedly this has been mainly

directed to enhanced production of sucrose rather than total sugars, which is the important criterion for animal feed. However, the implication of this practice in terms of the loss of potentially promising varieties is one of degree rather than direction, as there is a direct correlation between sucrose yield and feed value.
- Sugarcane is widely tolerant of soil and climatic characteristics. Maintaining a canopy of green leaves (or a mulch of dead ones) throughout the year helps to combat erosion, giving it a distinct advantage over competitive forage crops such as cassava and maize.[7]

Sugar production on Maui has centered around the crop as a source of sucrose: refined sugar; raw sugar and the value-added products of molasses and rum. There is considerable opportunity for additional value-added products from sugarcane processing. There is a market for boutique products such as organic raw sugar and juice. The antioxidant levels in sugarcane juice are thousands of times higher than the next best vegetable sources, and can sell for as much as $60/kg.[8] There are many uses for the bagasse including alcohol fuels, fiber for disposable plates, and other products. There are many cultivars of sugarcane possessing very different characteristics. Deeper analyses of the conditions unique to Maui can be done to indicate whether ***sugarcane may even be much more valuable converted to soil carbon and animal protein, as opposed to sucrose.*** It could be used as the fuel to feed the transition to regenerative agriculture.

Integrating Trees

The simple act of planting trees has so many beneficial effects. By integrating tree crops into the existing sugarcane fields as contour orchards and windbreaks, the current system may be retrofitted relatively easily and economically.[30]

Trees serve multiple functions:

- Diversifying production
  - Fruits, nuts, and fungi
  - Medicinals and herbs
  - Spices and oils
  - Timber
  - Biofuels
- Providing fodder for livestock
- Decreasing overall water usage and improving water cycling
- Windbreaks for protection
- Moderate temperatures
- Sequester carbon while producing oxygen
- Biomass for soil remediation
- Increasing the overall diversity of the system

Contour Orchards

Contour orchards may be established by planting tree rows directly into the sugarcane fields on contour at 120 foot centers, creating alley cropping and silvopasture systems. Trees can be planted mechanically at the rate of several thousand per day per planting team. Additional herbaceous cover crops can be undersown to sugarcane fields to manage and prevent weeds, and improve the physical, chemical, and biological characteristics of the soil.

Integration of trees will reduce the total acreage of sugarcane significantly. **If the total acreage devoted to sugarcane was reduced by 30-50% by replacing with tree crops with less water demand, then the cumulative water use would conceivably be reduced by that fraction.** In addition, contour farming and rainwater harvesting earthworks combined with organic soil building strategies will offset supplemental irrigation even more.

Multi-Function Windbreaks

Winds have many harmful effects upon soil, plants, and animals, that are exacerbated as wind speeds increase. These impacts include drying of the soil and resultant loss of nutrients and biota, and increased plant and livestock stress resulting in reduced production and performance.

To minimize and even eliminate the impacts of wind stress, windbreaks of diverse tree, shrub, and deep-rooted herbaceous species are sited across the landscape. Generally, windbreaks are oriented perpendicular to the wind's dominant direction; however, while there is commonly a dominant wind direction, winds can and do occur from any direction at any time of the year. A 'net pattern' of windbreaks both down and across slope would significantly buffer winds in the central valley while supporting bio-remediation and providing important ecosystem services. In certain areas the windbreaks may be oriented on contour as part of Agroforestry, Holistic Range Management, and other production systems.

Windbreaks are a significant feature of the mainframe design for the central valley's regenerative agricultural system, providing many key services while increasing the aesthetic value of the landscape.

Multi-Function Windbreak
https://www.agric.wa.gov.au/land-use/establishing-effective-windbreaks-swan-coastal-plain

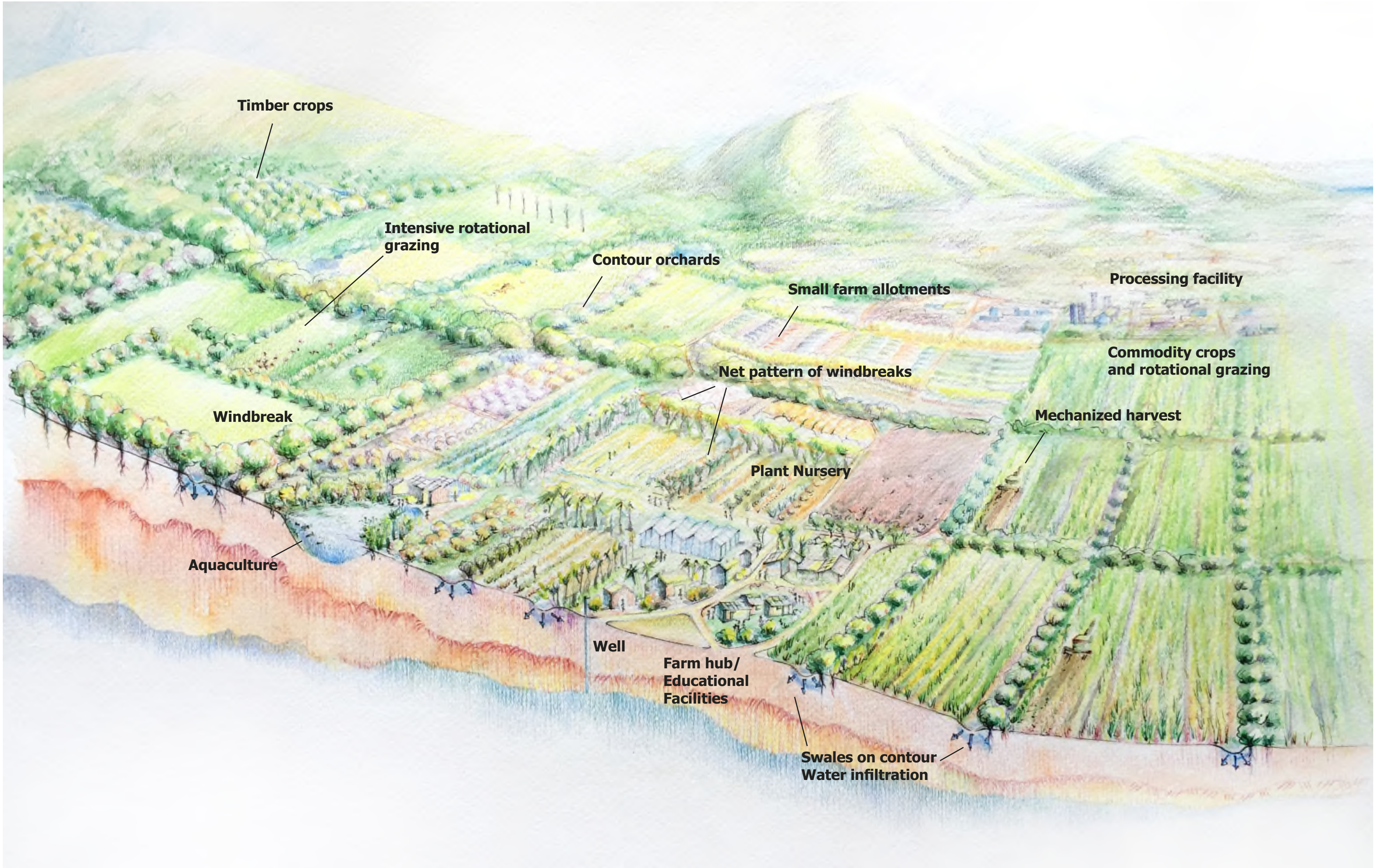


Illustration by Silvia Yordanova

Mainframe Design

The future of any successful regenerative agriculture venture hinges on excellent **Mainframe Design and Implementation**, as well as good management. The following design features must be prioritized as part of the transition strategy, as the success of the whole system is predicated on proper implementation of these elements.

In the case of the HC&S plantation, many existing elements may be retrofitted only slightly to maximize efficiency and economy. Below is a sequence of what that process may look like. Since the site is relatively dry, particular emphasis must be placed on harvesting the rain.

Conceptualized Implementation Sequence of Retrofitting Mainframe Design Elements:

1. Integrating tree crops into sugarcane alley cropping systems on contour while maintaining equal distance as much as possible to facilitate harvesting
2. As much as possible, shifting to contour farming for sugarcane fields for soil preservation
3. Planting multi-function windbreaks
4. Adjusting the shape and orientation of fields and grading the site to maximize rainwater harvesting, increase groundwater recharge, build soil, and eliminate erosion and storm-water runoff
5. Improving access, roads, ponds, and ditch systems to assist the above functions
6. Planting forestry blocks on slopes too steep to farm on contour
7. Implementing diverse soil remediation strategies
8. Restoring habitat to field borders, roads, ditches, and drainage gullies by planting native trees and shrubs
9. Researching and developing value-added products for local distribution and export
10. Creating cooperative business models to allow access to land for local farmers
11. Locating and building Farm Hubs; clustering facilities for processing, fertility management (composting and fertilizer production areas), plant nurseries, and agricultural sales facilities in order to increase efficiency of operations
12. Locating farm dwelling villages and affordable housing for farmers and farm labor
13. Integrating alternative energy production into operations, like solar and wind power, hydroelectric, biodiesel, and methane/biogas

Managed timber interplanted with commodity crops
http://www.aftaweb.org/latest-newsletter/tempo-rate-agroforester/94-2006-vol-14/april-no-2/86-summary-of-the-silvoarable-agroforestry-for-europe-safe-project.html

As the Mainframe elements are designed, planted, and built, a thorough study of appropriate crops should be conducted. These include:

- Annual crops - vegetables and row crops
- Herbaceous perennial crops - perennial vegetables and fodder crops
- Tree crops - fruits, nuts, timber, and fodder crops
- Cereals and grain crops - including pasture cropping [9]
- Livestock systems - ruminants, swine, fowl, invertebrates, and aquaculture
- Biofuels - both annual and perennial
- Textiles - including fiber and dye crops
- Specialty crops - including spices, medicinal herbs, cut flowers, cosmetic and essential oil crops

The selection criteria for crops may include:
- Low supplemental water needs
- Suitability to soils and climate
- Nutritive value
- Marketability and consumer demand
- Potential for job creation and value adding

Certain systems will work better together and should be appropriately linked. ***Isolating any one of these cropping systems is like taking one note out of a song - there is no harmony.***

Methods to Reduce Overhead

In addition to the production of crops, designing for energy independence of farming operations is important. There are many types of energy that farms rely on, from petrochemical to biological. Fuels and nutrients run the farm.

Production of Compost

The value of adding biologically active compost to the soil is measured in the reduction of operational expenses for materials such as fertilizers and biocides, as well as electricity and fuels costs for pumping irrigation water. As a plant relies on the macro-nutrients to produce sturdy roots, stems, and fruits, it also relies on macro and micro-nutrients to build up immunity to pathogens.

The production of compost is important as a source of humus and for the recycling of agricultural wastes. Compost is actually the final stage of the energy cascade of agricultural products. Below is a conceptual sequence of the "energy cascade" of an agricultural product in regenerative agriculture (in this case, fruit), from source to sink;

Agricultural Product Energy Cascade:

- Agricultural product: fruit
- Process: pulp for juice product
- Mash from juicing (adding value to processing "waste" feeds livestock such as for swine and layer chickens)
- Manure and feed scraps are used in a variety of composting operations
  - Anaerobic composting/methanogenesis generates biogas to run boilers or produce electricity
  - Thermophyllic compost can generate hot water
  - Vermicompost (worm compost)
- End uses for compost
  - Apply to fields
  - compost tea injection
  - soil medium for nursery plants

Biogas: Methane Production

George Chan of ZERI (Zero Emissions Research and Initiative) developed sophisticated systems for maximizing returns and reducing overhead for agricultural operations by integrating anaerobic methane digesters to process agricultural wastes. The production of biogas for power produces sludge that can be used to produce algae for animal feed and feedstock for vermi-compost.[10, 11]

Vermicompost

Vermicompost is an excellent solution to the accumulation of organic wastes on farms. It produces high-quality compost using worms with the added benefit of reproducing the worms

Pigs grazing in the understory
http://silvopasture.ning.com/photo/pigs-at-hop-kins-woods-low-res?context=user

Holistic management vs. desertification in South Africa
http://sheldonfrith.com/2015/11/23/the-future-of-agricul-ture-is-regenerative/

themselves, a high protein animal feed for chickens, fish, and pigs. The value and potential for worm composting on Maui is reported but certainly understated.[12] Extensive research has been done in Mexico using worms to compost "cachaza", (the residue of sugarcane juice filtration)[13]; this would be a natural choice for diverse fertility and soil-building strategies on Maui.

Pruning as a Management Practice

Pruning and coppicing are important management practices to increase soil organic matter and manage shade in agroforestry systems. Plants are specifically cultivated for biomass to provide feedstock for livestock and mulch. There is further opportunity to integrate biomass energy (syngas) from coppice wood.

Fodder trees can be mechanically pruned and the forage dropped in the field, and livestock allowed to graze on the wilted foliage, leaving manure residue to enrich the soil. Better yet, the animals can browse shrubs for late season stockpiled fodder.

Integrated Pest Management

The species diversity of regenerative agricultural systems provides a built-in Integrated Pest Management (IPM) function, further reducing reliance on agricultural chemicals. Insects and birds reduce pest populations, and maybe take a little fruit or nectar for their services. Yield is not only measured in production volume, but reduced expenses of operations.

Mechanization

Because of the scale of this operation, some degree of mechanization will be necessary as a transitional strategy and long-term reality. Therefore the layout of the plantings should reflect this, and have appropriate access for harvesting and pruning equipment.

Livestock and Holistic Management

Maui's cattle industry dates back to 1793. The Maui Cattle Company, six independent family-owned businesses with over 60,000 acres of prime grazing land, states as their mission "the re-invigoration of an agricultural lifestyle through the establishment of a sustainable ranching industry".

The demand for local beef far exceeds the island's production capacity. Most meats are currently exported off-island, and even if all the meat raised here were consumed locally it would only supply 20 – 25% of the Maui market.

Livestock production doesn't just feed people, it creates a wealth of skilled jobs in and around the industry - diversified production of multiple species, research, industry support, processing, value-added products, distribution and marketing, pasture consulting, business management, and more. Prioritizing meats for local markets requires a local slaughterhouse. Expanding and improving the livestock industry into Maui's central valley will require further research and analysis.

Holistic Management

Holistic Management is a systems approach to decision making that includes land planning, grazing planning, financial planning, and biological monitoring as they all relate to one another in the context of an agricultural operation. Holistic Planned Grazing is one aspect of the Holistic Management process, and is a revolutionary livestock management practice that mimics natural herbivore behavior with domesticated livestock. This method has been proven to be one of the best and most expedient ways to repair damaged ecosystems and reverse desertification.

Holistic Planned Grazing uses cattle and other ruminants that are moved frequently so their impact does not harm the land, but rather benefits it. Much like a herd of wild herbivores responding to predator pressure, herds are constantly on the move, only grazing the tops of plants. Pasture is allowed to rest so that overgrazing does not occur, and plants are allowed to recover and release carbohydrates into the soil, feeding soil microbes. With proper management, weedy species are

Sunflowers and lavender
http://imgc.allpostersimages.com/images/P-473-488-90/26/2659/D8DUD00Z/posters/steve-vidler-sunflower-fields-provence-france.jpg

Harvesting sunflowers
https://i.ytimg.com/vi/YpzTinI65iM/maxresdefault.jpg

replaced by more beneficial pasture species, and soil organic matter builds rapidly.

Livestock are bunched together in small groups called mobs, and their grazing patterns shift in response to increased competition for pasture; basically they eat weeds and other plants they might pass up if they were in a set stocked system

with little competition for feed. Stocking rates can be doubled or tripled, with up to one million pounds of livestock per acre possible, in rapid rotation. Livestock may be moved daily and even hourly, depending on the forage quality and quantity, and paddocks may be rested for up to one year depending on conditions and management, to allow recovery.

Multiple species can be integrated into one management system for diversified production. For example, cattle can be followed by pigs, which can be followed by chickens. The cattle browse grasses and forbs, pigs root for insects and tubers, and chickens eat fly larvae in the manure of the previous species, reducing the vectors for disease. These animals all work in synergy and complement each other, much like the wild populations of animals that are diverse and occupy various niches. This is an example of stacking systems in time. Economic opportunities and a cascade of skilled jobs are the result of diversifying operations.

Ancillary Agricultural Enterprises

There is considerable opportunity for embedding ancillary agricultural enterprises within the Holistic Management system early in the transition, such as:

- Breeding and sales of organic open-pollinated heirloom seeds
- Nursery plants - including native, edible, and ornamental plants
- Organic fertilizer production - including compost and microbial inoculants
- Value added products - including preserves and fermented foods
- Construction products - including timber and bamboo
- Agri-tourism - including farm tours, fresh farm lunches and dinners, direct sales of value-added farm products, and educational workshops
- Regenerative agriculture training and implementation programs

Plant Breeding and Seed Production

Seed saving, genetic selection, and animal breeding techniques have traditionally been passed down through intact farming lineages. Over time "landrace" cultivars and breeds develop that are hardy, resilient, and perfectly adapted to local conditions.

Modern plant breeding has been relegated to seed companies and research institutions. Hybrids and genetically modified organisms are usually patented and their genetic material owned by the companies who produce them. It is technically illegal to save these seeds, or propagate them without paying royalties. Farmers now need to buy their seed every year, and sadly, saving seed has become an antiquated, and sometimes illegal practice.

Silvopasture grazing with sheep
https://www.flickr.com/photos/baalands/2216308884/

Cattle grazing on leucaena, a perennial nitrogen-fixing fodder crop
http://portfolios.pratt.edu/gallery/3880677/Rethinking-food-production-in-the-tropics-research

Plants reproduced through biotech engineering, hybridization, or clonal propagation are genetically identical. Mono-crop plantings of clones are more susceptible to pests and diseases, as pathogens need only crack the code of one genetic makeup to infect the whole field. In nature all plants are sexually propagated through pollination, therefore their genetic makeup is varied. This means pests and pathogens must crack the code of many genetic expressions, conferring natural disease resistance to native populations. [31]

Globally there is an enormous need for open-pollinated seed varietals of both annual and perennial crops. While many sources for open-pollinated and heirloom annual vegetable seeds exist, there are very few seed companies that develop fruit and nut tree seed with stabilized traits – qualities that come true to type when planted. Changes in climate are creating the need for new provenances that are adapted to increasingly variable climatic conditions.

Hawai`i can grow certain seed crops that yield three harvests each year. GMO seed corporations have successfully and profitably capitalized on the unique attributes of Hawai`i's favorable climate, year-round sun, and available water. HC&S lands have locations suited to lease to organic open-pollinated seed companies, if they were recruited to relocate here to Maui. This nationally expanding agriculture sector provides good, highly skilled jobs. Local workers could be trained in these breeding and harvesting protocols.

Developing a breeding program for fruit and nut trees, much like was done by the legendary plant breeder Luther Burbank - who developed the russet potato and other improved fruit tree varietals - is much needed in the world, especially Hawai`i. The islands are well suited to testing new and improved seed varieties.

Hawai`i needs to develop new landrace seeds that have desirable characteristics, are adapted to the local climate, that are true to type, and make this seed available to farmers and gardeners to propagate at will. This is the real foundation of food sovereignty and security.

The University of Hawai`i College of Tropical Agriculture and Human Resources (CTAHR) recently began work on The Hawai‘i Public Seed Initiative, which emphasizes the importance and value of local seed systems. Working with the Kohala Center, they have gathered baseline data, taught seed-saving workshops, created seed networks on all the islands, and are establishing statewide and regional variety testing trials. [32]

Educational Opportunities

One important limiting factor inhibiting the proliferation of regenerative agriculture in Hawai’i is the lack of trained farmers. This is certainly not exclusive to Hawai`i; it is a global issue. Again, the problem reveals the solution. The sugarcane fields can be used as a living classroom to train farmers, and the initial curriculum would parallel the transition phase plan.

Regenerative agriculture practices build deep rich soil (left), compared side-by-side with conventional grazing soil (right) at Winona Farm in Australia.

The potential for creating a world-class educational curriculum on this site should not be understated. The demand for this type of learning experience is as great as the demand for the food these systems produce. There is a serious lack of hands-on training for aspiring farmers, and for seasoned farmers wanting to move out of conventional farming. An ongoing educational series can be developed in partnership with the many existing Maui institutions that will attract professionals from around the world.

As a venue, Hawai`i and Maui are in high demand, and this project would expand on the ever-growing sector of agricultural and educational tourism. Recruiting the world’s leading regenerative designers as instructors and hands-on trainers could put Maui on the map for excellence in regenerative agricultural education.

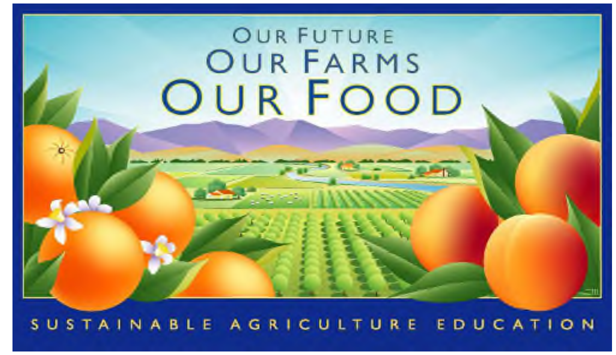
Examples of workshops and regenerative agriculture trainings include:

- Stakeholder process and community engagement
- Whole Farm Design
- Regenerative Agriculture Design and Management
- Holistic Management and Livestock Operations
- Tropical Agroforestry Design and Management
- Seed Breeding and Plant Propagation
- Earthworks Design and Implementation

There is significant income potential for educational offerings. Students regularly pay $200/day for specialized trainings from 4 days – 2 weeks, and attend longer in-depth courses for certification-level trainings.

Case Studies and Precedents

There are a growing number of successful regenerative farms sprouting up in Hawai`i and across the world. It is important to look to existing success stories to glean information applicable to central Maui lands. The challenges that these enterprises have faced during their development provide the most valuable information we can seek in order to avoid similar mistakes and move forward swiftly. The following case studies were chosen as they are particularly relevant to Maui, showcasing projects from similar climates, farm businesses that integrate sugarcane, profitable livestock operations that regenerate farmlands, and demonstrate how farmers have diversified income from multiple products within a mainframe design.



http://www.glenwoodgarden.com/wp-content/uploads/2014/06/SAGE-Food-farms-future-image-logo.jpg

Organic Sugarcane Production

Sugarcane Best Cultivation Practices, Brazil

Brazil has done pioneering work in developing and studying no-till management of sugarcane production, particularly for ethanol production. In a 15 year study, they found that no-till sugarcane operations provide many benefits to both the farms, the soils, and the environment. Through the combination of no-burn and mechanical harvesting while leaving the dry matter on the field, no-till sugarcane operations eliminate the air pollution caused by burning and at the same time create a net increase in soil carbon stocks of 9.7

Mg/hectare. Rather than coming at the expense of yields, no-till sugarcane operations yield 10 tons more per hectare than conventional plantings. Fertility is cycled by returning the sugarcane byproducts from the processing mills to the field and growing nitrogen-fixing cover crops such as sunn hemp (Crotalaria juncea) as a green manure. Advantages to no-till management of sugarcane include reduced costs in soil preparation, increased organic matter in the soil, improved fertility, reduced fertilizer applications, reduced compaction, reduced erosion, and lower emissions of greenhouse gases.[14, 15]

No-till Systems
The Brazilian sugarcane industry employs modern agronomic management practices to enhance productivity and protect the environment. Key features of Brazil's sustainable approach to cultivation and processing include:

Low Soil Erosion
Brazilian sugarcane fields have relatively low levels of soil loss, due in part to the semi-perennial nature of sugarcane. The same plant will grow back many times after it is cut, and its cane juice is extracted. In fact, sugarcane is typically only replanted every six or seven years. The Brazilian industry also emphasizes farming techniques that preserve soil stability while yielding approximately 34 tons of sugarcane per acre, as compared to an average of 11.5 tons per acre at HC&S.[30]

Strategies include:
- No-till production systems
- Crop rotation with soybeans or peanuts
- Green fertilization by planting cover crops such as Crotalaria juncea or using leftover sugarcane straw after mechanized harvesting as ground cover


Silvopasture at Pongamia, Australia

Thanks to these responsible agricultural practices, soil erosion in sugarcane fields is minimal when compared to many other crops such as rice and soybeans (for more information, read the "Environmental sustainability of sugarcane ethanol in Brazil" study). In some regions of the country, sugarcane has been produced on the same soil for more than 200 years with continuous yield and soil carbon increases.[16]

Organic Sugarcane Production, Ingenio El Mante, México
Nacho Simon recognized that the "cachaza", a by-product of sugarcane processing, was a problem for the majority of operations, so he decided to transform it into compost and return it to the fields. The addition of micro-organisms to the soil was very beneficial, as his soils had been depleted from repeated harvests.

The organic matter is the food and home of the life in the soil, and maintains the equilibrium and also transforms the dry waste in the fields to nutrients. The organic matter also retains humidity, reduces erosion, and improves the structure and texture of the soil, allowing roots to grow rapidly. The results of applying compost to the fields were a 100% increase in production and also the reduction of operating costs, allowing sugarcane operations to remain profitable.[17]

Cattle: Holistic Management

Florida, USA: Jim Elizondo, RegenGraze
Jaime (Jim) Elizondo of RegenGraze manages Mashona Cattle in an intensive silvopasture system with Leucaena leucophylla in North-central Florida. He also integrates high density grazing on mixed cover crops grown as stockpiled forages, which can be rapidly implemented on conventionally managed farmland under annual cropping and tillage practices.

Understory forages he uses in his intensive silvopasture system include bahiagrass, bermuda grass, torpedograss and a wide variety of herbaceous legumes. He also uses free-choice mineral supplementation based on the work of Mark Bader to improve the overall balance of soil minerals and forage quality for his livestock. Through these integrated systems, Elizondo has achieved cost savings "from $100-200 per cow per year compared to normal practice in the area, plus [he] carries double the normal stocking rate while improving the soil and respecting wildlife."

Starting with low fertility soils, they integrated compost extract liquid fertilizers at one gallon per acre to stimulate the soil microbes for the first two years. Once 100% soil cover was achieved, they stopped applying compost extracts and relied upon crop and litter management to feed soil microbes. Pasture cropping was also practiced, planting into winter perennial pastures with a mixture of summer annuals including lab-lab bean, sunflower, cowpea, hairy indigo, soybean, sudangrass, millet, sunn hemp, and clover.

Cover crops are trampled and harvested as forage using ultra-high density strip grazing (~1,000,000 lb -cow/acre moved 4-6x per day during this treatment). Based on his current success, he plans to develop shelterbelts and fodder tree rows of mimosa and mulberry plantings.[18, 19]

Commodity crops: Textiles and fiber

Winona NSW, Australia: Colin Seis
2,075 acres pasture cropping: cereals, sheep, native grass seed

One of the most powerful innovations in large scale regenerative agriculture is pasture cropping, a system pioneered by Colin Seis at his home and farm Winona in New South Wales, Australia. Colin has been practicing and refining the pasture cropping system on his 840 acre farm since 1992, when a wildfire wiped out his operation. By integrating native warm season perennial pastures with no-till cool season cereal grain production, Colin produces three 'stacked' enterprise product lines from each pasture: sheep wool and meat, cereal grain, and native grass seed. The balance between pasture grazing and cereal cropping is achieved through carefully timed grazing rotations. At the same time, he has decreased annual production costs by $120,000 AUS and increased soil carbon by over 200% in 10 years. While he has decreased costs and improved soil fertility and water holding capacity, his wool quality has also increased. All this is done on 650 mm (26") of avg. rainfall per year. Colin now works to expand his system to other farms and reports "over 2,000 farmers pasture cropping" cereal crops into summer (C4) and winter (C3) perennial native grass in NSW, South Australia, Victoria Queensland, West Australia and Tasmania as well as other areas around the world.[20]

Agroforesty, Contour Orchards, and Alleycropping

Agenda Gøtsch, Brazil: Ernst Gøtsch
Another example of regenerative agriculture transforming a landscape is on a cacao plantation in Northeast Brazil, owned and farmed by Ernst Gøtsch using a form of innovative agroforestry. When Gøtsch purchased the 1,200 acres of unproductive land in 1985, the land, like much in the region, was degraded and dry, considered unsuitable for cacao production.

Once covered in Atlantic rainforest, decades of timber exploitation and cattle grazing had left the land barren and the wells had run dry. Gøtsch used a unique blend of soil recovery techniques that mimic the natural regeneration of forests and reawaken the biology of the soil; within five years, water was again flowing in the wells. Within 10 years, he was obtaining 4,500 pounds of cacao per acre--1,250 pounds more than average for his region.

When disease destroyed much of the neighboring cacao plantations, his trees were untouched. He was generating 2-3 cm annually of new topsoil. The Atlantic Rainforest resurfaced on his 1200 acres, bringing with it its flora and fauna. Nearly 900 acres of his farm are now a natural heritage reserve. After 20 years, 14 springs have reappeared on the farm.[21]

Diversified Operations

Finca Luena Nueva, Costa Rica
This research project is unique in that it combines all three types of land use management on the same tropical farm - reforestation, cattle/pasture management, and commercial crop production. Crops that are grown include: cassava, turmeric, ginger, taro, sweet potato, banana, plantain, corn, various beans, various leafy greens, and vegetable crops. Cattle are dual-purpose, bred for meat and dairy production. The reforested land was once in open cattle grazing, and now has been replanted to native humid tropical rainforest.[23]

Laguna Blanca, Argentina:
Tompkins Conservation
7,418 acres; acquired in 2007

Laguna Blanca Farm, Argentina, diversified agriculture with terracing on contour
http://www.tompkinsconservation.org/farm_laguna_blanca.htm

Project of Kris and Doug Tompkins, Dolores Peréa-Muñóz and Eduardo Chorén, Entre Ríos Province, Argentina

Laguna Blanca is in the midst of a dramatic transformation from industrial monoculture to organic polyculture. Comprising more than 7,000 acres at the confluence of the Feliciano and Parana rivers in northeastern Argentina's Entre Ríos Province, Laguna Blanca offers an opportunity to develop a model of diversified organic agriculture for the region.

When it was purchased in 2007, Laguna Blanca was in serious need of restoration: its infrastructure needed attention, and its soils were eroding away. To counter erosion, terraces were built to create level fields in which a variety of grains—including oats, flax, sorghum, barley, and wheat—are now grown. New orchards produce eleven fruit and nut species, including peaches, pears, olives, dates, hazelnuts, pecans, and almonds. Many aromatic and herbal species are being cultivated alongside a wide assortment of horticulture crops, many of which are perennial varieties requiring zero tilling. Sheep graze in restored native pastures, and hay is made to feed them through the winter from the grasses surrounding the orchards. The practicality of this polyculture style of farming is becoming increasingly evident as interactions between diverse crops, healthy soils, and native wildlife are improving the farm's yields.[22]

Aquaculture/Aquaponics

Hawai`i, USA

There are several examples of successful commercial aquaponics enterprises in Hawai`i, including Kunia Country Farms[24] on Oahu, and Living Aquaponics[25] on Hawai`i Island. Both of these enterprises are on the order of one-quarter acre of total land area. Living Aquaponics is generating between $1,500-$3,000 gross income per week ($75,000-150,000/yr) with three people working 20 hrs/wk. They have been in business for five years and have managed to work through the challenges of disease and pest management in organic aquaponics with leafy greens and root crop production even during Hawai`i's warm and wet seasons.

Biofuels

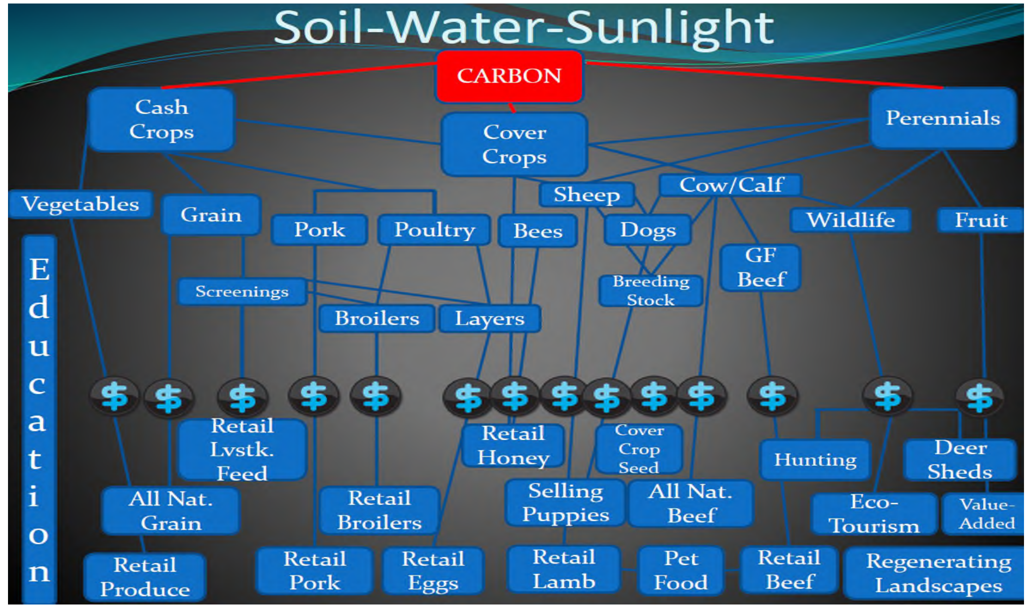
Pongamia silvopasture, Australia

Pongamia pinnata is an exciting legume tree native to Australia which tolerates a variety of climate conditions including salty soil, and can be integrated into silvopasture systems for biofuels production. Trees in trial plots of ~300 acres are producing 16kg of seeds per tree and 'elite' cultivars have produced up to 100kg of seeds per tree annually. In addition to producing biodiesel, the seed cake left after oil extraction can be fed to livestock as a supplement to silvopasture forage and fodder, allowing fertility to be returned to the system.[26]

Enterprise Systems

Gabe Brown's Nested Enterprise Model[27,28]

Although from a different climate, this case study showcases a number of successful diversified farming income streams on one farm using sophisticated regenerative agriculture techniques. The cascade of products shown in his Nested Enterprise chart are directly applicable to Maui.



Gabe Brown's Nested Enterprise model

Gabe Brown is rapidly building soil on more than 5,400 acres by merging back-to-basics agrarian practices with innovative, science-based sustainable farming techniques on his diversified family ranch in North Dakota. Beyond converting all cropland to no-till, he constantly seeds with a cocktail of dozens of cover crops. Through Holistic Management, a diverse cropping strategy, rotational grazing and no-till practices the farm has benefited in terms of soil health, mineral and water cycles, greatly reduced inputs, excellent production and profit, and an improvement in quality of life for the farmers.

Gabe Brown has been practicing his form of integrated regenerative agriculture for over 15 years. For decades the cropland had been conventionally farmed with tillage and the use of synthetic fertilizers and herbicides. Tillage had lowered organic matter levels to less than two percent. In 1993 Brown purchased a no-till drill and converted 100 percent of his cropland to no-till. Brown employs a diverse cropping strategy on his grain and cattle operation which includes over 25 different cash and cover crops, resulting in high yields and strong net profits. The Natural Resources Defense Council awarded one of its 2012 Growing Green Awards to Brown and says, "Gabe's trailblazing work has made him a leader in regenerative ranch management."

Educational Agritourism

Rancho San Ricardo, México

Using the magic of Keyline® planning and ingenuity, the Mashumus team has converted a mono-cropped sugarcane plantation in Mexico to one of the best examples of permaculture and organic agriculture in the world. With over 140 acres of sugarcane, the project was conceived by Pablo Ruiz Lavalle and Eugenio Gras of Mashumus to be one of the most innovative agricultural education sites of our time. Roads, ditches, fruit orchards, and the entire infrastructure were redesigned to harvest water, capture carbon, improve fertility, and beautify the landscape at the same time. Here, local cane growers who manage the surrounding 32,000 acres are able to learn the techniques of Keyline®, the secrets of biofertilizers and microorganisms, natural building techniques, and a myriad of other eco-technologies.[29]

> *Keyline planning is based on the natural topography of the land. It uses the form and shape of the land to determine the layout and position of farm dams, irrigation areas, roads, fences, farm buildings and tree lines. Keyline is an agricultural system in which great emphasis is placed on processes designed to increase substantially the fertility of soils. Emphasis is placed on the creation of a soil environment that rapidly accelerates soil biological activity, thus vastly increasing the total organic matter content within the soil. Keyline lay-outs of farm and grazing lands also incorporate designs permitting the storage of run-off water on the farm itself.*

The central valley of Maui is a large enough area to influence the local climate. Powerful winds bring energy and nutrients that can be harvested or deflected, including moisture, micro-organisms, minerals, and pollutants. Trees can help to mitigate the effects of the wind on this vast tract of land, and benefit the operation and local environment in many ways.

Regenerating our agriculture offers solutions to many of the “problems” facing the world today- water and food shortages, soil loss, rising energy prices and climate change. It may seem that agriculture has nothing to do with these issues, but in fact it has everything to do with them, and can address them all as a win for everyone.

(Endnotes)

1)http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&CategoryID=299
2)http://hawaiitribune-herald.com/sections/news/local-news/bills-promote-food-self-sufficiency.html
4)http://slmpartners.com/wp-content/uploads/2016/01/SLM-Partners-Investment-case-for-ecological-farming.pdf
5)http://epubs.scu.edu.au/esm_pubs/782/
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23)http://www.carbontosoil.com/en/farms.html
24)http://www.kuniacountryfarms.com/
25)http://www.livingaquaponics.com/
26)http://www.bioenergyplantations.com.au/update-on-roma-trial-plantation-progress/
27)https://greencoverseed.com/sites/default/files/attachments/Gabe%20Brown-Livestock%20Integration.pdf
28)http://www.acresusa.com/gabe-brown-large-scale-rapid-building-of-soil-with-cover-crops
29)http://mashumus.com/index.php/proyectos
30) while yielding approximately 34 tons of sugarcane per acre, as compared to an average of 11.5 tons per acre at HC&S (http://hcsugar.com/wp-content/uploads/2013/02/hcs_factsheet_2013_130201PDF.pdf) .

Water and Soil

Wai: water

Waiwai: true wealth

Mālama `āina: to care for and nurture the land so it can give back all we need to sustain life for ourselves and our future generations

The Constitution of Hawai`i states:
For the benefit of present and future generations, the State and its political subdivisions shall conserve and protect Hawai`i's natural beauty and all natural resources, including land, water, air, minerals and energy sources, and shall promote the development and utilization of these resources in a manner consistent with their conservation and in furtherance of the self-sufficiency of the State.

All public natural resources are held in trust by the State for the benefit of the people.

The State shall conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands.

Water

The majority of Hawai`i has a tropical climate and receives copious rainfall. However Maui's central valley is in a rain shadow, and receives between 15 and 60 inches of rain annually, so most of the 35,000 acres being farmed by HC&S are technically in a drylands/sub-humid micro-climate. Sugarcane, one of the world's thirstiest crops, could not be grown here without abundant supplemental irrigation.

This irrigation water arrives at the property in a series of long canals that divert streamflow from more than 100 streams and tributaries in East Maui, and four main streams in West Maui. On average 165 million gallons per day have been diverted from these sources. As a result, these streams no longer support the native habitat they once did, and the communities that live within their watersheds no longer have access to this water for farming and other uses.

Illustration by Silvia Yordanova

Swales are long, level excavations which are constructed on contour across the landscape to slow the flow of water, store water in sub-soils, and create fertile and diverse planting microclimates. They are not intended to encourage or allow water to flow but to simply hold the water by promoting infiltration into the soil. Swales will vary greatly in width and length depending on the dictates of the land and design parameters.

The soil is excavated on the contour and normally mounded on the downhill side on the swale. The swale system creates prolonged subsoil moisture, and provides excellent drainage for trees.

East Maui Irrigation ditch
Photo by Will Scullin

In 2004, over 400 MGD of water, fresh and brackish, is used for domestic, industrial, commercial or agricultural purposes. Only around one-eighth, or 45 MGD of that amount was used for domestic and commercial use. Less than one-tenth of Maui's water resources are actually under public control, although billions of gallons of water originate on public lands. **The vast majority of present use is for agricultural irrigation.**[1]

Control of the water is serious business on Maui. It is incumbent upon the next generation of farmers in the central valley to strive for smart water use and employ best practices that systematically reduce demands for agricultural irrigation, and that also bank water in the soil across the region. Restoring Maui watersheds must be a priority in any central valley farm design. Regenerative agriculture addresses this issue convincingly.

Strategies of Regenerative Agriculture to Improve Hydrological Cycling:[2]

- Capturing and storing rainwater through
  - Terracing
  - Building swales on contour
  - Keyline plowing
  - Ponds
- Building healthy soil to improve water holding capacity using
  - compost
  - mulch
  - cover crops
- Planting windbreaks to decrease evapotranspiration and harvest atmospheric moisture
- Using rotational grazing to improve soils
- Planting climate adapted crops that require minimal irrigation
- Using conservation tillage methods
- Using efficient irrigation methods
- Planting perennial crops requiring no tillage

In a 30-year farm systems trial, the Rodale Institute found that corn grown in organic fields had 30 percent greater yields than conventional fields in years of drought. Healthy soil that is rich in organic matter and microbial life serves as a sponge that delivers moisture to plants. **The trial also found that organic fields can recharge groundwater supplies up to 20 percent.[3]**

A study released by Cornell University Professor

Coffee under nitrogen fixing leucaena overstory: http://afrique-orientale-australe.cirad.fr/en/research-in-partnership/ongoing-projects/ecological-intensification/safse

Organic citrus orchard with herbaceous understory
http://www.goldengroveorchard.com.au

David Pimentel in 2005 reported that organic farming produces the same corn and soybean yields as conventional farming and uses 30 percent less energy and less water. Moreover, because organic farming systems do not use pesticides, they also yield healthier produce and do not contribute to groundwater pollution.[4]

Water Demand of Various Commodity Crops

Water demand varies greatly depending on climate, soils, cultivation practices, and species or cultivar selection. A brief look at alternative crops and livestock management shows significant potential reductions in total water use for the HC&S property.

<u>The data below is derived from conventional systems and does not represent efficiencies possible in regenerative agricultural systems.</u> However, according to the NRCS, a 1% increase in organic matter (carbon) in the top 6" of soil increases its water holding capacity by approximately 27, 000 gallons per acre.[5] **It is likely that water use would be 10-50% less than these numbers, if the recommended regenerative methods were to be embraced and implemented.**

Sugarcane: HC&S current water use has averaged 165 million gallons per day (mgd) on roughly 35,000 acres. Irrigation requirements vary across the central valley[6]:

- East Maui: 4,844 gallons/acre/day
- Waihe`e-Hopoi: 5,958 gallons/acre/day
- Iao-Waikapu: 5,408 gallons/acre/day

Carob: 0.5-1 acre feet/acre/year
- Low end: ~500 gallons/acre/day
- High end: ~900 gallons/acre/day

Avocado and citrus average: 2-4 acre feet/acre/year
- Low end: ~1,700 gallons/acre/day
- High end: ~3,500 gallons/acre/day

Macadamia = 3-4 acre feet/acre/year
- Low end: ~2,700 gallons/acre/day
- High end: ~ 3,500 gallons/acre/day

Mango: 5-9 acre feet/acre/year
- Low end: ~4,400 gallons/acre/day
- High end: ~8,000 gallons/acre/day

Sunflower:
- Could be rain fed = no irrigation = 0 gallons/acre/day

Dryland Kalo:
- Planted at the beginning of the rainy season, dryland kalo is rain fed in areas with 6-9 months of rain (the time required for the crop to mature). Supplemental drip irrigation would be required in the central valley

Cattle:

- One cow can drink up to 25 gallons/day
- If stocking rates are 2 head per acre, that is 50 gallons/acre/day for drinking
- Pasture is normally rainfed and requires no supplemental irrigation
- No hay will need to be fed in lean times if trees and shrubs are used as supplement to grass
- The only water needs of holistically managed livestock systems are for the stock themselves
- Compaction of soils through conventional farming activities and the removal of trees and organic matter reduces effective precipitation. Soils that are bare and hard will not absorb rainfall, leading to erosion and ultimately desertification.

Regenerative agriculture offers many solutions to this crisis, addressing the issue at every level, mauka to makai, from rainfall to aquifers. The thorough integration of elements in the Mainframe Design of the system ensures that less water will be used in the production of crops, and more water will be stored and available, banked in ponds, soils, and plants. Streams and springs may return, and local rainfall may increase through orographic effects if the central valley is designed with the intention to improve the hydrological l cycles of the land.

Soil

Bioremediation of Soils

Healthy soil is a dynamic living ecosystem, teeming with billions of microorganisms that continuously create humus, nourish plant growth, hold water, and sequester stunning amounts of carbon. Soils that are exhausted and contaminated from years of conventional agriculture tilling and chemicals have very little microbial action, but can be restored over time using specific targeted strategies depending on the level and types of pollution. The legal requirement to make the transition from conventional to certified organic agriculture is three years. The obvious first step is to stop using chemicals altogether; then begins the journey to robust and healthy soil.

Soil is a complicated mixture, and mechanisms for the metabolism of chemical pollutants are not completely understood. The research shows that healthy populations of microorganisms in the soil have the capability of bioremediating certain pollutants.[7] Even metals can be bound in the soil by humic acids.[8]

Definitions:

Bioremediation: The use of soil microbes to remove or neutralize contaminants in polluted soil or water. Bacteria and fungi generally work by breaking down contaminants such as petroleum into less harmful substances. Plants can be used to aerate polluted soil and stimulate microbial action. They can also absorb contaminants such as salts and metals into their tissues, which are then harvested and disposed of.

Biodegradation
Petroleum hydrocarbons will degrade with relative ease as a result of biological metabolism. Although virtually all petroleum hydrocarbons are biodegradable, biodegradability is highly variable and dependent somewhat on the type of hydrocarbon.[9]

Phytoremediation is the direct use of living green plants for in situ removal, degradation, or containment of contaminants in soils and groundwater. Advantages of phytoremediation include that it is generally low cost and has low energy requirements; has a low environmental impact; and contributes to landscape improvement. It provides habitat for animal life, reduces surface runoff and reduces the dispersal of dust and contaminants by wind. It is suitable for large areas of land.[10]

Rhizofiltration is a form of phytoremediation that involves filtering water through a mass of roots to remove toxic substances or excess nutrients.

Mycoremediation
Of particular interest are fungi and mycorrhizae, which have the ability to tie up inorganic salts in waxy excretions, and degrade pollutants (many agricultural chemicals are inorganic salts). Mycorrhizae are destroyed by tillage, underscoring

the importance of no-till systems. Stimulating microbial and enzyme activity, mycelium reduces toxins in situ. Some fungi are hyperaccumulators, capable of absorbing and concentrating heavy metals in the mushroom fruit bodies.[11]

To understand the extent and type of chemicals present, extensive soil testing is required across a site to measure baseline levels of pollutants. Consistent monitoring is important to document the efficacy of treatments. The most appropriate remediation protocols will depend on the types and quantities of chemicals present.

Soil Building Strategies and Bioremediation

Korean Natural Farming

Korean Natural Farming (KNF) involves the collection and cultivation of indigenous microorganisms (bacteria, fungi, nematodes, and protozoa), and the reintroduction of these microorganisms directly into agricultural systems to build rich and fertile soil. Using on-farm resources and recycling farm wastes, KNF minimizes dependency upon costly external inputs[12] and consistently produces higher yields without the use of chemical fertilizers.

The strategies and techniques of KNF were developed by Master Han Kyo Cho at the Janonge Natural Farming Institute in South Korea.[13] KNF has demonstrated its success to such a degree that it was adopted by the South Korean government. Rice farmers have since experienced larger yields, saved money on inputs, and are able to sell their rice for a premium. It has had the added benefit of cleaning the waterways, rivers, and even coastal waters.[14]

Farmer Samson Delos Reyes walks along kalo patches at S&J farms of Wai`anae; Photo by Jamm Aquino http://www.activistpost.com/wp-content/uploads/2011/01/natural-farm.jpg

Master Cho teaching on the Big Island of Hawaii http://natural-farming.weebly.com/about-mr-cho.html

Since its introduction into Hawai`i in 1999 by Dr. Hoon Park, KNF has been gaining in popularity with local farmers. Numerous trainings and workshops have been conducted on the islands. The University of Hawai`i's College of Tropical Agriculture and Human Resources (CTAHR) has published many articles on the techniques, established a Natural Farming Agent position and conducted field trials that have demonstrated improved plant health, increased yields and improved soil tilth using KNF techniques. [15]

Farmers in Hawaii are reporting success with KNF. Samson Delos Reyes of S&J Farms of Waianae stated in an article in the Honolulu Star Advertiser that **since trying Korean Natural Farming, production on his 10-acre plot has doubled.** "This is the first time having earthworms on my farm," he said, scooping up a handful of earth and nutrient-rich worm castings in his fingers. "They're cultivating the soil for me." His land was once classified as 'unsuitable for farming.[16]

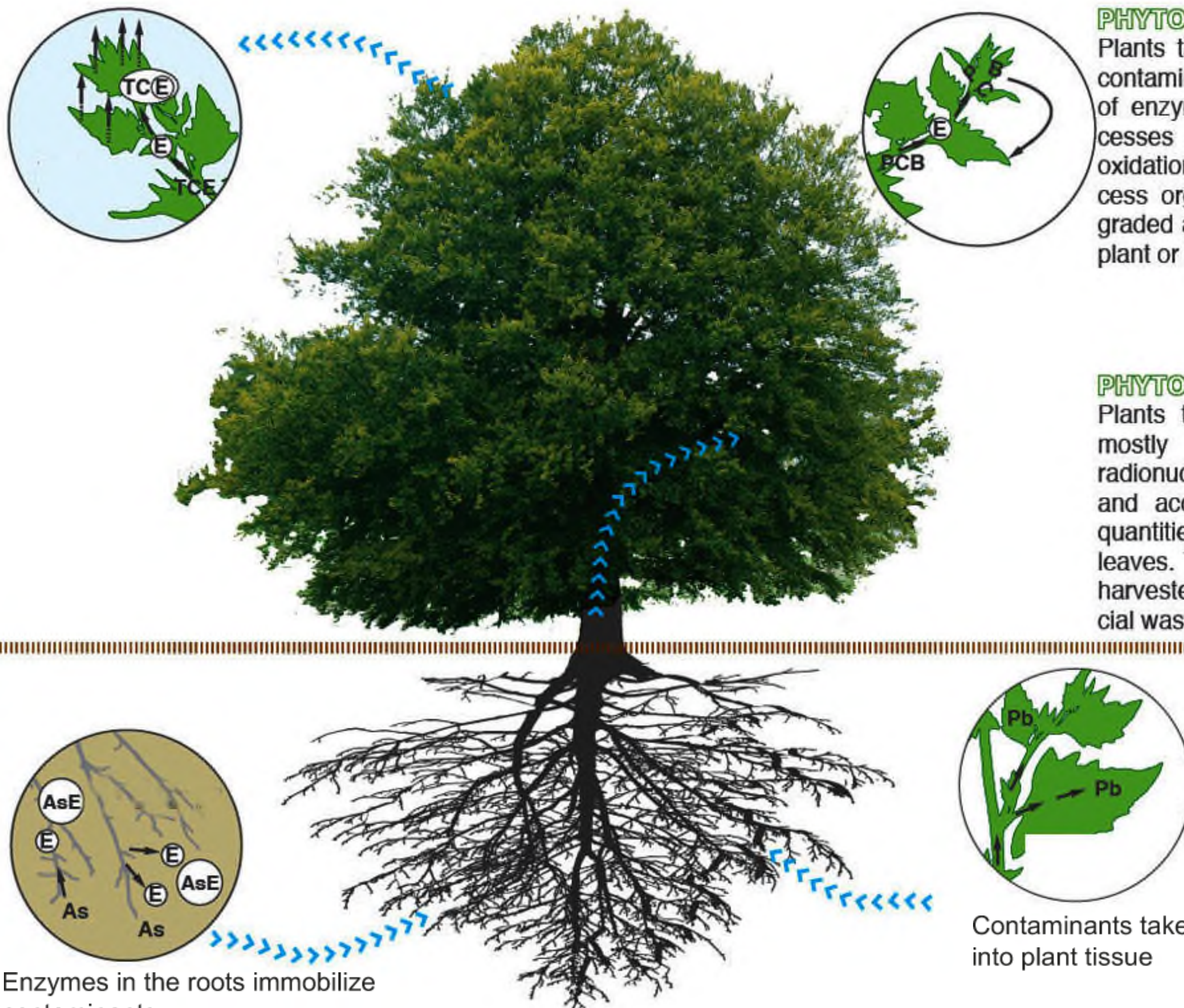
Chris Trump and his family have been farming 750 acres of macadamia nuts in North Kohala for 25 years. They began experimenting with Korean Natural Farming 5 years ago. Currently, they have 120 acres in its second year of utilizing KNF techniques. By August of 2016, they intend to utilize KNF on all 750 acres. He states, "This works. It is also organically certifiable and safe."

While field trials in Hawaii have thus far been conducted on a small scale, large scale experiments have been conducted in other parts of the world. Mr. Cho conducted an experiment in the Gobi Desert where previous tree planting efforts had failed three times due to harsh winds and very limited rainfall of the area. The trees he has planted using KNF techniques have had a 97% survival rate and are currently 20 feet tall. Corn and grasses have been

PHYTO VOLATILIZATION:
Some plants take up volatile contaminants and release them into the atmosphere through transpiration. The contaminant is transformed or degraded within the plant to create a less toxic substance before and then released into the air.

Contaminants are modified along the way and evaporate

Enzymes fragment contaminants and produces new plant fiber



PHYTO DEGRADATION:
Plants take up and break down contaminants through the release of enzymes and metabolic processes such as photosynthetic oxidation/reduction. In this process organic pollutants are degraded and incorporated into the plant or broken down in the soil.

PHYTO EXTRACTION:
Plants take up contaminants - mostly metals, metaloids and radionucleids- with their roots and accumulate them in large quantities within their stems and leaves. These plants have to be harvested and disposed as special waste.

PHYTO STABILIZATION:
Some plants can sequester or immobilize contaminants by absorbing them into their roots and releasing a chemical that converts the contaminant to a less toxic state. This mechanism limits the migration of contaminants through water erosion, leaching, wind, and soil dispersion.

Enzymes in the roots immobilize contaminants

Contaminants taken up into plant tissue

Soil remediation
urbanomnibus.net/2010/11/from-brownfields

planted as well for livestock feed, and wells have been dug. Watermelon farming now provides a stable income to farmers.

At his January 2016 workshop, Master Cho expressed a keen interest in working with Maui County to teach and implement KNF in the central valley.

Cover Crops

Cover cropping is the strategy of seeding a mixture of plants in a fallow field or within a perennial or annual cropping mix for the purposes of increasing soil fertility and organic matter content. It improves soil structure, controls erosion, holds water in the soil, manages weeds and diseases, and increases biodiversity. Cover cropping is also proven to increase carbon sequestration in the soil. The basic process of cover cropping is to sow a field after harvest with a variety of plant species which are then lightly tilled into the soil when they first start to show flower buds.

Soil fertility is enriched by the variety of plant species in the cover crop mix, which usually includes nitrogen fixing species such as legumes, and dynamic accumulators, which concentrate macro and micronutrients in their leaves. Examples of dynamic accumulators include sunflower, rye, buckwheat, sesbania, and mustard. Soil organics and structure are improved via the plant's rooting and with the tilling in of all plant material.

Cover crops further protect and bind the soil structure from compaction and erosion by rain and wind. The management of water is greatly improved as the vegetative cover vastly reduces any run-off, while significantly increasing infiltration rates due to its roots and improved soil structure, i.e. high percentage of soil air gaps. Covered soil dramatically reduces water loss by reducing exposure to the drying effects of the sun and wind.

Crimson clover cover crop fixes nitrogen, suppresses weeds, prevents erosion, and provides excellent forage for honey bees.
http://media.oregonlive.com/washingtoncounty_impact/photo/clover-001jpg-a027abb64673b3af.jpg

These effects increase and protect soil biology, and promote a living and dynamic soil ecology. Cover cropping reduces the presence of weeds by reducing their ability to germinate, occupying space that they would usually need, and by making it difficult for the weeds to complete their full life-cycle, thus not being able to produce seed. Certain cover crop species, rye and mustard as examples, have been shown to have allelopathic effects that suppress weeds and disrupt disease cycles.

Water and soil are the foundation for agriculture, and for society as a whole. Nations rise and fall following the health of their soils. It is our imperative to leave a legacy of clean, abundant water and healthy organic soils for our children, our keiki. We must mālama `āina.

Luckily, we have options for improving and restoring these vital resources that sustain life, for us and for all the earth's inhabitants.

(Endnotes)

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Multi-level Diversified Business Opportunities

Challenges facing local food production include access to affordable land for farmers, competition from foreign markets, a lack of skilled farmers, insufficient local processing and distribution facilities, and the lack of marketing and business skills of farmers. As a result of the above factors, food industry customers are unable to secure consistent supply of quality local produce.

There are, however, significant opportunities for local food production in Hawai`i, specifically on Maui. There is considerable demand for high quality local produce, with many people willing and able to pay a premium price for locally grown organic products. Maui schools, retailers, hotels and restaurants are all seeking local produce, with only a limited supply available. Exact numbers are outside of the scope of this report, but suffice to say that there is opportunity for multi-million dollar yearly contracts to supply local, island-wide, and export markets.

Maui County has extensive resources already in place to facilitate local agricultural enterprise and value-added innovation (manufacturing processes that increase the value of raw agricultural products). These include a large offering of classes, commercial kitchen facilities, small business mentoring, and a robust consortium of partners working to build capacity for agriculture enterprises.

Maui Food Innovation Center

The Maui Food Innovation Center (MFIC) provides business and technological expertise to food and agricultural entrepreneurs throughout the State of Hawaiʻi. A program of University of Hawaiʻi Maui College, MFIC helps farmers and food manufacturers increase profitability through the development of new value-added food products, reduces our dependence on imports, and contributes to the sustainability of island-based agriculture.

Maui Food INNOVATION CENTER

Workshop with interns at Hale Akua Garden Farm

MFIC has secured funding through the Hawaiʻi State Legislature to renovate the former campus cafeteria in the Pilina Building at UH Maui College in Kahului into a state-of-the-art, shared-use food processing facility. This facility will have the capacity to design, test, and produce foods such as sauces, soups, jams, jellies, entrees, bakery products, dehydrated snacks, refrigerated fresh-cut produce, and raw or cooked meat, poultry and seafood products.

Sustainable Living Institute of Maui

The Sustainable Living Institute of Maui (SLIM) is a center with a primary focus on non-credit based community outreach and development activities, as well as complementing UH-Maui College credit-based activities. These activities include the development and dissemination of knowledge and the provision of services to the County of Maui community in various areas of sustainability, particularly renewable energy and sustainable agriculture.

College of Tropical Agriculture and Human Resources (CTAHR)

CTAHR is a land-grant university that provides exceptional education, research, and extension programs in tropical agriculture and food systems, family and consumer science, and natural resource management for Hawaiʻi and the international community. Topics of recent articles and workshops included moringa, pineapple, beekeeping, soils, legal issues for growers, breadfruit, and aquaculture. Through its CTAHR Extension, the College provides numerous publications, trainings, support staff, and project assistance for farmers.

The Kohala Center [1] on Hawai`i Island has generated numerous excellent and in-depth reports on agriculture, aquaculture, biofuels, livestock, and other important farming and watershed issues.

There are many professional, non-profit, and government agencies/institutions working together to help create a vital farming future for Maui.

Skilled Farmers

It is a fact that Maui does not currently have the skilled farmers nor the business infrastructure to support a full-fledged transition to scores of diversified agriculture enterprises. On 35,000 acres there is ample room for large commodity crop and livestock operations exceeding 5,000 acres (biofuels, timber, and cereals), other operations from 1,000–5,000 acres (hemp, kenaf, fruit and nut orchards,), and numerous businesses that can span the 5–500 acre range (vegetable, nurseries, seed crops, aquaculture).

Maui County, A&B, HC&S, and non-profit organizations will have to invest in several strategies to jump-start farming businesses. These include providing incentives and assistance to local farmers, recruiting successful farmers from off-island to start businesses on Maui, recruiting and training new farmers, providing mentorship, and financial assistance.

Farm Incubators

Farm incubators provide land-leasing arrangements for beginning farmers who have farming experience and a business idea, but do not have access to land. It is a low-risk environment to launch a farming business and test ideas.

Will Allen from Growing Power teaches aquaponics to students from around the world
http://www.sustainablebrands.com/sites/default/files/imagecache/635x300/article_images/growing-power-fish.jpg

Farmers usually have access to multiple acres of ‘shovel-ready’ irrigated land, business planning and marketing support, shared equipment and processing facilities, dry storage, greenhouses, and other core infrastructure.

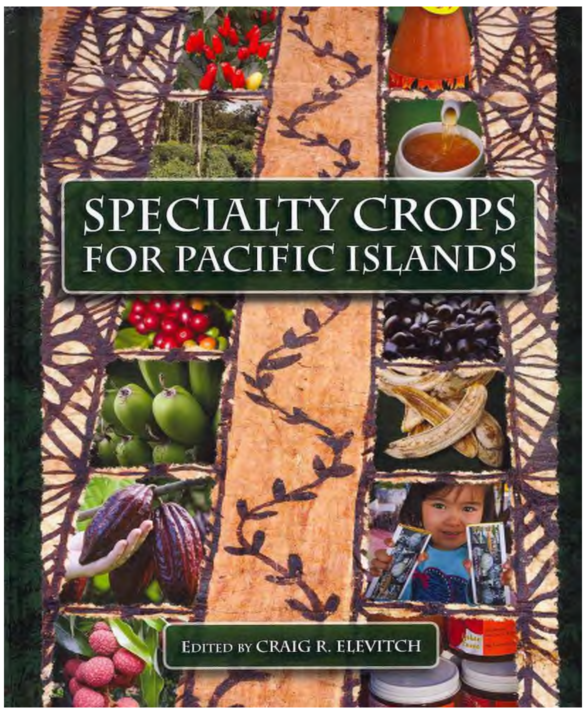
Incubator farms usually have a 3–5 year tenure, expecting the farmers to graduate to their own acreage, thereby making room for new business ventures. Often incubators have a number of permanent anchor businesses who provide stability, mentorship, and profitability.

Economic Multipliers and Job Opportunities
It has been variously estimated that, for every job in the sugar industry, between 1.24 and 2.82 jobs are created in other sectors.[2] Considering this, the loss of 675 jobs on the sugarcane plantation will result in the loss of around 1,370 jobs total. Considering value-added processing, diversified production, and increased agritourism, we anticipate the economic multiplier for regenerative agricultural systems to be higher than this.

Businesses must be profitable to survive. What kind of profit is possible for diversified agricultural systems? Can local food production be competitive with imports? It has been shown that sugarcane, when grown just for sugar, is not profitable and cannot compete on the global commodities market.

Economic metrics for regenerative agricultural systems are variable, but conservative estimates for diversified agricultural production put net profits at around $5000 to $7500 per acre per year, compared to a potential of $50 to $75 per acre per year for sugarcane[3] in a monocrop for export, a 100 fold increase. Some farmers claim to gross, and even net, up to $150,000 per acre per year for direct marketed organic vegetable production. [4]

http://www.oneisland.org/hawaii/



Cover of Specialty Crops for Pacific Islands by Craig Elevitch

Farm Enterprise Opportunities

The sampling of farm enterprises listed below is by no means complete, and is meant to demonstrate the potential mosaic of various land uses for the central valley agricultural lands. Each business has its own set of required skills, markets, customers, and distribution. When imagining scores of diverse farm enterprises integrated into a regenerative agricultural mainframe design, it is evident that Maui will create many more than the 675 jobs lost to HC&S closure.

Canoe Crops

Native Hawaiian canoe crops were not traditionally grown in the central valley, but with the reduced water needs of regenerative farming, and some supplemental water, many of these crops will thrive. These crops fed, clothed, housed, and provided medicines in abundance for generations, and are some of the most important crops to consider when analyzing Maui's food systems.

- Kō - Sugar Cane
- `Ohe - Bamboo
- Niu - Coconut Palm
- Kalo - Taro
- Kī - Ti Plant
- Pia - Polynesian Arrowroot
- Uhi - Yam
- Mai`a - Banana
- `Ōlena - Turmeric
- `Awapuhi - Wild Ginger
- `Awa - Kava
- `Ulu - Breadfruit
- Wauke - Paper Mulberry
- Kukui - Candlenut Tree
- Hau - Hibiscus
- `Ōhi`a `Ai - Mountain Apple
- `Uala - Sweet Potato
- Noni - Indian Mulberry
- Ipu - Bottle Gourd

Vegetable Crops and Diversified Fruit and Nut Orchards

Demand for local consumption of vegetables, fruits and nuts far outstrips current production. From direct sales through local farmer's markets up to multi-million dollar annual contracts for Hawai`i's school lunch program, Maui is well-situated to ramp up production. There are cascading job opportunities for value-added products, including:

Dried fruits

- Jams and preserves
- Juices
- Fermented products
- Salsas
- Processed nuts and seeds (salted, dipped in chocolate, in trail mixes)
- Superfood blends
- Alcohol distilleries and brewhouses (rum, vodka, beer, wine)
- Essential oils
- Root-crop chips
- Agritourism

Superfood Crops

There is an enormous demand for fresh and prepared nutrient-rich superfoods, as exemplified by the spending habits of customers seeking healthier lifestyles. A few examples include:

- Moringa
- Turmeric
- Poha berry
- Acai berry
- Cacao

Aquaculture

HC&S has dozens of reservoirs across the central valley, ranging in size from 1 million gallons to 80 million gallons. Converting several reservoirs to fresh-water fish aquaculture in conjunction

Sorghum is being considered as a biofuel crop for Maui
https://www.bungenorthamerica.com/products/categories/14-sorghum

Growing lettuces with aquaponics at Living Aquaponics Inc.
http://www.livingaquaponics.com

with neighboring farm operation or aquaponics (growing vegetables in conjunction with fish) would further diversify food supplies and provide skilled job opportunities.

Livestock
To raise meats for the local market Maui needs a full-service slaughterhouse, packing house, butcher services, and a mobile slaughter unit. There is demand for fresh meat, cured specialty meats, dairy, and eggs. Please refer to the section on Holistic Planned Grazing for details.

Biofuels
There is a great opportunity to grow biofuel crops to help make Maui more self-sufficient in energy, reduce air pollution, and cut our emissions of greenhouse gases. Biofuels - fuels made from plants and organic matter - are one way to decrease our consumption of fossil fuels, especially oil. Unlike oil, coal, or natural gas, biofuels are renewable and won't run out.[8]

Biofuels include:
- Ethanol
- Biodiesel
- Biogas/methane from anaerobic digestion
- Syngas from biomass gasification

Ethanol made from bagasse, a byproduct of sugarcane processing, has potential as a transition fuel for the HC&S property. Brazil is considered as a biofuel industry leader, with the world's first sustainable biofuels economy. Touted as a policy model for other countries, its sugarcane ethanol is called "the most successful alternative fuel to date".[9, 10] Hawai`i had hoped to spur creation of a local ethanol industry, using locally grown feedstocks, with a 2006 requirement that all motor

Polyface Farms mobile chicken coops with noticeably improved grass growing just two weeks after grazing rotation.
https://www.pinterest.com/pin/34410384625461897/

gasoline be blended with 10% ethanol, but no ethanol refineries have been built in the state. In 2015, the requirement was repealed (Act 161, Session Laws of Hawai`i 2015). [17]

Biodiesel crops include sunflower, safflower, hemp, kenaf, and soybeans, amongst others. Biodiesel burns cleaner than fossil fuels, and releases fewer pollutants and greenhouse gases into the atmosphere. Pacific Biodiesel, headquartered in Kahului, Maui, has 20 years experience internationally in biodiesel, manages a successful operation of biofuel crops on 10,000 acres on the Big Island of Hawai`i, and is considering expanding to Maui.

"Since its inception over 15 years ago, Pacific Biodiesel has built 12 facilities on the mainland U.S. and Japan, and completed expansions on several of those plants. It's newest venture, Big Island Biodiesel, located on Hawai`i Island, began production in the 4th quarter of 2012. Featuring zero-waste processing, this facility produces the highest quality biodiesel available in the country". [11]

Biodiesel production on Maui could offer lateral job opportunities for former HC&S sugarcane workers. It is a specialized farm business with many jobs in the biodiesel plant itself, and is highly mechanized.

Textiles and Fiber Crops - Kenaf and Hemp

Kenaf (Hibiscus cannabinis) and hemp (Cannabis sativa) are promising commodity crops that merit further research. Both grow well in the tropics, have multiple high-value yields, help with soil remediation, and have the potential to provide many employment opportunities.

Kenaf bales in warehouse
http://www.britsauto.co.za/index.php/natural-fibre-mat/

Harvesting Hemp in Romania:
http://www.hempworld.com/hemp-cyberfarm_com/images/Harvest%20w%20tractor04.jpg

Kenaf is a warm season annual fiber crop closely related to cotton and okra that can be successfully grown on Maui. Kenaf has been used as a cordage crop to produce twine, rope, and sackcloth for over six millennia, and today there is a robust market in paper products, building materials, flotation devices, absorbents, high-tech fine oil for industry, biofuels, viable seed, and livestock feed. Kenaf grows quickly to 9'-12'; the flowers produce a delicious honey, and can likely produce 2 – 3 crops annually on Maui.[12]

Hemp yields many diverse products from foods to medicine, paper and textiles, building materials and more. Hemp is an excellent soil remediation crop and like kenaf has a long history in twine, cloth, burlap, and other textiles.

Hemp's environmental footprint is relatively small; it requires few pesticides and no herbicides. It's an excellent rotation crop, often used to suppress weeds and loosen soil before the planting of cereals. However, it requires a relatively large amount of water (albeit less than sugarcane), and its need for deep, humus-rich, nutrient-dense soil limits growing locales.[13]

Further research is needed to know if hemp is a viable and profitable crop for Maui, and if it would be invasive, as its seeds are easily dispersed by birds. "Feral cannabis is an exceptionally hardy weed, widely dispersing its seeds, which can lie dormant for 7–10 years before sprouting again." [16]

Kenaf and hemp also offer lateral job opportunities for retrained HC&S workers.

Agritourism[14]
As part of a whole-farm strategy that complements the farm enterprise itself, farmers can generate significant income by diversifying into agritourism, especially on Maui. Our 2.6 million annual visitors seek out fun, delicious, and educational day-trips to local farms.

It can be difficult to make a living as a small farmer, and the supplemental income from agritourism, in conjunction with real farming, can be an important part of the solution to profitability. However, this will tend to raise the value, and thus the price, of agricultural land.

There are many ways to drive business to local farms including:

- Farm tours
- Farm-to-table lunches and dinners
- Tastings
- Workshops and trainings
- Ziplines
- Dude ranches
- Fishing/hunting
- Wineries/brewhouses/distilleries
- Gift shops
- Concerts
- Fairs
- Festivals
- Weddings

The Hawai`i AgriTourism Association (HATA) connects the agriculture sector with the visitor industry and residents across Hawai`i. They provide educational and economic opportunities to members that include farm diversification, agritourism marketing, developing farm tours, and producing and selling value-added products.

Tourists enjoying the zipline at Maui Tropical Plantation
http://mauitropicalplantation.com

(Endnotes)
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17)https://en.wikipedia.org/wiki/Ethanol_fuel_in_Hawaii

Community Engagement and Story of Place

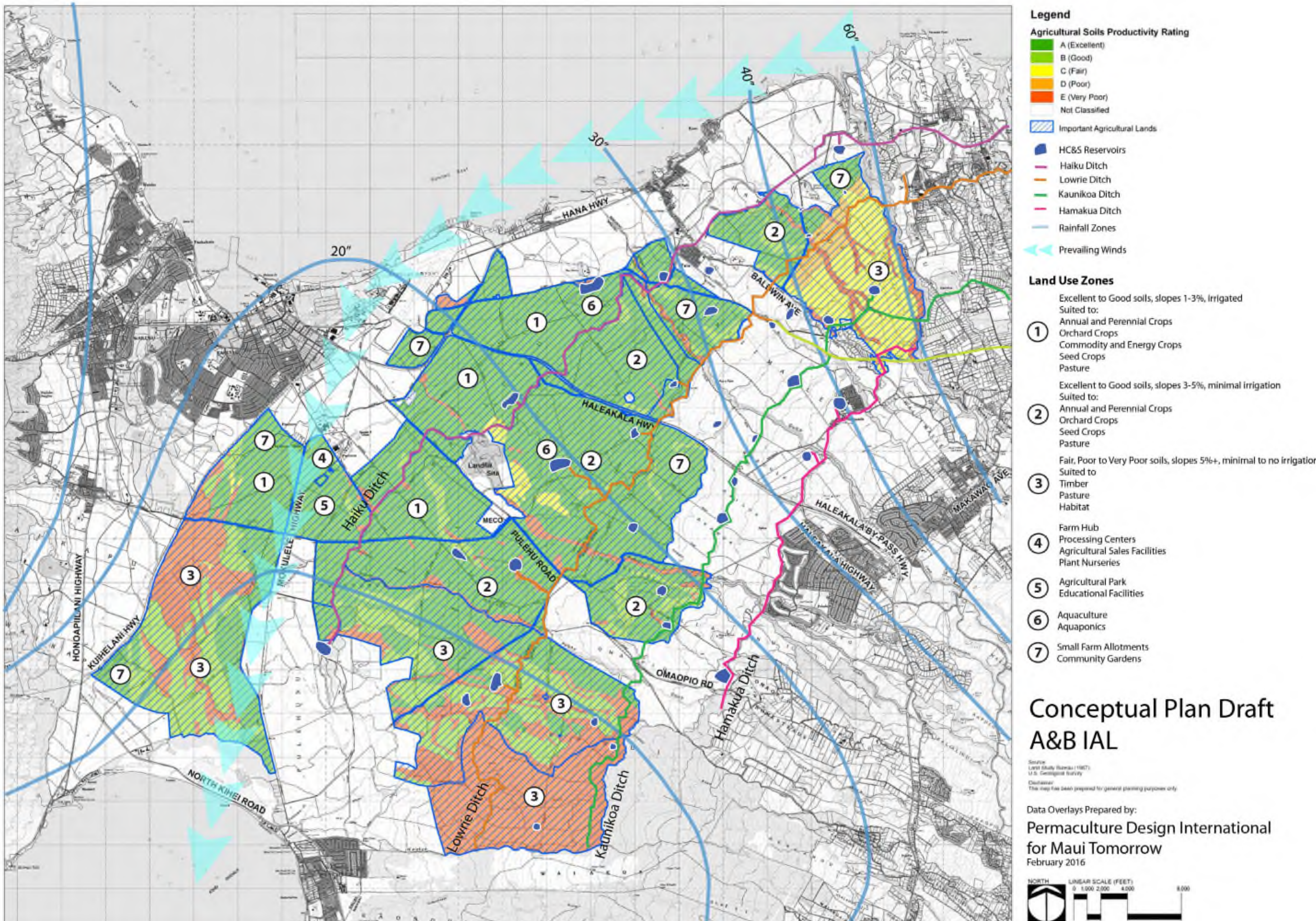
This report has examined many possibilities for how to begin a transition to regenerative agriculture. These options will require a large investment in research, design, implementation, infrastructure, training and much more. The research and potential outcomes outlined in this report are beginnings of a community discussion and vision. The key is to come together as a community, with our largest landowner, and chart this course together.

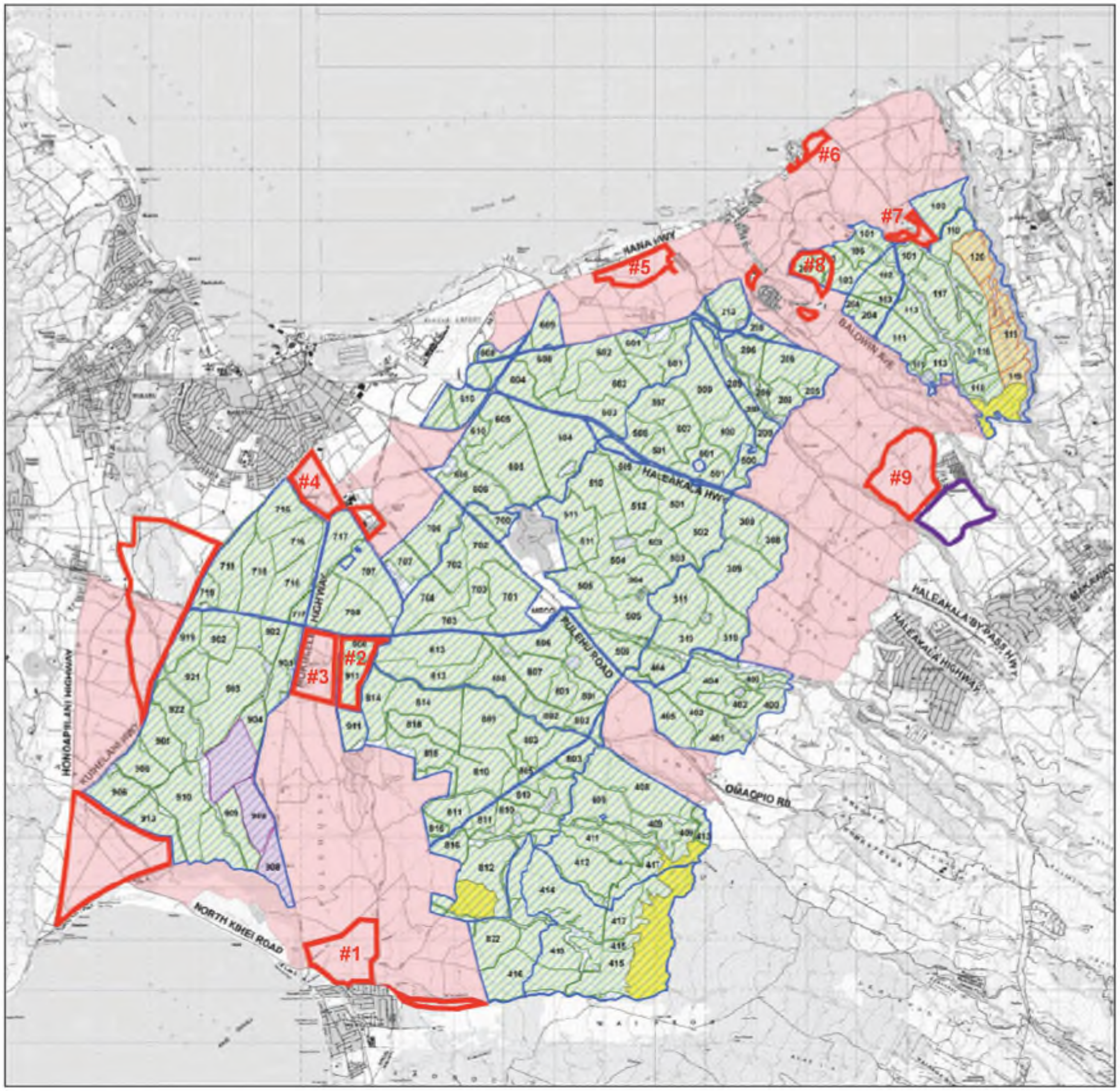
Moving forward hinges on addressing these important questions:

- How can private farm businesses have long-term access to land owned by A&B?
- Can some of the land be re-zoned to allow farmers to live on their farms? Could that include small farming communities like the plantation villages?
- What water rights will farmers have on these lands?
- Regenerative agriculture will use much less water than sugar cane. How can we guarantee watershed restoration post-sugarcane?
- Will A&B and HC&S continue to own the land and become a diversified multi-farm corporation?
- How will A&B work with the community and provide transparency regarding their farming and development agenda?
- Would A&B sell the land to a consortium of private buyers who are committed to regenerative agriculture? At what price?
- Can the land be held in perpetuity for regenerative agriculture, as a safeguard against development?
- How would the land be managed and distributed to farmers?

If A&B would sell the land at market value, a compelling alternative emerges: forming an island-wide Maui Farm Cooperative. Every citizen of Maui could be either a worker-member or consumer-member with voting rights, profit shares, access to healthy island-grown food, even health care. Under the umbrella of the Maui Farm Cooperative, independently managed divisions would oversee each main business branch: livestock, tree crops, vegetable crops, agritourism, composts, marketing, distribution, irrigation, education, and so on.

Sugarcane production ends this year. Maui needs agriculture jobs. The community has an opportunity to come together and help usher in a new era of farming on Maui. Cultivating beneficial relationships between stakeholders is the foundation for the success of any project. We look forward to hearing your stories, addressing your questions and concerns, and incorporating new ideas.


Legend
Agricultural Soils Productivity Rating
A (Excellent)
B (Good)
C (Fair)
D (Poor)
E (Very Poor)
Not Classified
Important Agricultural Lands
HC&S Reservoirs
Haiku Ditch
Lowrie Ditch
Kaunikoa Ditch
Hamakua Ditch
Rainfall Zones
Prevailing Winds
Land Use Zones
1 Excellent to Good soils, slopes 1-3%, irrigated
Suited to:
Annual and Perennial Crops
Orchard Crops
Commodity and Energy Crops
Seed Crops
Pasture
2 Excellent to Good soils, slopes 3-5%, minimal irrigation
Suited to:
Annual and Perennial Crops
Orchard Crops
Seed Crops
Pasture
3 Fair, Poor to Very Poor soils, slopes 5%+, minimal to no irrigation
Suited to
Timber
Pasture
Habitat
4 Farm Hub
Processing Centers
Agricultural Sales Facilities
Plant Nurseries
5 Agricultural Park
Educational Facilities
6 Aquaculture
Aquaponics
7 Small Farm Allotments
Community Gardens
Conceptual Plan Draft
A&B IAL
Data Overlays Prepared by:
Permaculture Design International
for Maui Tomorrow
February 2016
HANA HWY
BALDWIN AVE
HALEAKALA HWY
HALEAKALA BY-PASS HWY
HALEAKALA HIGHWAY
MAKAWAO AVE
PULEHU ROAD
OMAOPIO RD
HONOAPIILANI HIGHWAY
KUIHELANI HWY
MOKULELE HIGHWAY
NORTH KIHEI ROAD
Haiku Ditch
Lowrie Ditch
Kaunikoa Ditch
Hamakua Ditch
Landfill Site
MECO
15"
20"
30"
40"
60"



Comparison Map Current (2010) HC&S Ag Lands and Lands Committed to Future Ag as IAL.

Current HC&S Lands in Ag Production: 35,000 Acres

HC&S Lands Designated as Important Ag Lands 2009 by LUC: 27,133 Acres

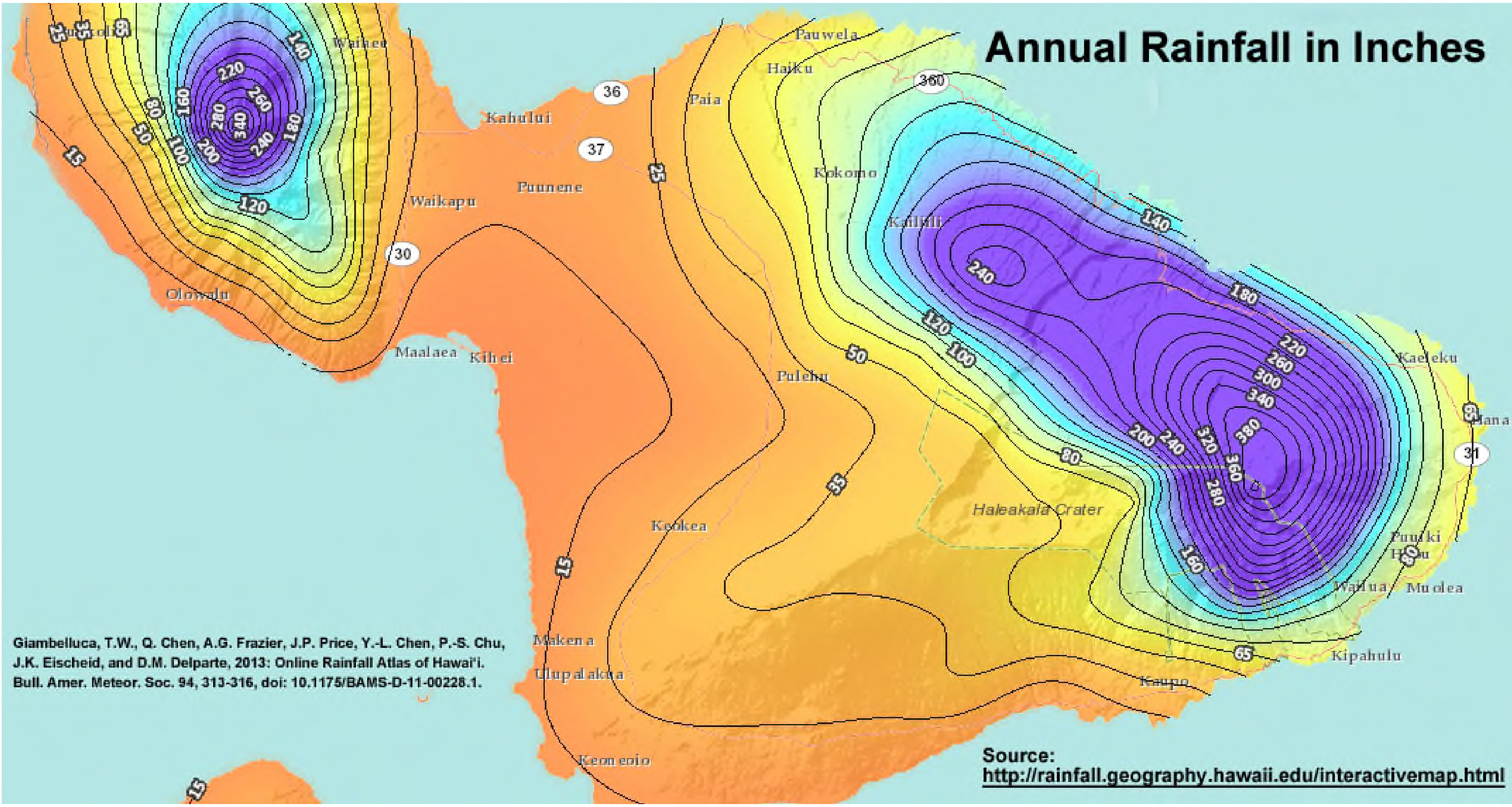
Current Water Use for 35,000 Acres from East Maui Sources 160mgd

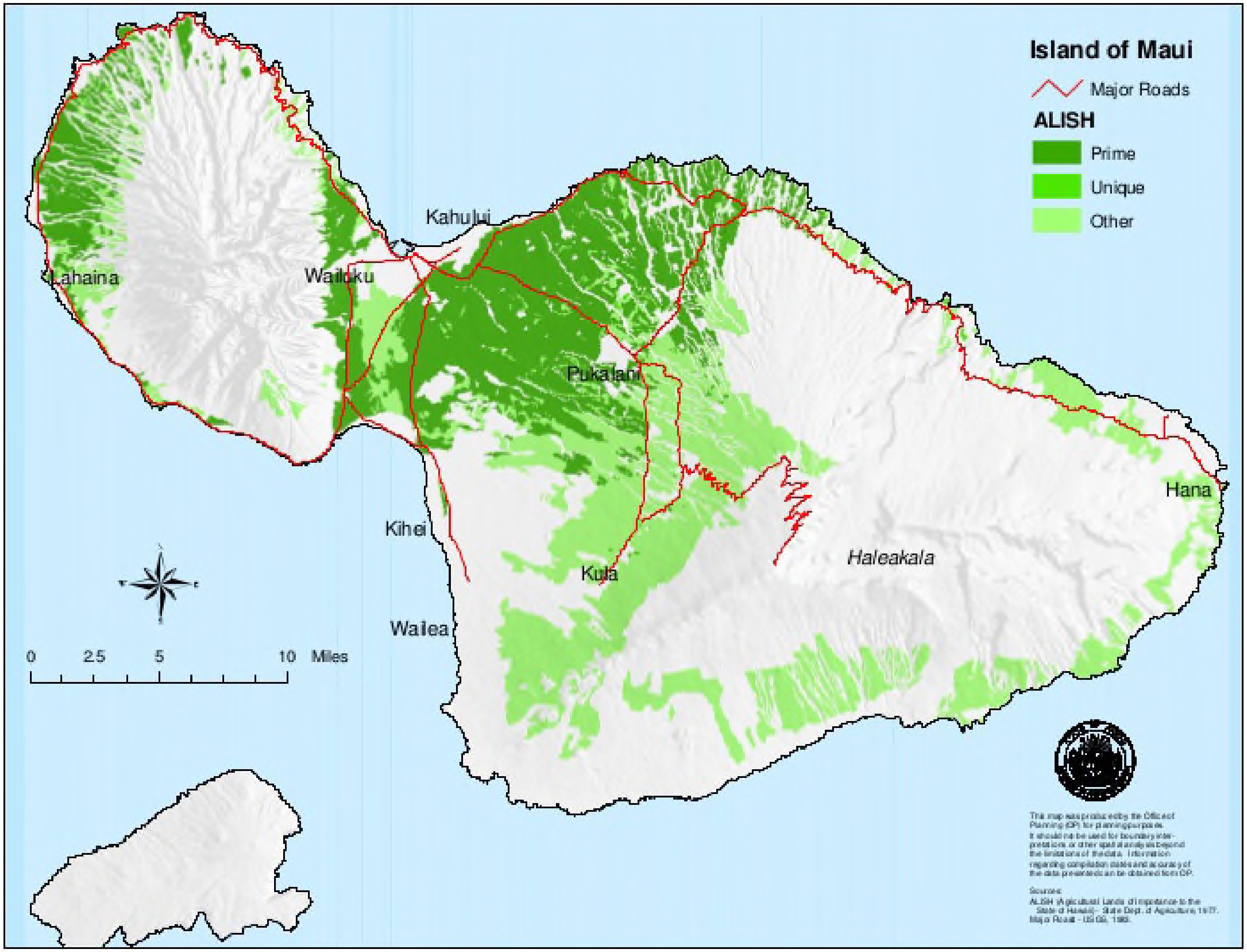
Legend

Crop Type

- Sugar
- Pineapple
- Seed Corn
- Pasture/ Other
- Proposed Important Agricultural Lands
- Existing HC&S Crop Lands not in IAL Boundary
- Development Areas Proposed During Maui Island Plan Process by A&B Inc. (Approx. 3,000 Acres)
- Proposed MLP Development Area

Map Source: HC&S IAL Application to LUC
Composite Map Provided by Maui Tomorrow May 2010


Annual Rainfall in Inches
Kahului
Puunene
Waikapu
Olowalu
Maalaea
Kihei
Paia
Haiku
Pauwela
Kokomo
Kailiili
Pulehu
Kaeleku
Hana
Haleakala Crater
Keokea
Makena
Ulupalakua
Keoneoio
Kipahulu
Kaupo
Wailua
Muolea
Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.-L. Chen, P.-S. Chu, J.K. Eischeid, and D.M. Delparte, 2013: Online Rainfall Atlas of Hawai'i. Bull. Amer. Meteor. Soc. 94, 313-316, doi: 10.1175/BAMS-D-11-00228.1.
Source:
http://rainfall.geography.hawaii.edu/interactivemap.html


Island of Maui
Major Roads
ALISH
Prime
Unique
Other
Kahului
Lahaina
Wailuku
Pukalani
Kihei
Kula
Wailea
Haleakala
Hana
0 2.5 5 10 Miles

Legume Trees with pods Edible to Livestock				
Common Name	**Species Name**	**Climate**	**Native Range**	**Nitrogen Fixation**
Carob	**Ceratonia siliqua*	Mediterranean	Mediterranean	No
Winter Thorn	**Faidherbia albida*	Arid to humid tropical lowlands and highlands	Africa	Yes
African Locust Bean	**Parkia biglobosa*	Semiarid to humid tropical lowlands	Africa	Yes
Palo Verde	**Parkinsonia aculeata*	Arid to semiarid tropics and subtropics	Americas	No
Monkey Bread	**Piliostigma thongii*	Semiarid tropics	Africa	Yes
Manilla Tamarind	*Pithecellobium dulce*	Semi-arid to humid tropical lowlands	Americas	Yes
Honey Mesquite	**Prosopis glandulosa*	Arid to semi-arid, subtropics to colA	North America	Yes
Kiawe	**Prosopis pallida*	Semiarid tropics	South America	Yes
Monkeypod Tree	*Samanea (= Albizia) saman*	Semi-arid to humid tropical lowlands	tropical Americas	Yes
Wild Cassia	*Senna singueana*	Semiarid tropics	Africa	No

**pods also edible by humans*

Adapted from Martin, Frank. Selecting the best Plants

Animal Feed (Grasses)								
Common Name	**Species Name**	**Food**	**Feed**	**Fiber**	**Const.**	**Fuel**	**Soil Amend.**	**Erosion Control**
Bermuda	*Cynodon dactylon*	0	5	0	0	0	0	4
Guinea	*Panicum maximum*	0	4	0	1	0	0	2
Kikuyu	*Pennisetum clandestin*	0	5	0	0	0	0	4
Napier	*Pennisetum purpureun*	0	5	0	2	1	0	4
Pangola	*Digitaria decumbens*	0	5	0	0	0	0	4
Star	*Cynodon nlemfluensis*	0	5	0	0	0	0	4
Sudan	*Sorghum sudanense*	0	5	0	2	1	0	1
Animal Feed (Legumes)								
Common Name	**Species Name**	**Food**	**Feed**	**Fiber**	**Const.**	**Fuel**	**Soil Amend.**	**Erosion Control**
Calliandra	*Calliandra calothrysus*		3					
Jack bean	*Canavalia ensiformis*	1	3	0	0	0	2	2
Leucaena	*Leucaena leucacephal*	4	4	0	2	4	4	3
Mesquite	*Prosopis sp.*	2	5	0	3	4	3	4
Mother-of-cacao	*Gliricidia sepium*	2	3	0	3	3	3	3
Tibet Tree	*Albizia lebbeck*		4					

Adapted from Martin, Frank. Selecting the best Plants

Fiber					
Common Name	**Species Name**	**Annual or Perennial**	**Growth Habit**	**Drought**	**Other Uses**
Abaca	*Musa textilis*	perennial	large herb	no	cord
Cotton	*Gossypium spp.*	annual	large herb	no	stuffing
Hemp	*Cannabis sativa*	annual	large herb	no	yes
Jute	*Corchorus capsularis*	annual	herb	no	cord
Kapok	*Ceiba pendandra*	perennial	tree	no	stuffing
Kenaf	*Hibiscus spp.*	annual	herb	no	cord, leaves
Mahoc	*Hibiscus tiliaceus*	perennial	tree	yes	no
Sisal	*Agava spp.*	perennial	herb	yes	cord
Baobab	*Adansonia digitate*	perennial	large tree	yes	clothing
Paper mulberry	*Boussingaltia*	perennial	large shrub	yes	clothing

From Toesnmeier, E. Carbon Farming Ch 22 industrial oils

Annual Biofuels Plants	
Latin Name	**Common Name**
Helianthus annus	Sunflower
Carthamus tinctorius L.	Safflower
Glycine max	Soybean
Cannabis sativa l	Hemp
Hibiscus cannabinus	Kenaf

Perennial Oil Biofuels plants				
Inedible oil yields compared				
Latin Name	**Common Name**	**Climate**	**Seed or fruit yield t/ha**	**Oil yield t/ha**
Jatropha curcas	Jatropha	Tropical lowlands, semi-arid to humid	1-15.0	0.3-5
Aleurites mollucanus	Candlenut	Tropical humid to semiarid	16	3
Ricinus communis	Castor bean	Tropics, subtropics, high or lowlands, semi-arid to humid	0.5-5	0.3-2.7
Pongamia pinnata	Pongamia	Subtropics, tropics, lowlands,highlands, humid	5-8.0	1.8
Simmondsia chinensis	Jojoba	Subtropics, arid to semi-arid	2.2-4.5	0.5-1.1
Azadirachta indica	Neem	Tropics, humid to semi-arid		0.5

Cover Crops							
Common Name	**Species Name**	**Adapt***	**Propagation**	**Nitrogen Fixation**	**Erosion Control**	**Mulch**	**Ground Cover**
Cowpea	*Vigna unguiculata*	I	seeds	4	3	4	4
Hosei	*Vigna hosei*	I,W	cuttings	4	4	5	5
Indigo	*Indigofera spp.*	I,W	seeds	4	5	3	5
Jack bean	*Canavalia ensiformis*	I,W	seeds	4	3	3	4
Lablab bean	*Dolichos lablab*	I,W	seeds	4	1-5	2	1-5
Perennial peanut	*Arachis spp.*	I	seeds, cutting	4	5	2	4-5
Sun hemp	*Crotalaria juncea*	I	seeds	4	3	4	3
Tinaroo	*Glycine wightii*	I,W	seeds	4	5	3	5
Velvet bean	*Stizolobium deeringianum*	I,W	seeds	4	5	3	5

Alley Cropping Fodder Trees								
Common Name	**Species Name**	**Adapt***	**Alley Crop**	**Nitrogen Fixing**	**Erosion Control**	**Mulch**	**WindBreak**	**Shade**
Agati	*Sesbania grandiflora*	I	5	3	4	2	1	1
Calliandra	*Calliandra calothrysus*	I,W	5	4	4	3	3	3
Horseradish tree	*Moringa oleifera*	I	4	0	1	2	0	1
Ice Cream Bean	*Inga edulis*	I,W	5	3	3	4	2	3
Leucaena	*Leucaena leucacephala*	I	5	5	2	3	1	1
Mother of cacao	*Gliricidia sepium*	I	4	4	2	3	1	3
Pigeon pea	*Cajanus cajan*	I	5	4	3	3	0	0
Tibet Tree	*Albizia lebbeck*	I,W						

*Key to adaptation: W= hot wet tropics; U= upland tropics, D= dry tropics, I = intermediate, neither too wet nor too dry.

Adapted from Martin, Frank. Selecting the best Plants

Specialty crops (beverages, oil, spices, sugar)			
Common Name	**Species Name**	**Annual/Perennial**	**Growth Habit**
BEVERAGES			
Cacao	*Theobroma cacao*	perennial	small tree
Coffee	*Coffea arabica,C. robusta*	perennial	small tree
Tea	*Camellia sinensis*	perennial	shrub
SPECIALTY OILS			
Tung	*Aleurites spp.*	perennial	tree
Ylang-Ylang	*Cananga odorata*	perennial	tree
SPICES			
Indonesian Cardamom	*Amomum cardamomum*	perennial	herb
Cardamom	*Elettaria cardamomum*	perennial	herb
Turmeric	*Curcuma domestica*	perennial	herb
Cloves	*Syzygium aromaticum*	perennial	small tree
Nutmeg & Mace	*Myristica fragans*	perennial	tree
Pepper	*Piper nigrum*	perennial	vine
Galangal	*Alpinia galanga*	perennial	herb
Ginger	*Zingiber officinale*	perennial	herb
Vanilla	*Vanilla fragrans*	perennial	vine

Arid/Semi-Arid adapted Multi-purpose windbreak species, Adapted from Elevitch, C. Multipurpose windbreak trees.										
Botanical Name	**Common Name**	**Mature Size (ft)**	**N-Fixer**	**Fruit/ Nut/**	**Fodder**	**Bee Forage**	**Wood/ Timber**	**Wind break**	**Growth Rate**	**Potentially Invasive**
Acacia koa	Koa	50-80'	Y		Y	Y	Y	Y	F	
Acacia confusa	Formosa Koa	50-80'	Y		Y	Y	Y	Y	F	
Acrocarpus fraxinifolius	Pink Cedar	80-160'					Y	Y	F	
Albizia lebbeck	Tibet Tree	25-35'	Y		Y	Y	Y	Y	M	Y
Aleurites moluccana	Kukui, Candlenut	50-80'		P	P			Y	M	
Anacardium occidentale	Cashew	35-40'		Y	Y		Y	Y	S	
Annona muricata	Soursop	<20'		Y				Y	S	
Araucaria bidwillii	bunya-bunya pine	90-120'		Y	Y		P		S	
Artocarpus heterophyllus	Jackfruit	30-70'		Y	Y		Y	Y	S	less drought hardy
Azadirachta indica	Neem	40-60			Y	Y	Y	Y	M	
Bambusa oldhamii	Oldhamii	40-60'		Y			Y	Y	M	
Casimiroa edulis	White Sapote	20-45'		Y			P	Y	S	
Ceratonia siliqua	Carob	45-55'		Y	Y		Y	Y	S	
Chrysophyllum cainito	Star Apple/Caimito	25-50'		Y				Y	S	
Cocos nucifera	Coconut	30-90'		Y		Y	Y	Y	S	less drought hardy
Eucalyptus cameldulensis	Red River Gum	80-120'				Y	Y	Y	F	Y
Eucalyptus sideroxylon	Red Iron Bark	50-60'				Y	Y	Y	F	Y
Eucalyptus robusta	Swamp Mahogany	80-120'				Y	Y	Y	F	
Gliricidia sepium	Madre de cacao	30-35'	Y		Y	Y	Y	Y	F	
Mangifera indica	Mango	80-120'		Y		P	Y	Y	S	
Manilkara zapota	Sapodilla	50-60		Y	Y		Y	Y	S	
Moringa oleifera	horseradish tree	30-45'		Y	Y	Y		Y	F	
Morus nigra	Mulberry	20-25'		Y	Y	Y		Y	M	
Pithecellobium dulce	Manila tamarind	35-50'	Y		P	Y	Y	Y	M	Y
Prosopis glandulosa	Honey Mesquite	20-30'	Y	Y	Y	Y		Y	M	
Pterocarpus indicus	Narra	90-120'	Y		P		Y	Y	M	
Senna siamea	Pheasantwood	50-60'			P		Y	Y	F	
Swietenia macrophylla	Mahogany	90-120'					Y	Y	M	less drought hardy
Tamarindus indica	Tamarind	80-100		Y	Y		Y	Y	S	
Thryostacys siamensis	Monastery Bamboo	20-45'		Y	P		Y	Y	M	

P=potential

Limitations of Livestock in Agroforestry				
Livestock Species	**Damage Young Trees**	**Scratch or Dig**	**Silvopasture Only**	**Diverse Perennial Understory**
Cattle	Yes		Yes	
Chickens		Yes	Yes	Yes^
Ducks & Muscovies				Yes^
Geese				Yes
Goats	Yes		Yes	
Hogs	Yes	Yes	Yes	Yes*^
Sheep	Yes		Yes	
Turkeys		Yes	Yes	Yes*

From Toensmeier, E.

Agroforestry Functions of Livestock						
Livestock Species	**Mow & Graze**	**Clear Brush**	**Eat Bugs**	**Till**	**Weed Grass Only**	**Clean Drops**
Cattle	Yes	Yes*				Yes*
Chickens	Yes		Yes	Yes		Yes
Ducks	Yes		Yes			
Geese	Yes				Yes	
Goats	Yes	Yes				
Hogs	Yes		Yes*	Yes	Yes*	Yes
Sheep	Yes	Yes*				Yes
Turkeys	Yes		Yes			

*Breed dependent
^Sequence and crop dependent

POTENTIAL FOOD CROPS FOR MAUI						
Grains						
CommonName	**SpeciesName**	**Annual/Perennial**	**Principal Nutrients**	**Yield (lbs/ac)**	**Water Use (gal/ac/day)**	**Reference**
Amaranth	*A. cruentis A. hypochondr*	protein, starch	protein, starch	800	1785	http://tinyurl.com/znvtkw2
Corn, Maize	*Zea mays*	protein, oil, starch	protein, oil, starch	6,000-12,000	893 - 1785	http://tinyurl.com/huo96od
Pearl Millet	*Pennisetum americanum*	protein, starch	protein, starch	3,000-4,000	893	http://tinyurl.com/jqk2tn4
Quinoa	*Chenopodium quinoa*	protein, starch	protein, starch	900-1,200	714 - 1071	http://tinyurl.com/nv4d34o
Sorghum	*S. bicolor*	protein, starch	protein, starch	4,000-5,000	893 - 1785	http://tinyurl.com/hla42od
Legumes						
Common Name	**Species Name**	**Annual/Perennial**	**Principal Nutrients**	**Yield**	**Water Use**	**Reference**
Bean, common	*Phaseolus vulgaris*	annual	protein, starch	1,200-1,800	1517 – 1875	http://tinyurl.com/ha4scb9
Chick pea, garbanzo	*Cicer arietum*	annual	protein, starch	800-2,000	446 - 893	http://tinyurl.com/h9r5vzg
Cowpea	*Vigna sinensis*	annual	protein, vit. B	1,000-3,000	893 – 1785	http://tinyurl.com/gr4yzyo
Lablab	*Dolichos lablab*	annual	protein, starch	1,000-2,000	1785 - 3571	http://tinyurl.com/zc8vmdj
Lima bean	*Phaseolus vulgaris*	annual	protein, vit. B, starch	2,000-3,000	1161 - 1785	http://tinyurl.com/h47cnn5
Mung bean	*Vigna radiate*	annual	protein, starch	300-2,000	1071 - 1518	http://tinyurl.com/zgcxl9f
Pigeon pea	*Cajunus cajan*	annual or weak perennial	protein	700	1785 - 3303	http://tinyurl.com/hnje8xa
Roots and Tubers						
Common Name	**Species Name**	**Annual, Bi/ Perennial**	**Principal Nutrients**	**Yield**	**Water Use**	**Reference**
Cassava	*Manihot esculenta*	per. Grown as annual	starch	15,000	3571 - 4465	http://tinyurl.com/h6z2uhy
Jicama	*Pachyrrhizus erosus*	weak per. used as annual	starch, protein	10,000-14,000	N/A	http://tinyurl.com/gt44ka8
Sweet Potato	*Ipomea batatus*	per. Grown as annual	starch, vit. C, maybe A	28,000-32,000	2233 - 3126	http://tinyurl.com/gmeexfa

POTENTIAL FOOD CROPS FOR MAUI -*Continued*						
Fruit Vegetables						
CommonName	**SpeciesName**	**Annual/Perennial**	**Principal Nutrients**	**Yield (lbs/ac)**	**Water Use (gal/ac/day)**	**Reference**
Chayote	*Sechium edulis*	perennial	tips high in vitamins, minerals	40,000-80,000	3571 - 4465	http://tinyurl.com/jeepw3g
Eggplant	*Solanum melongena*	weak perennial	low nut. Value	15,000-30,000	1339	http://tinyurl.com/jctgl2o
Okra	*Abelmoschus esculentus*	annual	fair source of most nutrients	7,000-10,000	893 – 1785	http://tinyurl.com/h3kr4wk
Pepper	*Capsicum annum*	weak perennial	vit. A & C	10,000-20,000	1785 - 2232	http://tinyurl.com/h9odpzh
Pumpkin tropical	*Cucurbita moschata*	weak perennial	vit. A & C, seed high in oil & protein	9,000-11,000	1518 - 2143	http://tinyurl.com/huqcrxb
Misc. Vegetables						
Common Name	**Species Name**	**Annual/Perennial**	**Principal Nutrients**	**Yield**	**Water Use**	**Reference**
Artichoke	*Cynara scolymus*	perennial		9,000-11,000	1339 - 1785	http://tinyurl.com/z7jzehu
Asparagus	*Asparagus officinale*	perennial	vit. C	2,500-3,000	1339 - 2232	http://tinyurl.com/hbcq7lt
Tropical Fruit Crops						
Common Name	**Species Name**	**Annual/Perennial**	**Principal Nutrients**	**Yield**	**Water Use**	**Reference**
Avocado	*Persia americana*	perennial	oil	4,000-7,500	1785 - 3572	http://tinyurl.com/zfjyhmv
Breadfruit	*Artocarpus elastica*	perennial	starch	12,000-25,000	1339 – 3572	http://tinyurl.com/k8csv63
Carob	*Ceratonia siliqua*	perennial	starch	6,000-8,000	446 - 893	http://tinyurl.com/j74wfrj
Citrus	*Citrus spp.*	perennial	vit. A & C	15,000-30,000	1785 - 3572	http://tinyurl.com/z3elcl2
Mango	*Mangifera indica*	perennial	vit. A & C	20,000-40,000	4465 - 8035	http://tinyurl.com/z7rljuy
Papaya	*Carica papaya*	perennial	vit. A & C	20,000-30,000	1785 - 2678	http://tinyurl.com/zraf4f2
Tropical Nuts						
Common Name	**Species Name**	**Annual/Perennial**	**Principal Nutrients**	**Yield**	**Water Use**	**Reference**
Cashew	*Anacardium occidentale*	perennial	protein	800-1,500	893 - 2232	http://tinyurl.com/j9ftwc7
Macadamia	*Macadamia spp.*	perennial	protein	2,500-3,000	2678 - 3572	http://tinyurl.com/jdxkgg7

General Report References

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Maui General Plan 2030:
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HAWAIʻI HOUSING PLANNING STUDY, 2019

Prepared for the Hawaiʻi Housing Finance and Development Corporation

EXHIBIT "I-56"

Prepared by SMS Research & Marketing Services, Inc.
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I. INTRODUCTION

A. BACKGROUND

The Hawai‘i Housing Planning Study (HHPS) series began in 1992. The studies have been conducted as comprehensive assessments of housing markets in Hawai‘i. Results covering all four of Hawai‘i’s counties have been presented in a set of reports summarizing market conditions. Since 1997, HHPS has included a housing projection to support housing planning. Over the years, HHPS studies have investigated a rotating list of housing issues. Some issues have remained part of the study, and some have been replaced with topics of greater interest. In 2019, HHPS includes the influence of access to public transportation and mass transit on preferred housing location, special finance options for home buyers, a new viewpoint on homelessness, the relationship between tourism and housing, and housing for special needs groups.

B. PURPOSE

The purpose of the 2019 HHPS report is to provide housing planners with contemporary data on the housing situation in Hawai‘i to support planning activity. Reported here is research conducted from January through August 2019. Included in this study are housing demand, housing supply, housing prices, affordable housing, and needed housing units. Findings are fully supported by analysis of data from both the Housing Demand Survey and numerous secondary data sources, including the United States Census Bureau and Hawai‘i's Department of Business, Economic Development & Tourism, among others. The State report is a summary of data collected from all study methods and across all counties.

C. METHODS

The HHPS 2019 incorporates data from ten data collection and analysis sources:

Housing Inventory: An inventory of all residential housing units in the State was conducted in the first quarter of 2019. The inventory data were taken from real property tax files for each of the four counties. Results are presented in a separate report and have been incorporated in this report as needed.

Housing Demand Survey: A statewide survey of more than 5,000 households was conducted in order to measure resident opinions and evaluations of current housing conditions, their plans to move to a new unit, their preferred characteristics of new units, their financial qualifications for purchase or rent, and household demographic information. Special topics for 2019 included: transportation and rail, transportation and employment, unique financing options, special needs housing, and housing prices.

Housing Projections: In the past, projections were taken from a separate housing model developed in the nineties. In 2019, the projection method was updated to incorporate new and more relevant data. Projected elements included housing units, housing demand, housing production, and housing prices, all to support an estimate of needed units by income group through the year 2025.

Housing Price Study: A study of housing prices (sales prices for ownership units and contract rents for rental units) was conducted. Data were collected from several sources, including rental unit advertisements, a national rent producer, several real estate data providers, the U.S. Department of Housing and Urban Development (HUD), and the American Community Survey (ACS).

Producers Survey: We conducted interviews with housing producers and planning department personnel to enhance understanding of issues related to housing development and to review County data on scheduled housing unit production. Findings were used to develop estimates of short-run housing production.

Housing for Special Needs Groups Study: This study centered on interviews with service providers and advocates for people with special needs. The focus was on the demand and supply of housing units to serve their needs. Statistical data were gathered to connect the needs data with housing planning and production in the next five years.

Homeless Study: Information was drawn from several HHPS components to generate a more comprehensive understanding of homelessness as a housing issue this year. The intention was to bring homelessness studies into the realm of housing planning and production. In 2019, we expanded the homelessness study to include data taken from a specially prepared extract of data from the Hawai‘i Homeless Management Information System.

Tourism Study: A separate study component covered the relationship between the number one industry in Hawai‘i - tourism - and the residential housing market. To our literature search and secondary data gathering, we added specific questions to the Demand Survey and conducted a survey specific to out-of-state property owners.

Native Hawaiians: To enable specific stakeholders to conduct more in-depth analysis, the number of surveys completed with residents self-identifying as Hawaiian or Part-Hawaiian was increased in the Housing Demand Survey and questions were added just for this group.

Secondary Data: The study team gathered existing data and available projections to support each of the study elements discussed here. We also reviewed housing plans and production, government spending on housing, and comparisons with housing data in other states and municipalities.

Although not directly part of HHPS 2019, a Fair Market Rent survey for the County of Kaua‘i was conducted during the study.

Each of these project elements is described in detail in the *HHPS 2019 Technical Report.*

D. REPORT STRUCTURE

The report begins with Section II, a description of current housing conditions in Hawai‘i including demand, supply, and pricing of residential units over time. Section III discusses the projections for demand and supply and presents the most requested output of the study --“Needed Units” -- the number of additional units required to house our people from 2020 through 2025. Section IV covers the current housing issues for the year: transportation, sustainable affordability, military housing, tourism, homelessness, and housing for persons with special needs. Section V discusses public sector housing resources, including recent housing production in the public sector. Section VI provides guidance on developing a data system for tracking housing production and an inventory of affordable housing units.

An appendix presents support materials for significant elements of the report and a glossary of terms.

II. CURRENT HOUSING SITUATION IN HAWAIʻI

The 2019 study of Hawaiʻi's housing market begins with a review of the fundamental data for housing planning -- housing supply, housing demand, and housing prices.

A. HOUSING SUPPLY IN HAWAIʻI

In this section, we consider (1) housing stock, the current collection of housing units available to Hawaiʻi residents and migrants, and (2) housing production levels and the rate at which new housing units are added to the housing stock.

1. Current Housing Stock

According to the Census, there were 532,880 housing units in Hawaiʻi in 2017, up about 2.0 percent from 524,852 units in 2014.

Total Housing Units (Table1) are units that are available for occupancy as residential owned or long-term rental accommodations. The definition excludes group quarters (prisons, dormitories, nursing homes, shelters, etc.) and commercial residential properties (hotels, condominium hotels, hostels, timeshare units, etc.), which are available only on a short-term rental basis.

Total housing units are further defined as either occupied or vacant. By Census convention, the number of occupied housing units is always equal to the number of households in the State. The total housing stock includes all occupied housing units plus vacant housing units available to the market (Table 1).

Residential housing construction fell after the Great Recession began in Hawaiʻi in 2008. Total housing units grew by about 5,600 units per year (2.2%) between 2009 and 2011. Between 2011 and 2014, growth slowed to 2,800 units per year – half what it was in the previous five years. Between 2014 and 2017, growth slowed further to about 2,675 units per year.

Table 1. Housing Unit Types by County, 2017

Housing Unit Types	Honolulu	Hawaiʻi	Maui	Kauaʻi	State
Total Housing Units	346,374	84,750	71,467	30,289	532,880
Occupied Housing Units	311,451	67,054	54,381	22,563	455,449
Vacant Housing Units	34,923	19,956	17,712	7,670	45,373
Vacant and Available	11,214	5,994	6,700	2,488	26,396
Vacant and Unavailable	23,709	13,962	9,242	5,732	52,645
Vacant for agricultural use	61	38	5	32	136
Vacant for seasonal use	14,358	9,708	6,937	4,301	35,304
Other Vacant	9,290	4,216	2,300	1,399	17,205
Housing Stock	322,665	73,048	61,081	25,051	481,845
Pct. available (occupied & vacant)	93.2%	86.2%	85.5%	82.8%	90.4%
Percent unavailable units	6.8%	16.5%	12.9%	18.9%	9.9%
Percent vacant for seasonal units	4.2%	11.5%	9.7%	14.2%	6.6%
Percent other vacant	2.7%	5.0%	3.2%	4.6%	3.2%

Source: ACS 2017 5-yr Estimates, Table B25004 and DP04.

a. Housing Stock Size

Among the 532,880 housing units in Hawai‘i in 2017, 482,803 housing units were available to the resident housing market (Table 2). We refer to this number as the housing stock. Within the housing stock, 455,449 were occupied units and 27,354 were available vacant units.

About 52,645 housing units (9.9%) were not part of the housing stock in 2017. Of those, over 67 percent were vacant for seasonal, recreational, or occasional use. A small number of units (136) were vacant and held off the market for use by migrant agricultural workers.

Units that were vacant for seasonal, recreational, or occasional use (seasonal) are the most significant component of Hawai‘i's unavailable housing units. There were 35,304 of them in 2017, up 6.8 percent from 2014. That was 44.1 percent of vacant housing units and 6.6 percent of all housing units in the State.

There were 17,205 housing units classified as "other vacant." The definition includes housing units that are held off the market while a decision is made regarding their status. Types of decisions include litigation, settling estates, involvement in other legal proceedings, units held while they are being refurbished or rebuilt, or while owners are deciding what to do with their vacant property. In 2017, Hawai‘i's other vacant units made up one-third of vacant and unavailable units and 3.2 percent of total housing units.

Hawai‘i has typically been in the top 15 percent of states losing housing units to vacancies. We ranked 12th for percent of total housing units held for seasonal, recreational, and occasional use in 2017. Only two states ranked higher than the counties of Hawai‘i, Kaua‘i, and Maui with respect to the percent of total units held off the market for seasonal use.

Across the State, there were differences in the percent of total housing units counted as housing stock. In Honolulu, 6.8 percent of all units were unavailable. In the other counties, that figure was significantly higher as in 19 percent for Kaua‘i County, 16 percent in the County of Hawai‘i, and 13 percent for Maui County.

b. Trends in Housing Stock, 2011-2017

A brief overview of housing trends from 2014 and 2017 Census data will highlight changes to the housing stock in recent years (Table 2).

Table 2. State of Hawai‘i, Changes in Housing Stock, 2014-2017

	2014		2017		Change 2014-2017	
	Number	Percent	Number	Percent	Number	Percent
Total Housing Units	**524,852**	100.0%	**532,880**	100.0%	**8,028**	1.5%
Single Family	282,060	53.7%	286,873	53.8%	4,813	1.7%
Multi-Family	242,792	46.3%	246,007	46.2%	3,215	1.3%
Total Available Housing Stock	**477,520**	91.0%	**482,803**	90.6%	**5,283**	1.1%
Total Occupied Housing Units	**450,299**	85.8%	**455,449**	85.5%	**5,150**	1.1%
Owner Occupied Units	257,121	49.0%	264,622	49.7%	7,501	2.9%
Renter Occupied Units	193,178	36.8%	190,827	35.8%	-2,351	-1.2%
Total Vacant Units	**74,553**	14.2%	**79,999**	15.0%	**5,446**	7.3%
Vacant Available	27,221	5.2%	27,354	5.1%	133	0.5%
For Rent	18,704	3.6%	20,026	3.8%	1,322	7.1%
Rented, not occupied	2,418	0.5%	2,134	0.4%	-284	-11.7%
For Sale only	4,085	0.8%	3,193	0.6%	-892	-21.8%
Sold, not occupied	2,014	0.4%	2,001	0.4%	-13	-0.6%
Vacant Unavailable	47,332	9.0%	52,645	9.9%	5,313	11.2%
Seasonal Use	33,054	6.3%	35,304	6.6%	2,250	6.8%
For Migrant Workers / Ag. Use	93	0.0%	136	0.0%	43	46.2%
Other Vacant	14,185	2.7%	17,205	3.2%	3,020	21.3%

Source: ACS 2014 and 2017 5-yr. Estimates, Tables B25004, S2504, and S1101.

The total housing unit growth rate is slowing. Between 2003 and 2007, Hawai'i added 31,639 housing units to its total. Between 2007 and 2011, 14,895 were added. Between 2011 and 2014, 7,468 units were added to total housing units and 8,028 units were added between 2014 and 2017.[1]

In recent years, Hawai'i has been building more units that aren't being used for Hawai'i families. In Table 2 we see that total housing units grew by 1.5 percent between 2014 and 2017. Housing stock, on the other hand, grew by only 1.1 percent. Vacant and unavailable housing units grew by 11.2 percent.

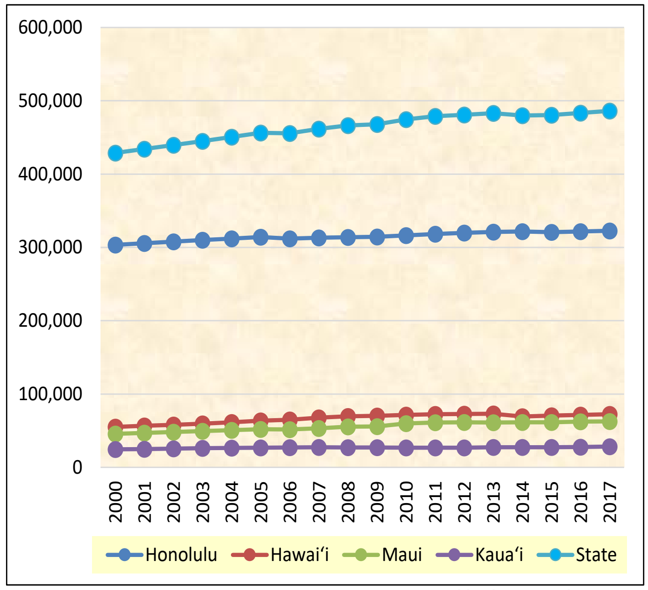
Within the housing stock, the number of occupied housing units grew by 1.1 percent, the same rate as housing stock. But the number of vacant units went up by 7.3 percent, due almost entirely to increasing numbers of rental vacancies.

Still, the major concern is over vacant unavailable units. The increase in seasonal units was 6.8 percent between 2014 and 2017, down somewhat over the earlier part of the decade but still rising faster than the usable housing stock. The growth in "other vacant" units was 21.3 percent in the last four years as more of our usable stock is remaining unoccupied when families vacate.

The County of Hawai'i had the largest average annual increase, adding 1.7 percent to its housing stock each year. The City and County of Honolulu had the smallest average annual increase at 0.3 percent per year. The counties of Maui and Kaua'i added 2.1 and 0.8 percent to their total housing stock each year.

Overall, the number of vacant and available units changed little. There were 27,221 vacant units in 2014 and 27,354 vacant units in 2017. The overall numbers hide a large increase in rental vacancies and a significant decrease in vacant-for-sale units. The market gets tighter as we build in more unavailable units.

Figure 1. Housing Stock by County, 2000–2017



Source: SMS calculations from *State of Hawai'i Time Series Data Book* and ACS Tables in Series B25000.

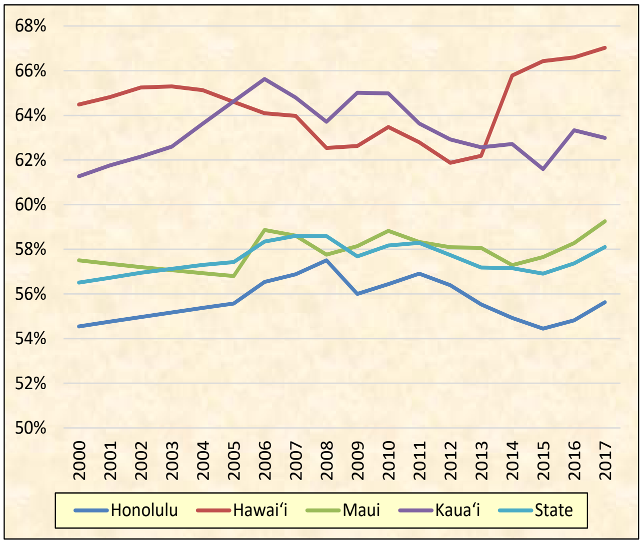
c. Homeownership

Homeownership rates fell across the nation as a result of the Great Recession and Hawai'i was no exception. Some experts feel the low homeownership rate is a sign that the housing market recovery is not yet complete. High prices, low inventories, and a lack of confidence in the market slowed sales, especially in high-priced markets like Hawai'i. More important, the impact of the slow recovery falls heaviest on first-time buyers. It is their entry to the market that boosts the homeownership rate.

Between 1990 and 2010, while the housing stock was growing, homeownership rates also grew. Homeownership rose during the market run-up in the early nineties and fell during the late nineties.

[1] DBEDT Data Book 2014, Table 21.20, Housing Units by County: 2000 to 2014.

Figure 2. Homeownership Rates, 2000-2017



Source: U.S. Census 2000; 2001-2006 calculated; ACS 2007-2008 3-year estimates; ACS 2009-2017 5-year estimates. An atypical one-year drop in 2007 has been smoothed here.

Homeownership rose again during the last housing market boom to a high of 60 percent in 2006. Homeownership in Hawai'i then fell steadily to its low of 56.9 percent in 2015. Since then, however, homeownership for the state and its counties appears to be trending upward. Figure 2 shows state and county homeownership rates as they drifted downward from the peak of the bubble through 2015, then began to climb between 2015 and 2017. The 2017 statewide homeownership rate was 58.1 percent.

d. Shelter Cost & Shelter-to-Income Ratios

High-priced housing markets like Hawai'i's often have high ratios of shelter cost to household income. Households with shelter-to-income (STI) ratios greater than 30 percent are said to be cost-burdened, and those with ratios higher than 50 percent are said to be severely cost-burdened.

In 2011, about 51 percent of Hawai'i residents were paying less than 30 percent of their monthly income for shelter.

In 2016, the proportion of Hawai'i households paying less than 30 percent of household income for shelter (rent or mortgage plus utilities) was up to 58.2 percent.[2] Roughly eleven percent of households (11.3%) devoted 30 to 39 percent of their income to shelter payments, leaving the remaining one-quarter of households spending 40 percent or more of their income on housing.

In 2019, 17.3 percent of households had no shelter payment and 43.2 percent had a shelter-to-income ratio of less than 30 percent. The rest were spending more than 30 percent of their income on shelter and were, therefore, shelter burdened. One in ten households statewide devotes 30 to 40 percent of their income to shelter costs. For nearly one-quarter of households statewide (23.1%), shelter payments take up more than 40 percent of their income each month.

Table 3. Shelter-to-Income Ratio by County, 2019

	Monthly Shelter Payment as a Percent of Monthly Household Income				
	No Shelter Payment	Under 30 percent	30 to 40 percent	Over 40 percent	Not enough information
Honolulu	17.0%	44.1%	9.7%	23.1%	6.1%
Maui	14.5%	43.3%	10.5%	23.8%	7.8%
Hawai`i	21.1%	41.0%	8.8%	21.8%	7.3%
Kaua`i	17.2%	38.3%	10.5%	24.5%	9.4%
State	17.3%	43.2%	9.7%	23.1%	6.7%

Source: Housing Demand Survey, 2019. Base is owners and renters in Hawai'i.

The shelter-to-income data show different levels of housing affordability across counties (Table 3). The City & County of Honolulu and Maui County had the largest percentage of households with STI ratios of less than 30 percent (44.1% and 43.3%, respectively). That was an approximately 20 percent increase over 2016 for these two counties. Kaua'i County had the largest percentage of households paying more than 40 percent of their income for shelter (24.5%), followed by Hawai'i County with 21.8 percent.

The percent of households with an STI ratio of more than 30 percent is often used as an indication of housing affordability. There is evidence that Hawai'i's STI ratios are higher than most of the nation. In 2019, the percentage of mortgage holders whose monthly housing cost was greater than 30 percent of monthly income was 40.3 percent, the highest in the nation.[3] The percentage of renters paying more than 30 percent was 55.6 percent, ranking Hawai'i third in

2 HHPS 2016.

3 ACS, Table DP04 2017 5-year estimates.

the nation after Florida (59.0%) and California (57.2%).

STI ratios usually rise slowly over time and have changed very little in Hawai'i in recent years.[4] STI ratios for rented households are higher than are those for homeowners and rise a bit faster over time. The depressed housing market of the nineties held prices and rents in check while the burgeoning economy raised household incomes. Housing prices soared between 2003 and 2006 and pushed the number of renter households paying more than 30 percent of their income for shelter to 48 percent in 2006, climbing to 60 percent in 2011 and 2016. The current STI ratio for renters has improved somewhat, with just over half of all renter households spending more than 30 percent of their income on housing.[5]

e. Crowding and Doubling-up

Crowding and doubling-up are frequently used measures of housing condition. Both are accepted as indicators of housing issues. They are thought of as measures of pent-up demand for housing and as a sign that household formation may be constricted.

We sometimes hear that Hawai'i's doubling-up rate is the result of our propensity for extended family living. Our relatively large household size supports that idea. However, survey questions measured doubling up for financial reasons only and show substantial doubling rates.

In past studies, crowding was measured using the Census method (the ratio of persons in the household to rooms in the unit they occupy). In 2016, we switched to the persons per bedroom definition, which we believe is the more appropriate measure for housing planning.[6]

Table 4. Crowding, State and Counties of Hawai'i, HHPS 1992 through 2019

County	Year	Total Households	Crowding Indicators: Crowded[a]	Doubled Up[b]	Crowded and/or Doubled Up[c]
Honolulu	1992	247,349	23.2%	N/A	32.0%
	1997	272,234	10.6%	N/A	27.2%
	2003	292,003	10.1%	10.0%	17.6%
	2006	303,149	8.1%	9.7%	15.2%
	2011	310,882	13.3%	13.8%	22.9%
	2016	317,459	11.4%	11.9%	21.0%
	2019	311,451	14.1%	13.3%	23.1%
Maui	1992	34,266	26.8%	N/A	25.9%
	1997	39,252	10.4%	N/A	24.8%
	2003	43,687	11.0%	8.7%	17.3%
	2006	49,484	7.7%	9.6%	15.3%
	2011	54,132	10.7%	13.0%	19.2%
	2016	55,059	9.8%	14.1%	21.4%
	2019	54,434	13.8%	14.1%	22.5%
Hawai`i	1992	39,789	18.7%	N/A	26.0%
	1997	46,271	7.9%	N/A	24.3%
	2003	54,644	7.0%	9.3%	14.4%
	2006	61,213	6.9%	11.2%	15.9%
	2011	67,096	8.4%	11.3%	17.2%
	2016	66,989	7.4%	11.1%	16.0%
	2019	67,054	11.5%	10.3%	18.0%
Kaua`i	1992	16,981	17.4%	N/A	26.3%
	1997	18,817	9.1%	N/A	25.4%
	2003	20,460	6.0%	12.5%	16.1%
	2006	21,971	6.6%	11.9%	15.5%
	2011	23,201	10.5%	11.7%	18.1%
	2016	23,369	8.9%	11.5%	19.2%
	2019	22,563	12.2%	14.5%	21.4%
State	1992	338,385	22.2%	N/A	30.3%
	1997	376,574	10.2%	N/A	26.5%
	2003	410,794	9.6%	10.0%	17.1%
	2006	435,818	7.8%	10.0%	15.3%
	2011	455,311	12.1%	13.2%	21.4%
	2016	462,876	10.5%	12.0%	20.2%
	2019	455,502	13.6%	13.0%	22.2%

Source: Housing Demand Survey, 1992 through 2019.
a. Based on more than one person per room for 1992-2011, then 2 persons per bedroom for 2016 and 2019.
b. More than one family per housing unit (See Glossary).
c. 1990-2003, asked if HH was crowded or doubled up. Later asked crowded/doubled up separately and combined them.

4 See Table A-10 and A-11 in the Appendix for trend data.
5 ACS, Table B25070, 2006-2017.
6 Crowding based on persons per bedroom is consistently only 4-8% higher than crowding levels based on persons per room.

Doubling-up includes having more than two generations in the household, having unrelated individuals in the household, or having same-generation relatives in the household. In all cases, the Housing Demand Survey shows that doubled-up persons are in the household because they cannot afford to live elsewhere.

Table 4 shows HHPS crowding and doubling-up data for the State and each of the counties. The 1992 study followed a major price run-up during which high prices kept many would-be buyers from entering the market. The study conducted in 1997 was nearing the end of a very long market recovery during which incomes were catching up with prices and crowding was notably lower than in 1992. The 2003 measure was taken at the beginning of the next price run-up.

By 2006, Hawai‘i was at the peak of the largest price run-up in its history. During that period, housing production increased and crowding and doubling remained low. In 2008, the Great Recession began in the housing market and the effects were dramatic. Crowding began to increase. In 2011, crowding seemed to have peaked. After a slight decline in 2016, levels of crowding appear to be on the rise again, with a 3.1 percent increase from 2016 to 2019.

Crowding and doubling-up behave differently in each of the counties. In general, the rates are more volatile in the City and County of Honolulu. Maui and Kaua‘i have similar profiles and are typically less crowded than O‘ahu. Hawai‘i County has been the least crowded and least volatile market. The pattern of change in crowding and doubling-up is nearly the same as for other counties, but the rate of change is lower.

Hawai‘i's crowding rate has long been among the highest in the nation. In 2017, Hawai‘i was ranked first in crowding for owner-occupied units (6.3%) and second for renter-occupied conditions (12.8%).[7]

f. Age and Condition of Units

Compared to other U.S. housing markets, Hawai‘i's housing stock is newer, nicer, and smaller. Except at the level of individual neighborhoods, these issues have not been big problems in our State.

Statewide, the median year built for residential units was 1978, which is slightly younger than the national median (1977). Among the Counties, Honolulu's homes are the oldest with a median build year of 1975, followed by Maui and Kaua‘i Counties (1984) and Hawai‘i County (1987).

According to the U.S. Census Bureau, very few of Hawai‘i's housing units are in poor or substandard condition (lacking complete plumbing or kitchen facilities). The 2017 5-year estimate from ACS, says that less than one percent of occupied housing units Statewide had incomplete plumbing facilities (0.6%), and 1.6 percent had incomplete kitchen facilities. Across the counties, the rate of incomplete plumbing facilities ranged from a high of 1.5 percent in Hawai‘i County to a low of 0.4 percent in Honolulu County. The counties' rates of incomplete kitchen facilities ranged from a high of 2.3 percent in Hawai‘i County and a low of 1.1 percent in Kaua‘i County.

Our housing units are smaller than those in other American housing markets. For the State, the median number of rooms per occupied housing unit was 4.6. Nationally, the average housing unit had 5.8 rooms in 2014. At the level of municipalities, Honolulu, Hilo, Wailuku, and Līhu‘e average room counts were lower than all but a handful of other major housing markets in the country (e.g., New York, 4.2; San Francisco, 4.4; Boston, 4.5).

2. Housing Production

Hawai‘i's total housing units count was 520,088 units in 2010 and 546,213 units in 2018[8]. During those years, we produced 26,125 units, an average of 2,902 units per year, for an average annual growth rate of about 0.6 percent. This was a bit lower than the national average annual growth rate of 1.3 percent for those years (0.9%).

7 ACS 2017 5-yr. est., Table B25014, tenure by occupants per room.

8 DBEDT Data Book Time Series, Table 21.20.

a. Housing Stock Growth, 1990-2017

Housing stock, adjusted for vacant and unavailable units, had a slightly different pattern (Table 5). The State's growth rate was the same as the average of all 50 states (4.5%).

Table 5. Housing Stock Growth 2010 - 2017

	Housing Units 2010	Housing Units 2017	Housing Units Added	Percent Change
State	461,437	482,864	21,427	4.6%
Hawai'i	65,872	72,384	6,512	9.9%
Honolulu	315,489	322,665	7,176	2.3%
Kaua'i	23,839	24,901	1,062	4.5%
Maui	57,470	62,912	5,442	9.5%

Source: SMS based these on ACS Tables B25001 – B25004.

When the population increases and household formation proceeds normally, additional housing units are needed to shelter the resulting new households.

Housing production can be measured by counting completion certificates, or by subtracting this year's stock from last year's stock.

As in all the previous HHPS reports, we find again that the housing supply continues to lag behind demand in Hawai'i. We will revisit this subject in the projections section of this report and in the closing remarks.

In the interim, we ought to note that the growth is not homogeneous across different types of housing stock. Production is slower at the lower end of the housing market. As found elsewhere in the nation, housing prices rise faster for the lower-income quintiles than for the upper ones.[9] In addition, production lags demand in the rental housing segment and produces higher numbers of single-family units.

b. Impediments to Production

In this section, we discuss some major barriers to housing supply in Hawai'i. They all affect the State and its four counties in like manner, and a significant amount of research has been reported in peer-reviewed journals to estimate the statistically significant correlation between the barrier and supply inelasticity and/or high housing prices. There is, however, no research that defines the net contribution of individual impediments to a change in housing production. Nor is there research that identifies the mechanism by which those elements affect housing prices or housing supply inelasticity. Finally, no definitive research has been conducted in Hawai'i concerning these production barriers. To address these issues effectively would require research that is outside the scope of this study.

Hawai'i's housing market is supply inelastic[10]. A change in demand does not lead to a change in supply in a timely or efficient manner. That leads to low production and high prices. Previous versions of the HHPS and other studies have identified major impediments to the development of housing in Hawai'i, including the lack of "reasonably priced," developable land, lack of major off-site infrastructure, high development costs, government regulations; community opposition; and growing environmental requirements.[11] We briefly recap the primary sources of the supply problem below.

Geographic Limitation: Hawai'i lacks sufficient land near its major population centers. If we subtract open water or wetlands and all areas with slopes in excess of five percent (Rose, 1989), the remaining land might be called suitable for development. As an island state, comprised of mountains rising from the ocean floor, Hawai'i percentage land suitable for development is the lowest among the 50 states (Saiz, 2010). Furthermore, our geography becomes more constrained over time. As more area is developed, fewer acres of undeveloped land

9 Popov, Igor. 2019. Housing markets and income inequality, *Rent Economics*, April 24, 2019.

10 A market situation in which any increase or decrease in the price of a good or service does not result in a corresponding increase or decrease in its supply.

11 State of Hawai'i, HHFDC, Consolidated Plan for Program Years 2015 through 2019, May 15, 2015.

remain. The value of undeveloped land increases and the political power of owners of developed land grows. Supply is attenuated, which causes prices to rise[12] and geographic constraints reduce housing supply by limiting housing investment[13].

The purely geographic limitation may not be the most critical element in limiting housing supply, but it is the most resistant to political attempts to mitigate its impact. Short of sweeping technological advancement in construction techniques, the geographic impediment will remain constant.

Lack of Major Off-Site Infrastructure: Lack of off-site infrastructure to support new housing development is the issue of concern here[14]. It has appeared in public policy documents[15] and was mentioned by developers, affordable housing advocates, and government housing officials in our stakeholder interviews this year.

Public infrastructure like roads, sewers, water, drainage, and schools has historically been developed by local government. In Hawai'i, as the cost of infrastructure increased and development requirements grew[16], the responsibility for off-site infrastructure was passed to developers. Housing developers and those who support affordable housing production agree that this increases the cost of housing. Some stakeholders noted that it places the burden of developing on the first developer in line and spares any who follow and make use of the new infrastructure.

Government policymakers respond that the costs are passed to the owners and renters of the new development, who are the primary beneficiaries of the housing units developed. The alternative – the county provides the infrastructure -- is equivalent to asking all taxpayers to fund the new development.

By 2006, a Joint Legislative Housing and Homeless Task Force encouraged creative, innovative, and cost-effective ways such as tax increment financing or the establishment of improvement districts to finance the construction of offsite infrastructure, as well as appropriating capital improvement project funds.[17] Similar provisions have been incorporated in the most recent update of the Hawai'i State Functional Housing Plan[18].

Construction Costs: There are substantial differences in construction costs across the U.S. and Hawai'i's construction costs are high.

Rose and La Croix (1989), however, showed that the difference in construction costs was not nearly enough to explain the difference in housing costs across markets. Gyourko and Saiz (2006) also reported construction costs were not significantly related to prices. The more significant contributors to building costs were unionization, local wages, local topography, and the regulatory environment. Combined with Hawai'i's highly volatile housing market, however, construction costs can affect individual projects. Construction costs can rise sharply in construction boom periods and make tight-margin projects like workforce housing units challenging to complete.[19]

The cost of construction has been impacted by the high cost of litigation and insurance. The Affordable Housing Advisory Committee notes that "everyone involved from accountant to mason contractors have insurance costs that go into the price of their goods and services. They include property, general liability, professional liability, excess liability, unemployment, health, auto,

[12] Hilbert and Robert-Nicoud identified a highly significant independent variable in their analyses of housing prices was the ratio of acres of developed land to acres of developable land.

[13] Paciorek, Andrew D. 2013. Supply constraints and housing market dynamics. *Journal of Urban Economics*, Vol. *77*, p. 11-26.

[14] As distinguished from the issue of inadequate or antiquated infrastructure in developed areas.

[15] Mayor's Advisory Housing Advisory Committee, City and County of Honolulu, Final Report & Recommendations, April 2006.

[16] Adding requirements for water prospecting, bike paths, jogging paths, etc.

[17] Joint Legislative Housing and Homeless Task Force, prepared by staff of the Senate Majority Office, with contributions from the House Majority Staff Office, "Report of the Joint Legislative Housing and Homeless Task Force Pursuant to Act 196, Session Laws of Hawai'i 2005," January 2006.

[18] Hawai'i Housing Finance and Development Corporation. 2017. The Hawai'i State Plan: Housing, State of Hawai'i, February 21, 2017, p. 19.

[19] Massive 'Aiea workforce housing condo project on hold. (2016), Hawai'i News Now, June 2016. Download at http://www.k5thehomteam.com/story/32389776/massive-aiea-workforce-housing-condo-project-on-hold.

workers comp, business interruption, and even terrorism, to name a few."[20]

Government Regulations: The purpose of housing planning and regulation is to bring order to the development of cities and towns, protect people against arbitrary development practices, and, more recently, to protect the character of neighborhoods as they exist. Evidence suggests these are still the objectives of planners and regulators. But, as the proliferation of housing regulations continues, some observers have come to see housing regulations as a barrier to production, a cause of housing supply inelasticity, and a pathway to higher housing costs.

Hawai'i's housing markets are more regulated than most others in the nation. Honolulu's score on the Wharton Residential Land Use Regulatory Index (Wharton Index[21]) is the highest in the country (See Appendix Exhibit C-1), and David Callies (2010) has painstakingly described the individual housing regulations in the Aloha State.

Government regulations and review processes are frequently identified as major impediments to housing production, and the 2019 stakeholder survey shows many people still see regulations as a significant obstacle to housing production.

A statewide Affordable Housing Regulatory Barriers Task Force was convened in 2007 to address regulatory barriers to affordable housing. The task force noted that *"in the context of building homes that are affordable, government regulations often work against the goal of delivering more affordable housing. Although government policies and regulations are often intended to control or direct growth, target resources, and prioritize areas of importance, the unintended consequence is often that these regulations add to the cost of building affordable homes.*[22] They identified 14 regulatory barriers, including the land use entitlement process, inconsistent state and county reviews, impact fees or exactions, fiscal policy, and administrative processes.

Some observers feel there are deficiencies and system-wide weaknesses in the way land use is managed. In 2014, the State Office of Planning (OP), initiated a review of the State Land Use District Boundary Amendment process. OP's effort was summed up in the State Land Use System Review Draft Report, which explored ways to increase the effectiveness of the land use system without compromising the original intent of the Land Use Law."[23] The process involved wide-ranging debate and ended with an agreement to consider the issue further.

Many stakeholders interviewed for this project commented on review processes rather than on regulations themselves. Reviews are required at several steps along the way to project approval. In 2018, it took eight pages to describe the process for using 201H-38 for workforce housing projects in Maui County.[24] Across the State and Counties, respondents told us that reviews were duplicative, requiring the same basic reporting to more than one agency. Some felt certain review procedures were carried out with less attention and diligence than expected. This sentiment was particularly true for SHPDA and DCAB reviews.[25] Some procedures require refiling if the initial submission is not approved. In the worst cases, a developer can go through the entire set of review processes, pass all requirements, and then be summarily disapproved at a County Council meeting attended by the public. All review procedures were said to be lengthy, and we lost count of the number of times we were reminded that "time is money."

Impact of Housing Regulation

It is widely accepted in 2018 that stringent regulation of housing production will result in high housing prices, decreasing elasticity of supply, and low supply, especially in high-priced, volatile

[20] Mayor's Housing Advisory Committee, City & County of Honolulu, Final Report & Recommendations, April 2006.

[21] Gyourko, Saiz, and Summers, 2007. Index scores were not calculated for other counties in Hawai'i.

[22] State of Hawai'i , Office of Governor Linda Lingle, "Report of the Governor's Affordable Housing Regulatory Barriers Task Force," December 2008.

[23] Office of Planning, State land use system review, http://planning.hawaii.gov/state-land-use-system-review, paragraph 1.

[24] See the process schematic in Appendix, Figure C-1.

[25] Housing Action Plan, p. 60.

markets[26]. However, the adverse effects of stringent regulations and onerous review processes on affordable housing development extend beyond supply shortages and high prices.

Some have said that regulations lead to an inefficient housing market. Markets are expected to sort supply and demand such that specific household needs are matched with appropriate unit characteristics. In highly regulated situations like Hawai'i's, the market seems unable to cope with that task. Some lower-income households were placed in units beyond their means and some higher-income families are placed in units that would better serve poorer households.

Another effect of regulation comes to us from Somerville and Mayer (2001, 2003). They found that stringent regulation causes the filtering[27] process to be reversed. In markets with heavy regulation and low supply elasticity, affordable units tend to filter up and become unaffordable[28]. Thus, regulation reduces the affordable housing stock, making regulation counterproductive.

Some researchers find that highly regulated housing markets hinder the movement of labor from one market to another, a process that decreases local GDP[29].

In 2018, the study of negative impacts of regulation on housing production reached a high point, with the publication of Kevin Erdmann's book, *Shut Out*. Erdmann provides strong evidence that the housing bubble of 2002–2007 and the resulting worldwide recession of 2008-2009 were caused by a housing supply shortage stemming from over-regulation in America's key housing markets.

B. HOUSING DEMAND IN HAWAI'I

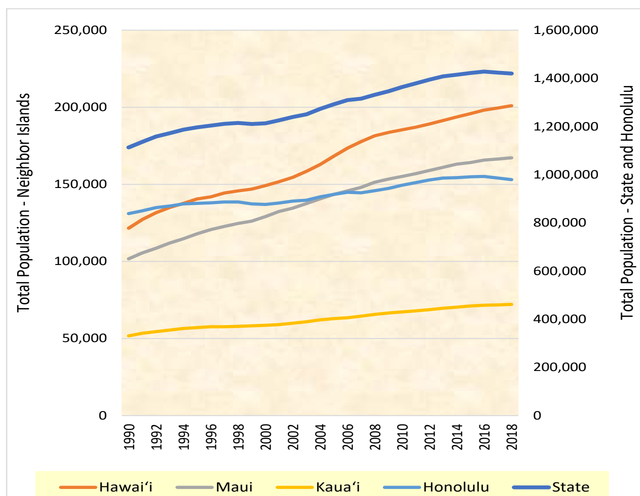
1. Historic Demand

a. Population and Growth Rates

Any discussion of housing demand must begin from population growth. It has been central to this study since 1992. In 2019, population change may be the most important topic we cover here.

Table 6 shows the annual population by County since 1990. In the nineties, Hawai'i's annual population growth rate (1.9%) was lower than in the previous decade. Between 2000 and 2010, population growth dropped to 1.2 percent per year. From 2010 to 2018, the rate fell to 0.5 percent annually. That rapid decline culminated when, in 2017 and 2018, the State's population went down by -0.3 percent each year.

Figure 3. Total Population, State and Counties of Hawai'i, 1990-2018



Source. DBEDT Data Book Time Series, 1990-2018.

26 The literature search conducted for the HHPS 2016 captured the first 15 years of the research. Glaeser and Gyourko (2018, pp. 14-16) summarizes the technical research since 2015. Gyourko and Molloy (2017) is the most recent and most comprehensive review of the work on regulation.

27 Bradford, Chris. 2008. "When property values rise, low-quality housing "filters up" to the high-quality housing sub-market. The reason is that rising rents encourage landlords to invest more in the property. When property values fall, high-quality housing "filters down" to the low-quality housing sub-market. The reason is that falling rents encourage landlords to invest less in property. The key in either case is that old housing costs more to maintain than new housing." We have several more citations on this. Filtering is a simple idea that ends up being very complicated. One of the issues that adds to that complexity is that regulations change the relationship. See Also, Rosenthal 2018, Hertz 2015.

28 Specifically, "regulation increases the probability that a rental unit currently deemed affordable will become unaffordable, owner-occupied, or demolished, relative to staying affordable", p. 53.

29 Hsieh and Moretti, 2017) calculated that GDP would be 9 percent higher if there were higher production of new housing units in Type 2 housing markets.

Table 6. Total Population, 1990-2018

	County				
	Honolulu	Hawai'i	Maui	Kaua'i	State
1990	838,534	121,572	101,709	51,676	1,113,491
1991	850,510	127,266	105,599	53,379	1,136,754
1992	863,959	131,630	108,585	54,439	1,158,613
1993	870,348	135,085	111,944	55,461	1,172,838
1994	878,591	137,713	114,754	56,478	1,187,536
1995	881,399	140,492	117,895	57,068	1,196,854
1996	883,443	141,935	120,689	57,688	1,203,755
1997	886,711	144,445	122,772	57,712	1,211,640
1998	886,909	145,833	124,648	57,843	1,215,233
1999	878,906	146,970	126,160	58,264	1,210,300
2000	876,629	149,244	129,078	58,568	1,213,519
2001	882,755	151,690	132,428	59,075	1,225,948
2002	890,473	154,576	134,583	59,981	1,239,613
2003	894,311	158,442	137,596	60,805	1,251,154
2004	907,997	162,852	140,625	62,095	1,273,569
2005	918,181	168,237	143,448	62,863	1,292,729
2006	926,954	173,536	145,776	63,465	1,309,731
2007	925,335	177,733	148,117	64,490	1,315,675
2008	933,680	181,506	151,424	65,603	1,332,213
2009	943,177	183,629	153,393	66,518	1,346,717
2010	956,296	185,358	155,096	67,213	1,363,963
2011	967,287	187,066	157,001	67,898	1,379,252
2012	978,073	189,164	158,977	68,691	1,394,905
2013	986,222	191,466	161,105	69,660	1,408,453
2014	987,649	193,736	163,153	70,324	1,414,862
2015	991,339	195,941	164,130	71,074	1,422,484
2016	992,692	198,126	165,712	71,575	1,428,105
2017	986,429	199,503	166,491	71,780	1,424,203
2018	980,080	200,983	167,295	72,133	1,420,491
AAPC 1990-2000	0.5%	2.3%	2.7%	1.3%	0.9%
AAPC 2000-2010	0.9%	2.4%	2.0%	1.5%	1.2%
AAPC 2010-2018	0.3%	1.1%	1.0%	0.9%	0.5%
AAPC 2016-2018	-0.6%	0.7%	0.5%	0.4%	-0.3%

Source: DBEDT Data Book, Table 1.06. Note: AAPC is Average Annual Percent Change.

Overall, the State's population decline since 2016 has been due primarily to losses in the City and County of Honolulu. While the population change has taken different paths for each county over the past 40 years, <u>all three of the other Counties experienced a significant decline in population growth rate since 2016.</u>

The situation has prompted a revision of Hawai'i's housing demand projections. It has also affected several sections of this report, most importantly, our estimates of needed units for the next five years.

b. Components of Population Growth

Hawai'i's population grew slower in the last decade than it did in the nineties. The State added an average of about 10,000 persons per year in the nineties, 15,000 per year in the previous decade, and about 7,500 per year since 2010 (Table 6).

Table 7 shows that, in the nineties, out-migration exceeded in-migration and reduced the population by almost 10,000 persons. In the next decade, in-migration was higher than out-migration causing population growth of 55,646 persons for the decade. So far this decade, the excess of out-migrants has reduced the population by 549 persons.

Table 7. Components of Population Change, Hawai'i, 1990-2018

	Net Change	Natural Increase	Net Migration
1990 to 2000			
Honolulu	39,925	86,733	-46,808
Hawai'i	28,360	10,477	17,883
Maui	27,737	11,301	16,436
Kaua'i	7,286	4,601	2,685
State	103,308	113,112	-9,804
2000 to 2010			
Honolulu	77,051	68,958	8,093
Hawai'i	36,402	9,914	26,488
Maui	26,683	10,729	15,954
Kaua'i	8,628	3,517	5,111
State	148,764	93,118	55,646
2010 to 2018			
Honolulu	26,874	46,553	-19,098
Hawai'i	15,907	5,993	9,992
Maui	12,365	6,604	5,840
Kaua'i	5,038	2,379	2,717
State	60,184	61,529	-549

Source: DBEDT Data Book, 2009-Table 1.59, 2010-Table 1.56, and Census, Estimates of the Components of Resident Population Change, 2010 to 2018.

The degree of natural increase in population change has diminished steadily over the last three decades. The excess of births over deaths contributed to 113,112 new residents in the nineties, 93,118 new people in the last decade, and 61,529 in the first eight years of the present decade.

The stronger impact of net migration in recent years was felt across all four counties but had the greatest impact on O'ahu. Honolulu lost almost

47,000 people to net out-migration in the nineties. Between 2000 and 2010, Honolulu's net migration accounted for 11 percent of total population growth. So far in this decade, Honolulu has lost more than 19,000 people due to a significant increase in domestic out-migration.

In just two years, 2017 and 2018, Honolulu lost more than 13,000 people due to domestic out-migration, far exceeding the number of people migrating to Honolulu. That resulted in a net loss of more than 13,000 Oʻahu residents. Although there were substantial gains in natural increase for all four counties, that was not enough to offset Honolulu's notable loss in net migration.

c. Households and Household Size

Assuming a constant household size, the number of households should increase at the same rate as the population. Slower household formation can be caused by social change, economic recession, or a shortage of new housing units. If new households can't move out, there will be an increase in household size (crowding), suggesting pent up demand. Table 8 shows the number of households for the State and counties since 1990.

Table 8. Number of Households, 1990-2017

	County				
	Honolulu	Hawaiʻi	Maui	Kauaʻi	State
1990	265,304	41,461	33,145	16,253	356,163
1995	275,877	49,282	38,326	18,967	382,452
2000	286,450	52,985	43,507	20,370	403,312
2005	300,557	60,396	48,393	21,997	431,343
2010	309,154	62,584	51,893	22,147	445,778
2015	307,703	64,201	52,080	21,862	445,846
2017	312,625	68,857	53,560	22,980	458,022

Source: Decennial Census 1990, 2000; ACS 1-year estimates 2005, 2010, 2015, 2017.

In Table 9, we see all three population growth factors related to housing demand: total population, households, and household size. Ideally, if there were a five percent change in the population, we would expect a five percent change in households and a zero percent change in average household size. If supply were running ahead of demand, we would get a five percent (or perhaps even greater) increase in households as pent-up demand is relieved. That would result in a zero or even a negative change in average household size.

If demand runs ahead of supply, then a five percent growth in population will produce less than five percent growth in households and larger average household size. This is a primary indicator of pent-up demand.

Table 9. Population Increase: Counties, 2007-2017

		% Change 2007 to 2017		
		Total Population	Number of HH	Average HH Size
County	Honolulu	6.8%	3.8%	2.8%
	Hawaiʻi	12.7%	10.9%	7.9%
	Maui	12.3%	10.2%	4.7%
	Kauaʻi	11.9%	5.7%	10.7%
State		8.5%	5.6%	6.4%

Source: Calculated from Table 6 and Table 8.

At the State level, the total number of households grew by 5.6 percent between 2007 and 2017 (Table 9) – slower than the population (8.5%) and indicating a constrained household formation rate. The average household size grew by more than 6 percent, indicating a corresponding increase in persons per household. This is evidence of pent-up demand.

Data for three counties were consistent with a housing market where demand exceeds supply.

Hawaiʻi's rise in pent-up demand was not unique in the United States. National data show more pent-up demand from 2010 to 2018. Observers[30] note that lower housing sales were related to decreasing supply as well as a reticence among young people to enter the real estate market. That caused pent-up demand in housing markets across the country.

The State's population growth was relatively slow during the nineties. The average household size

[30] Rappaport, Jordan. 23018. Pent-up demand and continuing price increases: The outlook for housing in 2018, *The Macro Bulletin*, Federal Reserve Bank of Kansas City, January 10, 2018.

(Table 10) fell off a bit by 2005 and even more by 2006. It then resumed faster growth but did not quite reach the level seen in the years before 2000. In 2017, the average household size for the State was 3.02 persons.

Census numbers reported for 2017 were equal to 2015 for Honolulu and the State. Average household size was slightly lower for the County of Hawai'i and slightly higher for Maui and Kaua'i Counties.

Table 10. Average Household Size, 1990-2017

	County				State
	Honolulu	Hawai'i	Maui	Kaua'i	
1990	3.02	2.86	2.99	3.09	3.01
2000	2.95	2.75	2.91	2.87	2.92
2005	2.91	2.77	2.86	2.85	2.88
2010	2.96	2.73	2.89	2.98	2.92
2015	3.06	2.90	2.96	3.07	3.02
2017	3.06	2.88	2.97	3.12	3.02

Sources: U.S. Decennial Census, 1990, 2000, 2010, ACS 2005 (1-yr. Estimate), 2010, 2015, 2017 (5-yr. Estimate).

d. Building Permits

The number of building permits awarded in a single year is often referenced as an indicator of the demand for new housing units. Since builders are unlikely to build new units they cannot sell, the number and nature of building permits is certainly related to the demand for housing units. Similarly, the number of building permits is related to housing supply in that new units cannot be constructed if permits are not approved. For both demand and supply, however, the number and nature of building permits approved each year is not an effective indicator of the number of housing units needed to satisfy demand or the number of units that will be built.

Table 11 shows the number of building permits approved by county planning departments over the last 27 years.

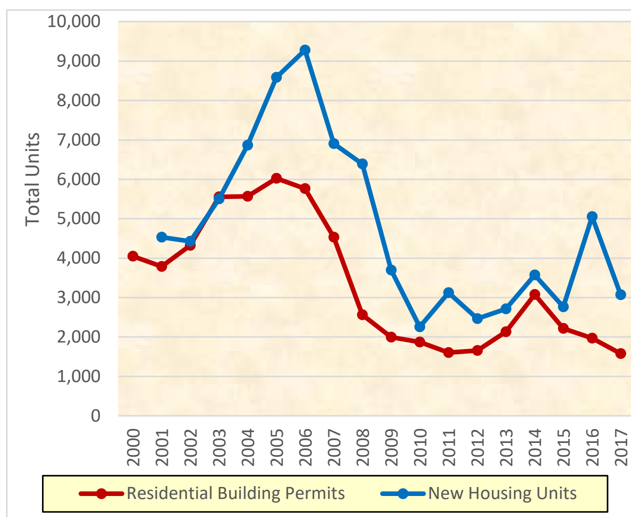
Table 11. Total Building Permits Issued, Counties and State of Hawai'i, 1990 – 2017

	County				State
	Honolulu	Hawai'i	Maui	Kaua'i	
1990	17,123	4,720	3,534	2,312	27,689
1995	11,956	2,707	1,514	1,054	17,231
2000	12,443	3,254	2,294	1,083	19,074
2005	15,174	5,436	2,348	882	23,840
2010	14,254	2,756	1,016	171	18,197
2015	20,146	5,426	1,280	199	27,051
2017	14,759	2,943	1,348	236	19,286

Source: *State of Hawai'i Time Series Data Book Table 21.01.*

Figure 4 presents data for the number of approved residential building permits and the number of added housing units in Hawai'i between 2000 and 2017. While the number of building permits issued and the number of housing units constructed tend to follow similar trends, there is not a clear, predictive relationship between the two.

Figure 4. Residential Building Permits & Added Units, State of Hawai'i, 2000-2017



Source: Permits from Census Table 2au: New Privately Owned Housing Units Authorized. Added units from ACS housing unit data.

2. Demand for Residential Property from Outside the State

Most of the demand for residential real estate in Hawai'i originates from our residents, but the housing market is also affected by demand from outside the State.

Perhaps more than any other state, Hawai'i has qualities that drive external demand for our housing units. We have a temperate climate, beautiful beaches, and abundant opportunities for outdoor activities and entertainment. Chronic health conditions are less prevalent than the national average, wages are above average, household incomes are higher than in other states, and our social welfare programs are at least perceived to be more easily available. Hawai'i's unique and welcoming culture is attractive to many people who wish to have a second home in the islands. All of these make Hawai'i attractive to buyers from outside the state. Hawai'i real estate is also considered to be a good investment to out-of-state buyers. Prices are high, but appreciation tends to be high, as well. Average annual prices rise steadily and appreciation has averaged 4.56 percent every year since 2000, earning Honolulu one of the highest appreciation rankings in the country[31]. Rents are usually high enough to provide positive cash flow for most properties, and the possibility of making even higher margins by renting to visitors is available.[32]

a. External Demand and Vacancy Rates

Until recently, the impact of external demand on the housing market was largely a matter of speculation. Since DBEDT's 2016 study of home sales trends[33], however, we have good data on the extent of out-of-state demand in Hawai'i.

For the last ten years, nearly a quarter of all residential home sales in Hawai'i were to persons who live outside the state. That rose as high as 33.5 percent in 2010 and has been drifting downwards to about 24 percent in 2018.

Table 12. Out-of-State Sales, 2008 - 2018

	Sales	Percent In-State	Percent Out-of-State
2008	13,616	72.4%	27.6%
2009	11,426	70.6%	29.4%
2010	14,069	66.5%	33.5%
2011	11,889	69.6%	30.4%
2012	12.017	74.1%	25.9%
2013	13,378	75.0%	25.0%
2014	13,455	76.0%	24.0%
2015	15,077	77.9%	22.1%
2016	15,311	77.2%	22.8%
2017	15,835	77.3%	22.7%
2018	15,525	76.1%	23.9%

Source: DBEDT Data Book 2018, Table 21.38.

Most (85%) out-of-state buyers were Mainland residents. About 15 percent were international buyers.

The counties were disproportionally impacted by out-of-state sales in the last nine years. In 2018, 15 percent of Honolulu sales were made to non-residents and 37.5 percent of Maui County's housing unit sales were made to persons living outside the State. Hawai'i and Kaua'i Counties also saw approximately 40 percent of their home sales go to outside buyers.

Table 13. Out-of-State Sales by County, 2018

	Buyers	Percent Out-of-State	Sales Price Differential[34]
State	20,409	23.9%	44.6%
Honolulu	12,993	14.9%	46.6%
Hawai'i	3,412	41.3%	87.8%
Kaua'i	1,176	40.2%	62.8%
Maui	2,828	37.5%	65.8%

Source: DBEDT Data Book 2018, Table 21.39.

[31] Honolulu Appreciation Trends, Neighborhood Scout, at https://www.neighborhoodscout.com/hi/honolulu/real-estate downloaded June 10, 2019.

[32] See Section IV-B, Tourism and Housing, p. 70.

[33] Hawai'i Department of Business, Economic Development and Tourism. 2016. Residential home sales in Hawai'i: Trends and characteristics, 2008-2015, May 2016.

[34] The differential between in-state and out-of-state average sales prices. For example, the average sales price for out-of-state units was 49.2 percent higher than the average sale price for sales to in-state residents.

In the same year, purchase prices for units bought by out-of-state buyers were, on average, 44.6 percent higher than prices paid by local buyers. On O‘ahu, out-of-state buyers bought units that were 46.6 percent higher than the average units sold to a resident. The price differential peaked in Hawai‘i County, where non-Hawai‘i buyers paid 88 percent more for their units than did County residents.

Overall, the impact of external demand for Hawai‘i housing units will have a notable impact on the efforts of housing planners. We will return to this topic in later sections of the report.

b. Use of Hawai‘i Property

In a 2019 survey, we contacted Hawai‘i property owners who had tax billing addresses outside the State. Among those property owners, 38 percent saw their property largely as an investment and 62 percent saw the property to be a vacation home for the use of their family and friends.[35]

About 48 percent of out-of-state owners rented their units while they were not using them. Another 52 percent left their units vacant or loaned them to family or friends. There was a strong correlation between the way owners perceived their properties and the way they used them (Table 14). For instance, 61 percent of the investors rented their property while they were not using it themselves. Among those who see their property as a vacation or second home, and 39 percent of vacation homeowners rented their units at least part of the time.

Table 14. Type and Use of Out-of-State Units 2019

	Percent of property owners				
	State	O‘ahu	Maui	Hawai‘i	Kauai
Vacation home	62	43	77	74	67
Rent unit	39	27	47	53	59
Investment property	38	57	23	26	33
Rent unit	61	73	53	47	41

Source, HHPS Out-of-State Owner Survey, 2019.

The pattern of owners and renters differs across counties. O‘ahu out-of-state properties are about 57 percent investments and 73 percent of those are rented when not occupied by the owner. Forty three percent (43%) are vacation homes and only 27 percent of those are ever rented.

In the other three counties, about a quarter of the units are investment properties and 50 to 60 percent are rented when not in use. Three-quarters of the units are vacation or second homes, but about 50 percent of those are rented at least part of the time. This certainly suggests some additional research. The dates of sale also differ across counties. The major growth in out-of-state owned units on O‘ahu began as early as 1990. Maui’s median year built was 2000, followed by Kaua‘i and Hawai‘i County in 2010. The first units reported in the survey were dated before 1920, so the demand for out-of-state housing units has always been significant.

c. External Demand and Vacant Units

Many units sold to out-of-state buyers were either second homes or timeshare units. Together they made up the bulk of units the Census calls *vacant, held for seasonal, recreational, or occasional use* (seasonal). These units are reported separately from the residential housing stock and are not available to residents in need of a housing unit.

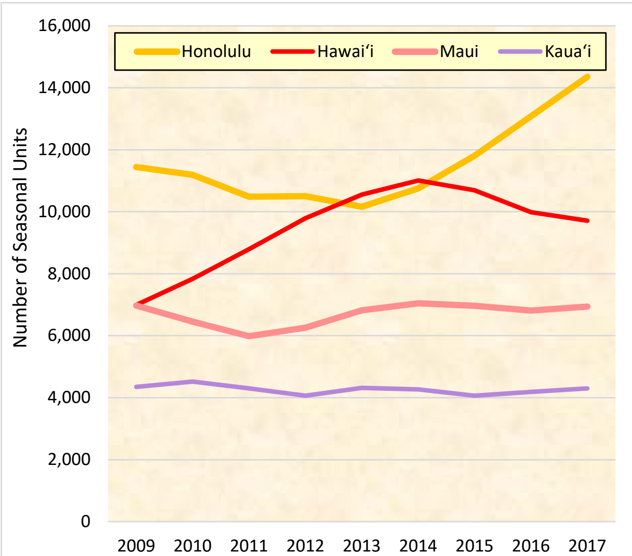
In Honolulu County (Figure 5), the 14,358 seasonal units enumerated in the 2017 ACS were 4.1 percent of O‘ahu‘s housing units. Maui County’s 6,937 seasonal units were 9.7 percent of total housing units. Hawai‘i County’s 9,708 units were 11.5 percent of the county’s total housing units. On Kaua‘i, 4,301 seasonal units accounted for 14.2 percent of all housing units.
Seasonal unit trend lines for Kaua‘i and Maui Counties have been flat for nine years. The impact of seasonal units in Hawai‘i county has been decreasing since 2014, and Honolulu County’s trend has risen sharply since 2013.

In all, 6.6 percent of Hawai‘i’s housing units were seasonal units in 2017. By comparison, the national average is about 2 percent. The figures indicate that external demand for housing units by

35 About 75 percent were from other U.S. states and 25 percent were from foreign countries. For methodology and content see SMS, Hawai‘i Housing Planning Study, 2019: Technical Report, p. 6.

non-residents substantially reduces the number of housing units that are part of the housing stock. The loss of those units decreases the housing stock needed to accommodate rising demand.

Figure 5. Vacant Units Held for Seasonal or Occasional Use, by County, 2009-2017



Source: ACS 5-yr. estimates 2009-2017.

Identifying exactly how many housing units were converted from residential owned or rented units were converted to seasonal units (vacation rental units [VRUs]) has been a challenge. In 2019, the emphasis on this research problem has changed to focus on the outcome of new regulations on short-term rentals on Oʻahu (see pp. 74-75).

3. Survey Demand Estimates

One objective of the HHPS is to estimate the demand for housing units for the next five years and use those projections to identify the number and types of units needed for the State. The Housing Demand Survey is conducted to facilitate demand estimates and provide details on prospective buyers and renters, their financial situations, and unit preferences. Data from the 2019 Housing Demand Survey were used to produce estimates of raw, effective, and qualified demand.

a. Raw Demand

Survey householders were first asked when they would next move to a new housing unit. Some said they would never move from their current units. They had found the place they wanted to live in and would stay there for the rest of their lives. Another group said they might move but had no plans to go anywhere very soon. Others said they would move sometime in the next ten years. Households with plans to move soon were classified as "movers" and the survey estimate for raw demand.

Table 15. HHPS Demand Survey Demand Estimates, by County, 2019

	County								State	
	Honolulu		Maui		Hawaiʻi		Kauaʻi			
	Count	Pct.	Count	Pct.	Count	Pct.	Count	Pct.	Count	Pct.
Total Households	311,451	100.0%	54,434	100.0%	67,054	100.0%	22,563	100.0%	455,502	100.0%
Will Not Move	108,025	34.7%	26,694	49.0%	34,175	51.0%	12,975	57.5%	181,870	39.9%
Raw Demand	203,426	65.3%	27,740	51.0%	32,879	49.0%	9,588	42.5%	273,632	60.1%
Will move, but no plans	67,934	21.8%	7,010	12.9%	8,400	12.5%	3,310	14.7%	86,654	19.0%
Move out of state	35,289	11.3%	4,105	7.5%	4,487	6.7%	1,332	5.9%	45,214	9.9%
Effective Demand	**100,203**	**32.2%**	**16,624**	**30.5%**	**19,992**	**29.8%**	**4,946**	**21.9%**	**141,765**	**31.1%**

Source: Housing Demand Survey, 2019. Raw demand is households except those who said they would never move. "Will move, but no plans" is the number of households who were unsure or refused to report when they expected to move. "Will move out of state" is the number of households whose first location choice was out-of-state. Out-of-state and no plan households are excluded from effective demand.

In 2019, raw demand affected 60.1 percent of households statewide, up from 56.8 percent in 2016 and 51 percent in 2011. At 65.3 percent of all households, the City and County of Honolulu had the highest raw demand. Other counties had similar levels of raw demand (Maui: 51%, Hawaiʻi: 49%, Kauaʻi: 42.5%). For all movers to realize their expectations and move to a new housing unit would result in 273,632 real estate transactions --

the number of units that would change hands during the period.

Reasons for Not Buying

We asked the 2019 Housing Demand Survey respondents who were interested in moving to a new home, but not interested in buying, why they would not buy. Fifty-seven percent (57%) of them told us that home prices were too high, or that it was too expensive to buy right now (Table 16). This was slightly lower than the 64 percent who cited expense as a reason in 2016. Roughly three in ten (31%) said they could not afford the down payment, while 17 percent could not afford the monthly payment and 19 percent would be unable to qualify for a loan.

Table 16. Top Six Reasons for Not Buying a Home, 2019

	County				State
	Honolulu	Maui	Hawai'i	Kaua'i	
Too Expensive	57.3%	61.8%	51.9%	61.1%	57.2%
Cannot Afford Down Payment	33.9%	23.5%	25.9%	17.2%	31.0%
Won't Stay Long Enough	17.6%	39.5%	32.1%	45.2%	23.1%
Do Not Want To Buy; Prefer To Rent	15.8%	41.6%	32.8%	47.9%	22.2%
Can't Qualify for a Loan	20.5%	13.8%	15.9%	7.6%	18.6%
Can't Afford the Monthly Payment	18.1%	15.2%	13.6%	11.0%	16.9%

Source: Housing Demand Survey, 2019.

Over 22 percent of those who do not plan to buy a home said they preferred to rent (22.2%). Some were not going to be in Hawai'i for a long time and they did not want to be tied to any one place. Others were not ready for the commitment and maintenance that they would require.

b. Effective Demand

In 2019, more households wanted to move away from Hawai'i (Table A-13). Over 24 percent of all movers (24.2%) wanted to leave the State on their next move -- the highest rate since 1997. That's much higher than in other states, too. At a time when Americans are moving away from their home state at unprecedented rates, Hawai'i leads the nation in intentions to leave.[36]

Reasons for Leaving the State

Once again, there were many families moving out of Hawai'i because they could not afford to buy a home, which is consistent with Hawai'i's high-priced market and low homeownership rates.

Statewide, about 22 percent of respondents who planned to leave Hawai'i said the high cost and limited availability of housing was one of the problems causing them to move. That was lower than the 31 percent in 2016 and 30 percent in 2011 who reported planning to leave the state for housing-related reasons.

Households that leave Hawai'i will not increase demand for Hawai'i housing units. For this reason, we computed effective demand to include only respondents who will move within the State.

Table 17. Effective Demand by County, 1992, 1997, 2003, 2006, 2011, 2016, and 2019

		Effective Demand *Percent of total households intending to move to a housing unit in Hawai'i*						
		1992	1997	2003	2006	2011	2016	2019
County	Honolulu	51.7	47.3	38.9	33.2	31.3	32.4	32.0
	Maui	38.8	41.4	35.7	39.6	31.3	31.9	30.5
	Hawai'i	40.2	34.3	33.8	36.3	26.0	30.2	29.8
	Kaua'i	38.5	34.2	31.4	30.6	27.3	27.6	21.9
State		48.4	44.4	37.5	34.2	30.3	31.8	31.1

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016, and 2019.

[36] U.S. data show Hawai'i is No. 2 among States (22.3%) for people wanting to leave. Kapfidze, Tendayi. 2019. LendingTree study reveals the top states where residents are staying put, moving from and moving to, LendingTree, November 19, 2019. See also New York Times. 2019. Frozen in place: Americans are moving at the highest rate on record, Nov. 20, 2019.

Across the State, effective demand fell in each Housing Demand Study year between 1992 (48.4%) and 2011 (30.3%). Statewide effective demand climbed slightly to 31.8 percent in 2016 but dropped back to 31.1 percent of all households in 2019.

Some observers believe there is more interest in home buying now because sales are stable and prices will be higher. Others see few reasons to buy and point to our decreasing population as a caution to prospective buyers. Regardless of buyer motivations, HHPS data show that the level of effective demand inside Hawai'i has remained unchanged since 2011.

Historically, the pattern of effective demand across counties has been stable. Honolulu's effective demand is highest among the counties. Among the Neighbor Island counties, effective demand has been highest in Maui County and lowest for Kaua'i County.

c. Qualified Demand

Qualified demand narrows the demand estimate further by considering only households that are financially prepared to pursue their preferred tenancy and unit type. This step eliminates households that do not have the financial qualifications to purchase or rent housing units in the current economy.

Table 18. Qualified Demand by Unit Type & County, 1992, 1997, 2003, 2006, 2011, 2016, and 2019

	County				
	Honolulu	Maui	Hawai'i	Kaua'i	State
1992	51.7%	38.8%	40.2%	38.5%	48.4%
1997	47.3%	41.4%	34.3%	34.2%	44.4%
2003	38.9%	35.7%	33.8%	31.4%	37.5%
2006	33.2%	39.6%	36.3%	30.6%	34.2%
2011	31.3%	31.3%	26.0%	27.3%	30.3%
2016	44.0%	39.7%	36.9%	35.1%	42.1%
2019	27.5%	40.2%	25.4%	39.7%	29.2%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016, and 2019.

Based on this analysis, we estimate that 29 percent of effective demand households are financially prepared to acquire a different residence (Table 18). This is the lowest level of financial preparedness among mover households since the HHPS was begun in 1992.

4. Purchase Preferences

Buyer and renter preferences and qualifications for housing unit types were measured in the Demand Survey. The objective was to provide information on consumer preferences to support housing issue analyses over the next few years.

Forty-nine percent (49%) of those who planned to move said they wanted to buy their next unit. Plans for homeownership were on the upswing, following an all-time low of 42 percent in 2011 and 47 percent in 2016. But plans to buy do not always translate into marketplace reality. About 17 percent of those who planned to purchase their next home conceded that they were not sure they would be able to afford it and may have to continue renting.

a. Buyer Qualifications

To evaluate the financial readiness of households wishing to buy a housing unit in Hawai'i in the next five years, we examined their income, affordable monthly housing payment, and total amount available for a down payment. These elements were evaluated against a median-priced home assuming a fixed-rate, 30-year loan, a four percent interest rate, and a 20 percent down payment. Results are shown in Tables 19 and 20.

Statewide, 41 percent of prospective single-family home buyers said they could afford to make the monthly mortgage payments, but not necessarily the 20 percent down payment. Twenty-seven percent (27%) said they had the funds to make a 20 percent down payment but could not afford the monthly payment. About 20 percent of households statewide were qualified to meet both requirements.

The same set of financial qualification measures was applied to potential homebuyers who sought to purchase a multi-family unit rather than a single-family home. We used the current median sales price for condominiums in each county rather than the single-family median. As shown in Table 20, residents planning to purchase a multi-family rather than a single-family unit were more likely to be financially able to do so.

The median price, monthly mortgage, and down payment required are lower for multi-family units. Therefore, more Hawaiʻi households were able to meet the requirements to purchase a townhouse or condominium unit. Study results confirmed that 29 percent of Hawaiʻi households in the market for a multi-family ownership unit in the next five years could afford to make the monthly payments. Twenty percent (20%) reported having enough to make the down payment. Just under 16 percent of multi-family buyer households were fully qualified to purchase their next home

This analysis does not include the impact of maintenance fees attached to many multi-family units. Across the State, maintenance and other fees are often calculated at $0.60 to $1.50 per square foot. While the national average for maintenance fees is $331, the average for Hawaiʻi has been quoted as $539. If the $539 for maintenance fees was added to the monthly mortgage payment of $1,827 (Table 20), this would almost certainly reduce the number of households who would qualify for purchase.

Table 19. Financial Qualification to Purchase a Single-Family Home, Counties & State, 2019

		County				
		Honolulu	Maui	Hawaiʻi	Kauaʻi	State
Median Sales Price		$770,000	$819,500	$362,000	$630,000	$695,000
Down Payment Required*		$154,000	$163,900	$72,400	$126,000	$139,000
Monthly Mortgage Payment**		$2,940	$3,129	$1,382	$2,406	$2,654
Total Effective Demand SFD Buyers		26,649	7,119	8,332	1,761	43,861
	Can Afford Monthly Payment	40.3%	28.4%	43.3%	34.2%	40.8%
	Have Adequate Down Payment	19.1%	26.8%	25.7%	27.4%	27.1%
	Fully Qualified	17.2%	11.7%	19.8%	20.3%	19.7%

Source. Locations Market Reports, Q1 2019; Housing Demand Survey, 2019.
https://www.locationshawaii.com/learn/market-reports/hawaii-statewide-real-estate-report/
* Assumes a 20 percent down payment.
**Based on a 30-year fixed loan with a 4% interest rate.
Base is effective demand households that plan to move within the next 5 years and purchase an SFD unit.
Can Afford Monthly Payment if the monthly payment is less than or equal to 30% of household income.

Table 20. Financial Qualification to Purchase a Multi-Family Unit, Counties & State of Hawaiʻi, 2019

		County				
		Honolulu	Maui	Hawaiʻi	Kauaʻi	State
Median Sales Price		$418,000	$444,444	$418,500	$459,000	$430,000
Down Payment Required*		$83,600	$88,889	$83,700	$91,800	$86,000
Monthly Mortgage Payment**		$1,596	$1,697	$1,598	$1,753	$1,642
Total Effective Demand MFD Buyers		20,994	1,298	1,655	493	24,439
	Can Afford Monthly Payment	29.2%	27.6%	34.9%	19.1%	28.6%
	Have Adequate Down Payment	20.3%	19.6%	26.5%	8.1%	20.1%
	Fully Qualified	16.7%	23.4%	13.2%	8.7%	15.7%

Source. Locations Market Reports, Q1 2019; Housing Demand Survey, 2019.
https://www.locationshawaii.com/learn/market-reports/hawaii-statewide-real-estate-report/
* Assumes a 20 percent down payment.
**Based on a 30-year fixed loan with a 4% interest rate.
Base is effective demand households that plan to move within the next 5 years and purchase an MFD unit.
Can Afford Monthly Payment if the monthly payment is less than or equal to 30% of household income.

b. Renter Qualifications

Seven in ten households planning to rent their next home cited financial reasons for their decision. Reasons for not buying included the inability to afford a down payment or monthly payment and the belief that homes in Hawai'i are just "too expensive." These households were also asked if they would opt to purchase a home if there was a unit available they could afford. Close to 70 percent responded affirmatively.

Financial qualification for households planning to rent their next unit was evaluated using the current average monthly rental rate for single-family and multi-family units in each county. Household income, current monthly shelter payment, and affordable monthly rent were examined as well to determine the financial readiness of prospective renters.

Statewide, 15 percent of those planning to rent a single-family unit indicated they could afford to make the median monthly rent payment of $2,220. For 23 percent of these households, their current income suggests that making the median monthly rent payment would require less than 30 percent of their income. Twenty-nine percent (29%), however, were currently paying more each month for housing than the median monthly rent amount.

Among the 53,850 households across the State that intend to rent their next unit, 35 percent prefer a single-family unit. Those planning to rent single-family units on Maui were most financially prepared to do so. Residents of Kaua'i County were better equipped than residents of Hawai'i and Honolulu Counties to make the median monthly rent payment for a single-family home.

Among those planning to rent their next unit, close to half (46%) plan to rent an apartment or other multi-family unit. Among those households, about 29 percent were currently making monthly rent payments equal to or higher than the median rent amount. Another 15 percent indicated they could afford the median monthly rent payment. For 23 percent of prospective multi-family renters, the current median rent payment would require less than 30 percent of their household monthly income.

Among those who wanted a multi-family dwelling as their next unit, those on Maui were the most financially prepared to do so. About 21 percent currently pay rent equal to or higher than the median rent amount for the county.

Table 21. Financial Qualification to Rent a Single-Family Unit, Counties and State of Hawai'i, 2019

		County				
		Honolulu	Maui	Hawai'i	Kaua'i	State
Median Monthly Rent Amount		$2,593	$2,498	$1,713	$2,076	$2,220
Security Deposit + 1st Mo. Rent		$5,186	$4,996	$3,426	$4,152	$4,440
Total Effective Demand SFD Renters		10,598	3,368	3,585	1,318	18,868
	Current Payment-Same or Higher	25.3%	44.3%	23.2%	30.9%	28.7%
	Affordable Rent*-Same or Higher	14.0%	12.7%	13.5%	31.9%	14.9%
	Income-Based Qualification	20.3%	26.1%	29.6%	22.5%	23.3%

Source: Median rents from RentRange® (April 2019) for all unit sizes. Qualified renters from the HHPS 2019. Base is households that plan to rent their next SFD unit in the State of Hawai'i in the next 5 years.

* Self-reported affordable rent amount.

Table 22. Financial Qualification to Rent a Multi-Family Unit, Counties and State of Hawai'i, 2019

		County				State
		Honolulu	Maui	Hawai'i	Kaua'i	
Median Monthly Rent Amount		$2,256	$2,248	$1,563	$1,926	$1,998
Security Deposit + 1st Mo. Rent		$4,512	$4,496	$3,126	$3,852	$3,996
Total Effective Demand MFD Renters		19,997	1,890	2,230	384	24,502
	Current Payment-Same or Higher	19.7%	21.0%	12.9%	0.0%	18.9%
	Affordable Rent*-Same or Higher	11.9%	18.7%	18.1%	5.8%	12.9%
	Income-Based Qualification	26.3%	37.6%	18.9%	19.9%	26.4%

Source: Median rents from RentRange® (April 2019) for all unit sizes. Qualified renters from the HHPS 2019. Base is households that plan to rent their next MFD unit in the State of Hawai'i in the next 5 years.
* Self-reported affordable rent amount.

5. Housing Preferences

a. For Owned Units

Once again, most effective demand buyers statewide (66%) preferred single-family detached homes. Single-family units are more important to buyers in Kaua'i (98%), Maui (86%), and Hawai'i Counties (82%) than in Honolulu (62%). Maui and Kaua'i also showed the lowest preference for condominium units (0.6 and 8%, respectively).

Nearly 43 percent of potential buyers said they would be looking for a three-bedroom unit and 19 percent said they would need four bedrooms. When asked about the minimum number of bedrooms they could accept, 53 percent felt two bedrooms would be enough and another 32 percent reported a three-bedroom minimum. This willingness to settle for fewer bedrooms was slightly higher than in the past, perhaps reflecting buyers' readiness to compromise on the unit size in the face of high prices. The same was true for the preferred number of bathrooms. More than three-quarters of households would prefer two to three bathrooms, and close to half (48%) of buyers conceded they would be willing to accept a unit with only one or one-and-a-half bathrooms.

b. For Rented Units

Households that planned to rent their next home in Hawai'i in the next five years were mostly renters (83%). Thirty-five percent (35%) of those wanted to rent a single-family house and 48 percent wanted a multi-family unit like an apartment (34%), condominium (8%), or townhouse (6%). Preference for single-family homes was once again much higher on Neighbor Islands, ranging from 57 to 70 percent versus 32 percent for Honolulu. On O'ahu, 9 percent of prospective renters wanted townhomes versus 2 to 3 percent on the other islands.

Across the State, renters preferred larger units with two (39%) or three bedrooms (25%). About 70 of them were willing to take units with fewer than three bedrooms. Again, the figures suggest a willingness to accept smaller units than in the past. The number of bathrooms required was also relatively low, with 64 percent reporting that they could accept one or one-and-a-half baths.
Seventy-two percent (72%) of households that plan to rent their next unit said they would like to buy a home in the future. Their reasons for not doing so now most often included the high cost of housing and insufficient funds for a down payment.

C. HOUSING PRICES

The most distinctive characteristic of Hawai'i's housing market is high prices. Sumner La Croix may have been the first to point out that our housing prices have been some of the highest in the nation, dating back to at least the end of World War II. The HHPS has been following the price trends since the first edition in 1992.

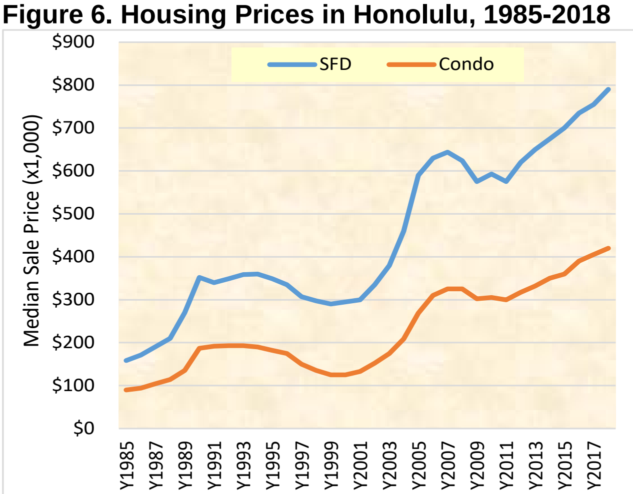
1. Sales Prices

Figure 6 shows single-family and condominium sales prices from 1985 to 2018 in Honolulu.

Our last two price run-ups are easily identified. Housing prices more than doubled in a few years. After each period of expansion, prices dropped slightly, then held in place. The adjustment period after 1989 was a decade long and the post-2008 recovery has lasted for ten years. Condominium prices regained their 2007 peak by 2012, single-family homes by 2013.

Since 2016, the median price of single-family homes went up by about 4.1 percent per year. During the same period, the median price of condominium units has increased by 5.1 percent per year, on average.

Figure 6. Housing Prices in Honolulu, 1985-2018



Source: Honolulu Board of Realtors.

Table 23 shows median sales prices for single-family homes and condominiums between 2010 and 2018. As suggested by Figure 6, the period was marked by increasing prices but was short of the rate increases expected during a run-up.

Table 23. Median Home Sales Prices, Counties and State of Hawai‘i, 2010-2019

	State of Hawai‘i	Counties			
		Honolulu	Hawai‘i	Kaua‘i	Maui
Single Family House Sales Price (in thousands)					
2010	$487	$600	$260	$498	$460
2011	$470	$580	$246	$455	$432
2012	$500	$625	$260	$459	$470
2013	$545	$650	$295	$529	$530
2014	$575	$674	$315	$533	$570
2015	$600	$700	$329	$614	$580
2016	$633	$735	$330	$626	$639
2017	$660	$760	$350	$660	$695
2018	$689	$790	$360	$700	$710
Multi-Family Condominium Sales Price (in thousands)					
2010	$310	$305	$260	$270	$378
2011	$290	$300	$213	$237	$310
2012	$318	$315	$258	$290	$358
2013	$333	$332	$250	$310	$374
2014	$351	$350	$280	$346	$415
2015	$363	$360	$275	$360	$410
2016	$390	$390	$300	$399	$415
2017	$409	$410	$312	$435	$445
2018	$430	$421	$350	$461	$500

Source: DBEDT Data Book Time Series, Table 21.36. Further details on home sales prices are shown in Appendix Table D-7.

Across the State, the median sales price for a single-family home increased 41.5 percent between 2010 and 2018 (+5.2% per year). Between 2017 and 2018, the single-family sales price rose by 4.4 percent. The increase in condominium sales prices was a bit lower at 38.7 percent between 2010 and 2018 (+4.8% per year). In 2018, it rose by 5.1 percent over the 2017 price.

2. Rents

In 2019, Hawai'i continues to have the highest average rents in the nation, followed by the District of Columbia and New York.[37] For the past decade, Hawai'i's median gross rent has consistently been 50 to 55 percent higher than the national median gross rent.

The HHPS review of rental housing prices gathered rent data from several sources and, although the sources don't match exactly, the conclusions are the same. Our analysis is based on data from the American Community Survey, from HUD Fair Market Rent data, and from detailed rental data from RentRange®.[38]

The important finding is that rent prices have leveled off in 2017 and have grown very little since then.

Table 24. Median Rent for All Units, Counties and State of Hawai'i, 2009-2019

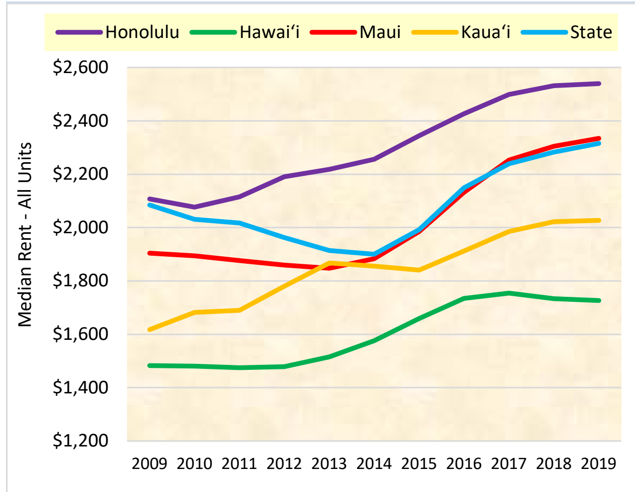
	County				
	Honolulu	Hawai'i	Maui	Kaua'i	State
2009	$2,108	$1,483	$1,904	$1,618	$2,085
2010	$2,077	$1,480	$1,894	$1,682	$2,031
2011	$2,115	$1,474	$1,876	$1,690	$2,018
2012	$2,191	$1,478	$1,859	$1,780	$1,963
2013	$2,218	$1,515	$1,848	$1,867	$1,914
2014	$2,256	$1,576	$1,883	$1,855	$1,900
2015	$2,344	$1,660	$1,985	$1,840	$1,992
2016	$2,427	$1,734	$2,132	$1,912	$2,149
2017	$2,499	$1,754	$2,253	$1,986	$2,239
2018	$2,532	$1,733	$2,304	$2,022	$2,283
2019	$2,540	$1,727	$2,334	$2,027	$2,315

Source: RentRange®, 2009-2019. Figures in current dollars.

The contract rent data suggest that, across all types (single-family and multi-family) and sizes (one-bedroom through five-bedroom) of rental units, renters in Hawai'i are paying more for their accommodations now than they were in 2014.

Figure 7 shows the change in median rents since 2009. For the State, the current median rent is 7.8 percent higher than in 2016. Maui County had the largest increase during the past three years, climbing 9.5 percent (+3.1% per year).

Figure 7. Median Rents, Counties and State of Hawai'i, 2009-2019



Source: RentRange®, 2009-2016.

HUD's Fair Market Rents for the counties are for households that qualify for government-assisted housing. They exclude units built in the last two years, renters who have been in their units for more than two years, and those receiving any form of housing assistance. As expected, FMR rents are lower than median contract rents and they continue to increase in all counties. (Table 25). Increases for Honolulu and Kaua'i Counties ranged from 7.2 to 9.9 percent, and the increase for Maui County was 12.9 percent. The FMR for the County of Hawai'i increased by 3.3 percent between 2016 and 2019.

Table 25. Average Fair Market Rent for All Units, Counties of Hawai'i, 2009-2019

	County			
	Honolulu	Hawai'i	Maui	Kaua'i
2009	$1,631	$1,160	$1,584	$1,332
2010	$1,906	$1,232	$1,682	$1,414
2011	$1,904	$1,280	$1,749	$1,470
2012	$1,977	$1,295	$1,625	$1,428
2013	$2,060	$1,150	$1,374	$1,835
2014	$2,046	$1,047	$1,318	$1,739
2015	$2,034	$1,268	$1,321	$1,330
2016	$2,172	$1,311	$1,692	$1,503
2017	$2,233	$1,359	$1,795	$1,555
2018	$2,278	$1,361	$1,848	$1,624
2019	$2,328	$1,354	$1,910	$1,652

Source: HUD, 2009-2019. Current U.S. dollars.

[37] ACS, Table B25064,5-yr. estimates, for Hawai'i, U.S., 50 States, and selected SMSAs, 2009 through 2017.

[38] RentRange®, see glossary.

Analyses of rents by unit type and size (Table 26) show that increases were common across all unit types and sizes. Between 2016 and 2019, increases in median FMR were larger for single-family (11.2%) than for condominium (6%) or apartment (7.6%) rental units.

Table 26. Median Rent by Unit Type and Size, State of Hawai'i, 2009-2019

	Single-Family Units						Condominium Units					Apartment Units				
	1BR	2BR	3BR	4BR	5BR	All SF Units	1BR	2BR	3BR	4BR	All Condo Units	1BR	2BR	3BR	4BR	All Apt Units
2009	$1,343	$1,690	$2,290	$2,735	$3,075	$2,250	$1,325	$1,650	$2,265	$2,695	$1,999	$1,280	$1,600	$2,188	$2,640	$1,936
2010	$1,300	$1,580	$2,155	$2,665	$2,950	$2,193	$1,285	$1,580	$2,190	$2,620	$1,939	$1,210	$1,520	$2,145	$2,595	$1,883
2011	$1,290	$1,595	$2,100	$2,535	$2,945	$2,192	$1,250	$1,558	$2,160	$2,600	$1,933	$1,175	$1,475	$2,108	$2,505	$1,856
2012	$1,250	$1,595	$2,065	$2,413	$2,690	$1,996	$1,250	$1,590	$2,115	$2,515	$1,909	$1,185	$1,510	$2,030	$2,425	$1,793
2013	$1,245	$1,605	$2,078	$2,413	$2,705	$1,995	$1,273	$1,620	$2,140	$2,475	$1,898	$1,210	$1,560	$2,095	$2,480	$1,841
2014	$1,205	$1,600	$2,065	$2,400	$2,638	$1,962	$1,260	$1,638	$2,185	$2,460	$1,894	$1,210	$1,575	$2,165	$2,515	$1,878
2015	$1,223	$1,595	$2,128	$2,468	$2,748	$2,028	$1,273	$1,703	$2,290	$2,548	$1,984	$1,205	$1,630	$2,240	$2,595	$1,928
2016	$1,300	$1,658	$2,280	$2,735	$3,048	$2,200	$1,335	$1,775	$2,370	$2,795	$2,110	$1,275	$1,700	$2,343	$2,785	$2,043
2017	$1,355	$1,745	$2,405	$2,890	$3,210	$2,324	$1,395	$1,800	$2,420	$2,920	$2,185	$1,335	$1,760	$2,385	$2,875	$2,110
2018	$1,350	$1,780	$2,498	$3,023	$3,343	$2,399	$1,425	$1,835	$2,423	$2,993	$2,225	$1,355	$1,793	$2,440	$2,930	$2,149
2019	$1,365	$1,798	$2,568	$3,095	$3,373	$2,447	$1,445	$1,875	$2,485	$3,053	$2,237	$1,398	$1,820	$2,475	$2,995	$2,198
% chg (2016-2019)	5.0%	8.4%	12.6%	13.2%	10.7%	11.2%	8.2%	5.6%	4.9%	9.2%	6.0%	9.6%	7.1%	5.7%	7.5%	7.6%

Source. RentRange®, 2009-2019. Figures are current U.S. dollars. Further details are shown in Tables D-2 through D-6 in the Appendix.

Median rent for a 2-bedroom single-family unit increased by 8.4 percent from 2016 to 2019. The monthly rent for a 2-bedroom multi-family unit increased by half as much (5.6 to 7.1%) during the same period. Similarly, the median rent for 4-bedroom single-family units went up by $360 (13%) between 2016 and 2019. In the same period, median rent for a 4-bedroom condominium unit went up by $258 (9%)

The trend is not unique to Hawai'i; rents were up for all major metropolitan areas. Honolulu is consistently ranked near the top of the list of America's high-rent cities and, in 2019, our average rent was second only to San Francisco.

3. Affordable Housing

Having one housing unit per household and enough vacant units to ensure a reasonable vacancy rate does not ensure that all households will be adequately housed. There must be a mix of unit types and sizes in the right locations. A functioning housing market needs luxury, high-priced units for those who can afford them. It needs a bulk of adequate and comfortable units for the middle-market and enough safe and affordable housing units for low-income people. These are the numbers most valuable for housing planners, and the numbers that are the most difficult to find.

a. Employment and Affordable Prices

There are many definitions of affordable housing and many ways to describe the impact of affordability on the population. We have already discussed the shelter-to-income (STI) ratio and its role in estimating affordability. Households with high STI ratios are said to be living in unaffordable units. Areas with high average STI ratios are less affordable than those with lower ratios.

In recent years, wage and salary income needed to rent a median-priced, two-bedroom apartment has been proposed as a measure of housing affordability. The measure was developed by the National Low-Income Housing Coalition (NLIHC) and is available annually in the *Out of Reach Report*. A summary of the findings for 2018 is shown in Table 27. See also Table D-1 in the appendix.

Table 27. FY16 Housing Wage, Hawai'i 2018

	Hourly wage necessary to afford a 2-bedrooom rental unit at HUD Fair Market Rent, 2018
State of Hawai'i	$36.13
Honolulu County	$39.06
Hawai'i County	$25.42
Maui County	$31.13
Kaua'i County	$29.06

Source. NLIHC *Out of Reach*, 2018.

Compare Hawai'i's Housing Wage ($36.13) with the average wage of a renter in the state ($16.16)[39], and it is understandable that there are many households with high shelter-to-income ratios. In 2018, Hawai'i had the largest shortfall (-$19.98) between the average renter wage (amount renters earn) and the two-bedroom housing wage (amount required to afford an average two-bedroom rental unit). At -$11.53, Maryland ranked a distant second on this shortfall measure.

Substantial differences also exist between the City and County of Honolulu and the other counties. Honolulu rental prices necessitate an hourly wage of $39.06 to afford a two-bedroom unit at FMR, while the housing wage in the other three counties is between $25.42 and $31.13.

The NLIHC measure allows us to compare our rent wage with other states. Hawai'i's 2018 rent wage ($36.13) was highest in the nation, $3.45 higher than second-place California ($32.68).

b. Affordable units in the housing stock

We also use a definition of affordable housing units recently developed by the Urban Institute (UI).[40] They define affordable housing units as units with a monthly mortgage or rent payment that would require no more than 30 percent of monthly household income for a household earning a specified percent of the HUD Area Median Income (AMI).

Unlike affordability measures based on household income, UI measures affordability as a condition of the housing stock. It counts units in the housing stock with shelter prices suitable for households at specific HUD income levels.

We applied this approach to 2017 housing unit prices throughout the State using guidelines for 30 percent, 50 percent, 80 percent, and 100 percent of AMI for each county.
In 2017, just over half of the housing stock statewide (55.5%) was affordable to households earning 80 percent of HUD AMI. A notably greater proportion of the units affordable to households earning up to 80 percent of the AMI were suited to the higher-income households within this range. Approximately half of the units were affordable to households earning between 50 and 80 percent AMI. Only about 14 percent of the units, however, were priced such that they would be affordable to households earning less than 30 percent AMI.

[39] NLIHC *Out of Reach*, 2018.
[40] Leopold, Josh, Liza Getsinger, Pamela Blumenthal, Katya Abazajan, and Reed Jordan. (2015). The housing affordability gap for extremely low-income renters in 2013, Urban Institute Research Report, June 15, 2015.

III. HOUSING PROJECTIONS, 2019-2040

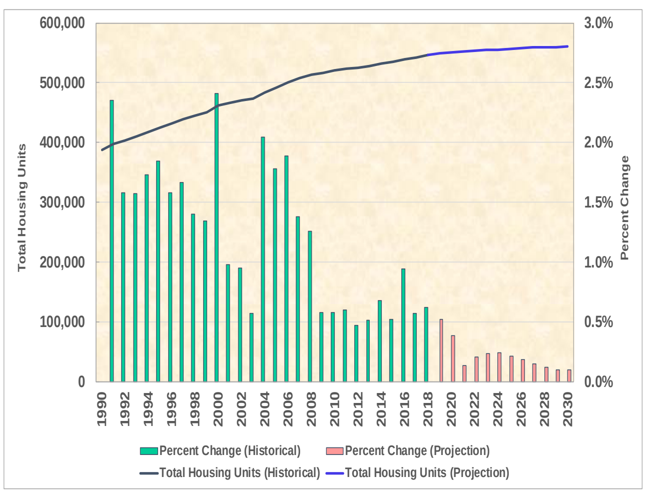
The focus of the HHPS is on planning – using housing information to develop policies and procedures to facilitate housing development that is consistent with housing demand. This future-oriented viewpoint requires more than information on past performance. It requires projections of how the housing market will function in the future.

A. HOUSING SUPPLY

The HHPS measures supply in terms of new construction each year. New construction was measured as the difference between the housing unit counts for two adjacent years. Supply projections were based on past performance of the housing market (added units) and population growth (new residents).

After testing several projection models, we selected a regression model with ARMA coefficients for the population. The model produced a reasonable outcome, as shown in Figure 8. All model parameters were statistically significant. Details are presented in Appendix Table C-2.

Figure 8. New Construction, State of Hawai‘i, 1990-2030



Source: SMS, 2019

[41] Hawai‘i Housing Demand 2020-2030, Hawai‘i Department of Business and Economic Development, Research and Analysis Division, December, 2019.

1. Housing Supply Projection

The HHPS housing supply projection is a projection of total housing units rather than housing stock. The objective was to prepare a housing supply projection that was consistent with the housing demand projection produced by DBEDT.[41] Total housing units include occupied housing units, and vacant and available housing units, seasonal units, migrant units, and other vacancies. Historical data were taken from decennial census and ACS data.

The historical supply data show the well-known pattern of housing production over the past two decades. Steady growth in production between 1990 and 2000 was followed by slightly higher growth after 1999 and a dip after the attack on the World Trade Center in 2001. That was followed by much faster growth through the housing bubble (2002-2008). The prominent downturn in housing production followed the Great Recession in 2009.

The projection line suggests a continued increase in housing supply at a rate somewhat lower than in the previous nine years. The slowdown was generated by the decreasing rate of population after 2016. Specifically, the model predicts lower production rates between 2020 and 2025. The percentage of growth during this period ranges from 0.4 percent to 0.2 percent annually.

There is no information in the historical data itself that indicates a change in the direction of the series. On the other hand, the decrease in population growth suggested that fewer housing units would be needed. Should population decline and housing demand projections fall, our supply projection would be adjusted downward.

2. Housing Supply Projection Caveats

The supply projection provided here was developed in an atmosphere of change. HHPS sponsors were interested in investigating a few issues that might affect this projection. We review several of those here.

Climate Change and Sea Level Rise

Recent studies (2-10) have shown that sea levels in Hawai'i will reach 6 inches by 2030, 1.1 feet by 2050, 2.0 feet by 2075, and 3.2 feet 2100.[42] Later studies suggest that the rate of change may be faster. A local study published in 2015 showed that the standard rate of change in beach erosion might be tripled by 2100.[43] That could bring about the predicted changes even earlier.

In terms of our housing projection, a study published in 2017[44] predicted that the 3.2-foot rise in sea level would destroy 6,500 structures and displace nearly 20,000 Hawai'i residents. There is no doubt that sea level rise will impact Hawai'i's housing stock in the remainder of this century, and planners should take note. Developing new housing units in the areas that will be affected by sea level rise would be unwise and that could be true even earlier than the first studies predict. The UH Mānoa study shows that the affected areas will be subject to greater damage from tsunami and hurricane storm surge well before the areas are totally inundated.

Studies continue to appear[45] and to clarify the situation. In the long run, however, the impact of sea level rise on the State's 2045 projection will be minimal and the impact on our 2020-2025 forecast will effectively be zero.

Baby Boomers

Some observers of housing trends worry that housing values may fall as baby boomers die off or sell off[46]. Two recent studies seem to support that contention, one from Fannie Mae[47] and one from the Fuller Institute[48]. The issue is relevant in Hawai'i because we have a rapidly aging population and Housing Demand Survey results suggest that our younger people are emigrating.

Baby Boomers – persons born between 1946 and 1964 - control about 32 million housing units worth more than $13.5 trillion[49]. The next generation of first-time buyers is the millennials, people born between the early 1980s and the 1990s. If Boomers decided to sell their units quickly and millennials do not buy them, the market could experience a demand shock. Demand will drop just as supply rises. Prices will fall, resulting in a large loss of value in the housing market.

The argument depends on certain characteristics of boomers that together make them look like heterogeneous groups with a single set of behaviors. Boomers have a desire to age in place[50]. They have not prepared themselves for retirement, have little savings, have health insurance problems and very few have long-term

42 Climate Change Impacts in Hawai'i: A Summary Of Climate Change and Its Impacts on Hawai'i's Ecosystems And Communities, UH at Mānoa, Sea Grant College Program, June 2014, p. iv.

43 Anderson, T.R., et al., *Doubling of coastal erosion under rising sea level by mid-century in Hawai'i.* Natural Hazards, 2015. 78(1): p. 75-103.

44 Hawai'i Climate Change Mitigation and Adaptation Commission. 2017. Hawai'i Sea Level Rise Vulnerability and Adaptation Report. Prepared by Tetra Tech, Inc. and the State of Hawai'i Department of Land and Natural Resources, Office of Conservation and Coastal Lands, under the State of Hawai'i Department of Land and Natural Resources Contract No: 64064.

45 https://www.staradvertiser.com/2018/07/05/hawaii-news/34-of-hawaiis-coast-at-risk-as-climate-change-accelerates-study-finds/

46 Harney, Kenneth R. 2018. Housing values may fall as baby boomers die off or sell off, two studies say. Washington Post, July 18, 2018.

47 Myers, Dowel and Patrick Simmons. 2018. The coming exodus of older homeowners, Perspectives, Fannie Mae.

48 Chapman, Jeanette. 2018. Demographic and economic factors affecting the upcoming home sales market in the Washington region. The Stephen S. Fuller Institute, School of Policy and Government, George Mason University, July 10, 2018.

49 Fannie Mae quoted in Lloyd, Alcynna. 2018. Can Millennials confront the looming threat of aging baby boomers?, Housing Wire, July 11, 2018.

50 AARP's Survey of Home and Community Preferences, showed that 76% of Americans want to remain in their current home, and 77% want to stay in their current community.

care insurance. Many of them lost a large part of their real estate value in the Great Recession. All this leads to a predictable set of expected behaviors. Baby Boomers will hang onto their homes until the market starts to fall and then sell off *en masse*.

To this point, the data do not show large numbers of sales by homeowners over the age of 65. In fact, the number of homeowners among the baby boomer generation is increasing. Additionally, evidence shows that not all boomers are tightly tied to their existing units. A 2018 AARP study showed 32 percent of seniors were willing to consider home sharing and 31 percent would consider ADU's. Over half of seniors were interested in villages that provide services to enable aging in place. Another 2018 survey conducted by Realtor.com found 85 percent of them had no plans to sell their present home.

The reality is that Boomers are a large and diverse group who will not act in lockstep with any cohort. They will approach the housing market each in their own way and in their own best interest. In the end, whatever happens will take place over many years and may not have any noticeable effect at all[51].

Table 28. Total Number and Aggregate Value of Occupied Housing Units Owned by Baby Boomers, 2017

		Units Owned by Boomers	
		# of Units	Agg. Value of Units
County	Honolulu	65,589	$47,872,716,700
	Hawai'i	16,659	$6,749,146,700
	Maui	10,826	$7,586,314,700
	Kaua'i	5,740	$3,746,144,700
State of Hawai'i		98,814	$65,954,322,800
United States		22,841,775	$6,260,165,953,800

Source: ACS 2017 5-yr. Estimates Table B25079, B25007. Owners age 65 and over.

In Hawai'i, baby boomers controlled about 98,814 housing units worth more than $65 billion. Our own survey found that Hawai'i residents become less likely to move to a new home as they get older. Sixty-four percent (64%) of seniors ages 60 to 65 said they would probably never move. For residents between 66 and 74 years of age, 68 percent have no intention of moving. At age 75 and older, the percentage of Hawai'i seniors who reported that they were unlikely to ever move jumped to 85 percent.

Millennials

Millennials are portrayed using the same kind of stereotyping. They are burdened by college loan debt, beset by a proclivity to marry late, have children even later, and not inclined to buy homes[52]. Their purchase preferences are for smaller units in the city, with higher densities near public transportation[53].

As with baby boomers, there are scholars who disagree with this viewpoint and offer evidence that millennials are a very large cohort with more diverse preferences than some might think[54].

Still other observers see all of this as much ado about nothing. That group, led by Lawrence Yun, chief economist at the National Association of Realtors, claims that those who worry about the baby boomer bust have ignored positive trends in the housing market, rising populations, and increasing demand from foreign buyers.

Even the Fannie Mae researchers don't think there is cause for major alarm but suggest it might be wise to develop some financing programs to encourage millennials to buy their first home now so they have the equity they will need to move up into the boomers old houses.[55]

51 Molinsky, Jennifer. 2017, quoted in *Realtor Magazine*, April 20, 2017.

52 Tabit, P.J. and Josh Winter. 2019. "Rural brain drain". Examining millennial migration patterns and student loan debt, *Consumer and Community Context*, Vol. 1, January 2019, pp. 7-14. Links millennials preference for cities to student loan debt. Millennials, especially rural millennials, go to college to escape the lack of opportunity in their rural home towns. They incur student debt in the process and move to cities to get jobs and pay back their debt.

53 Realtor Magazine. 2017. The big boomer sell-off coming in the 2020s?, Realtor, April 20, 2017, p. 1.

54 Stoetzer, Ethan. 2018. How millennials will reshape American politics in 2020. *Politics*, January 22, 2018.

55 Myers and Simmons, ibid., p. 3.

Vacation Rental Units

Vacation Rental Units (VRUs) are discussed in the Tourism section of this report (p. 65). They are clearly relevant to the supply of residential housing units in Hawai'i. If units are taken out of the housing stock and made available to non-residents, the housing supply is decreased. The decrease in housing stock will have the effect of increasing housing prices and asking rents.

There is evidence that the number of VRUs in Hawai'i has been rising. The Hawai'i Tourism Authority's annual Visitor Plant Inventory (VPI) tells us the State's inventory of vacation rentals is large and growing.

The Census shows the percentage of Hawai'i's total housing units used for seasonal or recreational purposes has been increasing. There is no evidence yet that the units removed from the housing stock are the ones that are being let to visitors in as short-term rentals. Most observers would agree, however, that VRU's represent a decrease in the supply of Hawai'i's housing stock.

Recent government actions to curb the spread of short-term rentals to visitors may have a significant effect. The success of those efforts is not known as we write this report. They are intended to significantly reduce the use of residential units for commercial business. If they are successful, then fewer units will be removed from the supply, and many may be returned to the housing stock as long-term rentals. In that case, our supply prediction would be increased even without construction activity.

Out-of-State Homebuyers

If a property is sold to a buyer who lives outside the State of Hawai'i, there may or may not be an impact on housing supply.

The buyer may treat the property as a vacation home or a second home, in which case the unit becomes part of total housing units, but not part of housing stock. The unit is occupied when the owner is in town, and vacant when the owner is away. It becomes a seasonal and recreational unit unavailable for use by Hawai'i residents.

Alternatively, the buyer may treat the unit as an investment, renting it all or most of the time the owner is away from Hawai'i. If the rental is available on a long-term contract, the unit is part of the housing stock. If the rental is available to visitors on a short-term contract, the unit is not part of the housing stock. Technically, it is a vacation rental and is removed from total housing to become a commercial accommodation unit.

To the extent that out-of-state buyers treat their homes as second homes or as vacation rentals, the units they purchase are not part of useable housing stock. If out-of-state buyers increase, then the stock projection must go up. DBEDT's measurement of out-of-state land sales shows fewer out-of-state sales every year. Thus, we expect little impact on our projection.

Government Spending on Housing

Government spending affects housing supply in two ways. First, it enables the development of housing units at the low end of the market that would not be built without subsidies. Housing built with government funding can be controlled using deed restrictions or agreements that require the units to remain within the affordable housing stock. Both subjects are treated elsewhere in this report.

To the extent that government funding is increased as a percentage of total construction costs, housing supply can be expected to increase. Federal and state allocations to housing in Hawai'i increased significantly since the last HHPS. In 2019, those allocations returned to their 2014 levels. The $200 million appropriation in 2018 will increase production of rental units during the 2020 through 2025 period.

In-Migration

Planners have long understood that in-migration is related to higher home prices and higher rents. Migrating households represent an instant increase in demand and supply cannot respond fast enough. Some economists have debated this basic model with a counterproposal that the amenities of the receiving municipality were the cause of both in-migration and housing costs. The issues were recently disentangled in an article[56] that showed, even adjusted for the characteristics of the receiving city, in-migration increases housing costs. Further, the contribution of in-migrants to higher housing costs was greater than the contribution of newly formed local households.

Hawai'i has had high in-migration, both foreign and domestic. It has higher amenities than most other States and it certainly has high rents and housing prices. Further, although the research does not describe the mechanism that links migration and shelter costs, it is not unreasonable to expect that in-migration will result in a decrease in supply relative to demand.

This weaker link between in-migration and supply is not likely to affect our projection. The projection model is based on total housing units as affected by population. In-migration is a component of population change and, therefore, already included in our projection figures. Unless there is a very large, short-term increase in in-migration, our projection will not be affected.

Out-Migration

The possible impact of net out-migration is much like our discussion of in-migration. The difference is that Hawai'i is currently experiencing increasing out-migration high enough to cause measurable population decline.

Other components of population change held constant, out-migration will free up housing units and cause an increase in supply without additional construction.

Evidence from the demand survey suggests that an increasing number of people are leaving the state and that lack of affordable housing is one of the primary reasons for their move.

Certainly, if outmigration continues or increases, there will be a positive impact on supply. But our supply projection model, based on population change and outmigration at its projected rate, would not be affected.

3. The Pipeline

The supply projection 2020-2025 is the number of housing units required to accommodate the rate of unit production adjusted for changes in population. It is similar in concept to the housing demand projection produced by DBEDT and is well suited to this project.

The HHPS 2019 scope of services added a request that we investigate housing supply using a "list of existing and planned housing projects in the City and County of Honolulu as the basis for gathering improved or supplemental information" on housing supply.[57] During the final contract negotiations, other counties agreed to supply similar lists so that the analysis could be applied statewide. For this analysis, the existing units are those built between 2000 and 2018 (inclusive). The planned units are those that are expected to be built between 2019 and 2025. The latter are sometimes referred to as units "in the pipeline" and ready to be built.

The County lists were collected, combined, and expanded to accommodate items of interest to one county or another. Results for the State have been summarized in Table 29.

a. Classifying Housing Units

Our definition of "total government-assisted units" is very broad. It includes units that were directly funded by federal, state, or county resources (loans, grants, tax credits, or tax exemptions), units that were supported by government grants for land acquisition or infrastructure, and market-rate units that were developed as part of inclusionary housing policy in which the attached

56 Sharpe, Jamie. (2019 Re-evaluating the impact of immigration on the U.S. rental housing market, *Journal of Urban Economics*, Vol. 111, May 2019, pp. 14-34.

57 Hawai'i Housing Finance and Development Corporation. 2018. RFP No. 18-017-PEO, Addendum No. 4, July 11, 2018, p. 2.

affordable housing was funded by the government.

Table 29 shows the breakdown by project status. Completed units are those that were completed each year according to the definition for each county. Planned units are those that have all the required permits and licenses to be classified as active projects in each county. Preliminary units are those for which plans have been discussed with the counties and have not been cleared as active projects. Some of those are still in very early planning stages.

It goes without saying that the State pipeline numbers are highly influenced by the City and County of Honolulu data. With the lion's share of Hawai'i's population, Honolulu's pipeline list makes up 92 percent of the total. Lists for the other counties are much smaller and reflect their production and planning in recent years.

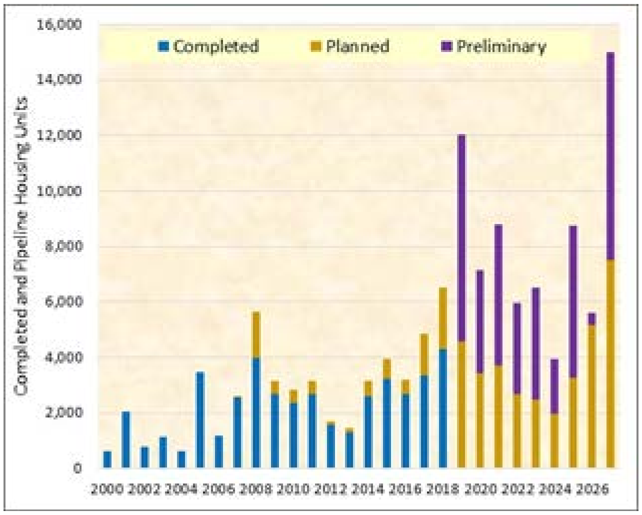
Across the State, government-assisted housing units are continually reclassified in the process of planning and construction. Figure 9 shows one point in time (mid-2019). Completed units resulting from government assistance are produced each year and flow into the housing market. They are shown as blue bar segments from 2000 through 2019.

Table 29. Government-Assisted Housing Units, State of Hawai'i, 2000-2025

	Government-Assisted Units		
	Completed	Planned	Preliminary
2000	606		
2001	2,039		
2002	773		
2003	1,122		
2004	633		
2005	3,465		
2006	1,158		
2007	2,564	15	
2008	3,997	1,651	
2009	2,663	481	
2010	2,352	464	
2011	2,663	494	
2012	1,559	131	
2013	1,292	174	
2014	2,601	532	
2015	3,238	710	
2016	2,674	532	
2017	3,365	1,488	
2018	4,306	2,209	
2019		4,554	7,474
2020		3,519	3,715
2021		3,811	5,112
2022		2,835	3,254
2023		2,474	4,044
2024		2,132	1,955
2025		3,269	5,473
2026		5,173	435
After 2026		10,982	21,604

Source. Government-Assisted Housing lists.

Figure 9. Completed, Planned, and Preliminary Government-Assisted Units, State, 2000-2025



Source: Government-Assisted Housing lists. The last column has been truncated (see text).

Planned units[58] are shown in gold. Note that some "planned units" are listed before 2019. That is an artifact of the list construction method[59]. They are projects that began in a year prior to 2019 and still have units that are scheduled for completion after 2019.

The same situation exists for "preliminary" units. These units in various stages of development, from preliminary project discussions to "only needs one more permit." Those are shown as purple segments.

The last column in Figure 9 has been truncated at 15,000 units. There are 10,982 planned units and 35,205 preliminary units (Table 29) included in that column. Those units represent projects with start dates in the far distant future.

b. Affordable and Market Rate Units

If we trim the end of this 25-year government-assisted housing series, we can get a better idea of what the numbers mean[60] for short-run housing production in Hawai'i. Table 30 shows the number of units built and planned for five years on either side of 2019.

Between 2014 and 2018, there were 6,101 affordable housing units produced in the state – 41 percent of total production. Another 8,590 market-rate units were produced during that same period, for an average of 2,938 units per year. Between 2019 and 2024 (inclusive), there are 12,555 affordable units and 17,155 market-rate units committed and ready for production. The affordable units account for 42 percent of these planned housing units.

On average, 3,300 units were constructed per year for five years before 2019. Of these, 47 percent were affordable. Plans are to build 3,439 units per year in the next five years, 41 percent of which will be affordable.

Table 30. Affordable and Market-Rate Housing Units, State of Hawai'i, 2014-2024

	Government-Assisted Units		
	Affordable	Market Rate	Total
2014	1,425	1,187	2,612
2015	2,051	1,260	3,311
2016	998	1,730	2,728
2017	1,784	1,679	3,463
2018	1,570	2,819	4,389
2019	2,671	3,719	6,390
2020	1,917	2,437	4,354
2021	2,505	4,050	6,555
2022	1,499	2,855	4,354
2023	2,999	2,065	5,064
2024	964	2,029	2,993

Source. Government-Assisted Housing lists.

58 In the City and County of Honolulu, this classification includes "committed" units, those with all permits in order, perhaps awaiting financing.

59 Ours is a list of projects. The classification is for units. Hence, a project that began in 2008 can have units yet unbuilt, or "planned".

60 In the years before 2010, numbers are less reliable because recoding was sporadic. In the years after 2024, the planned and preliminary unit counts may be based on plans that have not been fully conceived.

B. HOUSING DEMAND

The treatment of housing demand estimates and needed units is somewhat different in 2019 that it has been in the past. It begins from Hawai'i's most recent population projections as presented by DBEDT in their 2045 Series.[61]

1. Official Demand Estimates

In December of 2019, DBEDT released the latest update of its housing demand projections.[62] A decline in Hawai'i's population had resulted in a dramatic decline in the State's housing demand estimate from about 66,000 housing units in 2017 to 36,000 units in 2019.

DBEDT housing demand estimates measure the number of housing units required to house the new households each year. Estimates were based on the population residing in households and assumptions about the average household size (household formation).

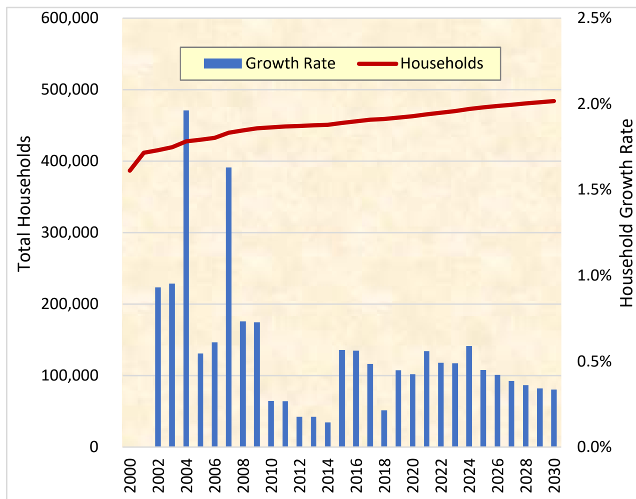
Three estimates were presented. The low estimate assumed that the population decline would continue in the short run and create the need for 25,737 units in 2035. The high estimate assumed that the population decline was an aberration and growth would continue as before 2017. That would result in demand for 46,573 units by 2030. The intermediate number was the average of the high and low estimates and would produce demand for 36,155 units by 2030. For this study we elected to use the intermediate estimate.

The primary driver of the decrease in the housing demand is population decline and the primary driver of the population decline is out-migration. Year-on-year population growth has been falling in all four counties since 2013. In 2017, the population of the City & County of Honolulu fell below its 2016 level and it fell again in 2018. Population growth rates continued to fall on all islands in 2018, the rate of change in Kaua'i County was zero.

The City & County of Honolulu's projections agree with the general direction of the State's projection (albeit for slightly different reasons), and the HHPS Housing Demand Survey found that our projected number of needed units fell between 2016 and 2019.

Figure 10 shows our own household growth estimates 2000 and 2030. The number of households will continue to grow, but at a slower rate than in the past.

Figure 10. Total Households, State of Hawai'i, 2000-2030



Source. DBEDT Data Book Time Series, Table 1.50 2000-2017; SMS estimates based on DBEDT Hawai'i Housing Demand: 2020-2030.

Changing model assumptions will alter results. Using DBEDT's lower population projection rather than the intermediate one would decrease the total number of households and needed housing units. Increasing employment would push up household incomes and release pent-up demand. Increasing interest rates would change the new projection as well. A host of other caveats, discussed in Section II.B.3, below, may affect

[61] Population and Economic Projections for the State of Hawai'i to 2045. Research and Economic Analysis Division Department of Business, Economic Development and Tourism (DBEDT). June, 2018.

[62] Hawai'i Housing Demand: 2020-2030, Department of Business, Economic Development and Tourism, Research and Analysis Division, December 2019.

these projections. In all, we feel confident that the general trends shown for DBEDT's latest Housing Demand Projections and the HHPS estimates of Needed Units reflect the most likely trends for the next five to ten years.

2. Total New Units Needed

Since 1997, HHPS has used population and housing projections along with survey data to develop estimates of unmet demand for housing in Hawai'i. They are called "needed unit estimates" and identify a set of housing units that are of interest to housing planners in Hawai'i.

Our needed units estimate has three components: (1) a 5-year housing demand estimate based on population change only (18,078), (2) a 5-year target for reducing pent-up demand caused by years of supply shortages (28,459), and (3) a 5-year estimate of the number of units needed to accommodate homeless households (3,619).[63] These 50,156 units represent the number (and characteristics) of units useful to planners.

The foundation for our estimates were discussed in previous sections, especially those on demand and supply projections, and the discussion of survey demand estimates.

The needed units estimate will cover housing unit demand for the next five years, 2020 through 2024. A new procedure for calculating needed units was applied on 2019. We calculated the unmet demand portion the same way and adjusted it to accommodate population change, then added units needed to accommodate homeless households entering the affordable housing market.

Table 31 shows summarizes the process used to generate Needed Units estimates for 2020-2024.

Table 31. Procedure for Estimating Unmet Demand, 2019

Element	Number	Comment	Steps	
Total Housing Units, 2019	455,502	total occupied housing units/ households		
Will move	273,632	will move at some time, excludes "never move"	-181,870	never movers
Final demand (10 yr)	186,978	probably move, not sure when, DKRF	-86,654	no plan to move, 10yr or less
Effective demand (10 yr)	141,764	has plan and date to move, will stay in Hawai'i	-45,214	will leave Hawai'i
Needed units (10yr)	60,005	not qualified to purchase or rent, 2019-2029	-81,759	qualified to buy
Needed units (5yr)	28,459	not qualified to purchase or rent, 2019-2024	-31,546	needed Units, 2025-2029
DBEDT est. pop growth	46,537	units needed to house population growth, 2019-2024	+ 18,078	add DBEDT demand 2019-2024
Homeless entering mkt.	50,156	units to house homeless persons entering the market	+ 3,619	add homeless unit estimates
Special needs impact	51,956	units to house special needs persons entering market	+ 1,800	add estimate for special needs

Source: Housing Demand Survey, 2019.

The first four lines of the process were taken from Table 15. There were an estimated 455,502 occupied housing units in Hawai'i in 2019. Based on the HHPS Housing Demand Survey, about 273,632 of these households (60%) were going to move from the current housing unit to another at some time in the future. Of those, 86,654 might move (32%) but had no idea when that would happen or were sure it would not happen in the next ten years. Since we were trying to measure demands for the next five or ten years, we subtracted those households to get our estimate of final demand at 186,978 households. We then subtracted 45,214 households (24%) who reported that they would be looking for a unit outside the State of Hawai'i when they next moved. That produced our estimate of Effective Demand of 141,674 households.

63 We eliminated units needed for special needs groups entering the housing market because our numbers were not strong enough. That makes our needed units estimate a conservative one.

We used survey data to classify households as either qualified or unqualified to purchase the unit they were looking for in the next ten years. Qualification procedures were applied separately for would-be owners and renters and then combined. That produced our ten-year estimate of unmet demand at 60,005 units.[64] The ten-year estimate was divided in half to produce the 5-year estimate of unmet demand at 28,459.[65]

Next, the unmet demand estimate was adjusted for population change. DBEDT Housing Demand Projections were also ten-year estimates. We halved them and added those 18,078 units to the unmet demand estimate.

Finally, we added the 3,619 affordable housing units needed to accommodate homeless households entering the housing market between 2020 and 2025 (Table 32). That gave us our estimate of 50,156 needed units in 2019.

The DBEDT demand estimates and homeless units seem reliable enough, but perhaps we should focus for a moment on the ten-year unmet demand estimate. First, we note that needed unit estimates have been about the same for the last three HHPS -- 60,000 units (± 4,000) since 2011.

There were 59,215 doubled-up-with-family units in 2019 and 25,213 of those wanted to move but could not for financial reasons. There were 34,002 households doubled-up with unrelated individuals who wanted to move but could not for financial reasons. In summary, we find 59,215 doubled-up households, which is indicative of unmet demand and consistent with our 50,156 needed units.

The percent of doubled-up households was 13 percent in 2019. These were households with more than one family per housing unit, sharing a unit with other relatives.[66] Crowding figures are about the same as doubled-up: 13.6 percent in 2019.[67] We don't have a national figure for doubled up, but in 2017, crowding in Hawai'i was the highest in the nation.[68]

Other data suggest pent-up demand is high in Hawai'i. Pent-up demand is high where there are many multi-generational households. There were 42,213 such households[69] in Hawai'i in 2019. That was 13.3 percent of all households, consistent with 13.6 percent crowded and 13.0 percent doubled up. In 2017, the U.S. Census reported 36,424 multi-generational households, about 8.0 percent of the housing stock.

Pent-up demand is high where there are relatively high numbers of households with hidden homeless persons in them. In 2019, there were more than 90,000 households in Hawai'i.

Pent-up demand is high where there are higher numbers of subfamilies. In 2017, the Census identified 36,566 subfamilies[70] in Hawai'i or 8.0 percent of all occupied housing units. Nationally the Census found 3.3 percent of occupied housing units with at least one subfamily. Hawai'i's subfamily rate is 2.5 times higher than the national rate.

Pent-up demand is high where there are many millennials living at home with parents or other relatives.[71] In 2017 there were 308,956 adults aged 18 to 34 in Hawai'i – 29 percent of the adult population. That was about the same as the percent of young adults in the nation that year (30%). Nationally, 35 percent of those young adults were living at home with their parents or other relatives. In Hawai'i, the comparable figure was 64 percent.

Table 32 shows needed units by HUD income guidelines. The guidelines are also qualifications for assistance through HUD programs.

[64] In 2016 the figure was 64,693 units in 10 years, indicating that our unmet demand estimate fell between 2016 and 2019. That was expected due to decreasing population and the increase in units produced since 2016.

[65] This number cannot be compared with the 2016 HHPS Report. We substituted the DBEDT Housing Demand Projection figure that year.

[66] Excludes sharing with non-relative. HHPS 2019, Table 45, p. 7.

[67] Same definition as the Census. Table 4, Page 7.

[68] ACS 2017, 5-yr estimates, Table B25014.

[69] Three or more generations in one housing unit, self-reported in the HHPS 2019 Housing Demand Survey. Distinguish this from the multi-generational (2 or more) data reported for Native Hawaiians on page 73.

[70] ACS, Table B11013, 5-yr estimates, Hawai'i and United States, 2017.

[71] See Broberg, Brad. 2018. The State of Housing Supply and Demand, *On Common Ground*, National Association of Realtors, December 12, 2018; Freddie Mac. 2018. Young Adults and Household Formation Report, March 16, 2018; Joint Center for Housing Studies. 2019. The State of U.S. Housing in 2019, JCHS for Harvard University.

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Table 32. Needed Housing Units by HUD Income Classification, Counties & State of Hawai'i, 2020-2025

	Total Units Needed, 2020 through 2025								
	HUD Income Classification								
	LT 30	30 to 50	50 to 60	60 to 80	80 to 120	120 to 140	140 to 180	180+	Total
State of Hawaii	10,457	5,730	3,141	6,910	6,055	4,011	5,854	7,997	**50,156**
Ownership Units	2,135	1,158	1,352	3,755	3,320	2,156	3,982	5,734	23,590
Single-Family	1,719	764	805	2,981	1,866	1,470	2,623	4,593	16,822
Multi-Family	415	393	547	773	1,454	685	1,359	1,141	6,768
Rental Units	8,322	4,573	1,789	3,155	2,735	1,855	1,872	2,263	26,566
Single-Family	3,257	1,871	471	1,724	986	1,047	851	1,149	11,355
Multi-Family	5,065	2,702	1,319	1,432	1,749	808	1,022	1,114	15,211
Honolulu	4,200	2,923	1,979	2,944	3,037	1,710	2,405	2,970	**22,168**
Ownership Units	543	520	860	1,772	1,553	1,198	1,622	2,243	10,311
Single-Family	392	190	412	1,271	628	675	866	1,484	5,918
Multi-Family	151	329	448	501	925	523	756	759	4,393
Rental Units	3,657	2,403	1,119	1,172	1,484	512	783	727	11,857
Single-Family	1,070	682	165	513	271	99	156	292	3,249
Multi-Family	2,587	1,721	954	658	1,213	413	627	435	8,608
Maui	1,721	777	492	1,272	740	647	1,800	2,955	**10,404**
Ownership Units	351	253	126	464	211	257	1,104	1,839	4,605
Single-Family	351	230	33	365	157	258	881	1,620	3,894
Multi-Family	0	23	93	99	55	-1	222	219	711
Rental Units	1,370	524	366	808	528	390	696	1,116	5,799
Single-Family	594	418	132	393	333	284	377	561	3,092
Multi-Family	776	106	234	415	195	105	319	555	2,706
Hawaii	3,475	1,356	373	2,285	2,143	1,163	1,198	1,309	**13,303**
Ownership Units	756	285	196	1,413	1,556	561	924	1,012	6,703
Single-Family	687	264	196	1,249	1,081	398	635	911	5,420
Multi-Family	69	21	0	164	474	164	289	102	1,283
Rental Units	2,719	1,071	178	872	587	601	274	297	6,600
Single-Family	1,225	443	49	514	307	384	251	215	3,389
Multi-Family	1,494	628	129	358	280	217	24	82	3,211
Kauai	1,060	674	297	408	136	492	451	763	**4,281**
Ownership Units	484	100	170	105	0	139	333	640	1,971
Single-Family	289	80	164	97	0	140	242	579	1,590
Multi-Family	195	20	6	8	0	0	91	62	381
Rental Units	576	574	127	304	136	352	119	123	2,310
Single-Family	367	328	124	303	75	279	67	81	1,625
Multi-Family	208	246	3	1	61	73	51	42	685

Source: Housing Demand Survey and Hawai'i Housing Model, 2019. Housing units needed to eliminate pent-up demand and accommodate new household formation between 2020 and 2025 for the State of Hawai'i and its counties by preferred tenancy and unit type.

Table 33. Needed Housing Units by Income Classification, Counties and State of Hawai‘i, 2020-2025

	Total Units Needed, 2020 through 2025							
	Income Classification							
	Less than $30k	$30k to $45k	$45k to $60k	$60k to $75k	$75k to $100k	$100k to $150k	More than $150k	Total
State of Hawaii	11,289	5,595	6,009	6,106	6,610	8,303	6,244	50,156
Ownership Units	2,376	1,321	2,732	2,922	4,227	5,529	4,484	23,590
Single-Family	1,832	897	1,927	1,952	2,915	3,859	3,439	16,822
Multi-Family	544	424	805	970	1,312	1,670	1,045	6,768
Rental Units	8,913	4,274	3,277	3,184	2,383	2,774	1,761	26,566
Single-Family	4,246	1,771	1,433	2,040	569	816	480	11,355
Multi-Family	4,667	2,503	1,845	1,144	1,814	1,958	1,281	15,211
Honolulu	3,979	2,539	2,241	2,368	3,439	4,077	3,526	22,168
Ownership Units	515	370	778	1,197	2,174	2,731	2,545	10,311
Single-Family	363	119	356	605	1,273	1,463	1,740	5,918
Multi-Family	152	251	423	592	901	1,268	805	4,393
Rental Units	3,464	2,168	1,462	1,171	1,265	1,346	980	11,857
Single-Family	1,284	347	489	425	378	178	148	3,249
Multi-Family	2,180	1,821	974	746	887	1,169	832	8,608
Maui	2,039	1,174	1,279	1,143	1,734	1,822	1,213	10,404
Ownership Units	460	316	376	490	929	1,224	810	4,605
Single-Family	407	205	282	391	849	1,023	736	3,894
Multi-Family	52	111	94	98	81	201	74	711
Rental Units	1,579	858	903	653	804	598	403	5,799
Single-Family	915	633	451	509	161	255	169	3,092
Multi-Family	664	225	452	145	643	343	234	2,706
Hawaii	3,904	1,497	2,285	1,982	943	1,774	918	13,303
Ownership Units	887	509	1,461	1,209	774	1,129	734	6,703
Single-Family	761	475	1,188	932	472	993	600	5,420
Multi-Family	126	34	273	277	302	136	134	1,283
Rental Units	3,017	988	825	773	169	645	184	6,600
Single-Family	1,555	581	409	377	30	384	54	3,389
Multi-Family	1,462	407	415	396	139	261	130	3,211
Kauai	1,367	385	204	613	494	630	588	4,281
Ownership Units	514	125	117	27	349	445	394	1,971
Single-Family	301	98	102	24	322	381	363	1,590
Multi-Family	213	27	15	2	28	65	31	381
Rental Units	852	260	87	587	145	185	194	2,310
Single-Family	492	210	84	730	0	0	109	1,625
Multi-Family	360	50	4	-143	145	185	85	685

Source: Housing Demand Survey and Hawai‘i Housing Model, 2019. Housing units needed to eliminate pent-up demand and accommodate new household formation between 2020 and 2025 for the State of Hawai‘i and its four counties, by preferred tenancy and unit type.

Table 33 shows the same projection distributed according to the survey income in each county as measured in the Housing Demand Survey.

Tables 32 and 33 show the method of estimating needed units, or pent-up demand, as it has been used since 1997. Experience has shown that the information in those tables is too detailed to serve housing planners and policy-makers in their work.

Figure 11 shows a simpler view of needed units by presenting the total number of units needed by the State and each of the four counties for the next five years. These numbers include those units needed to house new households (as specified in DBEDT's Housing Demand Projection), as well as to address unmet demand and to accommodate current homeless households that will be entering the housing market.

The data provided in Figure 11 is shown without detail regarding unit type (single-family v. multi-family) or tenure (own v. rent). In demand survey data, those details are gathered to serve as part of the analysis. The housing planning function is carried out under the assumption that the preference for single-family owned units can reasonably be filled by providing affordably-priced multi-family or rental units.

Figure 11. Needed Housing Units by HUD Category and Income Classification, Counties & State of Hawai'i, 2020-2025

	Total Units Needed, 2020 through 2025								
	HUD Income Classification								
	LT 30	30 to 50	50 to 60	60 to 80	80 to 120	120 to 140	140 to 180	180+	Total
State of Hawaii	10,457	5,730	3,141	6,910	6,055	4,011	5,854	7,997	50,156
Honolulu	4,200	2,923	1,979	2,944	3,037	1,710	2,405	2,970	22,168
Maui	1,721	777	492	1,272	740	647	1,800	2,955	10,404
Hawaii	3,475	1,356	373	2,285	2,143	1,163	1,198	1,309	13,303
Kauai	1,060	674	297	408	136	492	451	763	4,281

		Total Units Needed, 2020 through 2025							
		Income Classification							
		Less than $30k	$30k to $45k	$45k to $60k	$60k to $75k	$75k to $100k	$100k to $150k	More than $150k	Total
State of Hawaii		10,123	5,679	5,591	5,730	7,191	8,762	7,080	50,156
	Honolulu	3,979	2,539	2,241	2,368	3,439	4,077	3,526	22,168
	Maui	2,039	1,174	1,279	1,143	1,734	1,822	1,213	10,404
	Hawaii	3,904	1,497	2,285	1,982	943	1,774	918	13,303
	Kauai	1,367	385	204	613	494	630	588	4,281

Source: Housing Demand Survey and Hawai'i Housing Model, 2019

3. Housing Demand Projection Caveats

Other demand related issues:

a. Rising Mortgage Rates

An increase in mortgage rates nearly always reduces home sales, particularly among first-time homebuyers. While mortgage rates remain low by historical standards, some experts have been predicting the rates will rise. Zillow predicted a 5.8 percent increase by the end of 2019[72] but we have not yet seen that kind of increase. In fact, in early 2019, observers were reporting that rates were at near-record lows and Freddie Mac was predicting only 4.5 percent rates for July 2019.[73]

In its June 2018 Economic Commentary and Forecast, the Mortgage Bankers Association noted, "We forecast that 30-year mortgage rates will reach 5 percent by late 2018 or early 2019, pushed up by firming inflation, growing deficits, and the strong economy. Faster wage growth is likely to overcome any headwind of increasing mortgage rates, but more home price appreciation in combination with the housing inventory shortage could put a damper on purchase market growth."[74]

Current predictions by the Mortgage Bankers Association have national rates for 30-year fixed-rate mortgages increasing only slightly over the next several years, reaching 5.1 percent in 2021.

In Hawai'i, mortgage rates hover around 3.125 percent for a 30-year fixed-rate mortgage. Interviews with mortgage officers at local banks conducted in March and April 2019 were very positive. They said they expected low interest rates to continue and that qualification guidelines were expected to remain the same. They did note that the market was slowing down a bit – homes staying on the market slightly longer, fewer buyers paying more than asking prices – but there was no mention of belt-tightening. They were handling financing for "a limited number of out-of-state buyers" and expected that to continue.

One stakeholder noted some concern about the declining population in the State and the repercussions to Hawai'i's economy, particularly the banks, construction, and employment. The possibility of a worldwide recession that would impact the travel industry would make residents very nervous about buying was also mentioned.

b. Risk of Recession

Often the threat of a recession can affect the housing market as much a recession itself. The market frequently responds to a potential recession with decreased demand for housing units. As with increasing mortgage rates, this is most prevalent among first-time homebuyers who fear being caught on the front end of declining real estate values.

Economic experts suggest that the odds that the U.S. will be in recession in the next six months increased from 16 percent in May to 19 percent in June. The odds of a recession are low, as none of the classic causes of U.S. recessions—overheating risk, a shock to the economy's balance sheet, or financial imbalances—look worrisome. A decline in consumer sentiment and a drop in housing permits increased the probability of recession, while equity prices and limited initial claims for unemployment insurance benefits helped limit the increase in the odds of a recession.

A recent poll by the Honolulu Star-Advertiser indicated that the level of concern about a recession among Hawai'i residents was evenly divided among those who were concerned, somewhat concerned, and not concerned. If we were to move into a recession, the nature of the housing units needed to meet housing demand predicted in this report would certainly be affected.

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72 Allen, J.D. 201287. Zillow makes its 2019 real estate predictions, *The East Hampton Press & the Southampton Press*, December 28, 2018.

73 Lucas, Tim. 2019. Mortgage rates forecast for March 2019, *The Mortgage Reports Editor*, February 21, 2019.

74 Strong Economic Growth, Rate Hikes to Continue. MBA Economic and Mortgage Finance Commentary: June 15, 2018. Web. 26 June 2018. https://www.mba.org/news-research-and-resources/research-and-economics/forecasts-and-commentary/economic-commentary-archives.

c. Slowing Population Growth

All measures of Hawai'i's population indicate that population growth is slowing, but the timing and degree to which the growth rate will decline is less certain. The most recent Census data estimates that Hawai'i's population declined by about 3,700 people from July 1, 2017 to July 1, 2018. That's the fifth-largest population decline of any state.

Because housing demand estimates are closely tied to anticipated population growth and household formation, changes in the average annual growth rate for the population will necessarily impact demand.

d. Tax Reform

At the end of 2017, when the Tax and Job Act details were just appearing, many housing experts were concerned. Several parts of the act were thought to be problematic and some powerful opponents of those policies reacted strongly[75]. National surveys of housing experts showed them split, but with a plurality of 41 percent predicting pessimistic outcomes[76]. Their objections included:

- **a.** Lowering the threshold for the mortgage interest deduction (MID) to $750,000 or less would be a disincentive to home purchases
- **b.** Deductions for state and local taxes (SALT) were capped at $10,000, thus reducing disposable income that might be applied to home purchases.
- **c.** Increasing the standard deduction was expected to reduce the number of taxpayers who itemize deductions and, therefore, to take SALT or MID deductions in the first place.

All of this was expected to produce a slowdown in home sales in the short run and decreasing home prices by the end of the year.

Results after One Year

One year after they took effect, issues a and b do not seem to be true. Issue c has had some weak effect, but only in high-priced, highly-taxed blue states[77].

On the issue of decreasing the use of SALT and MID deductions, there have been two studies. In one, Zillow looked at taxpayers who took the SALT and MID deductions in tax year 2015 and compared them with taxpayers who took the deductions after tax reform was passed in 2018. They compared the number taking the deductions and the average annual home value appreciation for a year after filing.

Roughly one in five tax filers (22%) used the SALT deduction in a typical U.S. ZIP code in 2015. In those areas, annual home value appreciation in July 2018 was about 0.3 percentage points slower than the pace prior to the passage of tax reform in December 2017. In ZIPs with the most intensive use of the SALT deduction (44% of filers), home value appreciation slowed by 0.6 percentage points.

Controlling for common trends across markets, somewhat slower growth in home value was attributable to tax reform in ZIP codes with high shares of homeowners that historically used the SALT deduction, compared to those areas with less usage historically. The same does not appear to be true for the MID[78].

In another study[79], CoreLogic found no statistical evidence that the new tax law had any impact on

[75] The Tax Cuts and Jobs Act – What it means for homeowners and real estate professional, National Association of Realtors®, 2017 at https://www.nar.realtor/tax-reform/the-tax-cuts-and-jobs-act-what-it-means-for-homeowners-and-real-estate-professionals. This includes NAR reaction to the three issues discussed below, as well as objections to other elements of the proposed law, including some that were removed at NARs' urging.

[76] Zillow's 2018 Q1 Home Price Expectations Survey, as reported in De Vita, Suzanne. 2018. Experts on housing less optimistic as a result of Tax Cuts and Jobs Act, RISMedia.com, Feb 21, 2018, downloaded from https://rismedia.com/2018/02/21/experts-housing-less-optimstic-result-tax-cuts-jobs-act/.

[77] Tarrazas, Aaron. 2018. Housing market showing few ill effects from tax reform, Zillow, August 30, 2018.

[78] Test results were positive but not statistically significant.

[79] Sands, Wade. 2018. What are the effects of the Tax Cuts and Jobs Act on Housing? Corelogic Housing and Policy Division downloaded at https://www.corelogic.com/blog/2018/10/what-are-the-effects-of-the-tax-cuts-and-jobs-act-on-housing.aspx.

home prices or sales between June 1, 2017 and March 1, 2018. That was true no matter what the price of the home was.

Housing experts note problems in the housing market these days (fewer residential building permits, rising mortgage rates, scarcity of land, rising labor costs, and tariffs on building materials[80]). Still, most find that objections to the Tax Cut and Jobs Act were overstated in 2017. Even Lawrence Yun of NAR has said that the Act has had no significant impacts. Other experts say that whatever impact there may have been has been offset by other benefits of the Law, including general economic growth, personal savings prompted by lower taxes, and direct saving attributable to lower tax rates. We note, however, that we have found no empirical studies citing relating those outcomes to the Tax Cuts and Jobs Act.

Regardless, the portents for the future, even by opponents of the Act, do not include serious impacts of the new tax policy on housing prices or construction.

e. Student Loan Debt

Studies suggest that, beginning in the early 2000s, the high cost of a college education was affecting enrollments. The financial industry and the federal government reacted by producing education credit products for both the students and parents. In response, educational institutions raised their tuition and fees, which resulted in a sharp increase in student debt.

By 2019, student debt in the U.S. reached $1.41 trillion and became the second largest credit debt in the country, trailing only mortgage debt.[81]

The mechanism by which student loan debt affects local housing markets is what the Fed calls "complex".[82] On the one hand, student debt can reduce the buyer's ability to accumulate a down payment or qualify for a loan. On the other hand, a college education leads to higher lifetime earnings and insurance against unemployment. In either case, it delays the entrance of young people into the housing market.

Surveys of students with college loans[83] provide some examples of how this works. Fully 87 percent of all student debtors said their loans would delay life choices like marriage, starting a family, and continuing education. Others (61%) said repaying their loans would delay retirement because they would not be able to accumulate enough funds in their retirement accounts.

With respect to the impact on their housing prospects, 20 percent owned a home and 44 percent were paying rent (usually with others). Thirty percent (30%) were living with family or friends and paying little or no rent. Among the 80 percent who did not own a home, 83 percent said their student loans would delay their purchase of a home, 5 percent said there would be no delay, 7 percent said they didn't know if they would be delayed, and 5 percent said they never wanted to own a home. Among those who were living with family before college, 42 percent said their loans forced them to delay moving out of their parents' house.

Discussions with local realtors revealed that Hawai'i's slow home sales are even slower among young people and that the necessity to repay student loans was sometimes mentioned as a problem for young buyers.

In Hawai'i, less than half of the students had student loan debt in 2019, and the average debt was $35,000, up 5.8 percent from 2018. Data were not available at the county level. Hawai'i student debt is just below average in the national student debt scale. That may be due, in part, to lower debt incurred by in-state students. Those who opted to attend mainland schools may have incurred higher debt.

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[80] Tankersley, Jim. 2018. The Trump tax cuts were supposed to depress housing prices. They haven't*", New York Times*, August 27, 2018.

[81] Stolba, Stefan Lembo. 2019. Student loan debt climbs to $1.4 trillion in 2019, Experion.com, June 4, 2019, at https://www.experian.com/blogs/ask-experian/author/stefan-lembo-stolba/.

[82] Guerin, Jessica. 2019. Federal Reserve says student debt has hampered housing market*, HomeWire*, January 17, 2019

[83] National Association of Realtors and American Student Assistance. 2017 Student loan debt and housing report 2017: When debt holds you back, NAR, December 2017.

About half of Hawai‘i’s recent college graduates have some college debt. That number has been rising and we see no evidence that the situation will change soon. In a market characterized by very low inventory, with high and rising prices, college graduates with student loan debt are likely to delay home purchases. The net effect of student loan debt on the housing demand estimates would be negative.

The impact of student loan debt on entry into the housing market may be correlated with the loss of population over the last few years. The decline in population and housing demand since 2017 may involve young people disproportionately. Young people report leaving the state due to lack of opportunities in the kind of jobs they spent the last four years qualifying for and a lack of affordable housing. However, since we have already incorporated the impact of lack of jobs and housing options, perhaps the net impact of student loan debt is insignificant.

f. Homeless/Special Needs Households

The estimated number of needed housing units does not include homeless households or households with special needs. Including units required to accommodate persons entering the housing market from a homeless or residential treatment facility would increase the number of needed units. It would also impact the types of housing units needed between 2020 and 2025.

As outlined in Section III, to provide housing to households requiring minimal support services would require an additional 3,619 housing units. These majority of these units would likely be studio rentals, and about 250 larger rental units would be needed to accommodate larger families. Locating supportive services, such as standard case management, job training, and financial assistance may be needed as well.

It is difficult to estimate the number of housing units needed to accommodate homeless persons with multiple conditions or to estimate the number of affordable housing units that will eventually be needed when other special needs households enter the market.

C. NEEDED UNITS BY INCOME LEVEL

As identified by the Housing Demand Survey, the 2018 median household income for the State was $74,985. The median was somewhat higher for the City and County of Honolulu ($95,404). The median income for Maui and Kaua‘i counties was approximately equal ($74,710 and $74,357, respectively). At $59,473, the annual median household income for Hawai‘i County was well below the state median.

1. Types of Units Needed

Tables 32 and 33 reflect the demand for housing units by county, tenure and unit type for the next five years. They have been estimated for each of eight market levels following U.S. Department of Housing and Urban Development (HUD) income guidelines.

The distribution of needed units by tenure, type, and market-level was developed from Housing Demand Survey data. The analysis employs the assumption that needed units are distributed according to the effective demand estimates from the survey. It also excludes households deemed highly qualified to purchase or rent their next home, as these units will likely be developed by the private sector. The detail produced in this analysis will be useful in a variety of housing planning efforts in the next five years. It is relevant, reliable, and utilitarian.

Effective demand includes only Hawai‘i residents who are planning to move to a unit in the State of Hawai‘i in the next five years. The analysis for Tables 32 and 33 did not account for people who are currently doubled-up for economic reasons.

The lion’s share of the needed units is concentrated at the lowest HUD income levels. This finding suggests that the market is more effective in producing high-end units than low-end units. Inefficiencies are exacerbated in periods of rapid market expansion when fewer low-end units are built. More middle-market and low-end units are built during periods of market adjustment.

Needed units are also concentrated in the rental market rather than the ownership market. Again, the current housing market produces units for sale more efficiently than units for rent.

The estimates in the two tables above reflect the preferences of Hawai'i's likely movers, but do not account for their willingness to accept alternatives or their financial qualifications to make their preferred move. As was noted in the prior section on qualified demand, not every household is financially prepared to pursue their preferred housing situation.

A portion of demand survey respondents who indicated their preference to purchase their next residence conceded that they might have to rent instead. Similarly, several households that intend to buy a single-family home when they move noted that they would consider buying a multi-family dwelling if they could not find a single-family unit they could afford. Finally, a percentage of the survey respondents who indicated that they would be purchasing their next unit also reported that their current financial situation was incompatible with that goal (currently living in public housing, receiving Section 8 assistance, or with no money for a down payment).

We did not explicitly include nearly 60,000 respondent households that were doubled up. Many of those households were, however, included because one or both families in the households were unqualified to buy or rent another unit on their own.

Housing units needed to accommodate homeless persons re-entering the housing market were included in Tables 32 or 33. Households entering the affordable housing market from Special Needs housing have not been included in those tables. Most are in group quarters (prisons, dormitories, nursing homes, etc.) but some are located outside the market (homeless persons, for example) and some, like youths exiting foster care, are living with their foster families in occupied housing units. The data on this group, along with the process by which they enter the marketplace, are not yet clear enough to speculate on the number of units they might require in any given year. We are certain, however that including them would increase the number of needed units in Table 32 and 33.

Applying any one of these possible adjustments to the needed units' tables will result in a shift in the total number and type of housing units needed to accommodate Hawai'i's residents by 2025.

2. Units for Elderly Housing

Analysis was also conducted to identify the subset of total needed units that would be required to accommodate elderly households, that is, households with one or more persons 60 years of age or older, no children under the age of 18, and no persons other than immediate family. Of the 50,156 units needed for households between 2020 and 2025, 13 percent were for elderly households statewide (6,714 units; Table 34). This is up from 9 percent in 2016. All other needed units referenced here as "family units", would be for the use of all other types of households.

Considering just the units needed for elderly households, about 29 percent (1,967 units) are needed for low- and moderate-income households (80% AMI or less). The demand for single-family versus multi-family units was almost evenly distributed among elderly households. Of the 6,714 needed elderly units, there was demand for 3,129 (47%) single-family dwellings.

Table 34. Needed Housing Units by HUD Income Classification, Elderly Persons, Counties and State of Hawai‘i, 2020-2025

	Total Units Needed, 2020 through 2025								
	HUD Income Classification								
	LT 30	30 to 50	50 to 60	60 to 80	80 to 120	120 to 140	140 to 180	180+	Total
State of Hawaii	400	751	113	704	1,273	678	901	1,894	6,714
Ownership Units	358	190	64	400	772	349	653	1,723	4,509
Single-Family	282	0	14	354	363	152	423	1,229	2,818
Multi-Family	78	190	50	52	412	177	229	503	1,691
Rental Units	23	542	39	308	506	354	250	183	2,205
Single-Family	0	0	0	39	44	100	96	32	312
Multi-Family	23	542	39	269	462	253	154	151	1,894
Honolulu	288	714	72	538	1,159	436	486	1,330	5,022
Ownership Units	288	185	50	273	703	193	331	1,237	3,261
Single-Family	211	0	0	223	291	96	198	764	1,783
Multi-Family	78	185	50	50	412	97	133	473	1,478
Rental Units	0	529	22	265	456	243	154	93	1,762
Single-Family	0	0	0	0	0	0	0	0	0
Multi-Family	0	529	22	265	456	243	154	93	1,762
Maui	62	6	16	21	26	75	208	275	689
Ownership Units	43	0	0	16	10	29	197	233	528
Single-Family	43	0	0	16	10	29	146	203	447
Multi-Family	0	0	0	0	0	0	51	30	81
Rental Units	13	4	11	4	25	58	16	30	162
Single-Family	0	0	0	0	25	47	16	0	89
Multi-Family	13	4	11	4	0	10	0	30	73
Hawaii	49	22	15	132	88	167	160	155	787
Ownership Units	27	0	0	109	59	127	99	155	576
Single-Family	29	0	0	116	62	27	79	164	476
Multi-Family	0	0	0	0	0	81	20	0	100
Rental Units	9	9	6	29	25	53	80	0	211
Single-Family	0	0	0	29	19	53	80	0	180
Multi-Family	9	9	6	0	6	0	0	0	31
Kauai	0	9	11	13	0	0	48	134	215
Ownership Units	0	5	14	2	0	0	26	98	144
Single-Family	0	0	14	0	0	0	0	98	112
Multi-Family	0	5	0	2	0	0	26	0	32
Rental Units	0	0	0	10	0	0	0	60	70
Single-Family	0	0	0	10	0	0	0	32	42
Multi-Family	0	0	0	0	0	0	0	28	28

Source: Housing Demand Survey and Hawai‘i Housing Model, 2019.

IV. HOUSING ISSUES

A few housing issues associated with housing in Hawai‘i were selected for special attention in 2019. These included housing for persons with special needs, homelessness as a housing issue, the impact of the visitor industry on residential housing, homelessness as a housing issue, housing for Native Hawaiians, and two others.

A. SPECIAL NEEDS HOUSING IN HAWAI‘I

Beginning in 2011, the HHPS identified housing-related issues among persons belonging to ten special needs populations in Hawai‘i including:

- The elderly (age 62 and older) and frail elderly (elderly with physical or mental limitations that may interfere with their ability to independently perform activities of daily living)
- Persons with severe mental illness.
- Persons with alcohol and/or other drug addiction
- Persons with physical disabilities
- Persons with developmental disabilities
- Persons with intellectual disabilities
- Persons living with HIV or AIDS
- Victims of domestic violence
- Emancipated foster youth
- Exiting offenders

Many members of special needs populations live in existing households. Depending on their specific needs, they may be cared for by family members, engage services that come to the home, or have modifications done to their home to enable them to remain in place.

Some special needs persons may receive/require some public assistance or services to enable them to live in their current household. Others are transitioning from care programs and may need extra assistance finding or paying for appropriate housing.

A third group needs residential service programs or other group quarters that provide substantial levels of service delivered onsite. These persons with special needs may create demand for housing that is separate from, and in addition to, the rest of the residential housing market.

1. Demand for Special Needs Housing

Persons in special needs populations may experience challenges in obtaining or retaining housing. Low income, the need for supportive services in or near their homes, and the temporary nature of some special needs services can keep them from securing adequate and affordable housing.

a. Economic Barriers to Accessing Housing

Persons with special needs are often unable to afford adequate market-rate housing due to low rates of employment. For example, persons with substance addiction were more likely to be unemployed than employed.[84] Survivors of domestic violence were absent from work for an average of seven days at a time.[85] This resulted in a considerable loss of income.

Persons exiting prison leave without cash, food, transportation, or community support.[86] Many had less than high school diplomas, lacked adequate job training or work experience, and many suffered a physical disability or mental illness. There is also a bias against hiring former prisoners. As a result, it was difficult for exiting offenders to obtain steady work at pay rates high enough to afford market-rate rents.[87]

Though most of them do not require support in activities of daily living, exiting offenders will move into transitional housing if available. Ideally, transitional housing for exiting offenders provides substance abuse treatment, reintegration

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84 Substance Abuse and Mental Health Services Administration, *Results from the 2018 National Survey on Drug Use and Health: Summary of National Findings*.

85 Rothman, Hathaway, Stidsen, & de Vries (2007). How employment helps female victims of intimate partner violence. *Journal of Occupational Health Psych*, 12, p. 136.

86 Comprehensive Offender Re-entry Plan, State of Hawai‘I Department of Public Safety, 2019.

87 Urban Institute Justice Policy Center (2008). Employment After Prison: A Longitudinal Study of Releases in Three States. October, 2008. http://www.urban.org/sites/default/files/alfresco/publication-pdfs/411778-Employment-after-Prison-A-Longitudinal-Study-of-Releasees-in-Three-States.PDF.

counseling, and support services that encourage adherence to terms of release and promote successful reintegration into the community. In September 2019, the State's only Federal Halfway House is closing, and no replacement has been identified.[88]

Most young adults who exit the foster care system need to secure their own housing when they age out of the foster system. There are state- and federally-funded programs to facilitate transition from foster care to independent adulthood. Young people exiting foster care are less likely than average to have a high school diploma and many have difficulty finding employment that would qualify them for market-rate rentals.[89]

b. Need for Special Services

Although public housing, Section 8, and other similar housing support programs help to mitigate the economic barriers to accessing housing, many special needs persons may need access to support or treatment services delivered at or near their residence.

Table 35. Households with someone who has challenges performing activities with daily living[90]

At least one person in a household	O'ahu	Maui	Hawai'i	Kaua'i	Statewide
Difficult to walk or climb stairs	52,424	9,178	12,077	3,339	81,018
Difficult to bathe or dress themselves	19,587	3,015	3,181	1,192	27,575
Difficult to travel	28,857	5,042	1,441	1,730	42,688

As shown in Table 35, 81,018 households stated that "someone in their household had a physical, mental or emotional condition that makes it difficult to walk or climb stairs." Roughly 27,575 households included at least one member who had difficulty bathing or dressing themselves. In 42,688 households statewide, at least one member had a physical, mental, or emotional condition that made it difficult to travel to doctor's offices or shopping places. In these households, at least one member may require assistance with activities of daily living. This assistance may be provided by another family member or by a commercial vendor.

Table 36. One-person Households with someone who has challenges performing activities with daily living[91]

One Person Households	O'ahu	Maui	Hawai'i	Kaua'i	Statewide
Difficult to walk or climb stairs	15,147	2,250	3,221	753	21,370
Difficult to bathe or dress themselves	4,031	344	718	159	5,252
Difficult to travel	8,172	1,014	1,655	305	11,146

Nineteen to 26 percent of Hawai'i households are single-person households (Table 36). Persons in these households, along with households that include frail elderly, persons with advanced terminal illness, or persons with severe mental or physical disabilities, may be unable to perform activities associated with daily living. They are unable to live alone and will require shelter in group quarters where daily living support and medical treatment are available.

Persons with substance addiction will often enter residential facilities where treatment and counseling are integrated into the residential context. During long-term residential treatment, an addict will go through a course of treatment and receive counseling, job training, and other support services.[92] Upon the completion of residential treatment, persons recovering from substance addiction may move into sober houses, a form of transitional housing.

Victims of domestic violence require shelter that provides protection from abusers and that facilitates access to childcare services, financial and employment support services, and counseling.

c. Special Needs Housing is Often Temporary

If a person with special needs does secure affordable housing with access to support services, the challenge shifts from *becoming* housed to *staying* housed.

[88] *Hawai'i's Only Halfway House is Closing, Putting More Offenders Behind Bars*, Civil Beat, August 20, 2019.

[89] Hawai'i Kids Count (2012). Issue Brief. Improving Outcomes for Youth Transitioning Out of Foster Care. http://www.yeshawaii.org/wp-content/uploads/2015/09/TUES-HawaiiKidsCountBrief.jpg.

[90] HHPS Housing Demand Survey 2019.

[91] HHPS Housing Demand Survey 2019.

[92] National Institutes of Health, National Institute on Drug Abuse (2012). Principles of Drug Addiction Treatment: A Research-Based Guide (3rd ed.).

Housing in residential service programs - from domestic violence shelters to prisons - are, by their nature, temporary. After a designated period, residents are expected to move into permanent housing. Sponsoring agencies provide housing support only if their funding lasts.

d. Special Needs Persons in Need of Housing

Estimating the number of persons with special needs who need housing is challenging for a variety of reasons.

First, it is often difficult to estimate the number of people in the State who have a specific special need. Even when we have a population estimate, the number of persons who need housing is often unknown. Census estimates of the frail elderly and persons with disabilities say nothing of their housing need (all such persons are sheltered in existing households), and breakdowns of the group quarters population are not published.

Second, many agencies that serve persons with special needs are not required by contract or charter to provide housing. They may not know the housing needs in their target populations. Some may even provide housing referrals but keep no record of services provided outside of those required by charter or contract.

Third, co-occurring disorders are common in this group. In one study, 40 percent of persons with mental health problems also reported substance use problems.[93] About 65 percent of incarcerated persons have substance abuse issues.[94] Victims of domestic violence are more likely than other individuals to have HIV, mental health difficulties, or substance dependence, stemming from their abuse.[95] Co-morbidity causes double-counting and inflates housing need estimates.

Table 37. Special Needs Group Sizes

Special Needs Group (Statewide)	Number Persons	Source
Elderly-Related		
Elderly (65+) (2017)	253,750	2017 ACS
Elderly (65+) with any Disability (non-institutionalized) (2017)	82,723	2017 ACS
Elderly (65+) living alone (2017)	44,001	2017 ACS
Persons receiving Aid to Aged, Blind & Disabled (2016 average per month)	928	Hawai'i DHS Data Book January 2017
Substance-Abuse Related		
Substance abuse offenders in treatment programs (2017)	4,922	Substance Abuse & Mental Health Svcs. Admin. Behavioral Health Barometer, Hawai'i Volume 5, Released 2019, data from 2017 Survey
Persons with Substance Abuse (2017)	85,000	Substance Abuse & Mental Health Services Admin. Behavioral Health Barometer, Hawai'i Volume 5, Released 2019, based on data from 2017 Survey
Domestic-Violence Related		
Survivors in shelters one night 2018	445	13th Annual Domestic Violence Count , Hawai'i Summary conducted 09/13/18, SMS Calculation
Survivors with unmet requests for shelter one night.	29	13th Annual Domestic Violence Count, Hawai'i Summary conducted 09/13/18, SMS Calculation
Persons living with AIDS/HIV (2017)	2,393	HIV/AIDS Surveillance Report, State of Hawai'i DOH, December 31, 2017
Persons with Serious Mental Illness, Adults 18+ (2017 Average of five years)	36,000	Substance Abuse & Mental Health Services Admin. Behavioral Health Barometer, Hawai'i Volume 5, Released 2019, based on data from 2017 Survey
Paroles and Ex-offenders	852 per year	2018 Annual Statistical Report, Fiscal year 2018, Hawai'i Paroling Authority
Foster Care Children Exiting because of Emancipation (2016)	66	Hawai'i DHS Data Book January 2017

[93] Substance Abuse and Mental Health Services Administration (2016). Mental and Substance Abuse Disorders.

[94] The National Center on Addiction and Substance Abuse (2010). *Behind Bars II: Substance Abuse and America's Prison Population*.

[95] World Health Organization (2013). *Global & Regional Estimates of Violence Against Women: Prevalence of Health Effects of Intimate Partner Violence and Non-Partner Sexual Violence*.

Nevertheless, it is necessary to develop some estimate of the size of the special needs population. Table 37 presents some estimates of the number of persons in each special needs population. The counts are duplicated across categories and not every person with a special need requires housing.

Table 37 illustrates the challenge of determining the size of special needs groups and the size of the number of people currently being served. To better identify future needs for residential services with wrap-around services, a new approach needs to be developed. Ideally, this approach will correspond to the types of care facilities that are available. For example, instead of considering aged individuals as a group, we could identify the characteristics of adults age 65+ who use the services of a residential care facility versus a skilled nursing facility or other service provider. Once these characteristics are grouped by type of facility, we can better estimate total demand.

2. Inventory of Special Needs Housing

In this section, we deal with challenges in trying to assess system capacity for housing persons with special needs. Where available, we include data on type of facilities and vacancies.

Eight facilities statewide offer temporary shelter for survivors of domestic violence. The capacity of these shelters varies because some have a "no turn away" policy meaning they will accommodate as many survivors and family members as necessary. Stays at these facilities can last up to 120 days. During their stays, staff members work with survivors to find appropriate long-term residences.[96]

A "Special Treatment Facility" is a facility that provides a therapeutic residential program for care, diagnosis, treatment, or rehabilitation for socially or emotionally distressed persons, mentally ill persons, persons suffering from substance abuse, and developmentally disabled persons. There are 24 such facilities in the State: four on Hawai'i Island, one on the island of Maui and 17 on O'ahu. It is unclear the number of beds or vacancy level for each facility.[97]

"Therapeutic Living Programs" (TLPs) are long term (up to 6 months) residential programs for adults with severe and persistent mental illness who do not need the care of a specialized treatment facility. The primary goal of the program is to assist clients in meeting their basic needs until they can transition into an independent living option of their choice. Support is flexible, focused, and based on recovery. There are nine TLPs statewide: four on Hawai'i Island, one on the island of Maui, and four on O'ahu. It is unclear how many beds or vacancies for each of these facilities.[98]

"Developmental Disabilities Domiciliary Homes" are described under *Chapter 333F of Hawai'i Revised Statutes-Services for Persons with Developmental Disabilities or Mental Retardation.* They provide 24-hour supervision or care, excluding licensed nursing care, for a fee, to not more than five adults with mental retardation or developmental disabilities. There are 45 of these facilities statewide: one on Hawai'i Island, three on Maui and 41 on O'ahu. The number of beds and the occupancy rates for these facilities are unknown.[99]

"Community Care Foster Families" serve the aged and disabled persons by providing housing, supervision, direct care, and management of resident's non-medical and medical service needs. As shown in Table 38 below, there are 1,166 homes with 2,975 beds statewide. This is a significant increase from the 492 homes and 1,203 beds in 2016. These homes serve a mix of Medicaid and private pay patients.[100]

Table 38. Community Care Foster Families

	O'ahu	Maui	Hawai'i	Kaua'i	State
Number of Homes	957	57	130	22	1,166
Capacity	2,433	139	350	53	2,975

[96] Hawai'i State Coalition Against Domestic Violence.
[97] Hawai'i Department of Health, Office of Healthcare Assurance, State Licensing Section, January 2019.
[98] Hawai'i Department of Health, Office of Healthcare Assurance, State Licensing Section, January 2019.
[99] Hawai'i Department of Health, Office of Healthcare Assurance, State Licensing Section, January 2019.
[100] Hawai'i Department of Health, Office of Healthcare Assurance, State Licensing Section January 2019.

Table 39 shows the number and capacity for Adult Residential Care Homes (ARCH) and the number of EXP (Expanded Services Programs) and ARCH II EXP, which are ARCH II with expanded services).

Table 39. Adult Residential Care Homes, Hawai'i, as of January 2019

	Number Homes	Capacity	Vacant	Vacancy Rate
ARCH I	200	882	542	61%
ARCH II	4	109	85	78%
Total	204	991	627	63%
EXP	222	1098	676	62%
ARCH II EXP	35	423	315	74%
Total EXP	257	1521	991	65%
Grand Total	461	2512	1618	64%

ARCH I and ARCH II are intended to serve adults with minimal service needs, assist with activities of daily living. EXP and ARCH II-EXP provide 24-hour assistance with activities of daily living. These two programs also provide skilled nursing services, if needed. Statewide, there are 461 licensed ARCH homes providing 2,512 beds. This is a decrease of 23 homes and 154 beds compared with 2016. As of the last report noted above, 64 percent of these beds were vacant.

Table 40. Assisted Living Facilities, Hawai'i, as of January 2019

	O'ahu	Maui	Hawai'i	Kaua'i	State
No. Facilities	14	1	1	1	17
Capacity	2,219	144	220	100	2,683

Assisted Living Facilities (Table 40) provide a combination of housing, meal services, health care services, and personalized support services designed to respond to individual needs. Statewide there are 14 facilities with a 2,683 bed capacity.[101] This is a decrease of one facility since 2016, but an increase of 283 beds.

Table 41. Skilled Nursing and Intermediate Care Facilities, Hawai'i, 2019

	O'ahu	Maui	Hawai'i	Kaua'i	State
No. Facilities	28	3 +1	9	5	46
Capacity	2,830	459	886	333	4,508

Hawai'i's Skilled Nursing and Intermediate Care Facilities (ICF) provide types of care like those provided by ARCH homes but are housed in larger facilities (Table 41). ICF provides 24-hour assistance with activities of daily living and care provided by licensed nursing and paramedical personnel on a regular long-term basis.

Skilled nursing facilities provide skilled nursing and related services to residents who require 24-hour medical or nursing care or rehabilitation services. Statewide 46 facilities offer this level of care with 4,508 beds.[102] This is a decrease of four facilities and an increase of 153 beds.

Table 42 shows the number of Intermediate Care Facilities for Individuals with Intellectual Disabilities. Statewide there are 17 facilities with a total of 86 beds.[103] This is a decrease of one facility and two beds.

Table 42. Other Intermediate Care Facilities, Hawai'i, 2019

	O'ahu	Maui	Hawai'i	Kaua'i	State
No. Facilities	13	4	0	0	17
Capacity	62	24	0	0	86

Combining Community Care Foster Families, ARCH, Assisted Living Facilities, SNF and ICF, there are 12,754 beds providing different levels of care. This is a 19 percent increase over 2016 (2,006) primarily because of the increase in Community Care Foster Families.

[101] State of Hawai'i Department of Health, Office of Health Care Assurance, Medicare Facilities, June 23, 2016.

[102] State of Hawai'i Department of Health, Office of Health Care Assurance, Medicare Facilities, July 2019.

[103] State of Hawai'i, Department of Health, Office of Healthcare Assurance, Medicare Section, July 2019.

3. Needed Units for Special Needs Population

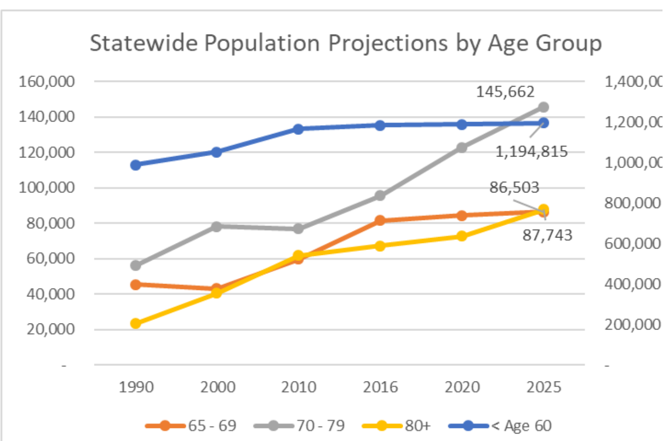
There are three types of units required for this population: units in care homes with appropriate services, temporary units in transitional programs, and housing units for people exiting programs.

a. Currently in Housing, Need for Care Homes/Facilities, or in-Home Services.

The largest special needs group is the elderly. The projection by age that DBEDT provided in its 2045 Series Report indicates that the population for the State below age 65 will grow very little between 2020 and 2025. However, the number of persons aged 65+ will increase significantly from 279,686 to 319,908 (14%; Figure 12).

Based on the 2020 65+ population, we have one "bed" in a care home/facility for every 22 seniors. By 2025, the number of 65+ seniors is projected to increase by 14 percent. If the need continues to be the same, the state will require a total of 14,541 beds, an increase of almost 2,000 beds.

Figure 12. Population Projection, State of Hawai'i, 1990-2025



With only 4.5 percent of seniors cared for in a home or facility, it is likely that family or care services will be required for many of the other 300,000+ seniors in the state age 65+. These seniors will choose to, or will have to, remain in their homes or with family, many of these homes will require retrofitting such as grab bars, ramps, emergency call systems, special telephones for the blind, etc.

Individuals with serious mental illness may also be seeking beds in a home or facility. The number of persons with SMI is assumed to increase proportionally between 2020 and 2025. In 2017, 36 percent of individuals with any mental illness received some type of service (including residential). Assuming this group still makes up 3.3 percent of the population, this would equate to 2,250 individuals by 2025.

b. Need for Shelter/Clinics/Transitional Housing, then Permanent Housing

The special needs groups seeking residential shelters/clinics (a form of transitional housing) are domestic violence survivors, persons with foster care, and perhaps persons with HIV/AIDS.

There are 19 identified domestic violence programs in Hawai'i, not all of which provide shelter for survivors.[104] In one night in 2018, there was an estimated need for 474 units for survivors and it is likely that many had children that stayed with them. Domestic Violence service providers believe the need is much higher and hope that, over time, more people who are abused will seek assistance. Assuming identified need increases at the rate of population for 20+, an additional 15 to 20 units will be required at a minimum by 2025. Most of the survivors exiting the shelter will need affordable, safe housing.

There are 4,922 Substance Abuse offenders in treatment programs. Some of these programs are residential treatment facilities. If the number of offenders increases at the same rate as the population, there will be 5,080 offenders seeking treatment in 2025. Likewise, current residential treatment programs will have to increase their availability accordingly. Upon the completion of residential treatment, persons recovering from substance addiction may move into sober houses, many of which are expected to be transitional in nature. Upon completion of the program, they will

[104] 13th Annual Domestic Violence Count , Hawai'i Summary conducted 09/13/18,

need assistance finding housing and subsidies to pay for rent while seeking employment.

The Hawai'i Paroling Authority identified 852 parolees and exiting offenders in one year. Ideally, most of them will have spent time in transitional housing prior to leaving the facility to provide them the resources and skills they will need to acclimate to community living. Unfortunately, the only Federal transition facility is closing in late September 2019, and it is unclear how many State facilities are available. The need is for group homes with specialized services that can accommodate at least 426 (assume a stay of six months) soon to be released or placed on parole offenders. Upon leaving the transitional home, there will be a need for assistance to find around 852 housing units per year. It is unclear if the number released per year will grow in the next five years.

Each year approximately 66 youth age out of the Foster Care system. There is a need for a transitional-type group setting for them that provides the training and resources to find employment, apply for scholarships, grants, and find affordable housing. By 2025 an additional ten spaces/units per year will be needed.

Approximately 2,393 individuals have AIDS/HIV. Based on the HMIS analysis (to be discussed in the next section), there were 107 persons who had been served in by a homeless program who self-identified as having HIV/AIDS and of these 28 exited to permanent housing. Having a transitional option while waiting for permanent housing will be beneficial for this group.

Overall, just based on the Special Needs Group discussed here, there is a significant need for:

- Care facilities and/or home service providers for the elderly and for persons with serious mental illness;
- Transitional shelters/clinics for
    - Domestic Violence Survivors
    - Substance Abuse Offenders
    - Paroles and Ex-Offenders
    - Emancipated Foster Care Youth
    - Persons with AIDS/HIV.
- Permanent housing available when persons exit their transitional shelters/clinics. Generally, these groups will require subsidized housing and assistance in finding housing.

4. Recommendation

As the population of Hawai'i continues to grow and age, identification of the demand for, and inventory of, special needs housing demand and supply will become more important. Even as we recognize that not every individual that has a special need will require a specific housing option, over time a better tool for projecting and tracking this population will be in order.

The following section on homelessness uses the data available in the State's Homeless Management Information System (HMIS). The data from the HMIS feeds into a coordinated entry system that matches homeless persons with available housing. The system identifies the specific needs within the population to enable a better match of supportive services required.

In fact, many of the people in the Special Needs group will become homeless if not offered both the transitional places to retreat and prepare for permanent housing and assistance in finding and funding permanent housing rental units upon leaving the transitional programs.

We strongly recommend that the State and County agencies serving persons with special needs begin exploring how to use HMIS data to determine the programs special needs persons will need in conjunction with housing.

B. HOMELESSNESS IN HAWAI'I

1. Introduction

Homelessness in Hawai'i is a persistent and vexing problem. Thousands of individuals and hundreds of families struggle to access and maintain housing while local, state, and federal governments funnel millions of dollars into outreach, shelter, housing, and service programs to curtail the problem.

Needs in the homeless community are diverse, but one constant is the need for permanent housing. To end homelessness, we must begin by ensuring the availability of housing units necessary for this sector of the population.

In accordance with Housing First best practice principles, now adopted federally and locally, it is understood that people need the safety and stability of a home in order to address challenges and pursue opportunities.[105] The availability of permanent housing is if we are to sustainably house Hawai'i's homeless. Additionally, a supply of supportive housing and service programs is needed to assist those dealing with the disabilities and life challenges that often compound housing struggles. Issues like mental illness, substance abuse, physical and developmental disabilities. Housing First prescribes that these issues are best dealt with once a person is stably housed.

HHPS 2019 continues to support the position that the lack of affordable housing is the primary driver of homelessness and that poverty and pathology are secondary issues.[106] That viewpoint is also reflected in Hawai'i's primary housing planning document, the Consolidated Plan (HHFDC 2015).

a. Definition of Homeless Status

The definition of homelessness has been refined since the last HHPS. HUD has added four categories of homelessness in its recent Final Rule Defining Homeless.[107]

1. Individuals and families who lack a fixed, regular, and adequate nighttime residence including an individual who is exiting an institution where he or she resided for 90 days or less and who resided in an emergency shelter or a place not meant for human habitation immediately before entering that institution;
2. Individuals and families who will imminently lose their primary nighttime residence;
3. Unaccompanied youth and families with children and youth who are defined as homeless under other federal statutes who do not otherwise qualify as homeless under this definition; and
4. Individuals and families fleeing, or attempting to flee, domestic violence, dating violence, sexual assault, stalking, or other dangerous, life-threatening conditions related to violence against an individual or family member.

b. Context, Policies and Impact

Hawai'i homelessness began an unprecedented climb in 2010, with overall numbers increasing 26 percent statewide by 2016.[108] Unsheltered numbers increased even more significantly, climbing 47 percent during the same time period. Homelessness had become one of the most visible issues in the state.

By 2014, momentum gathered around system-level changes to the homeless service system. Pilot projects and the implementation of several new evidence-based strategies were well underway, including the development and utilization of the Vulnerability Index & Service Prioritization Decision Assistance Tool (VI-SPDAT) to assist in identifying the highest need clientele.[93] This included new funding and increased investment in proven and strategies such as homeless prevention, Rapid Rehousing, Coordinated Entry, and an enhanced focus on Housing First practices within existing programs.

105 USCIH, https://www.usich.gov/solutions/housing/housing-first/
106 See HHPS 2006, 2011, 2016; Homelessness Section.
107 McKinney-Vento Homeless Assistance Act. HUD's Final Rule implementing the new definition at 24 CFR Part 91, 582 and 583. *Definition above reflects the changes.*
108 HUD, Hawai'i Point-in-Time Count Data.

By 2016, the development of Coordinated Entry Systems (CES), for the Oʻahu Continuum of Care (CoC), Partners in Care (PIC) and the neighbor island CoC, Bridging the Gap (BTG), made significant strides to streamline and increase efficiency in the homeless service system. The CES system connects individuals and families seeking services to the complete network of resources and housing options available within their CoC. In 2017, both CoCs launched their respective CES systems.

Prevention and Rapid Rehousing programs expanded significantly from their onset in 2010, initially funded by a $2 million federal grant. Prevention efforts have become an essential piece of effective homeless policy, often referred to as "closing the front door" to homelessness. Rapid Rehousing Programs are a key tool for moving homeless into permanent housing as quickly as possible.[109]

All these system changes were tipping the scale in the homeless crisis in Hawaiʻi and, in 2017, Hawaiʻi saw the first decrease in the Homeless Point-in-Time count in eight years. This reduction of 8.8 percent statewide was followed by two consecutive years of modest reductions.

In 2018, Hawaiʻi had the third-highest per capita rate of homelessness among the 50 states – 460 persons per 100,000. The homeless population decreased again from 2018 to 2019 by about 1.3 percent. However, there were still 6,448 homeless persons in Hawaiʻi on any given night in 2019 (Table 43).

Table 43. Homeless PIT Counts, State and Counties of Hawaiʻi, 2009-2019

	Year											Pct. Chg. 2016-2019
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Sheltered	3,268	3,535	3,632	3,726	3,745	3,813	3,666	3,613	3,420	3,055	2,810	-22.2%
Oʻahu	2,445	2,797	2,912	3,035	3,091	3,079	2,964	2,767	2,635	2,350	2,052	-25.8%
Hawaiʻi	321	286	229	170	160	211	220	271	275	200	243	-10.3%
Maui	422	392	394	420	421	445	505	484	395	399	420	-13.2%
Kauaʻi	80	60	97	101	73	78	88	91	115	106	95	4.4%
Unsheltered	2,514	2,299	2,556	2,520	2,590	3,105	3,843	4,308	3,800	3,475	3,638	-15.6%
Oʻahu	1,193	1,374	1,322	1,318	1,465	1,633	2,162	2,173	2,324	2,145	2,401	10.5%
Hawaiʻi	615	313	337	447	397	658	1,021	1,123	678	669	447	-60.2%
Maui	581	399	658	454	455	514	632	661	501	474	442	-33.1%
Kauaʻi	125	213	239	301	273	300	251	351	297	187	348	-0.9%
Total	5,782	5,834	6,188	6,246	6,335	6,918	7,509	7,921	7,220	6,530	6,448	-18.6%
Oʻahu	3,638	4,171	4,234	4,353	4,556	4,712	5,126	4,940	4,959	4,495	4,453	-9.9%
Hawaiʻi	936	599	566	617	557	869	1,241	1,394	953	869	690	-50.5%
Maui	1,003	791	1,052	874	876	959	1,137	1,145	896	873	862	-24.7%
Kauaʻi	205	273	336	402	346	378	339	442	412	293	443	0.2%

Source: State of Hawaiʻi PIT Counts, 2009-2019.

c. Methodology

There are two primary sources for homeless counts in Hawaiʻi: the annual Point-in-Time (PIT) Count;[110] and the Homeless Management Information System (HMIS).

The PIT count is gathered in an annual multi-night survey of homeless shelters and locations where homeless persons are known to congregate. PIT

[109] https://www.huduser.gov/Publications/pdf/Strategies for preventing_Homelessness.pdf

[110] See, for example, Partners in Care 2019 Point-in-Time Comprehensive Report for a detailed description of the methods, definitions, and results of the count. https://www.partnersincareoahu.org/sites/default/files/PIC%202019%20Oahu%20PIT%20Count%20Report%20-%20FINAL.pdf

Count data has been best used to track progress and changes within the homeless community over time, as it is a snapshot taken once a year.

The other source is the Homeless Management Information System (HMIS), which maintains data on homeless persons in shelters or encountered at unsheltered locations across the state.[111] The HMIS data file is populated by homeless services agencies and providers based on the clients they serve. The HMIS database is used daily by providers and state agencies to assist in the management and tracking of persons seeking services and in the coordination of resources in the homeless sector.

Most of this section of the report is based on an analysis of HMIS data gathered from April 2018 to April 2019. SMS obtained a de-identified listing of all single and family households encountered by Homeless Providers in Hawaiʻi from April 2018 to 2019. The overall dataset included all program types and households served regardless of housing status.

Analysis was done by household, rather than by individual, to identify the number of housing units needed to meet demand. The housing demand analysis considered only homeless households within outreach, emergency, and transitional shelter programs, and excluded those who had exited to permanent housing since entering programs.

2. Number of Homeless Households

Based on the HMIS data, there were 6,610 households served in homeless programs between April 2018 and April 2019. Of those 4,910 households, more than 70 percent were not permanently housed. Some of these unhoused households may have self-resolved during the year (found housing or were otherwise no longer homeless). Others may still need housing. Regardless, all were unhoused at some point during the year, and all were seeking help and assistance into housing from one or more homeless providers in Hawaiʻi.

These households represent an important part of the unmet demand for housing in Hawaiʻi. Their numbers are not included in Census data (the basis for population counts and housing demand estimates). They are not included in annual counts of occupied housing units and they are not housed in any public sector residential programs (Group Quarters). Their need for a housing unit represents unmet demand, new demand that is added to the demand estimates we develop from population and housing production data.

Characteristics of Homeless Population

Most homeless households are individuals (85%) (Table 44). The remainder are "family households," two or more individuals who reside together. There were 724 family households in the data (15%) and about six percent of those were couples or two-person households. The remaining nine percent of households had more than two members, with a few having eight or more persons in the unit.

Couples and family households made up a larger percentage of the homeless population in Maui and Kauaʻi counties (about 25%). In Honolulu and Hawaiʻi Counties, groups were about 15 percent of the homeless count.

Table 44. Household Size Among Homeless Persons

HH* Size	Hawaiʻi	Kauaʻi	Maui	Oʻahu	State
1	236	290	515	3,145	4,186
2	29	27	55	183	294
3	18	8	38	96	160
4	11	7	18	70	106
5	11	6	8	54	79
6	3	4	8	33	48
7	3	2	1	25	31
8+	0	0	0	6	6
Total	311	344	643	3,612	4,910

Source: Hawaiʻi HMIS Data, 2019.
* HH = Household

[111] See, Yuan, Sarah, Hong Vo, Kristen Gleason, and Javzandulam Azuma. 2016. Homeless Services Utilization Report, 2016, University of Hawaiʻi at Mānoa, Center on the Family, 2015.

3. Reducing the Number of Homeless

There are three significant leverage points where actions can be taken to reduce the number of homeless persons:

- While still housed, preventing homelessness;
- Immediately upon entering homelessness, providing housing as quickly as possible;
- When being placed in permanent housing from a homeless shelter, currently in programs.

All three options rely on the availability of affordable rental units.

a. Preventing Homelessness

Of the 6,610 households served in homeless programs between April 2018 to 2019, 2,177 (33%) of them were new to the homeless service system. Reducing in-flow to the homeless system and preventing homelessness is necessary to reduce the homeless problem.

There are two measures used to identify the households likely to become homeless: At-Risk-Households and Hidden Homeless. In the 2019 HHPS Housing Demand survey, respondents were asked how long they could stay in their current residence if they were to lose their primary source of household income. Twenty-five percent (25%) of Hawai'i households reported that they would be forced out of their homes after two months or less of sustained income loss. That was higher than the 21 percent of at-risk households in 2016.

The other indicator of potential homelessness examines households that have doubled up, also known as "hidden homeless." According to the U.S. Census, doubled-up households are defined as those that include at least one "additional" adult – in other words, a person 18 or older who is not enrolled in school and is not the householder, spouse or cohabiting partner of the householder. We exclude households sharing accommodations because they prefer to live as extended families.

Across the State, the percentage of households that contained hidden homeless persons increased from 17 percent in 2016 to 20 percent of households in 2019, as shown in Table 45.

Across the four counties, there was little difference in the percentage of at-risk or hidden homeless. Hawai'i County had lowest percent at risk of homelessness (21%) and hidden homeless (15%), but all other counties were within two percentage points of the Statewide average.

Table 45. Households At-Risk or with Hidden Homeless, State and Counties of Hawai'i, 2019

	At-Risk of Homelessness		Hidden Homelessness	
	At-Risk House-holds	House-holds Not at Risk	Some Hidden Homeless	No Hidden Homeless
Hawai'i	21%	79%	15%	85%
Honolulu	26%	74%	21%	79%
Kaua'i	24%	76%	19%	81%
Maui	24%	76%	22%	78%
State	25%	75%	20%	80%

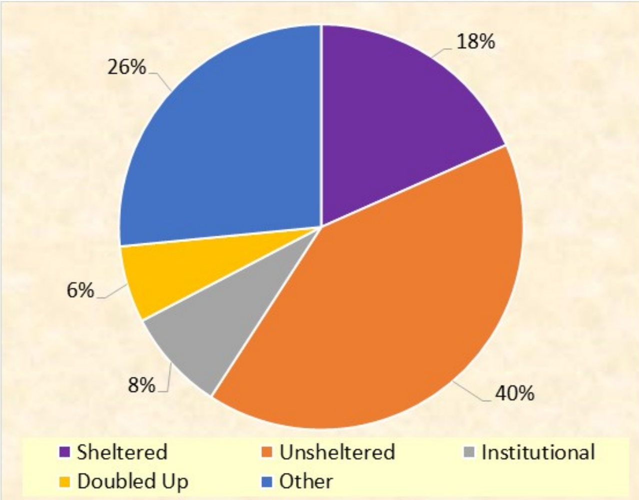
*The questions used to identify hidden homeless households changed after HHPS 2011. Source: HHPS 2019.

In all four counties, hidden homeless and those at risk of homelessness were more likely to be people who were younger, relatively recent arrivals to our state, and persons with fewer economic resources. Hidden homeless households were also larger, with 5.8 persons per household on average.

It was more common for hidden homeless persons to be doubled up with family members than with unrelated individuals. In 2019, more hidden homeless wanted to move in the next five years (37% compared to 31% in 2016). Further, hidden homeless households had lower income per household member than households that did not include hidden homeless members ($21,250 vs. $33,750).

Understanding where people lived prior to entering programs can help identify strategies to reduce homelessness. Figure 13 presents a breakout of these locations.

Figure`13. Location Before Entering Programs[112]



Source: Hawai'i HMIS Data, 2019.

The largest number of homeless persons entering shelters came from "unsheltered" locations (40%) followed by "other shelters" (18%). Others (8%) were in "institutional" settings prior to entering a homeless shelter. Roughly six percent (6%) were "doubled-up" with family or friends and two percent came directly from housed locations.

Many of the persons exiting from other shelters or institutional settings were likely special needs individuals coming from institutions like prisons or hospitals, or from other shelters such as HIV/AIDS transitional homes. Strategies to prevent homelessness in these groups were discussed in the earlier Special Needs Section.

Homeless prevention programs, prior to and at the onset of homelessness, can be an extremely effective tool for reducing homelessness in high-cost housing markets. Successful systems include supportive services (especially upon discharge from institutions), mediation in housing court, and subsidies for rents and mortgages.[113] The goal is to effectively prevent an episode of homelessness before it happens.

In 2019, Hawai'i homeless service providers prevented 1,198 households from becoming homeless. Progress in eliminating homelessness depends on reducing that level of in-flow. If only 10 percent of at-risk households lose their primary source of income, then approximately 14,000 households would need assistance to keep them from becoming homeless.

Table 46. Number of Households Assisted to Keep Them from Becoming Homeless

Program Type	Hawai'i	Kaua'i	Maui	O'ahu	State
Homelessness Prevention	204	15	102	877	1,198

Source: Hawai'i HMIS Data, 2019.

b. Providing Housing as Quickly as Possible

Rapid Rehousing programs have become essential for moving individuals and families out of homelessness quickly. Adhering to Housing First methods, these households are provided financial assistance to help access housing immediately. Often this type of housing includes wraparound support services before and after placement to assist with challenges related to the move. Statewide, 1,420 households of this type were placed by Rapid Rehousing programs statewide in a year.

Table 47. Number of Households Assisted in Exiting Homelessness

Program Type	Hawai'i	Kaua'i	Maui	O'ahu	State
Rapid Rehousing	211	46	84	1,079	1,420

Source: Hawai'i HMIS Data, 2019.

4. Unmet Demand for Housing for those in Homeless Programs

Among households being served, some cannot find or afford market-priced housing. The rest need additional support services, before and after placement. Table 48 shows total 2019 unmet demand for individuals, couples/2-person households, and family households of three or more. To estimate the number of needed housing

[112] HMIS, April 2018 to April 2019 Data.

[113] HUD, https://www.huduser.gov/Publications/pdf/Strategies_for_preventing_Homelessness.pdf.

units, we postulated that Individuals, couples and 2-person households can be accommodated with a studio. Families of three or more would need a larger unit.

Statewide, there were 4,186 individuals, 294 couples or families of two, and 430 larger families, who received homeless services over the course of the year but did not exit to permanent housing.

Table 48. Unhoused Households Statewide

Homeless Classification	Households
Individuals	4,186
Couples and Family Households of 2	294
Family Households of 3+	430
Total Households	4,910

Source: Hawaiʻi HMIS Data, 2019.

c. Households with No Special Needs

At program intake, clients complete the VISPDAT, which identifies any conditions or special needs that could affect their ability to access or maintain housing. These data are collected in HMIS. Table 49 shows the number of households for which VISPDAT data indicated no need for special services. About half of unhoused households in homeless programs in the target year had no conditions or special needs that would affect their ability to access or maintain housing.

Table 52 shows a need for 1,471 affordable or subsidized studios statewide for individuals (1,372) and couples or small families of two (99). An additional 289 family households of three or more would need larger units. Services needed by individuals and families with no special needs are limited and usually short-term. They include case management, job training, counseling, and short-to-mid-term financial or other assistance – services that do not require in-residence delivery.

d. Households with a Single Special Need

Many individuals and families need additional short to long-term support or residential services to sustainably maintain housing. Table 50 shows the breakdown of supportive housing and service needs statewide for unhoused households who have declared a single condition.

The largest unhoused group with a single condition was the 558 households dealing with substance abuse. Serving households with substance abuse issues requires an adequate supply of residential detoxification and treatment facilities, after which permanent housing units will be required. Our review of substance abuse treatment facilities (see Special Needs) showed that all or nearly all such facilities have waitlists. If our 558 households were to exit homelessness this year, we would need 558 additional substance abuse slots. After treatment, Hawaiʻi would need 558 housing units, 535 studios, and 23 larger units.

Mental health conditions affected 501 households in the 2019 HMIS target group. Serving their needs requires a combination of short-term treatment facilities and longer-term supportive housing services, depending on the nature and severity of the condition. Access to adequate medical care and treatment is likely necessary for this group to maintain housing. Data on what percentages of mentally limited homeless persons proceed to independent housing is hard to find. We have assumed that about half of the households would remain in permanent supportive housing and half would proceed to permanent housing. Thus, these cases will result in the need for 501 additional mental health beds and, eventually, 251 new housing units.

Table 50 shows 367 households having at least one person with a physical disability and 36 with at least one person having a developmental disability. Some of these households will need no residential treatment and proceed directly to permanent housing. Their units may require ramps, grab bars, easy access showers, etc. and housing for the developmentally disabled may requires wraparound services. Other households in this group may require some living assistance, either in an institutionalized setting or in small family care homes. Using the assumption that half of the households with a physical or developmental disability will be able to proceed to permanent housing, Hawaiʻi will need about 201 new affordable housing units and 202 spaces to accommodate households in need of assisted living situations.

e. Households with Multiple Conditions

There were 1,688 unhoused households that had more than one condition (Table 51) in the 2019 target year. For these households, overlapping conditions and complex household situations will require case management services. CES must identify on a case-by-case basis the most appropriate solution for each household.

This makes it even more difficult to develop assumptions about types of housing needed by these households. More than 90 percent of them are individuals. They will need treatment beds and studios with wrap-around services. The rest are families and only 57 of them had three or more members. This suggests that the complexity in the multiple conditions group is caused by co-morbidity rather than group size.

Table 49. Unhoused Households with No Special Needs

Households with No Special Needs	O'ahu	Hawai'i	Maui	Kaua'i	State
Individuals	1,049	35	209	79	1,372
Couples and Family Households of 2	66	8	25	9	99
Family Households of 3+	191	24	45	20	289
Total	1,306	67	279	108	1,760

Source: Hawai'i HMIS Data, 2019.

Table 50. Unhoused Households with a Single Condition

Substance Abuse Only	O'ahu	Hawai'i	Maui	Kaua'i	State
Individuals	386	14	55	51	506
Couples and Family Households of 2	21	0	5	3	29
Family Households of 3+	15	3	4	1	23
Total	422	17	64	55	558
Mental Illness Only	O'ahu	Hawai'i	Maui	Kaua'i	State
Individuals	328	34	54	26	442
Couples and Family Households of 2	16	4	2	0	22
Family Households of 3+	26	4	7	0	37
Total	368	42	63	26	501
Physical Disability Only	O'ahu	Hawai'i	Maui	Kaua'i	State
Individuals	224	18	39	31	312
Couples and Family Households of 2	18	3	7	4	32
Family Households of 3+	17	2	2	2	23
Total	159	23	48	37	367
Developmental Disability Only	O'ahu	Hawai'i	Maui	Kaua'i	State
Individuals	14	0	5	2	21
Couples and Family Households of 2	3	1	1	0	5
Family Households of 3+	3	1	4	2	10
Total	20	2	10	4	36

Source: Hawai'i HMIS Data, 2019.

Table 51. Unhoused Households with Multiple Conditions

Multiple Conditions	O'ahu	Hawai'i	Maui	Kaua'i	State
Individuals	1,144	135	153	101	1,533
Couples and Family Households of 2	59	13	15	11	98
Family Households of 3+	32	12	11	2	57
Total	1,235	160	179	114	1,688

Source: Hawai'i HMIS Data, 2019.

Some part of each subgroup will need permanent supportive housing. Using the assumption that half of the households with multiple conditions will be eventually proceed to permanent housing, Hawai'i will need residential treatment facilities for another 844 individuals, and another 844 studio apartments later. For those who are less fortunate, Hawai'i will need an additional 844 permanent supportive housing slots.

f. Summary of Needed Units

The homeless population upon which the former analysis was conducted consisted of 6,037 households active in homeless programs in the 12 months between April 2019 and March 2019.[114] By the end of that period, 1,127 of those households were permanently housed, suggesting that about 19 percent of homeless households can be accommodated without additional units each year. The remaining 4,910 homeless households never exited programs or exited to unknown destinations. These households require housing units that must be added to the current housing stock.[115] Table 52 summarizes the foregoing analysis and lays out the number and types of units that are needed for short-term (Transitional Shelter) and long-term (PSH and Affordable Housing) treatment of households with each type of conditions.

Table 52: Housing Units Needed to Accommodate Homeless Persons in 2019

Type of Household	Transitional Shelter Units[116]	Permanent Supportive Housing (PSH) Units	Affordable Housing Units
Individual or Couple (Studio)			1,471
Family HH 3 or more persons			289
Substance Abuse HH	*558*		558
Mental Health HH	*251*	250	251
Physical Disability HH		183	184
Developmental Disability HH		18	18
Mixed Conditions HH	*844*	844	844
Total	*1,653*	1,295	3,615

There is a demand for 1,653 additional transitional shelter beds, mainly for substance abuse (558) and mental health treatment (251), as well as mixed conditions. There is a need for 1,295 additional permanent supportive housing units for individuals and families with various special needs. Finally, there is a need for 3,615 additional subsidized or unsubsidized affordable housing units for individuals and families throughout the state.

An assumption was made for households in the mental health, physical disability, developmental disability, and mixed conditions categories: 50 percent of them would need PSH and 50 percent could either immediately, or after a time in transitional shelter, sustain an affordable rental unit, with or without wraparound services.

Overall, there are 4,910 households represented above. Households counted as needing transitional housing were also counted in the affordable housing category, as the transitional housing unit is not a permanent housing destination. Households without a head of household or with inadequate data collected were not included.

The SMS projections are more modest than similar projections generated by the Corporation

[114] Households without a head of household were excluded, as well as households with inadequate data collected.

[115] See Number of Homeless Households, Para 2, p. 62.

[116] Following HUD definitions, these units are fundamentally residential treatment facilities and not emergency shelter.

for Supportive Housing (CSH).[117] CSH estimated a need for 6,000 additional housing units.

This section of the SMS analysis focused on housing demand within homeless programs only. We developed estimates of current units needed beyond market capacity. The CSH report included a demand analysis for all levels of housing intervention, including demand for Prevention and Rapid Rehousing funding, as well as incorporating projected demand and financial modeling used for cost analysis. If annual newly homeless numbers remain high, demand for additional units in these categories will rise.

5. Maintaining Permanent Housing and Reducing Recidivism

One of the biggest challenges for keeping formerly houseless persons in permanent housing is their ability to afford rental payments over a longer period.

The average income for an unhoused homeless individual served in the state was $375 a month (Table 53). Homeless two-person family households did slightly better at $864 ($432 per person). Larger households per person income decreases as family size increases.

There is little likelihood that these households (especially those with conditions and special needs) can maintain available market-rate housing without deep, long-term subsidies, in the absence of significantly increased income.

In the 2019 Housing Demand Study, renters were asked how much per month they spent on rent and utilities. Average costs for single household renters was $1,280 a month, up to $2,200 a month for a 4-person household. Based on the average incomes for unhoused homeless households, an average subsidy of $960 a month would be needed for these families to pay rent on a market-rate unit.

Table 53. Average Homeless Household Income Source: Hawai'i HMIS Data, 2019.

Household Size	Hawai'i	Kaua'i	Maui	O'ahu	State
1	$521	$593	$413	$338	$375
2	$786	$1,595	$1,091	$700	$864
3	$1,445	$1,814	$1,127	$709	$946
4	$1,385	$2,709	$1,530	$980	$1,230
5	$1,057	$2,538	$1,191	$957	$1,115
6	$2,055	$2,575	$2,172	$931	$1,345
7	$1,493	$2,892	N/A	$1,245	$1,335
8+	N/A	N/A	N/A	$1,278	$1,278
HH Average	$673	$813	$576	$401	$470

Current subsidy programs pay varying amounts of subsidies for shorter and longer periods of time. Rapid Rehousing Programs can last from a few months to two years and can pay the entire rent for a household. These programs try to taper down assistance over time to promote long-term sustainability post-program. The Hawai'i Public Housing Authority (HPHA) Rental Subsidy Program can pay up to $500 a month for larger households. The Federal Housing Choice Voucher Program, more commonly referred to as Section 8, lasts for as long as the household qualifies and only requires a household to pay 30 to 40 percent of their gross income in rent depending on the affordability of the selected unit.

Waiting lists for these programs range from immediate access for some Rapid Rehousing funds for highly vulnerable families, the Public Housing Subsidy program is no longer accepting

[117] Corporation for Supportive Housing, Hawai'i Housing Projections and Financial Modeling, 2017.

applications due to limited supply, and up to three to five years for Section 8. Finding affordable units and landlords willing to work with homeless or Section 8 clients can prove challenging. This limits the potential of the program's success.

6. Strategy and Planning Implications

Our objective for 2019 was to bring together data to help planners develop homeless support programs and to estimate the number of housing units that might be needed to house homeless persons entering the ranks of the housed.

Between April 2018 and May 2019, nearly 9,000 households were served in Prevention, Outreach, Shelter, and Housing programs statewide. Of those, more than 2,500 households exited to permanent housing. That was about 30 percent of the total households served over the course of that year, which leaves about 70 percent of the served population still homeless, struggling, receiving services, or unaccounted for.

Table 54. Household Exits to Permanent Housing by Program Type

	Households Served	Permanent Housing	Exit Rate
Homelessness Prevention	1,187	702	59%
Rapid Rehousing	1,389	734	53%
Street Outreach	2,518	185	7%
Emergency Shelter (ES)	2,584	670	26%
Transitional Housing (TH)	935	272	29%
Total	8,613	2,563	30%

Source: Hawai'i HMIS Data 2019.

In addition to all the currently homeless persons, newly homeless will continue to enter the system, as shown in the number of at-risk and hidden homeless households. Over our 12-month period, approximately 2,000 individuals and 500 families became newly homeless. Given no significant changes in the economy, these numbers are likely to continue. While lower than the numbers served, these are less than the numbers being permanently housed.

The following are recommendations to improve the housing and policy environment, hopefully leading to progress in solving the homeless crisis in Hawai'i.

a. Increase Funding for Prevention Programs

In order to "close the front door" to homelessness, enhanced targeted prevention programs are needed to lessen the number of newly homeless families entering shelters and the streets each year. In the last year, statewide prevention programs served about 1,200 households. If those households had become homeless, the State could have seen an 18 percent increase in households on the streets or in shelters that year.

Prevention efforts reduce costs and pressure on the homeless service system. Prevention programs are more successful in keeping households in permanent housing over a longer period compared to other programs. It is easier, more humane, and more affordable to keep people in housing than to find them housing after they have become homeless.

More than 30 percent of those served by homeless service providers between April 2018 and April 2019 were newly homeless households. Reducing the number of households entering homelessness is a cost-effective way to reduce overall homeless numbers and is a significant leverage point in the system for addressing homelessness.

b. Increase Rent Subsidies

The cost of not placing homeless households into permanent housing is very high. For example, many of these individuals and families are served in emergency shelters for extended periods of time. The average length of stay in an emergency shelter in Hawai'i in the fiscal year 2017 was 112 days.[118] A shelter bed funded by the U.S. Department of Housing and Urban Development costs, on average, $8,000 more each year than a Section 8 housing voucher. A shift in resources, with an emphasis on expanding state-level prevention and rental subsidy programs and efforts, would lessen overall homeless program

[118] Hawai'i HMIS, Service Utilization Reports

expenses by targeting this sector of the population.

The average unhoused individual served during the year made less than $400 a month.[119] This reality is in stark contrast to average monthly housing costs paid by single-person households statewide: $1,280.[120]

Existing programs, including Section 8, HPHA Rental Subsidy Program, and Rapid Rehousing Programs, should be expanded to reach more of the unhoused population. Subsidies will need to be significant and long-term. Subsidies are often the only alternative to homelessness when there is a lack of affordable housing stock for the lowest income groups.

Extending the length of time a subsidy is available will enable newly placed households to continue in permanent housing and keep them from again becoming homeless.

Concern over landlords' reluctance to accept housing vouchers and subsidies remains a persistent problem in the service community. Finding a unit with a landlord who will accept a homeless or at-risk client can make the housing process even more time-consuming. The government could promote renting to low-income persons or leasing to social service organizations by providing incentives to those landlords willing to participate. Some programs have had more success in finding and maintaining affordable rentals long term by "master leasing" units and acting as the intermediary between their clients and the landlords.

Other options include creating Section 8 landlord guarantees and providing prompt money-back options for landlords who claim losses in excess of the security deposit due to damages caused by Section 8 tenants.
Piloting and expanding programs such as these may help increase the stock of housing units available to lower-income sectors of the population.

c. Build Additional Affordable, Permanent, and Supportive Housing Units

Adequate investment in suitable supportive temporary and permanent residential housing options, as well as supportive services for those in off-site housing, is necessary to effectively assist these households.

"Supportive housing not only resolves homelessness and increases housing stability, but also improves health and lowers public costs by reducing the use of publicly funded crisis services, including shelters, hospitals, psychiatric centers, jails, and prisons".[121] While the cost of housing this population can be quite high, the alternative is higher. For example, in Los Angeles, the average public cost for an unsheltered homeless person was $2,897 per month and the average public cost for a resident in supportive housing was $605 per month, a five times greater cost to the public for those unhoused versus those who were provided supportive housing.

Consideration should be given to identifying shelters or other facilities that can be retrofitted to provide single-person units offering specific supportive services. Supportive services can be delivered more efficiently when clients are in a residential setting. Depending on the conditions and special needs of the individuals, some shelters may be Permanent Supportive Housing or Transitional, eventually exiting to a permanent housing location with or without services. Given the number of individuals with single and multiple conditions, providing additional Supportive Housing options in the state will be necessary.

[119] Hawai'i HMIS Data 2019.
[120] HHPS Demand Survey, 2019.
[121] USICH, www.usich.gov/solutions/housing/supportive-housing/

C. HOUSING AND TOURISM

Hawaiʻi has a thriving visitor industry because it has many amenities – a pleasant climate, scenic beauty, great beaches and water sports, good visitor products and infrastructure, a well-trained and experienced labor force, a pleasant lifestyle, and a host culture that provides a foundation for hospitality and our Aloha Spirit.

The visitor industry has been Hawaiʻi's number one industry since replacing sugar and pineapple production in the nineties. It provides 164,000 jobs per year, accounts for a substantial percentage of the GSP, and contributes $1.8 billion each year in Hawaiʻi State General Excise Tax and the Transient Accommodations Tax.

Overall, residents understand the economic benefits of tourism. However, with visitor arrivals approaching the 10 million mark, residents seek benefits beyond the economic, a greater return on their "investment." While residents largely continue to view the industry favorably, some indicators of Hawaiʻi Resident Sentiment have weakened.[122] A strong visitor industry may also bring higher population growth, greater external housing demand, and higher housing prices.

What is of interest to us here is the impact of the visitor industry on the residential housing market in Hawaiʻi. Do rising room rates affect residential rents? Does the increasing demand for alternative visitor accommodations lead to a loss of residential housing stock?

1. Traditional Relationship

The traditional relationship between tourism and housing markets starts with tourism's benefits to local economies. Virtually all sources agree: (1) tourism is a good way to turn non-economic assets into exports, improve the economy, create jobs, and generate income[123]; and (2) if you choose the visitor industry as a way to run your economy, you can expect high housing prices[124] and other problems.[125] Fitz (2006) showed that tourism leads to an increase in second homes[126], which increases property taxes and Biagi, *et al*. found that higher housing prices lead to issues in affordability, displacement, and gentrification.[127] These research findings will not surprise anyone in Hawaiʻi's visitor industry.

In Hawaiʻi, the academic literature has not produced much on the direct impact of tourism on the housing market. The popular press, on the other hand, continues to investigate the issues. Some went as far as to claim, "Some people complain that illegal rentals have caused housing prices to soar and have torn apart communities where residents know all their neighbors".[128] In addition to these public reaction stories, some data appeared, noting that, "at 80 percent occupancy, the average Airbnb rent in 2015 would bring in $5,900 per month." That is nearly 3.5

122 Hawaiʻi Tourism Authority, *HTA Resident Sentiment Survey 2018 Highlights, 2019*.

123 Gunderson, Ronald J. and Pin T. Ng. 2005. Analyzing the effects of amenities, quality of life and tourism on regional economic performance using regression quantiles, *Regional Analysis & Policy*, vol. 35, no. 1.

124 Reeder, Richard J. and Dennis M. Brown. 2005. Recreation, tourism, and rural well-being. United States Department of Agriculture, Economic Research Services, Economic Research Report Number 7, August, 2005. See also Ko, Dong-wan and William P. Stewart. 2002. A structural equation model of residents' attitudes for tourism development, Tourism Management, Vol. 23, pp. 521-530, 2002. See also, Affordable homes and tourism are election issues in Midhurst, *Midhurst and Petworth Observer*, (UK), April 13, 2015.

125 Carlino and Saiz (2008) used visitor arrivals as a measure of consumer preference for local amenities. They found: (1) amenities were linked to population and job growth; (2) "beautiful cites" attracted more skilled employees; (3) growth in visitor arrivals was related to accelerated housing price appreciation, especially in supply-inelastic markets; and (4) local investment in physical amenities resulted in increased demand for visits. They saw this as evidence of a self-perpetuating cycle of tourist development housing appreciation.

126 Fitz, Richard G. (1982) Tourism, vacation home development and residential tax burden: A case study of the local finances of 240 Vermont towns, *American Journal of Economics and Society*, Vol. 41, No, 4, pp. 375-385, October 1982.

127 Biagi, Bianca, Dionysia Lambiri, and Alessandra Faggian. 2012. The effect tourism on the housing market, in Uysal, M., *et. al.*, (eds.), *Handbook of Tourism and Quality-of-Life Research: Enhancing the Lives of Tourists and Residents in Host Communities*, International Handbooks of Quality-of-Life, Springer Science+Business Media B.V. 2012.

128 Riker, Marina. 2015, State, City looking to crack down on illegal vacation rentals, *Honolulu Civil Beat*, March 10, 2015.

times the average rent for a residential rental unit in 2015.[129]

What concerns us here is one particular part of visitor industry operations in Hawaiʻi -- the number of rental properties being used for short-term rentals to transient parties. Short-term means rental contracts for 30 days or less. Transient parties include visitors from out of state and residents, traveling overnight or longer interisland.

These types of rental units have been discussed using a variety of names. In this report, we will use the term Vacation Rental Units (VRU). As used here, VRUs include single-family house rentals, multifamily condominium rentals, and bed and breakfast properties. For 2019, we also looked at additional alternative accommodation types: timeshare, room or rooms in the owner's place of residence, and cottage or other units on owner's property. Some VRUs started as visitor accommodations units and others may be transformed residential housing units. In Hawaiʻi, as in other visitor destination areas, VRUs are subject to regulations, registrations, business taxes, and tourist taxes. In addition, like other visitor communities, there are claims that some VRUs operate illegally, in violation of zoning codes or tax responsibilities.

Regardless of the nomenclature, there is little doubt that the number of VRUs in Hawaiʻi has been increasing. The Visitor Plant Inventory (VPI) shows an increase from 10,768 in 2015 to 13,082 in 2018[130], a 21 percent increase in just four years. The VPI Supplemental Report extracted data from four vacation rental booking sites to show that Individually Advertised Units (IAU) counts of VRU may have been as high as 30,135 in 2018.[131]

VPI supplemental studies show that short-term IAUs exist in nearly all communities in Hawaiʻi, suggesting that residential housing stock may have been affected. The same studies also show that the units are heavily concentrated in visitor destination areas. Because the regulation and permitting of vacation rentals is under each county's jurisdiction, counties have different permitting requirements and may prohibit short-term rental units outside specific districts.

2. Visitor Research Data

Hawaiʻi's tourism economy has been growing impressively for the last ten years. Between 2009 and 2018, visitor arrivals grew from 6.4 million to 9.8 million (53.1%).

Table 55 presents data for the recovery period following the Great Recession. Before the Recession, visitor volume reached 7.4 million visitor arrivals. The recovery was completed by the middle of 2012, but visitors continued to flock to Hawaiʻi. The two most recent years showed strong growth in arrivals of 5 - 6 percent.

Throughout this period of growth, the pattern of visitor accommodations has shifted. The percent of visitors who stayed at commercial visitor accommodations units grew during the recovery years but slowed down after 2016 to return to the 2009 level.

[129] Honolulu rental market: Affordable rental housing study update, 2014, prepared by Ricky Cassiday for Department of Community Services, City and County of Honolulu, December 30, 2014, p. 115.

[130] The Hawaiʻi Visitor Plant Inventory is an annual count of visitor accommodations units conducted by HTA. The study develops a list of visitor properties and then surveys them to measure the number of rooms available to visitors. Obtaining an accurate list of VRUs has been increasingly difficult and VPI has acknowledged that VRU counts may be underestimated.

[131] The report notes that the count includes listings of properties on the North Shore of Kauaʻi that were temporarily closed due to limited access after the April flooding and rentals in the Puna area that may have been destroyed following the May volcanic eruption.

Table 55. Hawai‘i Visitor Industry Statistics, 2009-2018

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	% Chg 2009-2018
Visitor Arrivals (x1,000) by air	6,420	6,917	7,174	7,867	8,003	8,196	8,563	8,822	9,278	9,827	53.10%
Number of Parties (x1,000)	2,899	3,102	3,282	3,497	351	3,662	3,915	4,010	4,191	4,431	52.80%
Percent Use Commercial Units[a]	87.6	88	88.8	89.4	89.7	89.6	89.4	89.7	87.6	87.6	0.00%
Percent Use Traditional Units[b]	82.2	82.4	82.6	83	82.5	81.9	80.9	75.6	74.3	72.4	-11.90%
Percent Use VRU	5.4	5.6	6.2	6.4	7.1	7.8	10.7	7.7	11.8	13.5	150.00%
Hotel Occupancy Rate (%)	65.3	70.7	73.3	76.9	76.6	77.1	78.8	79.1	80.2	80	22.50%
Average Daily Room Rate	$177	$175	$189	$205	$230	$235	$244	$254	$264	$277	56.60%
Average Residential Rent Rates	$1,755	$1,730	$1,743	$1,768	$1,806	$1,844	$1,917	$2,019	$2,069	$2,083	18.70%

[a.] The percent of all visitor parties that used any type of commercial visitor accommodations units. Excludes those who stayed with family and friends and those who remained aboard a cruise ship.
[b.] The percent of all commercial accommodations user parties that use traditional visitor accommodations units – hotels, apartment hotels, condominium hotels, hostels, or timeshare units.
Sources: DBEDT, HTA Annual Reports, RentRange®.

The number of visitors that used traditional visitor accommodations units[132] grew but at a slower pace than visitor arrivals -- from 5.3 million in 2009 to 7.1 million in 2018 (+35% growth vs. +53% growth for arrivals). However, the share of visitors that used traditional units declined from 82.2 percent to 72.4 percent over the past ten years.

There was a notable increase in demand for vacation rental units (B&Bs, private rooms, and shared rooms). The percent of visitors that used these units increased 1.5 times between 2009 and 2018 (5.4% to 13.5%). The growth rate for the use of VRUs by Hawai‘i's visitors outpaced the use of traditional visitor accommodations during this time.

Hotel occupancy rates rose from 65.3 percent to 80 percent during the recovery for a 22.5 percent growth rate over ten years. Most of the growth occurred before 2015 and occupancy rates have been relatively steady for the last three years. Moreover, even if the traditional visitor accommodation unit numbers suggest some loss of market share to VRUs, the share of revenue may not have been affected. Average daily hotel room rates rose from $177 to $277 during the same period, a growth of 56.6 percent.

Finally, the median monthly rent for residential housing units in Hawai‘i rose from $1,755 in 2009 to $2,083 in 2018 -- an 18.7 percent growth rate over ten years. Therefore, as the post-recession recovery proceeded, growing visitor arrival numbers were met by rising visitor rents (ADR). Residential rents grew by only a third of the rate in the visitor industry. A property owner considering the prospects of renting to visitors rather than residents might have been convinced by the numbers. There was a substantial difference in what could be charged for a room night – perhaps 3-times the local residential rate. In addition, there was a potential for even higher rents in the future as visitor rental rates grew much faster than residential rates.

3. Housing Study Research

This study brings additional data to the subject. A set of questions sponsored by the Hawai‘i Tourism Authority (HTA) were included in the demand survey and there was a separate survey

[132] Hotels, apartment hotels, condominium hotels, hostels, or timeshare units.

of out-of-state property owners. The demand survey queried Hawaiʻi property owners on the use of their real estate as a rental property and asked whether they rented to visitors. The out-of-state property owners' survey asked similar questions of a sample of owners whose tax billing address was outside of Hawaiʻi. It also borrowed data from the most recent visitor research by HTA.

4. Estimating VRU from Visitor Data

The HTA Visitor Plant Inventory (VPI) provides historical data on accommodations units available to house Hawaiʻi's visitors. The 2018 VPI reports that there were 13,082 vacation rentals available for visitor use in 2018 that was a +3.3 percent increase in units from 2017 (12,661). However, in the VPI Supplemental Report of the 2018 VPI, based on data extracted from the four booking websites, there were 30,135 Individually Advertised Vacation Rental Units (IAU)[133] listed in the State of Hawaiʻi in 2018. Furthermore, the total number of bedrooms available, represented by these IAU was 49,348.

HTA explained that this count was based on data extracted from four vacation rental booking sites. Even though VPI includes vacation rentals as a property type, "due to the large number of vacation rental properties and the fluid nature of the vacation rental supply, identifying and gathering survey data from vacation rentals has been a challenge. As a result, the Visitor Plant Inventory survey has likely undercounted the actual number of Vacation Rental Units."

The supplemental study estimate is a better match than the VPI counts for visitor reports of VRU usage. The estimated number of IAUs in Hawaiʻi in 2017 was 38,100, as reported in VPI. However, HTA noted, the figure may be overestimated[134] and the 2018 figure is a better estimate because a change in technology allowed the vendor to identify duplicate listings across platforms. Therefore, the best estimate of the number of VRUs in Hawaiʻi in 2018 was approximately 30,000

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5. Estimating VRUs from Survey Data

Two important data sources, first developed in the HHPS 2016, were used to estimate the number of VRUs in Hawaiʻi. The first was the Housing Demand Survey. In that survey of 5,599 Hawaiʻi resident households, we asked homeowners if they rent out any residential property they own and, more specifically, how many properties did they regularly rent out on a short-term (less than 30-day) basis. The short-term basis question is a better determinate of units available for visitors to rent than directly asking the owners if they rent to visitors. As mentioned earlier, a visitor would include those Hawaiʻi residents who live on another island; owners may not make that distinction and would instead classify their renter as a resident.

The second source was the Out-of-State Property Owners Survey, in which we asked 2,251 out-of-state property owners a similar set of questions to help estimate the number of VRUs they might contribute to the inventory.

Combining those data, SMS developed an analysis model in which the 2,251 Out-of-State surveys represented about 58,535 out-of-state property owners and the 5,599 Housing Demand Survey respondents represented 455,502 resident households. The results show that there were 64,843 units available for short-term rental to visitors in 2018.

133 HTA 2018 VPI, pp. 60-61.

134 The Supplemental Study suggests the estimate may be overstated, noting: "Because of the lack of unique identifying information associated with each vacation rental unit listed on the booking sites, it is currently not possible to identify and eliminate much of the double and triple counting that occurs when a property is listed on multiple booking sites."

Table 56. Residential Properties Rented Out on a Short-term Basis

Residential Properties Rented out on a Short-term basis	County				
	Total	Honolulu	Maui	Hawai'i	Kaua'i
Hawai'i Resident Owners (Demand Study)	43,712	31,013	5,091	5,633	1,975
Out-of-State Owners	21,131	6,042	6,797	3,038	5,255
Total Residential Properties Rented out on a Short-term basis	64,843	37,054	11,888	8,671	7,230

Source: HHPS Demand Survey, 2019; Out-of-State Owners Survey, 2019.

6. Adjusting the Estimate to Comparable VRU

Adjusting the Estimate from HHPS Results.

That figure of 64,843 units available for rent on a short-term basis included at least some commercial visitor rental units. These are units that would be included in the hotel or condo rental pool and would be classified as a traditional condo/condotel under the VPI unit classification.

The two surveys asked the question, "How is your rental property advertised to renters." If they answered, "Through a hotel pool or condo management company," then we can eliminate them from the VRU count. Using figures from both surveys, we determine that 55,576 units would be classified as VRU.

The estimates from VPI and the SMS studies would need to be adjusted for differing definitions and procedures. The VPI Supplemental Study measured IAU as the number of units offered for rent by the on-line booking sites Airbnb, HomeAway, TripAdvisor, and VRBO, at a specific point in time.

The Out-of-State Survey measured VRUs as the number of properties rented to visitors on short-term contracts. We adjusted that count to only include individually rented units (instead of those managed by a hotel or condo pool). VPI Supplemental study estimates would be short of the Out-of-State Survey estimate by (a) the number of units not being advertised when Internet downloads were made; (b) the number of units not advertised on those specific online booking sites, and (c) the number of units that do not advertise.[135]

Adjusting Units included in the VPI Supplemental Studies for advertising methods. The 2018 supplemental study used four online booking sites: Airbnb, TripAdvisor, HomeAway, and VRBO, where VRBO is a subsidiary of HomeAway. Those four sites accounted for 57.9 percent of the advertising methods mentioned by our Out-of-State Owners and only 36.7 percent of our Hawai'i resident owners.[136] If we use the most conservative value of 57.9 percent used those online sites then the VPI Supplemental estimate of 30,135 would actually represent 52,047 actual VRU in Hawai'i for 2018 (Table 57).

[135] VPI 2018, p. 60.

[136] Out-of-State Property Owners Survey, 2018.

Table 57. Adjusting the Estimates

	State Total (HHPS 2019)	Advertise through a hotel rental pool or condo management company	Individually Rented Units "Non-Commercial"	Advertised using AirBnB, VRBO, HomeAway, or Trip Advisor (HTA VPI Supply)	Adjusted VPI Supplemental Estimate
Hawai'i Resident Owners (Demand Study)	43,712	5.8%	41,177	36.70%	82,112
Out of State Owners	21,131	31.9%	14,399	57.90%	52,047
Total Vacation Rental Units	64,843		**55,576**	30,135	**52,047**

The locus of decision-making issue: Again, one of the findings of the Out-of-State Survey was that many property owners did not know how their units were rented. About 62 percent of them used a rental agent and 43 percent were not sure because someone else advertised the property for them. We assumed these "unaware" respondents had renter profiles similar to those of property owners who reported advertising details. That may have been optimistic. Property managers may be more likely to rent, more likely to list on booking websites, and more likely rent on short-term contracts.

In summary, the estimated number of VRU properties in Hawai'i available to visitors differs considerably depending on the source. The adjusted number from the VPI supplemental studies is about 52,000 and the estimate from the HHPS surveys is about 55,600.

7. Impact on Housing

Estimating the impact of VRU requires that we look at the related items in the multiple data sources available to us.

a. Units Used for Visitor Rental

Speculation is that the increase in visitor arrivals, the slow growth of visitor plant, the pressure of visitor demand for units outside of resort areas, and the rise of Internet booking sites decreased the size of the residential housing stock. The HHPS surveys found that there were between 52,000 and 55,600 housing units available for rent to visitors on short-term basis in 2018.

b. The Shared Economy

The HHPS Housing Demand Survey also asked questions related to the "shared economy" as part of VRU use in Hawai'i. Among all Hawai'i homeowners, 15,922 (6.5%) rented rooms in their homes; 5,495 (2.2%) rented out a cottage or other unit on their property; and 1,632 (0.7%) even rented out their whole house, part of the year

c. Impact on Residential Rents

Some studies have suggested that there is a relationship between greater use of vacation rentals and higher housing prices. The National Association of Realtors (NAR) blogs that VRUs increase rents, decrease affordability, and draw developers' attention to the top of the market. Local researchers report that VRUs exacerbate the affordable housing problem by reducing our housing stock and driving up rents, which in turn inflates demand for investment properties at the high end of the market.[137]

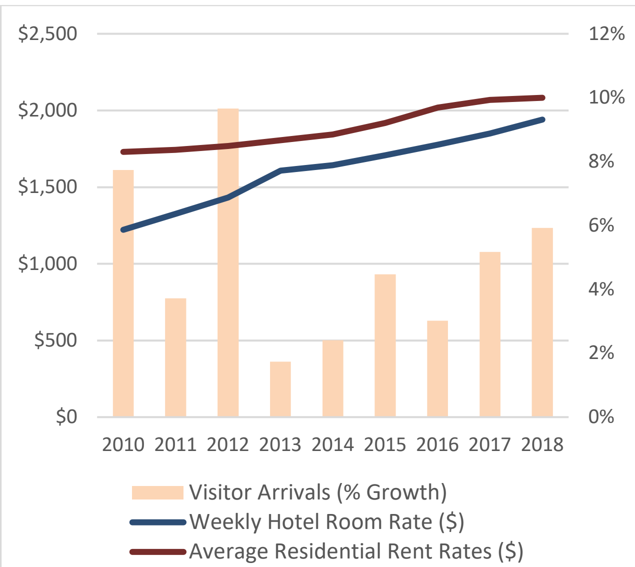
Figure 14 brings together some foundation data for visitor and residential rents in Hawai'i over the last nine years. For the visitor data, we took the

[137] Usborne, Isis and Benjamin Sadoski. 2016. The hidden cost of hidden hotels: the impact of vacation rentals in Hawai'i, in UNITE HERE Local 5, May, 2016, p. 8.

average daily room rate (ADR) for all commercial properties.[138] Figures shown here are six times the ADR to accommodate the scale of the graph. The graph compares the weekly (7-day) rate with the monthly rate for residential housing. The objective was to compare rates of change over time. For the residential figures, we chose the contract rent rates for all rental units in the State.[139] We added the hotel occupancy rate as a rough demand indicator.

In response to the Great Recession, both hotel room rates and residential rates fell and showed no sign of recovery until 2011. In fact, residential rents did not recover until sometime in 2012. Hotel room rates rose quickly with 8 – 12 percent growth per year until 2013. Residential rents grew only 1 to 2 percent annually

Figure 14. Hotel Room Rates and Resident Rent Rates, 2010-2018



Source: HTA; RentRange®.

Visitor rates increased again in 2014 and have maintained a steady 4 to 5 percent growth. Hotel room rate growth has mirrored the growth in overall visitor arrivals through much of the period after the Recession.

Residential rent rates also seemed to have accelerated in the 2014 to 2015 period but have slowed down in the last two years.

Therefore, in the present time frame, the two rent rates do not seem to be following in a similar pattern. However, that does not mean they are not related, of course. Proving that would require a more complex econometric analysis - one that is beyond the scope of this project.

Recently, a Hawaiʻi researcher investigated the link between the number of vacation rentals in Hawaiʻi and rising rent prices.[140] The research showed that residential rents in neighborhoods with high concentrations of vacation rentals did not rise significantly between 2016 and 2019. Our own unpublished research found similar results. These neighborhood-by-neighborhood studies lend support to the rates shown in Figure 14. Still, we await definitive research to establish the link between decreasing residential rental stock due to VRU conversion and rising residential rents.

On June 17, 2019, the Honolulu City Council passed two bills that contained strong regulations for Oʻahu's vacation rental industry.[141] The resulting Ordinance 19-18 allows for 1,715 owner-occupied bed-and-breakfast rentals in the County. The County says that 816 of those are currently registered and that there are 8,000-10,000[142] units operating illegally on O'ahu.

New units must be B&B-type VRUs located in resort areas (Waikīkī, Ko Olina, and Turtle Bay). They must be registered and renewed annually. The Ordinance prohibits transient vacation units without a Nonconforming Use Certificate (NUC) and regulates hosting platforms. It requires them to file monthly reports with the Department of Planning and Permitting (DPP). It makes it illegal

138 DBEDT Data Book 2015 has rates for hotels, condo hotels, and timeshare units. We used Hospitality Advisors reports for 1st quarter 2016 estimate.

139 Rent Range, average monthly rent for all rental units.

140 Rickie Cassiday. 2019. Cost for monthly housing in Hawaiʻi not hurt by illegal vacation rentals, study finds Hotel Online, Sunday September 22, 2019.

141 Hawaiʻi News Now. 2019. City Council approves tough new regulations for vacation rental industry, *Hawaiʻi News Now*, June 17, 2019. https://www.hawaiinewsnow.com/2019/06/18/city-council-poised-approve-tough-new-regulations-vacation-rentals/

142 Rizzo, Cailey. 20-19. Oʻahu just passed a new law that could affect your Airbnb, *Travel + Leisure*, June 26, 2019.

to advertise short-term rentals not compliant with zoning regulations in Ordinance 19-18. Vacation rental owners may not advertise without publishing their registration number in the ad. Violators will receive citations, and if they persist in advertising, they will receive fines as per the law. It is no longer necessary to prove that an illegal contract was signed or that there was intent to commit a crime. The advertisement is the crime.

The Ordinance provides for fines of $1,000 for first offense and up to $10,000 per day for repeat violations. These are the highest fines ever proposed for short-term rental violations.

The law was passed and signed in June. In July, DPP informed 5,000 vacation rental operators that their units were being considered for action under the ordinance. Ordinance 19-18 went into effect August 1, 2019.

In July, the City began to announce that there would be quick action on enforcement. They suspended front-desk operation to handle an expected increase in activity under the new rules. They added new staff to deal with increased inspections[143] and to convince rental landlords they were serious about enforcement.[144]

Initial reactions were interesting. The anti-vacation rental forces were quiet. Those against the new law were quick to predict serious problems. They spoke of reduced visitor accommodations stock, rising local rents, and home prices. They predicted that local landlords would be ruined financially and would be forced to sell their rental properties. Nationally, there was a prediction that the new regulations would hurt Hawai'i's economy (Expedia) and that Hawai'i would lose 7,000 jobs, 336 million in household income, 77 million in state taxes (Hawaiian Air). Countering that, pro-Ordinance representatives predicted that local rents will fall and that more new homes will be available at lower prices.

As a middle ground, there were predictions that effects would be minimal and short-term. Some researchers say that property sales, business terminations, and tax revenue decreases may happen, but not in any dramatic way. Santa Monica, after whose vacation rental law Honolulu's was patterned, passed their law in 2015 and did not experience large changes.[145]

Most researchers and market experts agreed it was too early to tell what the ultimate economic impacts will be on neighborhoods and landlords, real estate markets, visitor arrivals, and expenditure accounts.[146]

A few impacts have already been felt. Early articles in August and September noted that short-term rental listings dropped 37 percent in the first two weeks,[147] reports of vacation cancellations, and loss of revenue by those who supply post-arrival goods and services to visitors[148]. Some said that, in their attempt to find alternative reservations, they discovered that hotel and other rental properties had raised their rates substantially,[149] taking advantage of hapless tourists.

All counties have their own new rules for regulating vacation rentals as documented in the Department of Commerce and Consumer Affairs (DCCA) website.[150] We are not aware of and plan to use Honolulu as a field test of the economic impact of vacation rental regulation.

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[143] Associated Press. 2019. Honolulu adds inspectors to help enforce vacation rental law, Friday, August 16, 2019.

[144] City and County of Hawai'i. 2019. Short-Term Rentals, last update 8/23/ 2019, https://www.honolulu.gov/dppstr

[145] Schenfeld, Nikki. 2019. Real estate market impact if vacation rental bills pass, KHON2 June 9, 2019.

[146] Fujii-Oride, Noelle. 2019. Impact of O'ahu's vacation rental crackdown, Hawai'i Business Magazine, September 16, 2019.

[147] Associated Press. 2019. O'ahu illegal rentals drop after short-term rental law OKed, Associated Press, Wire Service Content, August 7, 2019.

[148] Lapan, Tovin. New vacation rental rules of O'ahu spark cancellations, complaints, Travel Weekly, August 15, 2019.

[149] Jedra, Christina. 2019. Tourists scramble as O'ahu vacation rentals disappear under new law, *Civil Beat*, August 12, 2019.

[150] See http://cca.hawaii.gov/ins?s=Transient+Vacation+Rentals&type=usa for updated information.

D. HOUSING AND NATIVE HAWAIIANS

There were 455,502 households in Hawai‘i in 2019. Of those, 117,371 households (25.8%) were Native Hawaiian households.[151] Over 6-out-of-10 Native Hawaiian households (62.4%) lived in the County of Honolulu and 19 percent resided in Hawai‘i County. Maui County was home to 13 percent of Native Hawaiian households and the remaining five percent lived on Kaua‘i.

Almost two-thirds (64.9%) of Native Hawaiian households, the head of household had lived in Hawai‘i all their life, compared to just 36 percent in non-Native Hawaiian households.

The household size among Native Hawaiian households was notably larger; almost half of all Native Hawaiian households (46.6%) have four or more people compared to just 21 percent of non-Hawaiian households. Native Hawaiian households were much more likely than other households to be crowded with more than two persons per bedroom (21.2% v. 10.9%) and much more likely to be doubled up (24.5% v. 9.0%). Native Hawaiian households also tended to be more multi-generational, with 63 percent of multi-person households having two or more generations living under the same roof, while only 45 percent of non-Native Hawaiians live in multi-generational households.

Of the Native Hawaiian households surveyed, 11 percent were living on Hawaiian Homestead Land (12,755 households) in 2019, similar to 2016.[152] Also, among Native Hawaiian households, 20 percent had at least one member on the waitlist to receive a DHHL award (23,883 households) on which they intended to reside. Of those households, only about three-quarters (73.0%) were sure that they intend to have a house on that land.

An additional 21,399 Native Hawaiian households stated that they have a household member eligible to apply for a Hawaiian Home Lands lease but were not yet a leaseholder nor an applicant.

Table 58. Crowding and Doubling Up, Native Hawaiian Households, State of Hawai‘i, 2019

		Native Hawaiian Households		Non-Native Hawaiian Households		Total	
		Count	Percent	Count	Percent	Count	Percent
Household Size	**4 or more-person-HH**	54,672	46.6%	72,198	21.4%	126,870	27.9%
Crowded Based on Persons Per Room	**More than 2 or more persons per bedroom**	23,975	21.2%	34,932	10.9%	58,907	13.6%
Households doubled up	**Yes**	28,702	24.5%	30,549	9.0%	59,250	13.0%

The household income of half (51.8%) of the Native Hawaiian households in 2019 was under $75,000, like the household income distribution (49.5%) of non-Native Hawaiians. Although both groups have a similar distribution of income, the income of the Native Hawaiian households supports a greater number of household members than non-Native Hawaiian households.

Over two-thirds of Native Hawaiian households lived in a single-family dwelling (66.7%) versus 57 percent of non-Native Hawaiians. The figure is down from 73 percent of Native Hawaiians living

[151] According to definitions used for the study, a Native Hawaiian household is one in which at least one person identified as Hawaiian or Part-Hawaiian resides. The figures will not match Census or ACS data which define a Native Hawaiian Household as one in which the householder (head of household) is all or any part Hawaiian. The unweighted sample size for Native Hawaiian households for the 2019 Demand Survey was 2,481.

[152] The counts reported from the survey differ from DHHL wait list, as the survey counted households and the wait list captures all unique individuals.

in single-family dwellings in 2016. Interestingly, Native Hawaiians were less likely to be living in a condominium than non-Native Hawaiians (5.3% v. 12.7%).

More than half (56.3%) of Native Hawaiian households continue to own their current residence, similar to the non-Native Hawaiian households (58.0%) ownership rate. This was a greater percentage of Native Hawaiian homeowners in 2016 (54%), but similar to the figure in 2011 (57%).

Overall, the monthly mortgage payment made by Native Hawaiian households was similar to non-Hawaiian households, with a third (35.3%) of the Native Hawaiian households paying $2,000 or more per month. However, Native Hawaiian households were less likely than other households to have paid off the mortgage on their current residence (19.3% v. 27.7%).

The percentage of Native Hawaiian and non-Native Hawaiian households renting their current residence was similar (39.2% v. 38.4%). The distribution of monthly rent paid by Native Hawaiian households and non-Native Hawaiian households was also very similar, with the median monthly rent being between $1,400 and $1,699.

Consistent with the findings on household income, Native Hawaiian households were more likely to be receiving rental assistance of some type than were non-Native Hawaiians (18.2% v. 12.8%). Roughly 8,400 Native Hawaiian households received some type of assistance (16,600 non-Native Hawaiians households receive rent assistance). Slightly more Native Hawaiians versus non-Native Hawaiian households lived in public housing (4.0% v. 2.7%), Native Hawaiians were much more likely than non-Native Hawaiian households to be recipients of Section 8 rental assistance (9.8% v. 5.6%).

The Housing Demand Survey indicated that 32 percent of Native Hawaiian households would be considered at risk for homelessness, up nine percentage points from the 2016 study. Among non-Native Hawaiian households, the comparable figure was 23 percent. These households reported they would become homeless if they lost their primary source of income for more than two months.

Native Hawaiian households sheltered many more hidden homeless persons than non-Native Hawaiian households. The Housing Demand survey data show that 38 percent of Native Hawaiian households included at least one person who was residing there because they had insufficient resources to buy or rent their own place (hidden homeless). The comparable figure for non-Native Hawaiian households was 19 percent.

When asked how soon they planned to move to another home, four out of ten Native Hawaiian households indicated that they would probably never move, similar to non-Native Hawaiians (38.8% vs. 40.3% of non-Native Hawaiian households). One-third reported that they plan to move within the next five years, with an additional four percent planning to move in six to ten years.

When they move, Native Hawaiian households were more likely to remain on the same island (63.1%), with only 7 percent planning to relocate to another island in the State. Among those who plan to relocate to another island, almost half (44.9%) stated that they wanted to move to Hawaiʻi Island. A significant portion of households, 16 percent of Native Hawaiian households, planned to leave Hawaiʻi when they move.

For those who planned to move within the State, 73 percent of Native Hawaiian households expected to purchase their next home, while 17 percent of these households, plan to rent their next unit, with the remaining households uncertain about their next tenure. Half of these movers would prefer a single-family home (54.4%) with two-thirds expecting three or more bedrooms and three-quarters (77.7%) expecting at least two bathrooms.

Over half (54.7%) of Native Hawaiian households planning to buy their next home reported that they had no more than $75,000 available for the down payment. A larger percentage of Native Hawaiian (7.8%) than non-Native Hawaiian households

(3.9%) reported that they had no funds available for a down payment. Almost half (44.9%) of Native Hawaiian households planning to purchase their next home could afford to make a median monthly mortgage payment of no more than $2,000 a month. This ability to pay was similar to non-Native Hawaiian households.

Among Native Hawaiian households not planning to buy their next home, more than 7 out of 10 indicated that it was simply too expensive to purchase a unit in Hawai‘i. Another major reason (44.8% of households) stated that they could not afford the down payment. For those Native Hawaiian Households who might rent when they move next, more than half (56.9%) feel they can only afford up to $1,400 per month for all housing costs.

Table 59. Demand and Housing Preferences, Native Hawaiian and Non-Native Hawaiian Households, 2019

		Native Hawaiian Households		Non-Hawaiian Households		Total	
		Count	Percent	Count	Percent	Count	Percent
Effective Demand Movers	Prefer to Buy	18,379	45.8%	49,921	49.1%	68,300	48.2%
	Prefer to Rent or Other/Unsure	21,779	54.2%	51,686	50.9%	73,465	51.8%
	Total	40,158	100.0%	101,607	100.0%	141,765	100.0%

Source. HHPS Demand Survey, 2019.

Previously, we calculated the Effective Demand for housing to be 141,765 households (Table 15). Of those units, 40,158 (28.3%) would be from Native Hawaiian households. Across the State, units needed to house Native Hawaiians were almost evenly divided between ownership (46%) and rental units (54%).

Finally, we have prepared a table of needed units for Native Hawaiian households (Table 60). Of the 50,156 housing units needed to accommodate Hawai‘i's households between 2020 and 2025, approximately 14,407 will be needed by Native Hawaiian households.

Fifty-seven percent (57%) of the 14,407 units would be needed to accommodate Native Hawaiian households that earned 80 percent or less of the HUD AMI (8,142 units). Approximately 13 percent of the needed units would be required to house Native Hawaiian households earning more than 180 percent of AMI annually.

Statewide, of the units needed to accommodate Native Hawaiian households, demand for single-family dwellings was roughly 68 percent (9,864 units).

Table 60. Needed Housing Units by HUD Income Classification, Native Hawaiian Households, Counties and State of Hawai‘i, 2020-2025

	Total Units Needed, 2020 through 2025								
	HUD Income Classification								Total
	LT 30	30 to 50	50 to 60	60 to 80	80 to 120	120 to 140	140 to 180	180+	
State of Hawaii	3,554	1,319	473	2,797	1,853	736	1,765	1,911	14,407
Ownership Units	912	519	145	1,711	655	696	1,383	1,746	7,766
Single-Family	882	358	142	1,287	506	641	1,221	1,520	6,556
Multi-Family	30	160	3	424	149	55	163	226	1,210
Rental Units	2,642	800	328	1,086	1,199	40	381	165	6,641
Single-Family	1,207	353	30	804	687	19	140	68	3,308
Multi-Family	1,435	447	298	282	512	21	241	97	3,333
Honolulu	2,349	986	206	2,046	1,256	478	1,208	1,117	9,644
Ownership Units	522	384	0	1,240	286	478	910	1,074	4,893
Single-Family	502	236	0	861	178	423	820	849	3,869
Multi-Family	20	148	0	378	108	55	89	225	1,024
Rental Units	1,826	602	206	806	970	0	298	43	4,751
Single-Family	731	250	0	655	499	0	99	42	2,277
Multi-Family	1,095	351	206	151	471	0	199	1	2,474
Maui	374	143	59	219	237	106	334	472	1,945
Ownership Units	120	74	0	115	68	67	264	362	1,068
Single-Family	120	62	0	70	67	66	228	361	974
Multi-Family	0	12	0	45	0	0	35	1	94
Rental Units	254	69	59	104	170	40	71	110	876
Single-Family	222	67	15	65	148	19	29	26	590
Multi-Family	32	2	44	39	22	21	42	84	286
Hawaii	727	164	178	439	335	101	209	277	2,430
Ownership Units	222	61	131	329	302	101	197	265	1,607
Single-Family	222	61	131	329	261	101	159	265	1,528
Multi-Family	0	0	0	0	41	0	38	0	79
Rental Units	504	104	48	109	34	0	12	13	824
Single-Family	212	36	0	17	15	0	13	0	292
Multi-Family	292	68	48	92	19	0	0	13	532
Kauai	105	26	29	94	25	51	13	45	388
Ownership Units	47	0	14	27	0	51	13	45	198
Single-Family	37	0	11	27	0	51	13	45	185
Multi-Family	10	0	3	0	0	0	0	0	13
Rental Units	58	26	15	67	25	0	0	0	191
Single-Family	42	0	15	67	25	0	0	0	149
Multi-Family	16	26	0	0	0	0	0	0	41

Source. Housing Demand Survey and Hawai‘i Housing Model, 2019.

E. SUSTAINABLE AFFORDABILITY

A sustainable lease is a leasehold arrangement that sustains a property in an affordable price range for a specified period. Details of the arrangement vary and are written to preserve government-assisted affordable housing stock and to facilitate housing acquisition by low-income households.

Leasehold arrangements have been included in the HHPS studies over the last 16 years.[153] That research has determined that about 16 to 18 percent of potential homeowners want to lease their next home. Another 30 to 35 percent would be willing to consider leasing. Together the two groups demonstrate that leasing is a reasonable solution for about 45 percent of households, as many as 5,500 households per year statewide.[154]

As more conditions or features were added to the lease questions, leasing became more attractive to potential buyers. Several features that have been attractive to HHPS respondents in the past include: (1) a nominal down payment [46%], (2) a renewable long-term lease (66 to 99) years [55%], (3) ability to pass the lease to heirs [61%], and a guaranteed buyback at a fixed ROI [71%].

In the end, 50 to 60 percent of potential buyers prefer fee simple ownership. They would not consider leasehold in any format.

The characteristics of those who are interested in leasehold are of interest. In the past, we have said that leasehold arrangements are most attractive to those who need them most.[155]

Leases appealed more to renters than to owners. They appealed to households that were crowded and/or doubled up. They had strong support among households earning between 80 and 140 percent of the AMI on Oʻahu. On Maui and Kauaʻi, interest was highest among households making less than 80 percent of County AMI.

Results of past research show that there is a role for the sustainable lease concept in developing affordable housing in Hawaiʻi. Leasehold arrangements can provide access to more affordable housing units and maintain them in the affordable housing stock. Even where leasehold property is unpopular, a sustainable lease appeals to many potential homebuyers.

a. The 99-Year Lease Research

The 2019 Housing Demand Survey investigated a specific sustainable lease product proposed by the Hawaiʻi Housing Finance and Development Corporation. Elements of the lease product were introduced two at a time, as shown in Figure 15.

The questions were asked only of Demand Survey respondents who were going to move to a unit in Hawaiʻi, wanted to purchase their next residence, and said they could afford monthly payments between $1,100 and $2,999. In total, 608 respondents answered all four questions.

Analysis began with 56 percent willing to buy under the proposed sustainable lease. That was much higher than the starting position of any question we have used in the past. In part, that may have been because we were asking the persons most qualified to use the program. The initial question in the past was whether the respondent would prefer to buy leasehold or fee simple property. This year the set began by asking people to give their evaluation of the owner-occupancy and shared equity option of the 99-year lease product (Figure 15).

As each subsequent question was asked, some respondents changed their position on the lease. When asked about the multi-family and 99-year lease option, 25 percent said they preferred the lease, 30 percent were willing to consider a lease, and 39 percent said “no.” The third question introduced the non-profit agency but reduced the lease period to 60 years. The “yes” responses went down to 24 percent, willing-to-consider went up to 34 percent, and negative responses dropped to 36 percent.

[153] Hawaiʻi Housing Planning Study, 2006, 2011, and 2016. The individual questions used were formulated differently at times, and they were asked of different groups of respondents. See Appendix Exhibit C-3 for details.

[154] None of the leasehold research respondents were qualified by income or any other resources, so the number of lessees is likely to be over-estimated.

[155] Hawaiʻi Housing Planning Study 2016. p. 72.

Figure 15. 99-Year Lease Questions

No.	Features	Question Wording
SL1	Owner occupancy and shared equity	The State or county government can assist private home builders in making homes more affordable by reducing the cost of development. If you purchase a government-assisted home at an affordable price, you must (1) own and occupy the home for an initial period of at least 10 years and (2) share a percentage of the increased value of your home if you no longer use the home as your primary residence (e.g., you rent or sell it). Would you be willing to buy a home at an affordable price with the 10-year owner-occupancy and shared equity appreciation restrictions?
SL2	Multi-family and 99-year lease	The State is looking into developing townhouses and condominium units on State land and offering these homes for sale in leasehold at affordable prices. If you purchase an affordable leasehold property, you would own the housing unit and make fixed land lease payments to the State over the term of the lease, say 99 years. You could sell or transfer ownership subject to the 10-year occupancy and shared equity appreciation restrictions we covered in the last question. Would you be willing to buy an affordable townhouse or condo with a 99-year lease on State land?
SL3	Non-profit agency and 60-year lease	Would you consider buying an affordable leasehold property if the land was owned by a non-profit agency, instead of the State, and leased to you for 60 or more years?
SL4	Summary: Owner occupancy, pass to heirs and buy-back at Fair ROI, non-profit agency	Would you consider buying this kind of leasehold property from a non-profit agency if you had to occupy it as your primary residence and never rent it, but could pass the home on to your children with a new long-term lease or sell the home back to the non-profit at a fair return on your investment?

The general impact of the piecemeal introduction of elements of the 99-year lease product was to increase the number of people who were willing to consider the option. Each new set of options added to the complexity of the issue.

The fourth question summarized the major elements of the product in slightly different languages. At that point, 34 percent preferred the 99-year lease, 37 percent who were willing to consider it, and 36 percent who still said "no," indicating they preferred fee-simple property. We did not lose any respondents as we went along, and the number who said "don't know" or refused to answer a question dropped steadily as we proceeded with the interview.

During the process, 71 percent of respondents changed their positions on the issue, some more than once.

In the end, 27 percent preferred the 99-year lease option (Figure 15) and another 40 percent were willing to consider it. Applying those figures to the demand estimates in the survey, the market potential for the product would be as many as 32,000 buyers (including those willing to consider) in the next five years. That is, there could be 32,000 households wanting to begin the process of obtaining a 99-year lease on a multi-family condominium unit on State-owned land with a 99-year lease as described in the survey. A more conservative estimate would be 13,300 buyer households based on those who answered "yes" to the lease questions.

Our questions were asked of people who expected to move in the next five years. In year one, about 2,600 households may apply to buy a multi-family unit with a 99-year lease with the conditions described in Figure 15. All of them would be able to pay between $1,100 and $2,999 per month in shelter payments.

Table 61. 99-Year Lease Reaction by County

	State	Honolulu	Hawai‘i	Kaua‘i	Maui
Yes, would buy a 99-year lease	27%	23%	31%	46%	43%
Willing to consider a 99-year lease	40%	43%	36%	24%	30%
No, not interested	27%	27%	30%	22%	23%
Other	6%	7%	3%	7%	4%
Total	100%	100%	100%	100%	100%

Percent of movers who wish to buy and expect to pay between $1,100 and $2,999 in monthly shelter costs.

Results differed to a small extent across counties. The overall support was between 66 and 73 percent. The “would buy” response showed that a lesser preference on O‘ahu (23%) compared to the other counties (31 to 43%). At the same time, O‘ahu had the highest proportion (43%) of people who were willing to consider the 99-year lease.

Older people were less likely (63%) to favor the lease than younger people (73%) and support reached 78 percent among people younger than 35. Married people were more likely (75%) than single, widowed, divorced, or separated people (66%) to be willing to use the lease product.

Native Hawaiians were more likely (84%) than non-Hawaiians (69%) to favor the new lease product.

There was no systematic difference in household income. That was not surprising since income varies with household size. Neither was there a substantial difference in support for the lease product when we looked at HUD income levels. These are adjusted for household size. As expected, the lower HUD classifications were more in favor of the lease. In the less than 30 percent AMI category, support reached 81 percent. Also expected, people in the highest classification were least likely to approve (64%). In the mid-range, we found that households with incomes between 50 and 80 percent of AMI expressed less support (65%) than we expected, and those with incomes between 120 and 180 percent of the area AMI were more likely to support the lease (80%).

Current homeowners were less likely (65%) to favor the 99-year lease than were current renters (83%).

Renters who want to own (84%) were more likely to favor the 99-year lease than homeowners who want to own their next units (65%).

Crowded households were more likely to approve the lease, and support among households with more than 1.5 persons per room (the U.S. Census definition of extremely crowded) reached 77 percent.

People who were going to move relatively soon were more likely to value the 99-year lease product. Those who wanted to move in the next five years (about 80%) were willing to use or consider the lease. Among those whose plans to move were less immediate (5 to 10 years), 59 percent were interested.

People who live in multi-family units, whether renters or owners, were more likely (74%) to approve of the State’s proposed 99-year lease than people who live in single-family units (69%). The same was true for those who wanted to move to a multi-family unit (78%). This is a familiar finding based on the respondent’s experience with multi-family living accommodations.

F. HOUSING AND TRANSPORTATION

The Housing and Affordability Index,[156] also called the H+T Index, provides a different perspective on housing affordability by including transportation costs in the equation. The Index provides insights throughout the U.S., including Hawai'i.

The more traditional measure of affordability recommends that housing costs should not exceed 30 percent of household income. Under this view, a little over half (55%) of US neighborhoods are considered "affordable" for a typical household. However, that measure fails to consider transportation costs, which are typically a household's second-largest expenditure. The H+T Index offers an expanded definition view of affordability. It sets a new benchmark: combined housing and transportation costs should not exceed percent of household income.

Based on the 45 percent of combined housing and transportation costs plus percentage of household income benchmark noted, all four counties have significantly higher index levels (Table 62). Hawai'i County, the largest of the islands, has the highest transportation costs and combined index overall.

Table 62. Housing & Transportation Index by County

Counties	Housing Cost (% of HH income)	Transportation Cost (% of HH income)	Combined (% of HH income)
Hawai'i	33%	29%	61%
Maui	34%	23%	57%
Honolulu	33%	19%	52%
Kaua'i	32%	24%	56%

Concepts such as these are the foundation for transit-oriented-development (TOD) nationally - building affordable housing centered on public transportation hubs in order to keep housing and transportation costs affordable to working-class households. Questions related to the interest in living near a transportation hub were included in both the 2016 and 2019 Housing Demand Surveys.

The tables below show Index results for each of the Counties and select communities.

Table 63. Examples of O'ahu Housing & Transportation Index

Areas on O'ahu	Housing Cost (% of HH Income)	Transportation Cost (% of HH income)	Combined Cost (% of HH income)
C&C Honolulu	33%	19%	52%
Kapolei	35%	22%	57%
Pearl City	33%	20%	53%
Kailua	45%	21%	66%
Urban Honolulu[157]	29%	16%	45%

Table 64. Examples of Maui Housing & Transportation Index

Areas on Maui	Housing Cost (% of HH income)	Transportation Cost (% of HH income)	Combined (% of HH income)
Maui Island	34%	23%	57%
Lahaina	33%	21%	54%
Kīhei	32%	21%	53%
Kahului	34%	21%	54%

Table 65. Examples of Kaua'i Housing & Transportation Index

Areas on Kaua'i	Housing Cost (% of HH income)	Transportation Cost (% of HH income)	Combined (% of HH income)
Kaua'i County	32%	24%	56%
Po'ipū	53%	24%	60%
Kīlauea	37%	27%	65%
Kapa'a	26%	23%	49%
Līhu'e	33%	22%	55%

Table 66. Examples of Hawai'i Housing & Transportation Index

Areas on Kaua'i	Housing Cost (% of HH income)	Transportation Cost (% of HH income)	Combined (% of HH income)
Hawai'i County	33%	28%	61%
Hilo	30%	27%	57%
Kona	32%	26%	57%
Waimea	42%	29%	72%
Ocean View	19%	29%	48%

Statewide over 56 percent of respondents commute to and from work or school at least four

[156] The Center for Neighborhood Technology's Housing and Transportation Affordability Index, http://htaindex.cnt.org.

[157] This includes areas from Hālawa to Wai'alae Kāhala.

days a week. The percentage of commuters is highest on O‘ahu and lowest on Hawai‘i Island. O‘ahu has the highest percentage of commuters that use public transportation at 13 percent. Maui and Hawai‘i Counties have the lowest at 5 percent. This is likely due to the extensive bus service available on O‘ahu.

Monthly transportation cost for households who use public transportation is highest on Kaua‘i at $131.62 and is lowest on O‘ahu at $95.52. This is likely due to the lower cost of gasoline on O‘ahu, as well as the greater availability of mass transit. The average time for the longest commute in a household on O‘ahu is almost 30 minutes, with Maui and Kaua‘i averaging closer to 24 minutes.

Table 67. Commuter Characteristics

Characteristic	O‘ahu	Maui	Hawai‘i	Kaua‘i	State
Percent of households in which one or more adults commute to and from work or school at least four days a week	58.0%	55.5%	51.3%	57.1%	56.7%
Percent of commuters who use public transportation at least three days a week	13.3%	5.4%	5.4%	8.1%	11.1%
Average monthly transportation cost for commuters who use public transportation	$92.52	$112.51	$108.59	$131.62	$101.21
Number of adult commuters in the household	1.81	1.73	1.60	1.80	1.81
Average travel time for the commuter with the longest commute in the household in minutes	29.9	24.3	29.2	23.3	28.8

a. Households that Want to Live Closer to a Rail Station (Honolulu)

Demand Survey respondents who were likely to move were asked if they would “want to move closer to one of the rail stations when they are built.” Seventeen percent (17%) of them said they would want to move closer to a rail station. This percentage is lower than the 24 percent who responded positively in 2016.

Among households that wanted to move closer to a rail station, 68 percent would be interested in a multi-family, for sale unit (condo or townhouse) near a rail transit station. In 2016 when given an option between single-family and multi-family units, 52 percent selected multi-family.

Those interested in moving closer to a rail station must have one to two parking spaces. The majority of those who wanted a parking space (77%) would rather pay for the parking space as part of the purchase price of their unit rather than as a monthly maintenance fee.

Fifty-two percent (52%) of movers who would like to live near a rail station said they could afford to pay between $500 and $1,100 per month for all housing costs. The smallest number of bedrooms they can live with in their new home is two (66%) and the smallest number of bathrooms is one (44%). It is notable that there is a small percentage of those wanting to live near rail stations that want a minimum of four bedrooms (10%) and two and one-half to three bathrooms (7%), therefore having some larger units available would be beneficial.

The major characteristics of mover households that want to live near a rail station were working fulltime (79%); currently paying rent of $500 to $2,000 per month (71%); household income greater than $75,000 (51%), and significantly more likely to use public transportation currently compared to the rest of the population (25% v. 13%). It’s likely that this group is looking for an entry-level opportunity to buy a unit and take advantage of the nearby rail to commute.

b. Households Wishing to Move Closer to Place of Employment (County of Hawai‘i)

On Hawai‘i County, 31 percent of potential movers “when they moved intended to move closer to the workplace of someone in the household to reduce transportation costs or commute time.” Those desiring a unit closer to place of employment compared to those who don’t differ on the following characteristics: more likely to be a renter (59% v. 54%); live in an apartment (20% v. 14%); be younger - age 18 to 34 (29% v. 16%); and single, never married (35% v. 25%).

Households that wanted to move closer to their place of employment wanted to buy their new home (46%). They would prefer a single-family home (49%) with two to three bedrooms (67%) and one and a half to two bathrooms (54%).

Twenty-three percent (23%) of future movers believe they could afford to pay rent amounts between $800 and $1,099; 40 percent can afford $1,100 to $1,999 per month. Twenty-two percent (22%) of movers who would like to buy a home closer to employment say they have less than $25,000 to pay for a down payment, and 10 percent say they have $400,000 or more. Monthly housing costs of $2,000 to $2,999 would be manageable for 23 percent of homebuyers, 31% would be able to manage a higher amount.

Hawai‘i County had the highest Housing and Transportation Index of all the Counties (61% of household income). This may be why 31 percent of Hawai‘i mover households want to move closer to their place of employment – to reduce the combined cost of housing and transportation together.

V. PUBLIC SECTOR HOUSING RESOURCES

This section covers important public sector housing resources, including funding, public housing, public housing subsidies, and housing planning. Government-assisted housing has been a part of the government's role in zoning and in developing and maintaining public housing for the lowest income groups. Today, with the advent of inclusionary housing policy, the role of government in providing housing for its citizens has expanded to touch on nearly every type of housing in the local market.

HHPS data focus on public sector housing. In part, that is because HHPS is funded by the public sector and its data are published by government agencies. More importantly, the study has always found that housing need is greatest at the lower end of the market. Supply, demand, and needed units estimates show that housing shortages are more prominent among lower-income families and they often require subsidized housing as a solution.

A. HOUSING FUNDING PATTERNS

In the public sector, funding comes largely from two sources: federal and state governments.

1. Federal Allocations

Before 2010, USASpending tells us that federal allocations for housing in Hawai'i amounted to about $133 million per year (HHPS, 2011). Allocations were high in 2000 and 2001, then leveled off at about $70 million a year during the middle of the decade. With added funds from the American Recovery and Reinvestment Act of 2009, HUD spending rose to over $200 million a year in 2008 and 2009 and settled back to $161.3 million in 2010. Between 2012 and 2015, expenditures grew substantially to a level of $226.6 million in 2015. Federal expenditures on housing grew to $268.5 in 2018 and $269.1 million in 2019.

Table 68. Federal Housing Expenditures in Hawai'i, 2015-2019

HUD Funding for Hawaii, 2015 - 2019					
Hawaii, All Counties and State Agencies	2015	2016	2017	2018	2019
Community Planning & Development (CPD) Programs (a)	$ 30,754,643	$ 10,535,048	$ 127,283,754	$ 36,164,936	$ 36,162,130
Public & Indian Housing (PIH) Programs(b)	$ 147,507,059	$ 153,540,813	$ 171,032,492	$ 187,175,581	$ 186,833,240
Native Hawaiian (c)	$ 9,100,000	-	$ 2,000,000	$ 2,000,000	$ 2,000,000
Fair Housing	$ 580,342	-	$ 537,350	$ 487,350	$ 487,350
Multifamily Housing Programs(d)	$ 38,702,635	-	$ 41,833,576	$ 42,724,546	$ 43,619,098
Subtotal	$ 226,644,679	$ 164,075,861	$ 342,687,172	$ 268,552,413	$ 269,101,818
FHA Mortgage Insurance Programs(e)	$ 201,949,260	$ 201,949,260	$ 583,223,204	$ 5,264,612,644	$ 4,732,258,506
TOTAL	$ 428,593,939	$ 366,025,121	$ 925,910,376	$ 5,533,165,057	$ 5,001,360,324
State Agencies	2015	2016	2017	2018	2019
Community Planning & Development (CPD) Programs (a)	$ 5,480,246	$ 1,764,244	$ 28,415,304	$ 9,113,785	$ 9,334,610
Public & Indian Housing (PIH) Programs(b)	$ 61,558,633	$ 63,618,839	$ 71,820,437	$ 82,231,738	$ 80,413,466
Native Hawaiian (c)	$ 9,100,000	$ -	$ 2,000,000	$ 2,000,000	$ 2,000,000
Fair Housing	$ 580,342	$ -	$ 537,350	$ 487,350	$ 487,350
Multifamily Housing Programs(d)	$ -	$ -	$ -	$ -	$ -
Subtotal	$ 76,719,221	$ 65,383,083	$ 102,773,091	$ 93,832,873	$ 92,235,426
FHA Mortgage Insurance Programs(e)	$ -	$ -	$ -	$ -	$ -
TOTAL	$ 76,719,221	$ 65,383,083	$ 102,773,091	$ 93,832,873	$ 92,235,426

(a) CPD programs include Community Development Block Grant, HOME Investments Partnership, National Housing Trust Fund, and Homeless programs
(b) PIH programs include rental subsidy vouchers, self-sufficiency, and public housing operating and capital improvement programs
(c) Includes Native Haw aiian housing block grant, training and technical assistance, and loan guarantees
(d) Multifamily programs provide supportive housing for the elderly and persons w ith disabilities. They are distributed directly to projects.
(e) Includes mortgage insurance for single family and multifamily (rental housing) loans. They are distributed directly to projects.

Source: HUD Honolulu Field Office. Note: HUD expenditures are by Fiscal Year, although certain funds, including Continuum of Care and Fair Housing funds are subject to a one-year lag. Funds are aw arded by formula grant or competitively to the State, Counties, and private entities.

Among other uses, funds allocated through Community Planning and Development Programs can be used to produce or preserve housing units. They include CDBG, HOME, HOPWA, and ONAP and amounted to about $39.8 million in 2015 and $38.2 million in 2019. Funding increased notably in 2017, when HUD granted the State additional funding for the Housing Trust Fund. In all, the level of funding to build units has been relatively steady over the last few years.

There were steady increases in homeless program support and administration as well as administrative and operations funding for the State, the Counties, and the Hawaiʻi Public Housing Authority.

Multifamily housing support has also risen steadily since 2015 with a slight decrease in 2019. The most important funding level increase, however, has been for the FHA Mortgage Insurance Program. Total FHA-insured mortgage loans have increased from $202 million in 2015 to $4.7 billion in 2019, 22.4 times the 2015 level.

2. State Allocations

In all the states, most housing funds spent by local governments come from federal sources. In Hawaiʻi, State allocations to housing have been substantial throughout the last decade (Table 69).

Between 2010 and 2015, the total State allocation to housing amounted to about $90 million per year. Between 2015 and 2018, State allocations to housing rose from $81.1 million to $352.6 million, with a growth rate of about 335 percent. Much of the increase (60 to 80 percent) was in the form of very generous allocations to the Rental Housing Revolving Fund (RHRF) and the Dwelling Unit Revolving Fund (DURF). There were also greater allocations for rental assistance, rental services, homelessness, and administration.

In 2019, State allocations to housing support returned to the 2015 level ($ 96.8 million) and there were no major allocations to the revolving funds.

Table 69. State Legislative Funding for Affordable Housing, 2014 to 2019

	Affordable Housing Funds	Capital Improvement Projects	Administration	HPHA Administration	Total
2014	$29,764,536	$1,300,000	$6,874,086	$58,006,911	$95,945,533
2015	$51,510,777	$14,332,000	$7,197,377	$8,047,324	$81,087,478
2016	$73,056,877	$1,700,000	$9,842,662	$73,867,668	$158,467,207
2017	$99,600,000	$12,230,000	$11,039,417	$54,028,875	$176,898,292
2018	$298,000,000	$4,200,000	$11,747,671	$38,673,088	$352,620,759
2019	$38,000,000	$2,900,000	$10,930,425	$44,976,508	$96,806,933

Source: Budget, House and Senate approved allocations, 2014 - 2019.

Legislative allocations were of two types. First, the State issued general obligation bonds to fund specific projects. They were usually associated with Capital Improvement Project (CIP) appropriations for public housing and revolving funds (RHRF and DURF) that are used to finance housing development. Second, the State appropriated General Funds to support homeless shelters and homeless services, as well as public housing renovations and rent subsidies.

Recapping, HUD funding under the CDBG and HOME programs[158] can be used to produce or preserve units, for acquisition, or provide infrastructure. Those funds amount to about 9 percent of total HUD funding in 2015 and have been steady over the past five years.

In the past, State funding for housing has been lower than federal funding. It expanded in the middle of the current decade primarily due to

[158] In some years HOPWA and ONAP as well.

higher allocations to the RHRF, which provides equity gap financing[159] to support rental housing development or preservation. As of June 2016, equity gap financing from the RHRF assisted in construction or preservation of over 4,300 units. Between June 2016 and June 2019, RHRF funds were used to develop over 1,280 more units.[160]

There would be very few affordable housing units produced today without federal- and state-funding. It is not unusual for a rental project to be financed by tapping several funding sources, including LIHTC, HOME (or CDBG), and RHRF.

The increases in both federal and state funding are especially important because the costs of producing affordable housing are increasing. Construction costs have been rising and pushing funding gaps up with them.

B. GOVERNMENT-ASSISTED HOUSING

The State's list of government-assisted housing units was expanded this year.[161] It began as a list of units produced with the assistance of federal, state, and county resources. The list has been updated for each of the last three HHPS projects. This year the list includes more types of housing, including units under construction, planned for the near future, and preliminary units that may be constructed over the nets ten or more years.

The list was initiated by HHFDC and has been updated periodically with the assistance of the County housing officers and administrators and some County Planning Departments. The data file uses the housing project as a unit of analysis and has one record per project. Projects may be of any size and include federal, state, or county funding or support for new construction as well as acquisition, redevelopment, and refurbishing.

A large and growing number of variables describe each project. Most important among those are the number of units associated with each project and a breakdown of those units according to tenure (owner/renter), type (single-family/multi-family).

The list includes units in housing projects developed using any federal, state, or county resources. Government-assisted units include those the government financed, developed, or required through the State Land Use Commission, county development plans, or zoning. The initial list included only "affordable" housing units. It now includes market-rate units built under inclusionary housing policies for which the affordable units received some government assistance.

The Government-Assisted Housing List is a work in progress. It continues to expand in terms of time, space, content, and unit types. This year the list was an important part of three sections of the HHPS 2019 report: (1) the Pipeline section, (2) the government resources section, and (3) the Housing Tracking Study (next section).

The current list contains data on 736 projects and 165,643 housing units constructed in Hawai'i with the help of public housing funds. Expansion and refinement have been sporadic but effective.

Some major improvements are scheduled for the future, including expanding the list to include sustainability or preservation. Those will be further discussed in the tracking study section.

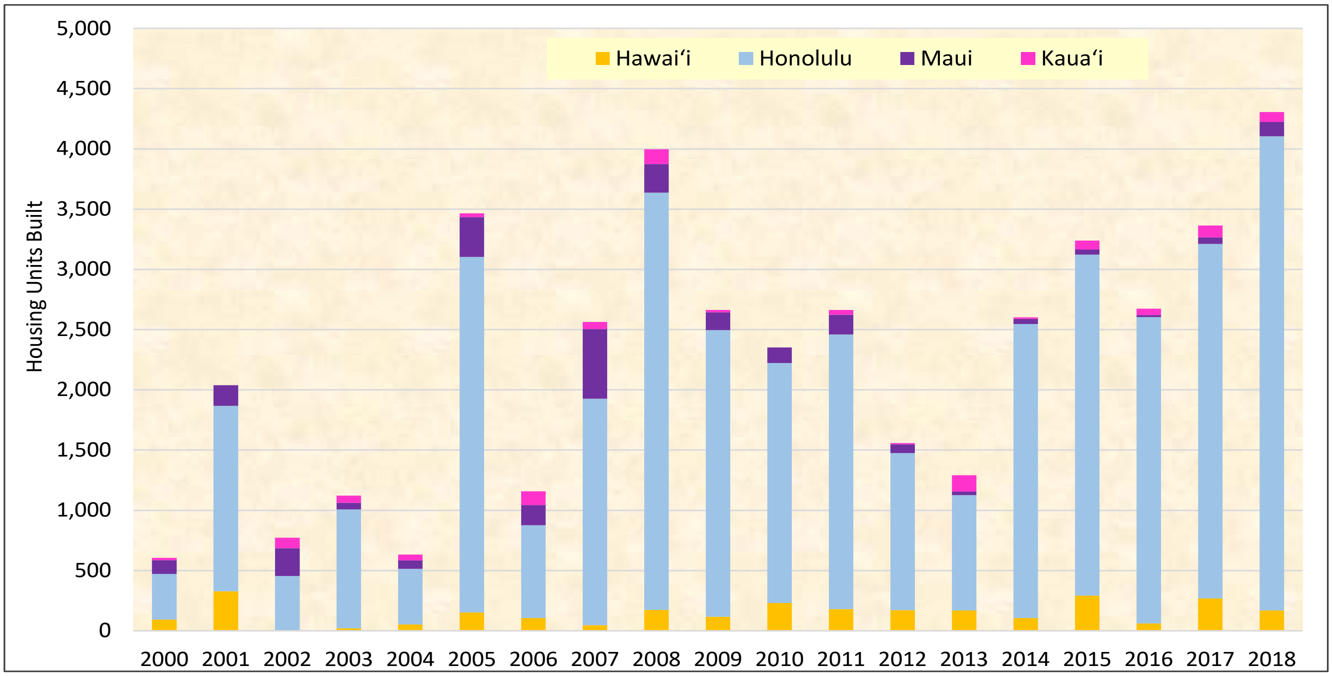
Figure 16 presents a graphic representation of the units produced in each of Hawai'i's four counties by year in which the units were completed.

[159] Equity gap funding is intended to cover the difference between project costs and available sources of construction and permanent financing for affordable rental or mixed-use projects.

[160] HHFDC, internal records.

[161] Section 3, pp. 36-38.

Figure 16. Government-Assisted Housing Units Constructed, 2000-2018



Source. Government-Assisted Housing List, SMS analysis.

Between 2000 and 2009, there were 10,907 government-assisted housing units constructed or preserved (through acquisition or rehabilitation) in the State of Hawai'i. That was 1,091 units per year. Between 2010 and 2019, state and county housing agencies added or preserved 14,322 housing units, or about 1,432 per year.

Production of government-assisted affordable housing rose from 2002 through 2009, then was stable from 2010 to 2013, and dropped in 2012 and 2013. Production has been rising since 2014.

Government-assisted units were predominantly multi-family and rental units. In Honolulu, half the affordable units were rentals and 68 percent were multi-family. In the other three counties, close to 90 percent of affordable units were multi-family and rental units. The situation was different for Honolulu and the other counties (Table 70).

The type of units produced has shifted somewhat since 2010. Maui County moved toward producing a greater number of multi-family units for rent. Honolulu and Hawai'i counties, on the other hand, produced more single-family units for ownership compared to the previous decade.

Table 70. State Legislative Funding for Affordable Housing, 2014 to 2019

		State	County			
			Hawai'i	Honolulu	Kaua'i	Maui
2000 to 2009	Total	10,907	1,258	7,234	562	1,853
	Percent Multi-family	64	68	72	46	40
	Percent Rentals	67	68	72	46	55
2010 to 2014	Total	9,933	4,071	198	381	5,283
	Percent Multi-family	78	42	94	69	21
	Percent Rentals	60	39	60	69	79
2015 to 2019	Total	4,389	592	3,382	177	238
	Percent Multi-family	71	100	66	100	79
	Percent Rentals	71	100	74	100	21

VI. TRACKING AFFORDABLE HOUSING STOCK

A. BACKGROUND

Recent literature on affordable housing has repeatedly urged that efforts to provide affordable housing be accompanied by accurate data and rational analysis. In addition, virtually all Hawai'i's recent investigations into housing (State Plan, ten-year plan, etc.) have identified an affordable housing tracking system as a priority. Following this rationale, the 2019 HHPS RFP called for a study of ways to track affordable housing projects.

The list of government-assisted housing units discussed throughout this report might well provide the basis for such a tracking system. It now contains most, if not all, of the housing unit types that need to be tracked. In addition, it was improved with each successive HHPS project since 2011 and is familiar to all the housing offices in the State.

Building and maintaining an accurate, up-to-date database will require resources and patience, especially for the initial development phase. Having data to understand affordable housing, knowing what happens to affordable housing units over time, and having the ability to develop effective housing programs and evaluate them for continuous improvement will be worth the effort.

1. Objectives

The objective of this phase of the project was to provide guidelines to develop a data system for tracking production and inventory of affordable housing units in all four counties. For purposes of this project, affordable housing units are units produced specifically to be sold or rented at prices below market level. They are subsidized by government agencies in order to address the housing need among households in specified income groups. Those units may or may not enter the market at below-market prices or rents. When they do, they may or may not remain at an affordable price forever. Tracking is applied to determine the length of time those units remain affordable.

2. Methodology

The tracking system was covered in stakeholder interviews with State and County personnel. It also benefitted from our interaction with county housing, planning, and tax assessment personnel in the process of collecting data on affordable housing. We also met with Housing Directors, HHFDC, and State of Hawai'i Department of Business, Economic Development and Tourism, the Hawai'i Office of Planning, managers of the Homeless Management Information System, and GIS specialists to explore barriers and opportunities for development of an affordable housing tracking system.

B. DESIGN

It was decided early in the project to pattern the affordable housing tracking system after the Homeless Management Information System (HMIS). The HMIS was developed to address the information needs of homeless services providers and state agencies. It was necessary in order to understand how homelessness worked in Hawai'i and which programs and services were best suited to meeting the needs of homeless people. HMIS is funded by HUD, maintained by IT service providers, and managed by its users.

The HMIS is maintained centrally and its use is required of all homeless service providers who receive State or Federal funds. Providers use HMIS input formats for new clients and update case information on a regular basis. They can then generate a variety of reports that help them better understand their clients and evaluate the services they receive. For the 2019 HHPS, SMS used a de-identified dataset extracted from HMIS to develop this year's analysis of homeless persons' need for housing.

The structure that we would like to preserve for the affordable housing tracking system is that of an independent, transaction-based data system to serve the needs of affordable housing providers. All public and private affordable housing providers will contribute data on a continuing basis. The dataset will remain accessible to all providers. Management of the dataset will be centralized and independent as it serves the continuous technical capacity of the system and the rigorous pursuit of accuracy of the data. Management will assure unfettered access to the data to all subscribers and will not define or hinder analysis by qualified users.

1. Major Features

Working from the HMIS concept, and with the advice of affordable housing stakeholders in Hawaiʻi, we have put together a set of features that will be central to the affordable housing tracking system for Hawaiʻi.

Phasing: Our interviews with public and private sector officials who may be involved with the development and use of the affordable housing tracking system suggest that the project will benefit for some phasing. The first phase would be planning, during which affordable housing providers and government agencies involved could be offered input to the system design. The second phase might include designing a follow-up method, security systems, and formulating an RFP for development. That process will describe the project elements that must be included. The third phase would be development – the coding and testing of the database system. The fourth phase would be data entry – the populating of the database, along with training for those who will input data, and opportunities to tweak the system to serve the needs of data providers. This phase can also include service to providers who need assistance with data access on their end. The last phase would be operations, or the continued management and improvement of the system to serve the needs of providers.

Content: The tracking system requires a set of data and an analysis method suitable for tracking the long-range affordability of units produced with governmental assistance and provided to owners or renters at below-market prices. In fact, housing officials in Hawaiʻi are considering a more comprehensive dataset that could be applied to housing issues other than affordable housing tracking. The content we will discuss here is already expanded to meet that objective.

Software: The software for creating and updating the database should be commercial database management and analysis software from an established vendor. It should be elementary enough to be used by non-specialists. Its primary functionality should be data input and updating. A good, non-proprietary database can be accessed by many kinds of analysis software programs. Our current recommendations are Microsoft Excel for data entry and Microsoft Power BI for analysis and display.

Geographical Interface: Nearly all housing issues are location-oriented. The system must bring together land use and tax map key information. Ideally, it should accommodate GIS information for mapping output and to interface with State and County GIS systems.

Input: Most of the database content items we describe here are already collected by affordable housing providers in Hawaiʻi. The exception may be the follow-up items we have described in the next paragraph. Data input should be in the hands of the providers, allowing them to control the transfer of their data to the centralized database. The initial data entry and periodic update of those items should provide for options. The providers should be able to physically enter data to the system, electronically transfer data across the database firewall, or submit data in hard copy.

Follow-Up: Tracking affordable housing involves periodic monitoring of the status of individual housing units. Affordable status is conveyed upon housing units that are developed or acquired using public sector funds or under the aegis of public programs. They remain in the affordable housing stock as long as they continue to be available at below-market prices. For any number of reasons, affordable housing units may revert to market prices in the years after they are first made available. To track affordable units will require that the project (with input from providers) develop a mechanism for monitoring or following up affordable units for several years after they are first sold or rented. To date, this has not been done on any comprehensive or consistent basis.

It is likely that systematic information on the fate of affordable units developed before 2020 can be recovered. We can only propose that tracking will begin as soon as possible as part of the project.

Output: There are many types of output from a good data tracking system and these are often developed as the system matures and the new utilities are discovered. Two types of output are usually programmed at the beginning. First, there is a need for a set of standard reports to serve the primary users. Second, there is an analysis function to provide simple analyses and data extracts as needed.

Management: The project will track affordable housing statewide and the database will be managed at the State level. Management functions include maintaining the statewide database, managing the data input and update functions, and distributing system products and outputs to users. The managing agency must have the appropriate resources and authority to carry out those tasks. It will be necessary to develop a data users' group with the collective power to make decisions about data access, membership, and future directions.

Access: Data output will be available to all system sponsors (initially, state and county housing and planning departments). Access to original data will be available to the contributing agencies and to a system management agency. Access to any system-wide data developed from the originally input data will be determined by the user's group. The access, maintenance, and management functions may or may not be delegated to a single agency.

Security: Standard system security measures required of all government data must always be in place . Special security procedures will be required once the tracking data that identifies new owners and renters is developed. Finally, the management agency must monitor the decisions of the users' group regarding access by one county to data input by another county.

2. Data Elements

Table 71 presents a preliminary a list of data fields to be considered for the database. The list is based on the items that were cited as useful to county stakeholders in our interviews. Items address the kinds of data they would need to effectively deal with the affordable housing sustainability issue.

Table 71. Fields for Affordable Housing Database

Section Name		
	Field Name	**Type of Entry**
Identifiers		
	Unique ID Number	
	Project Name; Phase	
	Street Address	
	City, District, Island	
	Zip Code	
	TMK Number	
	Parcel Number	
	GIS Coordinates	
	Zoning code	
Project Type		
	Type: Land use	Residential, Ag, C&I
	Type: Tenure	For sale, for rent, other
	Type: Groups served	Family, seniors, spec. need
	Type: Policy	Inclusionary, other, self-help
	Type: Transaction	vacant land, lots, turnkey
	Building Type	Single-family, multi-family
	Project Type	Rehab; New Construction
	Project Status	Planned, construction, complete, etc.
	Status change date	Date format
Unit Mix – Market Rate		
	Total	#
	For sale; rent, other	#
	SFD, MFD	#
Unit Mix – Affordable		
	Total	#
	For sale; rent, other	#
	SFD, MFD	#
Income Targets for Affordable Units		
	≤ 30 % of HUD AMI	#
	31 to 60% AMI	#
	61 to 80% AMI	#
	81 to 100% AMI	#
	101 to 120% AMI	#
	120 to 140% AMI	#
	>140% AMI	#
Number of Units by Bedrooms		
	Studio	#
	One Bedroom	#
	Two Bedroom	#
	3 or More Bedrooms	#
Project Dates		
	Start	Year
	Expected finish	Year
Development Data		
	Agency	name
	Funding Source	names
	Developer	name
Tracking data		
	Designed affordable	#
	Sold/rent affordable	#
	Deed restrictions	Specify, #
	Affordable after 1 yr.	#
	Affordable after 5 yrs.	#
Update Information		
	Most Recent Update	date
	Person that Updated	name

Most of this information is already being collected. Much is included in the Government-Assisted Housing List developed for HHPS 2019. The new data are the items to record a change in status of affordable units.

C. RESOURCES REQUIRED

The Affordable Housing Tracking System will require allocation of resources at both the state and county levels. The state is expected to be the managing agent and would be responsible for the up-front development costs and the ongoing maintenance of the system.

At the state level, the initial expenditures will be for software, development, and training. The software cost is expected to be reasonable and some functionality may already be available in state government programs. The basic Microsoft 365 package, for instance, includes access to Excel and Power BI. Developing the database, input/output systems, and security systems is a one-time cost that could be substantial. We have not priced this aspect of the system. Once the system is developed, it will be necessary to train state and county employees to use it. All these costs can be expensed.

The ongoing resources for the management, maintenance, development of the system are primary personnel costs. They are both annual and long-range. The number of employees required for that task depends on the nature of the system, but the initial specifications presented here would probably require one person full-time. It is unlikely that the job description exists now at the state housing agency, and a new hire would be required.

At the county level, there would also be initial hard costs for software (if not currently part of the Microsoft programs), development, and training. These would be one-time costs and that will be considerably less than cost incurred at the state level. The county-level costs for long-term management, maintenance, and development would also be less. If data input and updating for housing data are being handled at the county level now, there may be no need for additional personnel. If new positions are needed, they may not require full-time attention to the task and would not require the same skills levels that are needed for project management at the state level.

Developing a tracking system for affordable housing in Hawaiʻi is not technically difficult, time-consuming, or expensive. The most challenging aspects of the problem are developing a system with clear responsibilities and well-understood benefits for all parties concerned. It will also be necessary to establish a central management agency with the authority to enforce compliance, if needed, and a users' group.

VII. APPENDIX

APPENDIX A: HHPS HOUSING TRENDS

Tables presented in Appendix A, referred to in prior years as the “A Tables” or “Trend Tables,” provide detailed demographic and housing-related data for the State of Hawai‘i and its counties. This data is taken from the Housing Demand Survey each year. The fundamental components of the Housing Demand Survey were designed to ensure compatibility with previous versions. These tables allow for the evaluation of trends in the Hawai‘i housing market across the past 25 years.

Table A-1. Characteristics of Housing Units, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Tenancy		Unit Size (Bedrooms)			
			Own	Rent	Studio or 1 Bedroom	2 Bedrooms	3 Bedrooms	4+ Bedrooms
Honolulu	1992	247,349	48%	52%	20%	32%	30%	19%
	1997	272,234	54%	46%	16%	27%	36%	21%
	2003	292,003	61%	39%	15%	25%	35%	25%
	2006	303,149	59%	41%	18%	25%	37%	20%
	2011	310,882	56%	44%	15%	21%	37%	26%
	2016	317,459	55%	45%	17%	26%	32%	25%
	2019	306,898	56%	44%	19%	24%	33%	24%
Maui	1992	34,266	61%	39%	14%	26%	46%	15%
	1997	39,252	65%	35%	12%	23%	46%	19%
	2003	43,687	61%	40%	13%	28%	42%	17%
	2006	49,484	60%	40%	15%	27%	43%	17%
	2011	54,132	54%	46%	17%	26%	37%	20%
	2016	55,059	57%	43%	16%	25%	38%	20%
	2019	55,842	59%	41%	16%	25%	38%	20%
Hawai`i	1992	39,789	68%	32%	7%	25%	53%	14%
	1997	46,271	72%	28%	8%	21%	54%	17%
	2003	54,644	70%	30%	12%	19%	50%	19%
	2006	61,213	69%	31%	11%	22%	49%	18%
	2011	67,096	67%	33%	13%	21%	47%	19%
	2016	66,989	66%	34%	12%	23%	46%	18%
	2019	70,662	67%	33%	17%	21%	42%	20%
Kaua`i	1992	16,981	60%	40%	12%	19%	53%	15%
	1997	18,817	67%	33%	8%	19%	57%	15%
	2003	20,460	66%	34%	11%	20%	53%	17%
	2006	21,971	66%	34%	10%	21%	51%	18%
	2011	23,201	59%	41%	12%	19%	51%	18%
	2016	23,369	63%	37%	13%	17%	50%	19%
	2019	22,023	63%	37%	14%	19%	49%	18%
State	1992	338,385	52%	48%	17%	30%	35%	18%
	1997	376,574	58%	42%	14%	25%	40%	20%
	2003	410,794	62%	38%	14%	24%	39%	23%
	2006	435,818	61%	39%	17%	24%	39%	20%
	2011	455,311	57%	43%	15%	22%	39%	24%
	2016	462,876	57%	43%	16%	25%	36%	23%
	2019	455,425	58%	42%	18%	24%	35%	23%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

Table A-2. Household Income Data, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Household Income: Less than $15,000	$15,000 to $24,999	$25,000 to $49,999	$50,000 to $74,999	$75,000 to $99,999	$100,000 or more	Median HH Income
Honolulu	1992	247,349	N/A	24%	29%	12%	6%	7%	$36,974
	1997	272,234	9%	9%	28%	15%	9%	6%	$42,234
	2003	292,003	8%	10%	36%	18%	11%	17%	$47,917
	2006	303,149	13%	7%	26%	22%	12%	20%	$58,385
	2011	310,882	12%	7%	25%	22%	9%	25%	$59,076
	2016	317,459	9%	6%	18%	21%	15%	31%	$73,824
	2019	311,451	8%	6%	16%	17%	14%	39%	$95,455
Maui	1992	34,266	N/A	20%	36%	11%	2%	3%	$35,843
	1997	39,252	10%	8%	33%	15%	7%	6%	$38,908
	2003	43,687	9%	13%	34%	19%	14%	11%	$44,297
	2006	49,484	11%	8%	29%	20%	15%	17%	$49,795
	2011	54,132	12%	10%	27%	19%	11%	21%	$58,424
	2016	55,059	11%	8%	23%	21%	12%	25%	$59,733
	2019	54,434	8%	7%	19%	18%	14%	34%	$74,451
Hawai`i	1992	39,789	N/A	24%	39%	11%	3%	4%	$34,063
	1997	46,271	14%	14%	30%	12%	4%	4%	$31,831
	2003	54,644	14%	12%	39%	17%	9%	9%	$36,905
	2006	61,213	13%	10%	29%	22%	10%	16%	$51,920
	2011	67,096	18%	13%	25%	17%	10%	17%	$44,696
	2016	66,989	16%	11%	28%	18%	11%	18%	$44,879
	2019	67,054	14%	10%	20%	18%	13%	24%	$59,503
Kaua`i	1992	16,981	N/A	20%	36%	10%	5%	3%	$36,966
	1997	18,817	11%	13%	30%	15%	5%	3%	$34,891
	2003	20,460	13%	12%	37%	18%	9%	12%	$42,205
	2006	21,971	10%	10%	27%	23%	11%	19%	$53,116
	2011	23,201	13%	11%	25%	19%	9%	19%	$49,730
	2016	23,369	11%	11%	26%	20%	11%	21%	$58,789
	2019	22,563	10%	6%	20%	16%	15%	34%	$74,527
State	1992	338,385	N/A	24%	31%	12%	5%	6%	$36,289
	1997	376,574	10%	10%	29%	15%	8%	6%	$39,883
	2003	410,794	10%	10%	36%	19%	10%	15%	$46,086
	2006	435,818	13%	7%	27%	21%	12%	20%	$58,393
	2011	455,311	13%	8%	26%	21%	10%	23%	$58,700
	2016	462,876	11%	7%	20%	21%	14%	28%	$72,821
	2019	455,502	9%	7%	17%	17%	14%	36%	$74,983

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

Table A-3. Households at HUD Income Guidelines by County, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	HUD Household Income Guidelines					
			30% or less	Over 30% to 50%	Over 50% to 80%	Over 80% to 120%	Over 120% to 140%	Over 140%
Honolulu	1992	247,349	N/A[a]	20%	19%	23%	10%	27%
	1997	272,234	8%	15%	21%	30%	7%	20%
	2003	292,003	5%	19%	22%	22%	7%	25%
	2006	303,149	14%	10%	20%	22%	9%	24%
	2011	310,882	19%	16%	25%	12%	7%	21%
	2016	317,459	15%	11%	22%	16%	15%	22%
	2019	311,451	16%	14%	20%	12%	9%	28%
Maui	1992	34,266	N/A[a]	20%	19%	24%	9%	28%
	1997	39,252	7%	11%	27%	24%	10%	21%
	2003	43,687	10%	17%	28%	18%	7%	21%
	2006	49,484	13%	11%	19%	21%	7%	28%
	2011	54,132	20%	19%	22%	9%	5%	25%
	2016	55,059	16%	14%	19%	14%	12%	25%
	2019	54,434	14%	9%	15%	7%	10%	45%
Hawai`i	1992	39,789	N/A[a]	20%	18%	24%	10%	29%
	1997	46,271	3%	19%	21%	23%	10%	24%
	2003	54,644	5%	14%	28%	22%	6%	25%
	2006	61,213	14%	11%	18%	20%	5%	31%
	2011	67,096	21%	16%	19%	13%	6%	24%
	2016	66,989	19%	12%	22%	10%	9%	28%
	2019	67,054	19%	13%	18%	13%	11%	26%
Kaua`i	1992	16,981	N/A[a]	21%	18%	21%	9%	30%
	1997	18,817	9%	18%	27%	25%	9%	12%
	2003	20,460	6%	23%	27%	20%	7%	18%
	2006	21,971	12%	11%	18%	21%	10%	28%
	2011	23,201	19%	18%	23%	13%	6%	22%
	2016	23,369	19%	19%	20%	7%	11%	23%
	2019	22,563	17%	11%	17%	6%	13%	36%
State	1992	338,385	N/A[a]	20%	19%	22%	11%	28%
	1997	376,574	7%	15%	22%	28%	7%	20%
	2003	410,794	9%	15%	20%	22%	8%	24%
	2006	435,818	14%	11%	20%	22%	8%	26%
	2011	455,311	20%	17%	24%	12%	7%	22%
	2016	462,876	16%	12%	21%	14%	13%	23%
	2019	455,502	17%	13%	19%	12%	10%	30%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019
Note: HUD household income guidelines of 30% or less was not available in the Housing Demand Survey 1992.

Table A-4a. Housing Unit Condition, Owned Units, 1992, 1997, 2003, 2006, 2011, and 2016

			Owner Occupied			
County	**Year**	**Total Households**	Excellent condition	Satisfactory condition	Fair condition	Poor condition
Honolulu	1992	247,349	47%	43%	9%	2%
	1997	272,234	31%	47%	18%	4%
	2003	292,003	42%	46%	11%	1%
	2006	303,149	39%	46%	12%	3%
	2011	310,882	40%	45%	12%	4%
	2016	317,459	N/A	N/A	N/A	N/A
Maui	1992	34,266	52%	38%	10%	1%
	1997	39,252	35%	48%	15%	3%
	2003	43,687	45%	42%	10%	3%
	2006	49,484	44%	43%	11%	2%
	2011	54,132	49%	37%	11%	2%
	2016	55,095	N/A	N/A	N/A	N/A
Hawai`i	1992	39,789	52%	41%	6%	1%
	1997	46,271	42%	42%	13%	4%
	2003	54,644	46%	44%	9%	2%
	2006	61,213	44%	44%	11%	1%
	2011	67,096	48%	38%	11%	3%
	2016	66,989	N/A	N/A	N/A	N/A
Kaua`i	1992	16,981	49%	42%	7%	2%
	1997	18,817	42%	42%	13%	3%
	2003	20,460	48%	42%	9%	2%
	2006	21,971	44%	43%	11%	2%
	2011	23,201	44%	39%	15%	2%
	2016	23,369	N/A	N/A	N/A	N/A
State	1992	338,385	49%	42%	8%	2%
	1997	376,574	34%	46%	17%	4%
	2003	410,794	43%	45%	10%	2%
	2006	435,818	41%	45%	12%	3%
	2011	455,311	43%	42%	12%	3%
	2016	462,876	N/A	N/A	N/A	N/A

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, and 2016
Note: This question was not asked in the Housing Demand Survey 2019

Table A-4b. Housing Unit Condition, Rented Units, 1992, 1997, 2003, 2006, 2011, 2016

County	Year	Total Households	Renter Occupied			
			Excellent condition	Satisfactory condition	Fair condition	Poor condition
Honolulu	1992	247,349	23%	52%	20%	6%
	1997	272,234	21%	46%	27%	6%
	2003	292,003	22%	52%	22%	4%
	2006	303,149	24%	42%	25%	10%
	2011	310,882	31%	46%	19%	5%
	2016	317,459	N/A	N/A	N/A	N/A
Maui	1992	34,266	27%	43%	24%	6%
	1997	39,252	25%	48%	22%	5%
	2003	43,687	28%	47%	20%	6%
	2006	49,484	31%	40%	22%	7%
	2011	54,132	35%	43%	16%	6%
	2016	55,095	N/A	N/A	N/A	N/A
Hawai`i	1992	39,789	29%	46%	16%	9%
	1997	46,271	26%	45%	20%	10%
	2003	54,644	27%	46%	23%	5%
	2006	61,213	22%	48%	20%	10%
	2011	67,096	37%	42%	15%	7%
	2016	66,989	N/A	N/A	N/A	N/A
Kaua`i	1992	16,981	25%	55%	15%	5%
	1997	18,817	27%	44%	22%	7%
	2003	20,460	30%	47%	18%	5%
	2006	21,971	24%	46%	25%	6%
	2011	23,201	26%	42%	27%	5%
	2016	23,369	N/A	N/A	N/A	N/A
State	1992	338,385	24%	51%	20%	6%
	1997	376,574	22%	46%	26%	6%
	2003	410,794	24%	51%	21%	4%
	2006	435,818	24%	43%	24%	9%
	2011	455,311	32%	45%	19%	5%
	2016	462,876	N/A	N/A	N/A	N/A

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, and 2016
Note: This question was not asked in the Housing Demand Survey 2019

Table A-5. Average Monthly Housing Cost, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Average Monthly Mortgage Payment			Average Monthly Rent	
			Total	Single-family	Multi-family	Total	2-bedroom apartment
Honolulu	1992	247,349	$821	$915	$832	$864	N/A
	1997	272,234	$1,430	$1,369	$1,335	$928	$923
	2003	292,003	$1,546	$1,650	$1,239	$1,014	$1,072
	2006	303,149	$1,142	$1,173	$1,029	$1,300	$1,393
	2011	310,882	$1,415	$1,393	$1,510	$1,502	$1,487
	2016	317,459	$2,140	$2,353	$1,753	$1,652	$1,688
	2019	311,451	$2,275	$2,395	$2,060	$1,818	$1,824
Maui	1992	34,266	$776	$831	$719	$730	N/A
	1997	39,252	$1,210	$1,664	$789	$850	$1,138
	2003	43,687	$1,310	$1,346	$1,104	$979	$1,072
	2006	49,484	$1,461	$1,451	$1,458	$1,256	$1,253
	2011	54,132	$1,461	$1,468	$1,411	$1,280	$1,303
	2016	55,059	$2,045	$2,100	$1,729	$1,444	$1,429
	2019	54,434	$2,063	$2,119	$1,856	$1,644	$1,689
Hawai`i	1992	39,789	$651	$691	$579	$556	N/A
	1997	46,271	$954	$1,069	$840	$697	$644
	2003	54,644	$1,072	$1,078	$919	$859	$843
	2006	61,213	$1,057	$1,039	$1,407	$1,146	$1,152
	2011	67,096	$1,106	$1,102	$1,389	$1,121	$986
	2016	66,989	$1,357	$1,379	$1,106	$1,164	$1,153
	2019	67,054	$1,483	$1,505	$1,292	$1,210	$1,274
Kaua`i	1992	16,981	$726	$773	$612	$807	N/A
	1997	18,817	$1,151	$1,290	$881	$830	$860
	2003	20,460	$1,284	$1,306	$1,014	$983	$885
	2006	21,971	$1,165	$1,178	$974	$1,230	$1,271
	2011	23,201	$1,273	$1,254	$983	$1,311	$1,292
	2016	23,369	$1,824	$1,841	$1,682	$1,256	$1,354
	2019	22,563	$2,134	$2,155	$1,946	$1,543	$1,673
State	1992	338,385	$800	$863	$813	$793	N/A
	1997	376,574	$1,319	$1,330	$1,286	$897	N/A
	2003	410,794	$1,433	$1,488	$1,213	$992	$1,037
	2006	435,818	$1,167	$1,183	$1,081	$1,274	$1,346
	2011	455,311	$1,355	$1,332	$1,495	$1,421	$1,398
	2016	462,876	$1,987	$2,081	$1,728	$1,554	$1,577
	2019	455,502	$2,108	$2,149	$2,016	$1,717	$1,750

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

Table A-6. Mortgage Payments by Years in Unit, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Average Monthly Mortgage by Years in Unit			
			Less than 1 year	1 to 5 years	6 to 10 years	More than 10 years
Honolulu	1992	247,349	$886	$879	$656	$564
	1997	272,234	$1,431	$1,668	$1,697	$1,241
	2003	292,003	$1,616	$1,729	$1,689	$1,414
	2006	303,149	$2,865	$1,865	$1,445	$824
	2011	310,882	$2,488	$2,255	$2,007	$1,088
	2016	317,459	$2,850	$2,378	$2,580	$1,905
	2019	311,451	$2,841	$2,686	$2,427	$2,091
Maui	1992	34,266	$824	$781	$755	$609
	1997	39,252	$1,497	$1,519	$1,339	$986
	2003	43,687	$1,972	$1,448	$1,436	$1,091
	2006	49,484	$2,245	$2,037	$1,565	$1,072
	2011	54,132	$1,671	$1,962	$1,720	$1,202
	2016	55,059	$2,516	$2,301	$2,134	$1,898
	2019	54,434	$2,065	$2,276	$2,090	$1,973
Hawai`i	1992	39,789	$752	$707	$455	$314
	1997	46,271	$1,030	$1,168	$1,122	$730
	2003	54,644	$1,455	$1,143	$1,174	$953
	2006	61,213	$1,700	$1,662	$987	$725
	2011	67,096	$1,591	$1,531	$1,403	$792
	2016	66,989	$1,985	$1,325	$1,384	$1,316
	2019	67,054	$1,845	$1,578	$1,635	$1,418
Kaua`i	1992	16,981	$888	$722	$559	$552
	1997	18,817	$1,448	$1,304	$1,167	$968
	2003	20,460	$1,673	$1,490	$1,373	$1,089
	2006	21,971	$2,666	$1,634	$1,442	$824
	2011	23,201	$2,285	$2,039	$1,587	$1,026
	2016	23,369	$2,518	$2,022	$2,221	$1,619
	2019	22,563	$3,113	$2,620	$2,182	$1,928
State	1992	338,385	$867	$853	$634	$553
	1997	376,574	$1,387	$1,548	$1,501	$1,135
	2003	410,794	$1,636	$1,559	$1,577	$1,299
	2006	435,818	$2,468	$1,837	$1,378	$835
	2011	455,311	$2,157	$2,013	$1,805	$1,049
	2016	462,876	$2,547	$2,186	$2,294	$1,798
	2019	455,502	$2,490	$2,437	$2,242	$1,956

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

Table A-7. Household Composition, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Household Type: Single member	Married, no children	Parent(s) & children	Unrelated roommates	Multiple Families / Other	Undetermined
Honolulu	1992	247,349	11.9%	24.4%	26.3%	1.7%	32.0%	3.7%
	1997	272,234	14.1%	25.6%	27.3%	4.2%	27.2%	1.6%
	2003	292,003	22.0%	28.9%	21.2%	3.2%	22.9%	1.8%
	2006	303,149	24.1%	21.8%	20.9%	3.3%	29.3%	0.5%
	2011	310,882	22.2%	19.6%	14.1%	5.0%	37.6%	1.4%
	2016	317,459	23.5%	20.2%	13.8%	5.5%	36.5%	0.1%
	2019	311,451	23.5%	20.4%	12.6%	5.9%	37.3%	0.2%
Maui	1992	34,266	12.6%	24.4%	32.9%	1.6%	25.9%	2.3%
	1997	39,252	14.1%	25.0%	27.9%	5.4%	24.8%	2.7%
	2003	43,687	21.9%	29.6%	25.4%	3.2%	17.6%	2.3%
	2006	49,484	21.5%	24.8%	24.0%	3.6%	25.8%	0.3%
	2011	54,132	24.7%	22.2%	12.8%	7.0%	30.7%	2.6%
	2016	55,059	23.9%	22.2%	13.9%	6.7%	32.4%	0.9%
	2019	54,434	23.9%	20.3%	12.9%	8.1%	34.5%	0.3%
Hawai`i	1992	39,789	9.6%	27.2%	32.3%	0.6%	26.0%	4.3%
	1997	46,271	14.8%	27.0%	28.4%	3.5%	24.3%	2.1%
	2003	54,644	22.3%	30.6%	24.4%	3.2%	18.1%	1.4%
	2006	61,213	19.5%	25.6%	22.6%	2.6%	28.7%	1.0%
	2011	67,096	24.6%	25.0%	13.5%	6.5%	29.0%	1.4%
	2016	66,989	26.5%	26.3%	13.5%	5.9%	27.5%	0.3%
	2019	67,054	25.9%	23.4%	13.0%	9.0%	27.8%	0.7%
Kaua`i	1992	16,981	12.7%	26.1%	31.0%	0.5%	26.3%	3.5%
	1997	18,817	13.2%	27.1%	30.0%	1.7%	25.4%	2.5%
	2003	20,460	20.9%	26.9%	26.8%	3.2%	20.5%	1.7%
	2006	21,971	19.8%	25.0%	23.3%	3.3%	28.2%	0.4%
	2011	23,201	22.5%	23.6%	14.8%	4.4%	32.5%	2.2%
	2016	23,369	22.9%	25.3%	15.3%	5.7%	30.3%	0.5%
	2019	22,563	23.3%	25.7%	13.1%	5.6%	32.1%	0.1%
State	1992	338,385	11.7%	24.9%	27.9%	1.5%	30.3%	3.6%
	1997	376,574	14.2%	25.8%	27.6%	4.1%	26.5%	1.9%
	2003	410,794	22.0%	29.1%	22.3%	3.2%	21.6%	1.8%
	2006	435,818	22.9%	22.8%	21.6%	3.2%	28.8%	0.6%
	2011	455,311	22.9%	21.0%	13.9%	5.5%	35.2%	1.6%
	2016	462,876	23.9%	21.6%	13.8%	5.7%	34.4%	0.2%
	2019	455,502	23.9%	21.1%	12.7%	6.6%	35.3%	0.3%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019
Note: [a] Other household types include a mixture of related and unrelated individuals.

Table A-8. Household Crowding, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Crowding Indicators		
			Crowded[a]	Doubled Up[b]	Crowded and/or Doubled Up[c]
Honolulu	1992	247,349	23.2%	N/A	32.0%
	1997	272,234	10.6%	N/A	27.2%
	2003	292,003	10.1%	10.0%	17.6%
	2006	303,149	8.1%	9.7%	15.2%
	2011	310,882	13.3%	13.8%	22.9%
	2016	317,459	11.4%	11.9%	21.0%
	2019	311,451	14.1%	13.3%	23.1%
Maui	1992	34,266	26.8%	N/A	25.9%
	1997	39,252	10.4%	N/A	24.8%
	2003	43,687	11.0%	8.7%	17.3%
	2006	49,484	7.7%	9.6%	15.3%
	2011	54,132	10.7%	13.0%	19.2%
	2016	55,059	9.8%	14.1%	21.4%
	2019	54,434	13.8%	14.1%	22.5%
Hawai`i	1992	39,789	18.7%	N/A	26.0%
	1997	46,271	7.9%	N/A	24.3%
	2003	54,644	7.0%	9.3%	14.4%
	2006	61,213	6.9%	11.2%	15.9%
	2011	67,096	8.4%	11.3%	17.2%
	2016	66,989	7.4%	11.1%	16.0%
	2019	67,054	11.5%	10.3%	18.0%
Kaua`i	1992	16,981	17.4%	N/A	26.3%
	1997	18,817	9.1%	N/A	25.4%
	2003	20,460	6.0%	12.5%	16.1%
	2006	21,971	6.6%	11.9%	15.5%
	2011	23,201	10.5%	11.7%	18.1%
	2016	23,369	8.9%	11.5%	19.2%
	2019	22,563	12.2%	14.5%	21.4%
State	1992	338,385	22.2%	N/A	30.3%
	1997	376,574	10.2%	N/A	26.5%
	2003	410,794	9.6%	10.0%	17.1%
	2006	435,818	7.8%	10.0%	15.3%
	2011	455,311	12.1%	13.2%	21.4%
	2016	462,876	10.5%	12.0%	20.2%
	2019	455,502	13.6%	13.0%	22.2%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

[a] Based on more than 2 persons per bedroom.

[b] More than one family group in a single housing unit (See Glossary).

[C] Percent of households crowded, doubled up, or both. Before 2003, HHPS measured crowding and "crowded or doubled up." After 2003, HHPS measured crowding and doubled up and the combination of both.

Table A-9. Household Crowding by Tenancy, State and Counties of Hawai‘i, 2019

	Current Owners				Current Renters			
	Total Households	Crowded[a]	Doubled Up[b]	Crowded and/or Doubled Up[c]	Total Households	Crowded[a]	Doubled Up[b]	Crowded and/or Doubled Up[c]
Honolulu	171,222	6.7%	15.2%	18.8%	140,229	23.9%	11.0%	28.3%
Maui	32,008	8.1%	14.8%	19.2%	22,426	22.3%	13.1%	27.2%
Hawai`i	44,735	7.8%	11.2%	16.0%	22,319	20.0%	8.5%	21.9%
Kaua`i	14,122	8.3%	16.4%	19.9%	8,441	19.3%	11.5%	23.9%
State	262,087	7.1%	14.5%	18.5%	193,415	23.1%	11.0%	27.2%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

[a] Based on more than 2 persons per bedroom.
[b] More than one family group in a single housing unit (See Glossary).
[C] Percent of households crowded, doubled up, or both. Before 2003, HHPS measured crowding and “crowded or doubled up.” After 2003, HHPS measured crowding and doubled up and the combination of both.

Table A-10. Shelter-to-Income Ratios, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Monthly Shelter Payment as a Percent of Monthly				
			No Shelter Payment	Under 30 percent	30 to 40 percent	Over 40 percent	Not enough information
Honolulu	1992	247,349	55.7%		14.1%	20.2%	10.0%
	1997	272,234	55.1%		18.9%	18.4%	7.5%
	2003	292,003	16.4%	36.3%	17.9%	14.4%	15.0%
	2006	303,149	19.2%	35.7%	10.9%	22.0%	12.2%
	2011	310,882	14.6%	35.7%	10.1%	30.6%	9.0%
	2016	317,459	21.3%	37.1%	11.4%	24.4%	5.9%
	2019	306,898	17.0%	44.1%	9.7%	23.1%	6.1%
Maui	1992	34,266	59.3%		18.1%	15.8%	6.7%
	1997	39,252	47.9%		16.0%	19.8%	16.4%
	2003	43,687	12.0%	40.6%	17.5%	16.2%	13.6%
	2006	49,484	16.0%	33.1%	14.4%	27.1%	9.4%
	2011	54,132	16.2%	35.5%	12.0%	29.2%	7.1%
	2016	55,059	15.0%	35.2%	12.4%	31.4%	6.0%
	2019	55,842	14.5%	43.3%	10.5%	23.8%	7.8%
Hawai`i	1992	39,789	70.2%		12.4%	11.5%	5.9%
	1997	46,271	51.8%		18.1%	20.4%	9.7%
	2003	54,644	17.9%	38.7%	16.5%	14.4%	12.5%
	2006	61,213	15.9%	38.2%	10.9%	23.0%	12.1%
	2011	67,096	19.4%	34.1%	12.0%	26.8%	7.7%
	2016	66,989	27.0%	37.2%	10.3%	19.3%	6.2%
	2019	70,662	21.1%	41.0%	8.8%	21.8%	7.3%
Kaua`i	1992	16,981	60.3%		17.7%	13.7%	8.1%
	1997	18,817	44.9%		18.7%	24.7%	11.7%
	2003	20,460	17.3%	38.9%	14.8%	16.1%	12.9%
	2006	21,971	18.8%	38.7%	10.8%	21.6%	10.0%
	2011	23,201	18.6%	35.0%	12.2%	25.5%	8.6%
	2016	23,369	20.8%	36.8%	10.8%	26.3%	5.2%
	2019	22,023	17.2%	38.3%	10.5%	24.5%	9.4%
State	1992	338,385	58.0%		14.5%	18.4%	9.1%
	1997	376,574	53.5%		18.5%	19.1%	8.9%
	2003	410,794	16.1%	37.2%	17.5%	14.7%	14.4%
	2006	435,818	18.4%	35.9%	11.3%	22.7%	11.8%
	2011	455,311	15.7%	35.4%	10.7%	29.6%	8.6%
	2016	462,876	21.4%	36.8%	11.3%	24.6%	5.9%
	2019	455,425	17.3%	43.2%	9.7%	23.1%	6.7%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019
Note. Under 30 percent includes households with no shelter payment for 1992 and 1997.

Table A-11. Shelter-to-Income Ratios by Years in Unit, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Percent with shelter-to-income ratio of 30% or more					
			by Years in Unit				by Tenancy	
			Less than 1 year	1 to 5 years	6 to 10 years	More than 10 years	Rented or no cash	Owner occupied
Honolulu	1992	247,349	61.1%	43.7%	34.9%	12.7%	44.6%	23.0%
	1997	272,234	40.8%	43.2%	46.9%	35.1%	41.4%	39.2%
	2003	292,003	42.5%	49.6%	37.6%	24.9%	48.9%	28.0%
	2006	303,149	53.0%	43.1%	36.9%	22.1%	47.2%	22.7%
	2011	310,882	65.8%	55.7%	44.9%	25.9%	61.9%	24.5%
	2016	317,459	60.3%	48.8%	38.5%	21.7%	58.1%	23.2%
	2019	311,451	56.2%	40.8%	38.1%	20.6%	49.7%	20.3%
Maui	1992	34,266	47.3%	49.8%	30.6%	17.0%	43.8%	27.6%
	1997	39,252	41.4%	50.0%	47.3%	33.7%	38.6%	46.1%
	2003	43,687	52.2%	38.3%	26.5%	26.0%	40.5%	30.0%
	2006	49,484	66.3%	46.8%	44.8%	26.3%	54.6%	32.6%
	2011	54,132	60.2%	51.5%	40.6%	27.6%	52.7%	31.1%
	2016	55,059	65.5%	50.2%	48.4%	33.5%	66.3%	31.4%
	2019	54,434	54.2%	41.3%	37.0%	21.4%	51.2%	23.1%
Hawai`i	1992	39,789	51.5%	35.8%	18.5%	6.7%	37.8%	17.2%
	1997	46,271	49.6%	52.5%	42.6%	30.8%	52.0%	37.0%
	2003	54,644	42.4%	41.7%	31.2%	26.8%	49.0%	27.8%
	2006	61,213	60.8%	43.7%	27.5%	20.3%	48.3%	27.1%
	2011	67,096	66.4%	48.7%	38.4%	23.0%	57.3%	28.1%
	2016	66,989	38.7%	39.7%	33.3%	21.3%	61.9%	17.7%
	2019	67,054	54.2%	41.3%	37.0%	21.4%	53.4%	19.8%
Kaua`i	1992	16,981	46.3%	31.1%	18.5%	15.6%	36.9%	28.1%
	1997	18,817	61.2%	56.5%	41.4%	39.6%	53.4%	46.1%
	2003	20,460	43.2%	43.2%	31.4%	26.0%	44.4%	29.7%
	2006	21,971	51.6%	45.2%	37.1%	18.8%	47.7%	24.3%
	2011	23,201	65.8%	53.9%	42.9%	29.3%	56.0%	31.7%
	2016	23,369	64.5%	50.6%	39.7%	26.3%	58.9%	28.0%
	2019	22,563	54.2%	41.3%	37.0%	21.4%	51.4%	25.7%
State	1992	338,385	57.8%	43.3%	31.1%	12.6%	43.7%	23.0%
	1997	376,574	42.2%	45.6%	46.0%	34.7%	40.1%	40.1%
	2003	410,794	43.6%	46.2%	35.3%	25.3%	28.3%	28.3%
	2006	435,818	56.4%	43.8%	36.7%	22.1%	48.2%	24.6%
	2011	455,311	65.0%	53.9%	43.2%	25.8%	59.8%	26.3%
	2016	462,876	58.2%	47.8%	39.2%	23.2%	59.6%	23.5%
	2019	455,502	54.2%	41.3%	37.0%	21.4%	50.4%	20.9%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

Table A-12. Intention to Move, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

	Intention to Move			When Household Will Move				
Total Households	Probably Will Not Move	Will Move to a New Unit	Raw Demand-Total Will Move*	In 1 Year	In 2 Years	3 to 5 Years	More Than 5 Years	Not Sure When
247,349	42.6%	57.4%	142,090	29.2%	21.5%	19.0%	10.2%	20.1%
272,234	44.8%	55.2%	150,194	23.5%	20.9%	16.2%	10.9%	28.5%
292,003	56.3%	43.7%	127,683	27.9%	20.5%	19.3%	10.3%	22.0%
303,149	61.2%	38.8%	117,597	24.5%	22.9%	15.5%	8.2%	29.0%
310,882	45.4%	54.6%	168,946	21.5%	21.4%	20.1%	15.6%	21.5%
317,459	40.0%	60.0%	190,377	19.8%	18.3%	20.0%	15.8%	26.1%
311,451	34.7%	65.3%	203,426	18.4%	19.3%	15.9%	13.0%	33.4%
34,266	56.8%	43.2%	14,793	28.6%	24.7%	17.1%	9.2%	20.4%
39,252	51.9%	48.1%	18,894	23.1%	17.2%	13.4%	18.2%	28.1%
43,687	51.9%	48.1%	18,205	22.1%	20.6%	18.6%	10.0%	28.7%
49,484	54.9%	45.1%	22,318	19.6%	26.9%	15.0%	14.0%	24.5%
54,132	52.9%	47.1%	25,282	24.8%	19.4%	17.6%	16.1%	22.2%
55,059	47.7%	52.3%	28,784	20.6%	19.9%	19.9%	17.1%	22.5%
54,434	49.0%	51.0%	27,740	21.2%	16.1%	16.8%	20.8%	25.2%
39,789	55.6%	44.4%	17,685	28.8%	20.8%	17.8%	14.0%	18.6%
46,271	60.0%	40.0%	18,491	22.3%	18.1%	15.5%	15.9%	28.2%
54,644	55.6%	44.4%	21,252	21.4%	19.2%	15.9%	17.3%	26.2%
61,213	57.9%	42.1%	25,769	22.4%	19.3%	19.4%	11.2%	27.7%
67,096	58.4%	41.6%	28,223	20.9%	12.9%	24.9%	20.8%	20.6%
66,989	50.2%	49.8%	33,336	21.7%	17.9%	17.4%	18.9%	24.1%
67,054	51.0%	49.0%	32,879	21.8%	16.5%	17.0%	19.4%	25.3%
16,981	56.8%	43.2%	7,337	32.8%	17.4%	21.4%	6.4%	22.0%
18,817	58.0%	42.0%	7,907	17.1%	13.9%	16.3%	15.3%	37.4%
20,460	63.5%	36.5%	7,468	22.1%	22.4%	15.6%	12.1%	27.9%
21,971	64.4%	35.6%	7,826	23.4%	17.5%	13.6%	17.1%	28.4%
23,201	57.2%	42.8%	9,628	30.3%	15.5%	15.1%	18.3%	20.8%
23,369	55.7%	44.3%	10,355	21.1%	21.6%	19.9%	19.9%	17.6%
22,563	57.5%	42.5%	9,588	18.8%	11.9%	18.8%	16.0%	34.5%
338,385	46.2%	53.8%	181,905	29.2%	21.5%	18.8%	10.4%	20.1%
376,574	48.1%	51.9%	195,486	23.1%	20.0%	15.9%	12.3%	28.8%
410,794	57.5%	42.5%	174,608	26.3%	20.5%	18.6%	11.2%	23.5%
435,818	60.2%	39.8%	173,510	23.5%	22.6%	15.9%	9.8%	28.2%
455,311	49.2%	50.8%	232,079	22.1%	19.8%	20.2%	16.4%	21.4%
462,876	43.2%	56.8%	262,852	20.1%	18.6%	19.6%	16.5%	25.1%
455,502	39.9%	60.1%	273,632	19.3%	18.4%	16.2%	14.7%	31.6%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019
Base for intention to Move is all respondent households
Base for When Households Will Move is 262,852 households who provided a time frame or said not sure (excludes probably never move)

Table A-13. Preferred Location for Next Move, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Total Households	Final Demand - Total Will Move[a]	Preferred Location for Next Move			
				Same Island	Different Island	Not Sure	Out-of-State
Honolulu	1992	247,349	142,090	62.2%	5.3%	6.3%	26.1%
	1997	272,234	150,194	52.5%	4.3%	11.0%	32.2%
	2003	292,003	127,683	65.7%	2.8%	11.6%	19.8%
	2006	303,149	117,597	66.1%	4.5%	8.9%	20.5%
	2011	310,882	132,696	63.4%	4.3%	5.6%	26.6%
	2016	317,459	139,823	59.3%	3.4%	14.2%	23.1%
	2019	311,451	135,492	61.1%	4.9%	8.0%	26.0%
Maui	1992	34,266	14,793	71.7%	13.3%	5.7%	9.4%
	1997	39,252	18,894	72.5%	2.7%	13.0%	11.8%
	2003	43,687	18,205	68.3%	6.9%	10.8%	14.0%
	2006	49,484	22,318	71.5%	9.5%	6.7%	12.3%
	2011	54,132	19,774	58.5%	5.4%	24.9%	11.2%
	2016	55,059	21,877	65.9%	6.6%	8.9%	18.7%
	2019	54,434	20,729	61.4%	8.9%	9.9%	19.8%
Hawai`i	1992	39,789	17,685	80.9%	4.2%	4.4%	10.6%
	1997	46,271	18,491	74.3%	4.0%	7.7%	14.0%
	2003	54,644	21,252	73.4%	5.4%	12.1%	9.1%
	2006	61,213	25,769	73.0%	6.0%	9.4%	11.5%
	2011	67,096	22,327	61.9%	7.8%	8.3%	22.1%
	2016	66,989	24,746	61.4%	7.2%	13.9%	17.5%
	2019	67,054	24,479	68.3%	5.4%	8.0%	18.3%
Kaua`i	1992	16,981	7,337	76.7%	6.2%	6.0%	11.1%
	1997	18,817	7,907	69.8%	5.7%	10.1%	14.3%
	2003	20,460	7,468	71.8%	9.7%	9.0%	9.5%
	2006	21,971	7,826	64.8%	7.4%	9.1%	18.7%
	2011	23,201	7,586	62.8%	7.0%	11.1%	19.2%
	2016	23,369	8,211	65.7%	5.2%	7.6%	21.5%
	2019	22,563	6,278	63.9%	6.8%	8.2%	21.2%
State	1992	338,385	181,904	65.4%	5.9%	6.1%	22.6%
	1997	376,574	195,485	57.2%	4.2%	10.9%	27.8%
	2003	410,794	174,607	67.2%	3.9%	11.5%	17.5%
	2006	435,818	173,511	67.8%	5.5%	8.7%	18.0%
	2011	455,311	182,384	62.6%	5.0%	8.7%	23.8%
	2016	462,876	194,656	60.5%	4.2%	13.4%	21.9%
	2019	455,502	186,978	62.2%	5.5%	8.2%	24.2%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019
[a] The total number of Final Demand households differs from the Raw Demand number in Table A-12 because households who didn't know or refused to report when they might move are excluded from the final demand counts.

Table A-14. Tenancy Preference of Current Owners & Renters, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

County	Year	Effective Demand-Total Will Move[a]	Current Owners			Current Renters		
			Total	Planned Next Tenancy		Total[c]	Planned Next Tenancy	
				Buy	Rent[b]		Buy	Rent[b]
Honolulu	1992	127,810	33,243	89.7%	10.3%	94,567	32.7%	67.3%
	1997	128,791	44,335	89.1%	10.9%	84,456	44.0%	56.0%
	2003	113,638	41,616	85.5%	14.5%	72,022	55.4%	44.6%
	2006	100,545	30,973	86.8%	13.2%	69,572	55.4%	44.6%
	2011	97,429	32,688	74.2%	25.8%	64,621	25.1%	68.3%
	2016	136,933	58,933	75.2%	24.8%	78,000	31.0%	70.3%
	2019	100,203	43,447	78.5%	21.5%	56,755	31.1%	68.9%
Maui	1992	13,284	4,600	87.6%	12.4%	8,684	49.5%	50.5%
	1997	16,239	6,450	84.8%	15.2%	9,789	46.8%	53.2%
	2003	15,593	5,657	95.1%	4.9%	9,936	52.4%	47.6%
	2006	19,584	7,083	92.0%	8.0%	12,501	52.3%	47.7%
	2011	16,937	5,370	72.0%	28.0%	11,396	29.4%	70.6%
	2016	19,434	7,431	73.5%	26.5%	11,877	35.4%	64.6%
	2019	16,624	6,588	77.6%	22.4%	10,036	38.2%	61.8%
Hawai`i	1992	16,004	7,132	93.7%	6.3%	8,872	64.9%	35.1%
	1997	15,884	7,694	87.5%	12.5%	8,190	49.6%	50.4%
	2003	18,471	8,679	90.0%	10.0%	9,792	57.1%	42.9%
	2006	22,200	10,264	93.8%	6.2%	11,936	54.7%	45.3%
	2011	17,412	6,838	70.1%	29.9%	10,540	37.2%	62.8%
	2016	24,570	12,856	67.4%	32.6%	11,568	37.3%	62.7%
	2019	19,992	8,823	77.1%	22.9%	11,169	37.8%	62.2%
Kaua`i	1992	6,530	2,264	95.9%	4.1%	4,266	54.9%	45.1%
	1997	6,428	2,054	92.9%	7.1%	4,374	48.2%	51.8%
	2003	6,426	2,737	90.5%	9.5%	3,689	51.6%	48.4%
	2006	6,715	2,614	87.6%	12.4%	4,101	39.3%	60.7%
	2011	6,339	1,700	61.3%	38.7%	4,521	20.9%	79.1%
	2016	6,750	2,670	70.1%	29.9%	4,077	35.2%	64.8%
	2019	4,946	2,088	75.4%	24.6%	2,858	31.7%	68.3%
State	1992	163,664	47,239	90.4%	9.6%	116,425	37.2%	62.8%
	1997	167,343	60,533	88.6%	11.4%	106,810	44.9%	55.1%
	2003	154,129	58,689	87.6%	12.4%	95,440	55.1%	44.9%
	2006	149,044	50,934	89.0%	11.0%	98,110	54.3%	45.7%
	2011	138,116	46,595	72.9%	27.1%	91,079	26.8%	73.2%
	2016	187,687	81,889	73.8%	26.2%	103,997	31.4%	68.6%
	2019	141,765	60,947	78.1%	21.9%	80,818	33.0%	67.0%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019
Base for Effective Demand is households who plan to move, have some idea when they will move, and plan to stay in the State of Hawaiʻi when they move
Base for Current Owners is 60,947 households included in 141,765 Total Will Move households that own their current residence.
Base for Current Renters is 80,818 households included in 141,765 Total Will Move households that currently rent their unit or occupy without paying cash rent.

[a] The total number of mover households differs from Table A-12 because those who plan to move out of state are excluded from effective demand counts. Total Current Owners and Total Current Renters do not sum to Total Will Move because those households that refused to provide their current tenancy were excluded from the analysis.

[b] Includes households that plan to rent or are not sure about their next tenancy.

[c] Includes households that currently rent or occupy without payment of cash rent.

Table A-15. Preferred Unit Type, Buyers, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

	County	Year	Total Will Move Buyers[a]	Preferred Unit Type					
				Single Family	Townhouse	Condo	Apartment	Other	No Preference
PLAN TO BUY	Honolulu	1992	60,724	73.9%	14.3%	8.7%	1.1%	0.0%	2.0%
		1997	76,663	78.7%	4.2%	12.7%	0.2%	1.3%	2.9%
		2003	75,482	78.6%	5.1%	6.8%	1.8%	1.3%	6.4%
		2006	65,495	69.7%	7.5%	12.7%	1.0%	1.3%	8.6%
		2011	40,483	61.0%	7.2%	26.7%	0.0%	2.0%	3.1%
		2016	64,168	57.9%	6.2%	21.9%	6.1%	0.2%	7.6%
		2019	47,643	55.9%	6.7%	23.8%	5.3%	1.0%	7.2%
	Maui	1992	8,328	89.7%	2.5%	5.3%	0.6%	1.9%	0.0%
		1997	10,051	87.1%	2.2%	8.0%	0.8%	0.0%	1.9%
		2003	10,586	85.0%	1.2%	7.4%	1.6%	0.1%	4.7%
		2006	12,539	85.6%	2.7%	7.6%	0.0%	0.4%	3.7%
		2011	7,156	83.0%	5.7%	9.7%	0.0%	0.4%	1.2%
		2016	9,172	80.1%	3.6%	9.7%	1.2%	1.9%	3.3%
		2019	8,417	84.6%	2.5%	9.4%	0.6%	1.1%	1.9%
	Hawai`i	1992	12,441	91.8%	3.3%	2.2%	1.0%	0.8%	0.9%
		1997	10,794	91.7%	1.9%	4.8%	0.2%	0.2%	1.1%
		2003	13,402	91.4%	1.8%	2.1%	0.5%	0.2%	4.0%
		2006	15,940	84.2%	4.4%	4.9%	0.0%	2.1%	4.4%
		2011	8,711	87.3%	4.0%	5.9%	0.0%	1.0%	1.8%
		2016	11,407	80.3%	0.3%	8.0%	0.3%	1.1%	10.0%
		2019	9,986	83.4%	2.6%	8.4%	0.6%	1.3%	3.6%
	Kaua`i	1992	4,513	95.1%	1.1%	2.9%	0.0%	0.0%	0.9%
		1997	4,016	91.0%	4.1%	4.9%	0.0%	0.0%	0.0%
		2003	4,381	86.9%	3.8%	5.8%	0.0%	1.7%	1.8%
		2006	3,879	79.0%	5.3%	8.2%	0.0%	1.3%	6.1%
		2011	2,046	81.8%	4.4%	8.3%	0.0%	2.8%	2.6%
		2016	3,040	86.7%	1.7%	7.5%	3.4%	0.7%	
		2019	2,253	78.1%	6.0%	7.5%	0.7%	2.7%	5.0%
	State	1992	86,006	79.2%	10.9%	7.1%	1.0%	0.1%	1.7%
		1997	101,524	81.4%	3.8%	11.0%	0.3%	1.0%	2.5%
		2003	103,851	81.3%	4.3%	6.2%	1.5%	1.0%	5.7%
		2006	97,853	74.5%	6.3%	10.6%	1.0%	1.3%	7.2%
		2011	58,395	68.3%	6.5%	20.9%	0.0%	1.7%	2.6%
		2016	87,787	64.1%	5.0%	18.3%	4.8%	0.5%	7.2%
		2019	68,300	64.2%	5.6%	19.2%	3.9%	1.1%	6.0%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

[a] Total Will Move is effective demand households (plan to move, have some idea when they will move, and plan to stay in the State when they move) that want to buy their next unit rather than rent.

Note. Sum of county figures may not equal the State total due to rounding.

[b] Single-family is a single-family detached dwelling unit.

[c] Townhouse is a side by side housing unit that does not meet the definition of single-family.

[d] Condo is an apartment building with five units or more in which each owner owns a unit and holds a joint ownership in common areas with other owners in the building.

[e] Apartment contains residential suites in which each individual unit is leased to different occupants.

[f] Other includes type of units that are not Single-family, Townhouse, Condo, and apartment

Table A-16. Preferred Unit Type, Renters, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

	County	Year	Total Will Move Renters[a]	Preferred Unit Type: Single Family	Townhouse	Condo	Apartment	Other	No Preference
PLAN TO RENT	Honolulu	1992	67,086	64.3%	3.9%	12.5%	13.6%	0.6%	5.1%
		1997	52,128	50.8%	8.3%	11.4%	19.3%	1.1%	9.1%
		2003	38,156	56.0%	9.1%	4.1%	21.1%	2.9%	6.8%
		2006	40,585	41.3%	10.7%	8.3%	28.8%	2.8%	8.2%
		2011	46,396	34.5%	4.3%	13.8%	44.2%	2.0%	1.2%
		2016	67,065	26.3%	4.7%	12.4%	30.9%	0.9%	24.8%
		2019	50,218	39.1%	6.7%	14.4%	16.6%	3.1%	20.0%
	Maui	1992	4,956	82.1%	3.8%	6.3%	4.1%	3.7%	0.0%
		1997	6,188	60.3%	3.9%	14.0%	17.6%	2.0%	2.2%
		2003	5,007	77.9%	6.7%	4.7%	7.2%	1.8%	1.7%
		2006	7,265	65.1%	0.8%	11.4%	14.1%	0.5%	8.0%
		2011	7,751	57.3%	7.8%	5.0%	14.8%	5.4%	9.7%
		2016	9,178	52.4%	3.3%	6.8%	18.1%	5.1%	14.3%
		2019	7,963	60.3%	3.3%	10.7%	7.8%	4.6%	13.2%
	Hawai`i	1992	3,563	80.1%	5.4%	4.7%	4.7%	0.0%	5.1%
		1997	5,090	65.3%	4.1%	4.7%	16.4%	3.4%	6.1%
		2003	5,069	69.9%	1.3%	5.0%	18.1%	3.4%	2.3%
		2006	7,659	61.6%	4.5%	7.7%	15.8%	5.4%	5.0%
		2011	6,294	74.1%	4.8%	2.8%	11.7%	1.8%	4.8%
		2016	10,410	48.8%	0.9%	5.0%	16.6%	6.8%	21.8%
		2019	11,402	65.2%	3.2%	4.4%	10.7%	3.3%	13.1%
	Kaua`i	1992	2,017	84.4%	3.6%	8.1%	0.8%	3.2%	0.0%
		1997	2,412	79.3%	2.3%	1.1%	5.3%	2.3%	9.7%
		2003	2,045	77.3%	0.0%	1.7%	12.9%	0.0%	8.1%
		2006	3,177	64.4%	2.0%	9.8%	10.9%	5.7%	7.1%
		2011	3,525	66.5%	1.8%	11.9%	10.6%	3.9%	5.3%
		2016	3,179	65.1%	1.5%	4.4%	15.6%	0.9%	12.4%
		2019	2,305	62.5%	3.7%	4.3%	10.0%	3.5%	15.9%
	State	1992	77,622	66.7%	4.0%	11.6%	12.3%	0.8%	4.6%
		1997	65,818	53.9%	7.3%	10.8%	18.4%	1.4%	8.2%
		2003	50,277	60.4%	7.7%	10.8%	19.1%	2.7%	5.9%
		2006	58,686	48.1%	8.2%	10.8%	24.3%	3.0%	7.7%
		2011	63,697	42.9%	4.6%	11.6%	35.6%	2.5%	2.8%
		2016	89,832	33.0%	4.0%	10.7%	27.4%	2.0%	23.0%
		2019	71,888	45.5%	5.8%	12.4%	14.7%	3.3%	18.3%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

[a] Total Will Move is effective demand households (plan to move, have some idea when they will move, and plan to stay in the State when they move) that want to rent their next unit rather than buy.

Note. Sum of county figures may not equal the State total due to rounding.

[b] Single-family is a single-family detached dwelling unit.

[c] Townhouse is a side by side housing unit that does not meet the definition of single-family.

[d] Condo is an apartment building with five units or more in which each owner owns a unit and holds a joint ownership in common areas with other owners in the building.

[e] Apartment contains residential suites in which each individual unit is leased to different occupants.

[f] Other includes type of units that are not Single-family, Townhouse, Condo, and apartment.

Table A-17. Preferred Number of Bedrooms, Buyers, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

	County	Year	Total Will Move Buyers[a]	Preferred Number of Bedrooms				
				Studio or One	Two	Three	Four or More	No Preference
PLAN TO BUY	Honolulu	1992	60,724	2.9%	30.5%	43.3%	23.3%	0.0%
		1997	76,663	1.4%	17.6%	49.1%	31.0%	0.8%
		2003	75,482	3.9%	22.3%	46.7%	25.5%	1.6%
		2006	65,495	0.1%	15.1%	41.6%	39.0%	4.2%
		2011	40,483	4.5%	23.6%	37.8%	34.1%	0.0%
		2016	64,168	3.0%	33.4%	41.0%	22.5%	0.1%
		2019	47,643	5.3%	26.7%	43.4%	24.5%	0.4%
	Maui	1992	8,328	0.4%	27.5%	56.9%	15.2%	0.0%
		1997	10,051	6.4%	19.7%	44.5%	28.1%	1.2%
		2003	10,586	4.1%	21.8%	37.7%	36.0%	0.4%
		2006	12,539	1.7%	19.9%	46.0%	31.7%	0.7%
		2011	7,156	1.1%	20.2%	49.1%	29.3%	0.4%
		2016	9,172	1.3%	18.1%	56.1%	23.6%	0.9%
		2019	8,417	1.4%	22.6%	45.8%	29.0%	1.2%
	Hawai`i	1992	12,441	1.1%	25.4%	55.9%	17.3%	0.3%
		1997	10,794	6.2%	22.7%	40.3%	29.0%	1.7%
		2003	13,402	4.0%	18.4%	45.9%	31.7%	0.0%
		2006	15,940	3.1%	17.1%	41.2%	35.4%	3.3%
		2011	8,711	9.5%	29.7%	34.5%	25.3%	1.1%
		2016	11,407	1.3%	22.8%	61.6%	14.3%	0.0%
		2019	9,986	6.0%	24.2%	51.6%	18.2%	0.0%
	Kaua`i	1992	4,513	0.7%	29.3%	48.3%	21.7%	0.0%
		1997	4,016	1.6%	21.9%	51.6%	24.9%	0.0%
		2003	4,381	5.0%	19.5%	37.6%	37.5%	0.4%
		2006	3,879	0.8%	18.5%	46.3%	34.1%	0.3%
		2011	2,046	1.2%	16.5%	49.1%	33.2%	0.0%
		2016	3,040	5.1%	20.5%	53.7%	20.7%	0.0%
		2019	2,253	8.0%	25.4%	47.6%	19.0%	0.0%
	State	1992	86,006	2.3%	29.4%	46.7%	21.6%	0.1%
		1997	101,524	2.5%	18.5%	47.8%	30.3%	0.9%
		2003	103,851	4.0%	21.6%	45.2%	28.0%	1.2%
		2006	97,853	0.8%	16.2%	42.3%	37.3%	3.5%
		2011	58,395	4.7%	23.8%	39.1%	32.1%	0.2%
		2016	87,787	2.7%	30.0%	45.7%	21.5%	0.1%
		2019	68,300	5.0%	25.8%	45.0%	24.0%	0.1%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

Table A-18. Preferred Number of Bedrooms, Renters, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

	County	Year	Total Will Move Renters[a]	Preferred Number of Bedrooms				
				Studio or One	Two	Three	Four or More	No Preference
PLAN TO RENT	Honolulu	1992	67,086	15.2%	40.0%	35.3%	9.5%	0.0%
		1997	52,128	7.3%	40.2%	32.4%	19.7%	0.4%
		2003	38,156	17.7%	40.6%	28.0%	12.4%	1.3%
		2006	40,585	11.8%	35.1%	33.4%	16.3%	3.5%
		2011	46,396	21.2%	42.8%	29.9%	5.7%	0.4%
		2016	67,065	17.4%	35.9%	34.9%	11.4%	0.4%
		2019	50,218	20.4%	40.8%	25.3%	13.0%	0.4%
	Maui	1992	4,956	6.4%	41.0%	49.0%	1.0%	2.6%
		1997	6,188	17.9%	34.3%	34.8%	12.7%	0.2%
		2003	5,007	9.1%	37.4%	34.0%	18.1%	1.4%
		2006	7,265	7.5%	43.7%	35.9%	11.9%	1.0%
		2011	7,751	11.6%	47.3%	34.8%	6.3%	0.0%
		2016	9,178	11.2%	41.9%	36.9%	8.9%	1.2%
		2019	7,963	11.2%	43.8%	30.5%	13.4%	1.1%
	Hawai`i	1992	3,563	5.1%	43.9%	38.7%	12.3%	0.0%
		1997	5,090	10.7%	31.7%	40.1%	16.8%	0.6%
		2003	5,069	18.0%	35.9%	37.5%	8.6%	0.0%
		2006	7,659	9.3%	31.6%	41.2%	16.6%	1.3%
		2011	6,294	7.6%	37.6%	34.7%	20.1%	0.0%
		2016	10,410	13.3%	37.5%	35.0%	14.3%	0.0%
		2019	11,402	22.0%	40.4%	27.8%	8.7%	1.1%
	Kaua`i	1992	2,017	0.8%	38.1%	47.8%	13.3%	0.0%
		1997	2,412	4.6%	14.7%	63.8%	14.3%	2.6%
		2003	2,045	17.8%	23.7%	44.3%	11.7%	2.5%
		2006	3,177	7.3%	33.3%	41.7%	17.1%	0.5%
		2011	3,525	12.9%	44.6%	31.9%	8.6%	2.1%
		2016	3,179	14.5%	34.7%	39.8%	10.1%	0.9%
		2019	2,305	3.7%	37.7%	41.4%	17.2%	0.0%
	State	1992	77,622	13.8%	40.2%	36.6%	9.2%	0.2%
		1997	65,818	8.5%	38.0%	34.4%	18.6%	0.5%
		2003	50,277	17.7%	40.6%	28.0%	12.4%	1.3%
		2006	58,686	10.7%	35.6%	35.1%	15.8%	2.7%
		2011	63,697	18.3%	42.9%	31.0%	7.4%	0.4%
		2016	89,832	16.2%	36.7%	35.3%	11.4%	0.4%
		2019	71,888	19.0%	41.0%	26.9%	12.6%	0.5%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016, and 2019

Table A-19. Affordable Housing Cost for New Units, Buyers, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

	County	Year	Total Will Move Buyers[b]	Affordable Monthly Housing Cost[a]								
				Less than $200	$200 to $499	$500 to $799	$800 to $1,099	$1,100 to $1,399	$1,400 to $1,699	$1,700 to $1,999	$2,000 to $3,000	More than $3,000
Plan to Buy	Honolulu	1992	60,724	0.9%	1.1%	14.7%	29.9%	10.7%	22.0%	7.7%	5.9%	7.2%
		1997	76,663	0.0%	0.6%	9.3%	21.7%	18.4%	20.7%	11.6%	14.2%	3.4%
		2003	75,482	2.4%	1.3%	4.5%	14.1%	15.5%	17.3%	19.4%	19.1%	6.5%
		2006	65,495	1.8%	3.9%	6.7%	9.3%	9.2%	12.0%	6.0%	21.5%	13.3%
		2011	40,483	0.1%	0.8%	3.1%	7.0%	9.0%	4.3%	8.8%	27.4%	39.5%
		2016	64,168	1.5%	2.5%	5.1%	9.8%	13.5%	14.9%	31.5%	13.0%	8.2%
		2019	47,643	1.8%	3.8%	4.9%	7.1%	10.4%	10.4%	27.1%	19.1%	15.5%
	Maui	1992	8,328	3.1%	5.5%	36.5%	23.6%	12.7%	8.4%	4.7%	4.0%	1.5%
		1997	10,051	1.1%	6.2%	20.5%	30.8%	13.5%	14.6%	5.4%	6.3%	1.6%
		2003	10,586	1.8%	5.9%	11.9%	26.8%	13.4%	12.7%	9.6%	12.1%	5.8%
		2006	12,539	2.0%	2.5%	4.3%	7.9%	9.3%	13.8%	8.7%	28.8%	12.4%
		2011	7,156	0.0%	0.2%	0.6%	7.7%	5.8%	19.1%	5.3%	32.7%	28.8%
		2016	9,172	1.6%	3.0%	5.2%	9.7%	17.9%	8.3%	31.5%	14.0%	8.8%
		2019	8,417	2.7%	2.1%	3.1%	4.5%	9.2%	9.8%	39.4%	17.2%	12.1%
	Hawai`i	1992	12,441	0.9%	3.4%	17.6%	31.0%	22.8%	11.3%	4.9%	5.0%	3.2%
		1997	10,794	0.9%	3.1%	9.6%	25.0%	12.6%	26.0%	9.6%	10.7%	2.5%
		2003	13,402	1.3%	1.7%	7.2%	16.9%	15.2%	15.6%	20.5%	13.8%	7.9%
		2006	15,940	1.4%	3.2%	6.3%	17.8%	8.2%	12.8%	2.3%	18.6%	10.7%
		2011	8,711	1.7%	1.6%	6.8%	10.5%	11.2%	18.3%	6.0%	22.2%	21.6%
		2016	11,407	5.4%	13.9%	9.1%	17.2%	16.7%	7.5%	21.7%	5.2%	3.2%
		2019	9,986	4.1%	15.1%	11.5%	13.3%	18.1%	8.6%	18.9%	7.2%	3.3%
	Kaua`i	1992	4,513	0.0%	1.6%	14.5%	31.3%	23.6%	14.7%	8.5%	4.6%	1.2%
		1997	4,016	1.0%	4.5%	13.1%	28.0%	17.2%	16.6%	9.6%	7.5%	2.4%
		2003	4,381	1.5%	1.2%	5.7%	21.3%	15.8%	22.3%	14.4%	12.6%	5.2%
		2006	3,879	1.4%	2.4%	3.6%	12.9%	12.4%	12.9%	5.4%	20.1%	13.5%
		2011	2,046	2.3%	6.3%	2.1%	11.7%	4.8%	14.7%	9.4%	24.0%	24.8%
		2016	3,040	4.9%	3.6%	9.3%	11.6%	14.5%	10.0%	34.6%	4.6%	6.9%
		2019	2,253	7.4%	7.6%	2.6%	7.1%	10.5%	11.2%	31.2%	18.3%	4.0%
	State	1992	86,006	1.0%	1.9%	17.2%	29.5%	13.4%	18.7%	7.0%	5.5%	5.7%
		1997	101,524	0.3%	1.6%	10.6%	23.2%	17.3%	20.5%	10.7%	12.8%	3.1%
		2003	103,851	2.1%	1.8%	5.6%	16.0%	15.3%	16.8%	18.3%	17.4%	6.5%
		2006	97,853	1.8%	3.5%	6.2%	10.5%	9.2%	12.4%	5.8%	21.9%	12.8%
		2011	58,395	0.4%	1.0%	3.3%	7.8%	8.8%	8.7%	7.9%	27.1%	34.9%
		2016	87,787	2.1%	4.1%	5.8%	10.9%	14.4%	13.0%	30.3%	11.7%	7.6%
		2019	68,300	2.5%	5.3%	5.6%	7.7%	11.3%	10.1%	27.5%	17.1%	13.0%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016, and 2019

[a] Based on self-report from respondents regarding the level of monthly payment they would be able to afford.

Table A-20. Affordable Housing Cost for New Units, Renters, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

	County	Year	Total Will Move Renters[a]	Affordable Monthly Housing Cost[a]								
				Less than $200	$200 to $499	$500 to $799	$800 to $1,099	$1,100 to $1,399	$1,400 to $1,699	$1,700 to $1,999	$2,000 to $3,000	More than $3,000
Plan to Rent	Honolulu	1992	67,086	1.5%	2.8%	29.6%	35.1%	16.3%	9.6%	2.8%	2.3%	0.0%
		1997	52,128	2.0%	7.5%	26.1%	31.6%	16.7%	10.6%	3.1%	2.4%	0.0%
		2003	38,156	4.4%	10.2%	19.0%	24.9%	11.4%	11.4%	10.3%	5.2%	3.2%
		2006	40,585	0.0%	7.8%	13.6%	21.1%	13.3%	9.5%	8.8%	6.7%	5.0%
		2011	46,396	0.0%	2.2%	14.6%	22.5%	18.7%	12.2%	6.6%	18.5%	4.7%
		2016	67,065	3.3%	5.0%	8.7%	21.9%	12.2%	13.2%	8.9%	20.2%	6.7%
		2019	50,218	6.2%	4.0%	10.5%	16.8%	12.4%	15.7%	14.0%	16.3%	4.1%
	Maui	1992	4,956	0.9%	7.6%	53.2%	29.2%	6.8%	2.2%	0.2%	0.0%	0.0%
		1997	6,188	4.6%	18.7%	41.7%	21.8%	5.1%	4.5%	1.8%	1.9%	0.0%
		2003	5,007	8.0%	11.0%	38.6%	22.2%	9.0%	8.0%	0.0%	1.7%	1.5%
		2006	7,265	0.0%	10.2%	12.9%	19.9%	12.5%	17.3%	5.2%	9.1%	3.6%
		2011	7,751	3.1%	5.2%	8.1%	30.8%	14.3%	18.9%	8.6%	7.2%	3.9%
		2016	9,178	4.3%	4.6%	13.7%	16.0%	17.3%	17.7%	6.3%	16.9%	3.3%
		2019	7,963	4.0%	5.4%	5.9%	10.1%	21.5%	21.1%	9.1%	18.0%	4.9%
	Hawai`i	1992	3,563	0.1%	6.6%	23.8%	32.4%	25.2%	9.7%	1.0%	1.0%	0.0%
		1997	5,090	6.0%	15.5%	26.5%	31.6%	15.3%	2.9%	0.6%	1.7%	0.0%
		2003	5,069	7.8%	5.3%	17.7%	33.2%	10.0%	11.2%	3.8%	11.0%	0.0%
		2006	7,659	0.0%	18.3%	16.5%	19.1%	10.7%	9.9%	5.8%	8.6%	1.6%
		2011	6,294	4.8%	10.5%	21.0%	22.9%	8.1%	8.8%	12.5%	7.6%	3.8%
		2016	10,410	12.3%	8.5%	22.1%	24.4%	5.4%	8.1%	6.0%	10.3%	2.8%
		2019	11,402	8.7%	10.4%	15.7%	25.8%	15.2%	10.5%	3.9%	8.8%	1.1%
	Kaua`i	1992	2,017	1.0%	8.2%	30.3%	21.4%	22.2%	17.0%	0.0%	0.0%	0.0%
		1997	2,412	6.7%	16.2%	43.0%	24.3%	4.4%	3.7%	1.8%	0.0%	0.0%
		2003	2,045	4.2%	2.2%	13.8%	34.9%	15.7%	15.0%	2.5%	11.7%	0.0%
		2006	3,177	0.0%	9.1%	5.2%	17.7%	15.3%	25.0%	4.5%	7.1%	4.9%
		2011	3,525	3.4%	5.3%	8.1%	14.9%	15.7%	16.7%	7.1%	25.9%	2.9%
		2016	3,179	6.6%	2.4%	10.9%	20.9%	12.2%	17.6%	9.2%	11.3%	8.9%
		2019	2,305	0.9%	5.5%	1.4%	16.6%	14.3%	28.3%	6.8%	11.6%	14.7%
	State	1992	77,622	1.4%	3.4%	30.8%	34.2%	16.3%	9.3%	2.5%	2.0%	0.0%
		1997	65,818	2.7%	9.5%	28.2%	30.4%	15.0%	9.2%	2.7%	2.2%	0.0%
		2003	50,277	5.1%	9.5%	20.6%	25.9%	11.2%	11.2%	8.3%	5.7%	2.6%
		2006	58,686	0.0%	9.5%	13.4%	20.5%	13.0%	11.4%	7.8%	7.2%	4.4%
		2011	63,697	1.3%	3.8%	14.1%	23.2%	16.6%	13.0%	7.6%	16.1%	4.3%
		2016	89,832	4.6%	5.3%	10.9%	21.4%	12.0%	13.4%	8.3%	18.3%	5.9%
		2019	71,888	6.1%	5.1%	10.3%	17.2%	14.0%	16.1%	11.8%	15.3%	4.2%

Source: Housing Demand Survey, 1992, 1997, 2003, 2006, 2011, 2016 and 2019

[a] Based on self-report from respondents regarding the level of monthly payment they would be able to afford.

Table A-21. Preferred Location of New Housing Unit, 2019

Preferred Next Location	County of Residence									
	Honolulu		Maui		Hawaii		Kauai		State	
	Count	Pct.	Count	Pct.	Count	Pct.	Count	Pct.	Count	Pct.
HONOLULU										
PUC	34,449	44.4%	305	2.1%	846	5.1%	117	3.2%	35,717	29.1%
Central O‘ahu	15,593	20.1%	195	1.4%	166	1.0%			15,954	13.0%
East Honolulu	6,901	8.9%	64	0.5%					6,965	5.7%
Leeward O‘ahu	9,402	12.1%	369	2.6%	401	2.4%	13	0.4%	10,185	8.3%
Windward O‘ahu	7,964	10.3%	46	0.3%	208	1.3%			8,218	6.7%
O‘ahu , any	147	0.2%	82	0.6%					229	0.2%
HAWAI'I										
South Kona-Ka‘ū	25	0.0%	141	1.0%	318	1.9%	48	1.3%	532	0.4%
Puna	367	0.5%	40	0.3%	1,206	7.2%			1,613	1.3%
North & South Hilo	453	0.6%	327	2.3%	5,226	31.4%	33	0.9%	6,039	4.9%
North Hawai‘i	107	0.1%			2,780	16.7%			2,887	2.4%
North Kona	921	1.2%			4,844	29.1%	148	4.1%	5,913	4.8%
Waimea (Hawai‘i Island)									0	0.0%
Hawai‘i Island, any					201	1.2%			201	0.2%
MAUI										
Hana	31	0.0%	115	0.8%			599	16.4%	745	0.6%
Makawao-Pukalani-Kula	365	0.5%	3,564	25.1%					3,929	3.2%
Wailuku-Kahului	83	0.1%	3,179	22.4%	69	0.4%	15	0.4%	3,346	2.7%
Paia-Haiku	134		484	3.4%	59	0.4%			677	0.6%
Kihei-Makena	207	0.3%	2,467	17.4%	65	0.4%	231	6.3%	2,970	2.4%
West Maui			1,975	13.9%			214	5.9%	2,189	1.8%
Molokai	50		120	0.8%					170	0.1%
Lanai			22	0.2%					22	0.0%
Maui, any	122	0.2%	716	5.0%	45	0.3%			883	0.7%
KAUA'I										
Waimea (Kaua‘i)							38	1.0%	38	0.0%
Koloa					71	0.4%	428	11.7%	499	0.4%
Lihue	196	0.3%					665	18.2%	861	0.7%
Kawaihau					115	0.7%	449	12.3%	564	0.5%
Hanalei							492	13.5%	492	0.4%
Kaua‘i, any					19	0.1%	156	4.3%	175	0.1%
Total	*77,518*	*78.8%*	*14,212*	*81.6%*	*16,639*	*77.8%*	*3,647*	*78.3%*	*122,663*	*83.4%*
Total No Preference	20,807	21.2%	3,196	18.4%	4,745	22.2%	1,008	21.7%	24,500	16.6%
Total Effective Demand Movers	98,325	100.0%	17,408	100.0%	21,384	100.0%	4,655	100.0%	147,163	100.0%

Source: Housing Demand Survey, 2019

Table B-3. Vacancy Categories, 2009 - 2017

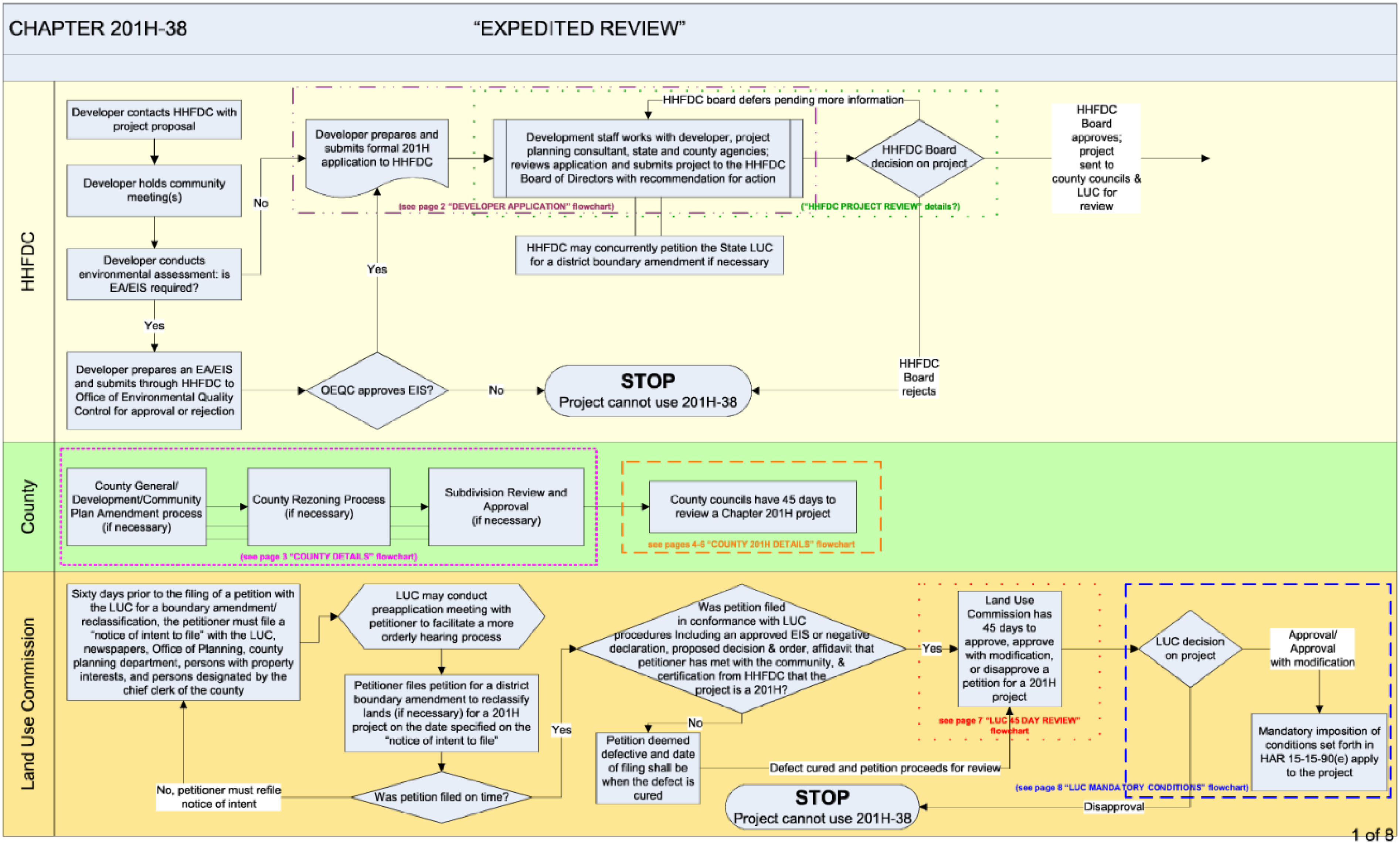
Statewide	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Vacant and Available Units	Total Available Units (Housing Stock)	Current Residence Elsewhere	Seasonal
2009	505,087	437,976	67,111	23,496	461,472	12,633	29,786
2010	512,157	442,267	69,890	26,240	468,507	12,526	29,955
2011	516,394	445,513	70,881	28,163	473,676	11,582	29,564
2012	519,811	447,453	72,358	28,193	475,646	11,310	30,624
2013	522,164	449,771	72,393	27,155	476,926	11,350	31,854
2014	524,852	450,299	74,553	27,221	477,520	11,160	33,054
2015	527,388	450,572	76,816	27,606	478,178	11,526	33,538
2016	530,289	452,030	78,259	27,832	479,862	12,230	34,088
2017	535,543	455,502	80,041	27,362	482,864	11,600	35,324
%chg. from 2014-2017	2.0%	1.2%	7.4%	0.5%	1.1%	3.9%	6.9%

Source: ACS 2009 – 2017, 5-year estimates, Tables DP04, B25005, B25007

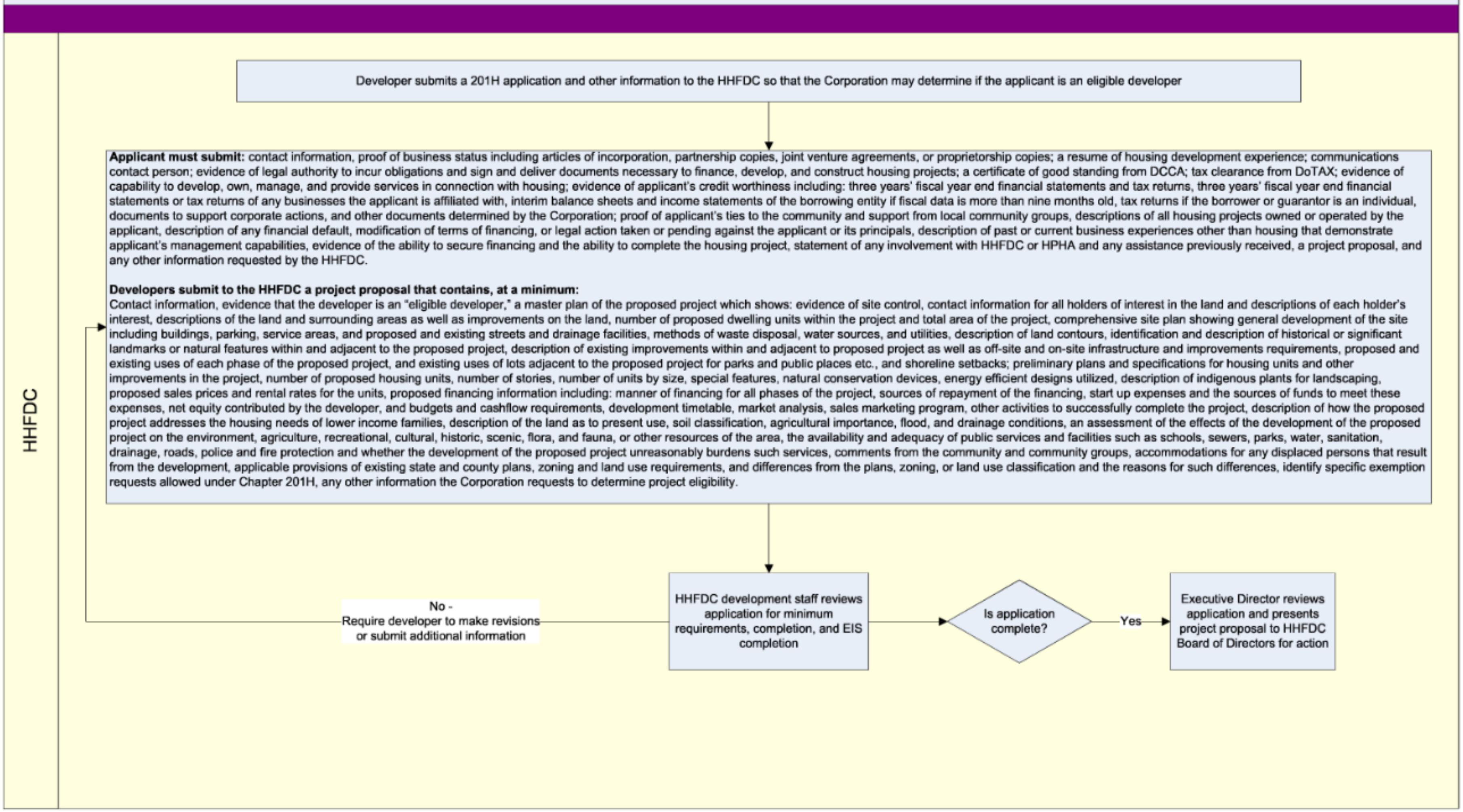
Table B-3 summarizes the current housing vacancy status for the State of Hawai‘i over the years of 2009-2017. The total housing units shows us how many total housing units there are in the State of Hawai‘i, regardless of whether they are occupied or vacant. In 2017, there were 535,543 housing units, versus 524,852 housing units in 2014. This was an increase of 2 percent. Of the 535,543 housing units, 455,502 (85.1%) of them are occupied by households and the remaining 80,041 (14.9%) units are vacant. Not all the vacant units are available for sale or rent to the housing market. Vacant and available units excluded vacant units that are not available to residents. In 2017, vacant and available units account for only 34.2 percent of the total vacant housing units in contrast to 36.5 percent in 2014. Summing the vacant and available units with the occupied housing units define the total housing stock. As was found in 2014, the number of vacant and available housing units in 2017 accounted for about 5.7 percent of the total housing stock.

APPENDIX C: REFERENCED MATERIALS

Table C-1. 201H Process Flowchart



DEVELOPER APPLICATION – ELIGIBLE DEVELOPER, INFORMATION REQUIRED, PROJECT PROPOSAL REQUIREMENTS



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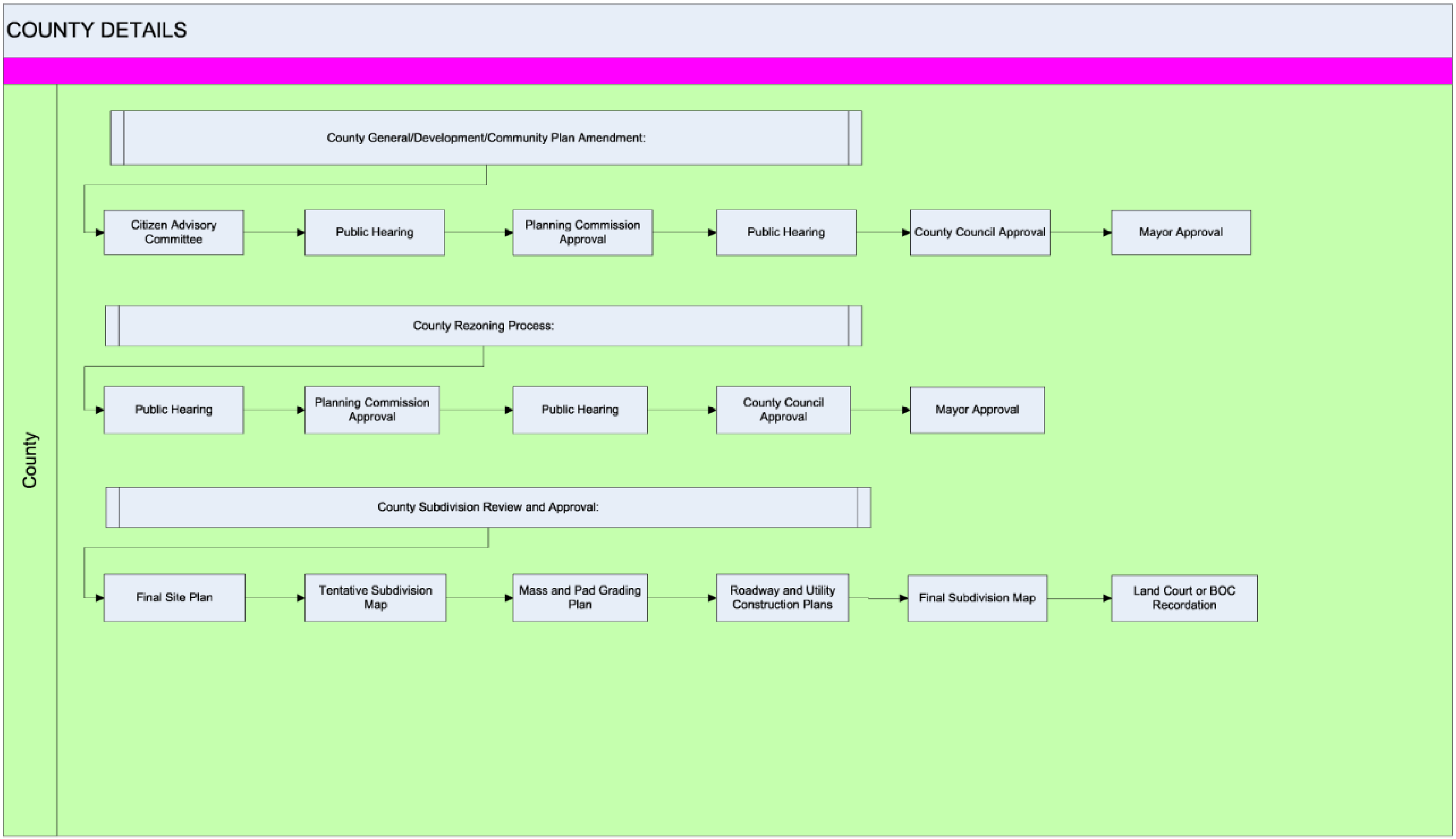
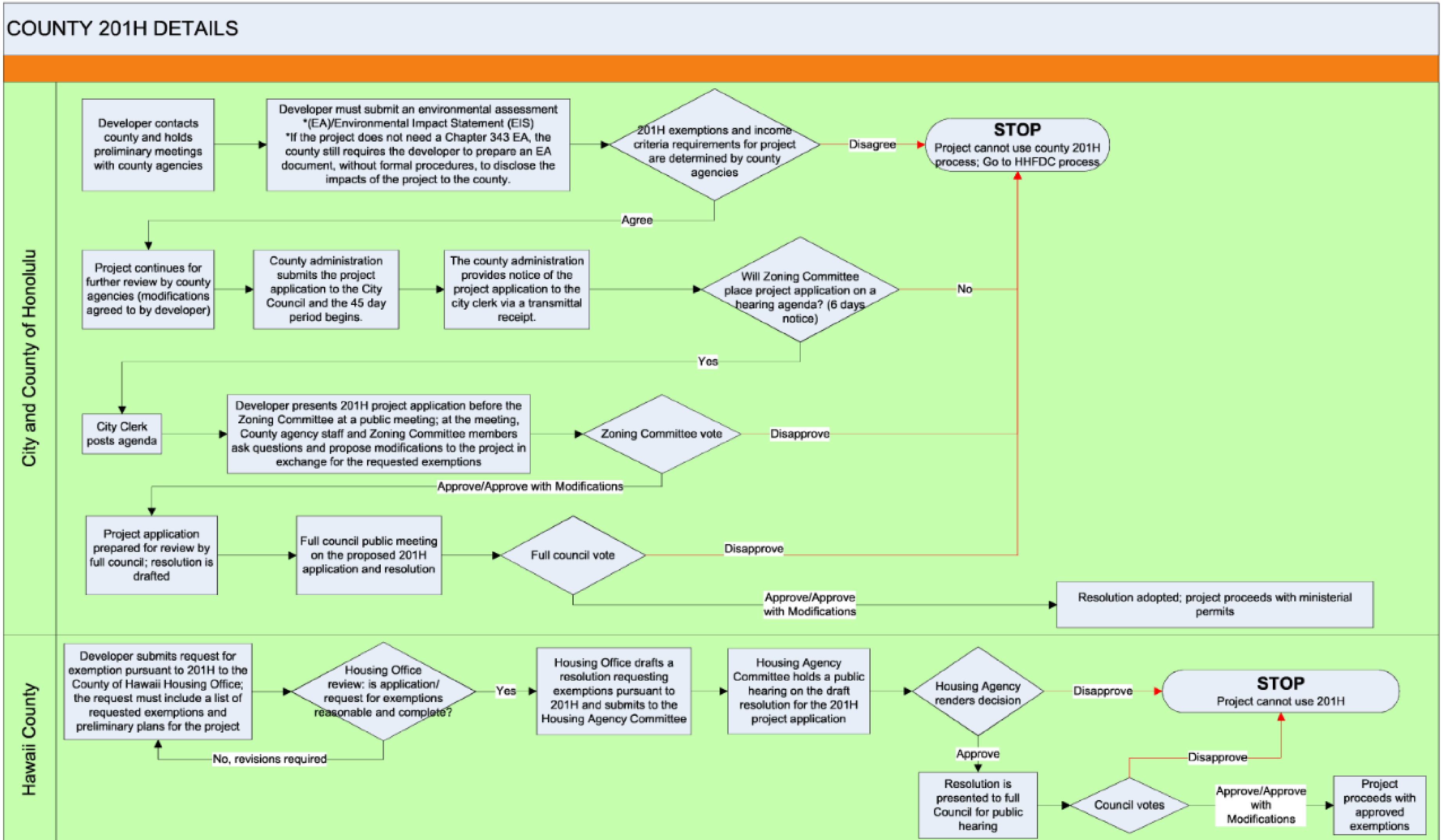
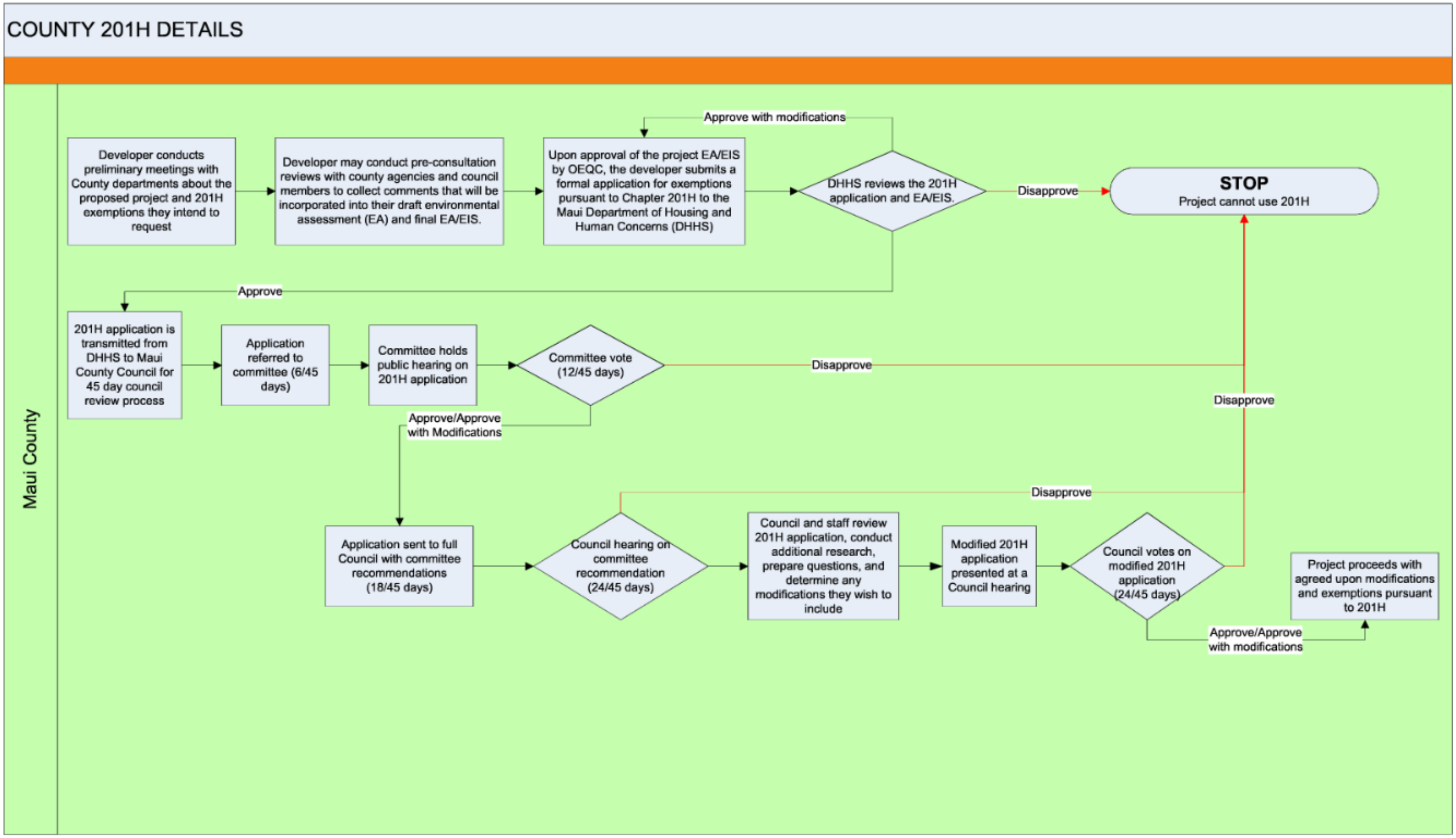
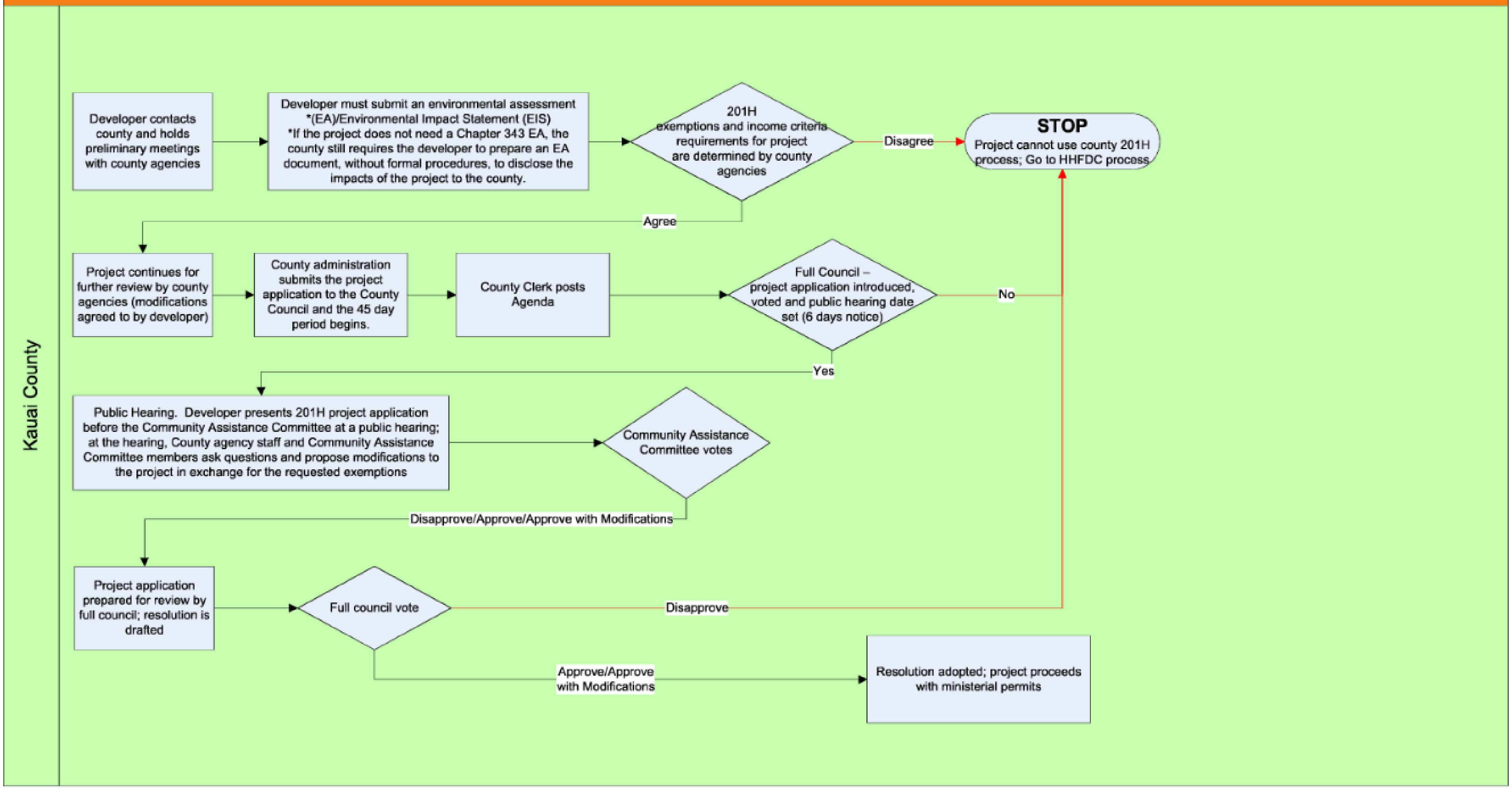

COUNTY DETAILS
County
County General/Development/Community Plan Amendment:
Citizen Advisory Committee
Public Hearing
Planning Commission Approval
Public Hearing
County Council Approval
Mayor Approval
County Rezoning Process:
Public Hearing
Planning Commission Approval
Public Hearing
County Council Approval
Mayor Approval
County Subdivision Review and Approval:
Final Site Plan
Tentative Subdivision Map
Mass and Pad Grading Plan
Roadway and Utility Construction Plans
Final Subdivision Map
Land Court or BOC Recordation


COUNTY 201H DETAILS
City and County of Honolulu
Developer contacts county and holds preliminary meetings with county agencies
Developer must submit an environmental assessment *(EA)/Environmental Impact Statement (EIS) *If the project does not need a Chapter 343 EA, the county still requires the developer to prepare an EA document, without formal procedures, to disclose the impacts of the project to the county.
201H exemptions and income criteria requirements for project are determined by county agencies
Disagree
STOP
Project cannot use county 201H process; Go to HHFDC process
Agree
Project continues for further review by county agencies (modifications agreed to by developer)
County administration submits the project application to the City Council and the 45 day period begins.
The county administration provides notice of the project application to the city clerk via a transmittal receipt.
Will Zoning Committee place project application on a hearing agenda? (6 days notice)
No
Yes
City Clerk posts agenda
Developer presents 201H project application before the Zoning Committee at a public meeting; at the meeting, County agency staff and Zoning Committee members ask questions and propose modifications to the project in exchange for the requested exemptions
Zoning Committee vote
Disapprove
Approve/Approve with Modifications
Project application prepared for review by full council; resolution is drafted
Full council public meeting on the proposed 201H application and resolution
Full council vote
Disapprove
Approve/Approve with Modifications
Resolution adopted; project proceeds with ministerial permits
Hawaii County
Developer submits request for exemption pursuant to 201H to the County of Hawaii Housing Office; the request must include a list of requested exemptions and preliminary plans for the project
Housing Office review: is application/ request for exemptions reasonable and complete?
Yes
No, revisions required
Housing Office drafts a resolution requesting exemptions pursuant to 201H and submits to the Housing Agency Committee
Housing Agency Committee holds a public hearing on the draft resolution for the 201H project application
Housing Agency renders decision
Disapprove
STOP
Project cannot use 201H
Approve
Resolution is presented to full Council for public hearing
Council votes
Disapprove
Approve/Approve with Modifications
Project proceeds with approved exemptions



COUNTY 201H DETAILS
Maui County
Developer conducts preliminary meetings with County departments about the proposed project and 201H exemptions they intend to request
Developer may conduct pre-consultation reviews with county agencies and council members to collect comments that will be incorporated into their draft environmental assessment (EA) and final EA/EIS.
Upon approval of the project EA/EIS by OEQC, the developer submits a formal application for exemptions pursuant to Chapter 201H to the Maui Department of Housing and Human Concerns (DHHS)
Approve with modifications
DHHS reviews the 201H application and EA/EIS.
Disapprove
STOP
Project cannot use 201H
Approve
201H application is transmitted from DHHS to Maui County Council for 45 day council review process
Application referred to committee (6/45 days)
Committee holds public hearing on 201H application
Committee vote (12/45 days)
Disapprove
Disapprove
Approve/Approve with Modifications
Disapprove
Application sent to full Council with committee recommendations (18/45 days)
Council hearing on committee recommendation (24/45 days)
Council and staff review 201H application, conduct additional research, prepare questions, and determine any modifications they wish to include
Modified 201H application presented at a Council hearing
Council votes on modified 201H application (24/45 days)
Project proceeds with agreed upon modifications and exemptions pursuant to 201H
Approve/Approve with modifications

COUNTY 201H DETAILS



LUC MANDATORY CONDITIONS IMPOSED ON APPROVED 201H PROJECTS

Land Use Commission

If a 201H project is approved or approved with modification by the LUC on the 46th day, the following mandatory conditions apply to the project:

1. Petitioner must develop the reclassified area in substantial compliance with the representations made to the commission; failure to do so may result in a reversal of the decision or reclassification of the land
2. Petitioner is required to provide notice to the commission of any intent to sell, lease, assign, pace in trust or otherwise voluntarily alter the ownership interests in the reclassified area prior to development of the area
3. Petitioner must provide annual reports to the commission updating the status of the project
4. Petitioner must record with Bureau of Conveyances a statement of the required conditions imposed by the LUC and provide a copy of the recorded statement to the commission
5. Petitioner must provide affordable housing opportunities for low, low-moderate, and moderate income residents to the satisfaction of the county in which the reclassified land is located
6. If proposed use of land includes residential, the petitioner shall contribute to the development, funding, and construction of public school facilities as determined by the DOE
7. Petitioner shall participate in funding and construction of adequate wastewater transmission and disposal facilities, on a fair-share basis as determined by the county and HI-DOH
8. Petitioner shall prepare a traffic analysis report to identify traffic impacts and mitigation measures; report to be reviewed by HI-DOT and county transportation departments; petitioner may be required to fund or contribute to transportation improvements
9. Petitioner shall fund and construct on a fair-share basis adequate civil defense measures as determined by State Civil Defense
10. Petitioner shall have a professional archaeologist conduct an archeological inventory survey with significance evaluations and mitigation commitments acceptable to the State Historic Preservation Division (SHPD)
11. Petitioner shall submit and execute a detailed historic preservation mitigation plan to the SHPD to verify in writing that the plan has been successfully executed
12. Petitioner shall stop work if significant archaeological sites are found and may resume when mitigative measures have been implemented to the satisfaction of SHPD
13. Petitioner shall monitor air quality as specified by the HI-DOH
14. Petitioner shall mitigate noise pollution
15. If the approved boundary amendment involves conversion of prime agricultural land, the petitioner shall contribute to the protection of an equivalent amount of prime agricultural lands and related infrastructure via long-term agricultural conservation easements or other ag-related assets as determined by and to the satisfaction of the HI-DOA.
16. Petitioner shall notify all prospective buyers of property of the potential odor, noise, and dust pollution if there are agricultural district lands surrounding the reclassified area
17. Petitioner shall notify all prospective buyers of property of the Hawaii Right to Farm Act limitations on "nuisance" determinations
18. Petitioner shall fund the design and construction of drainage improvements to the satisfaction of State and county agencies
19. Petitioner shall address and provide for solid waste management in cooperation with HI-DOH and county agencies in accordance with a schedule/timeframe satisfactory to HI-DOH
20. To the extent required by the HI-DOH, petitioner shall ensure that nearshore, offshore, and deep ocean waters remain in pristine condition
21. Petitioner shall participate in the funding and construction of adequate water source, storage, and transmission facilities and improvements to accommodate the proposed uses, as coordinated by State and county agencies
22. Petitioner shall protect and preserve existing native Hawaiian gathering rights

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Table C-2. Projecting Housing Supply in Hawai‘i, 2020 through 2050

Projection Model for Housing Supply, State of Hawai‘i, 1990 through 2030

Regression with ARMA Errors

Series: StateHU[, "TotalHU"]
IV: Resident Civilian Population
Regression with ARIMA(1,0,2) errors

Coefficients:

	arf1	ma1	ma2	xreg
Coef.	0.9546	0.8729	0.6656	0.3699
s.e.	0.0526	0.1669	0.1872	0.0132

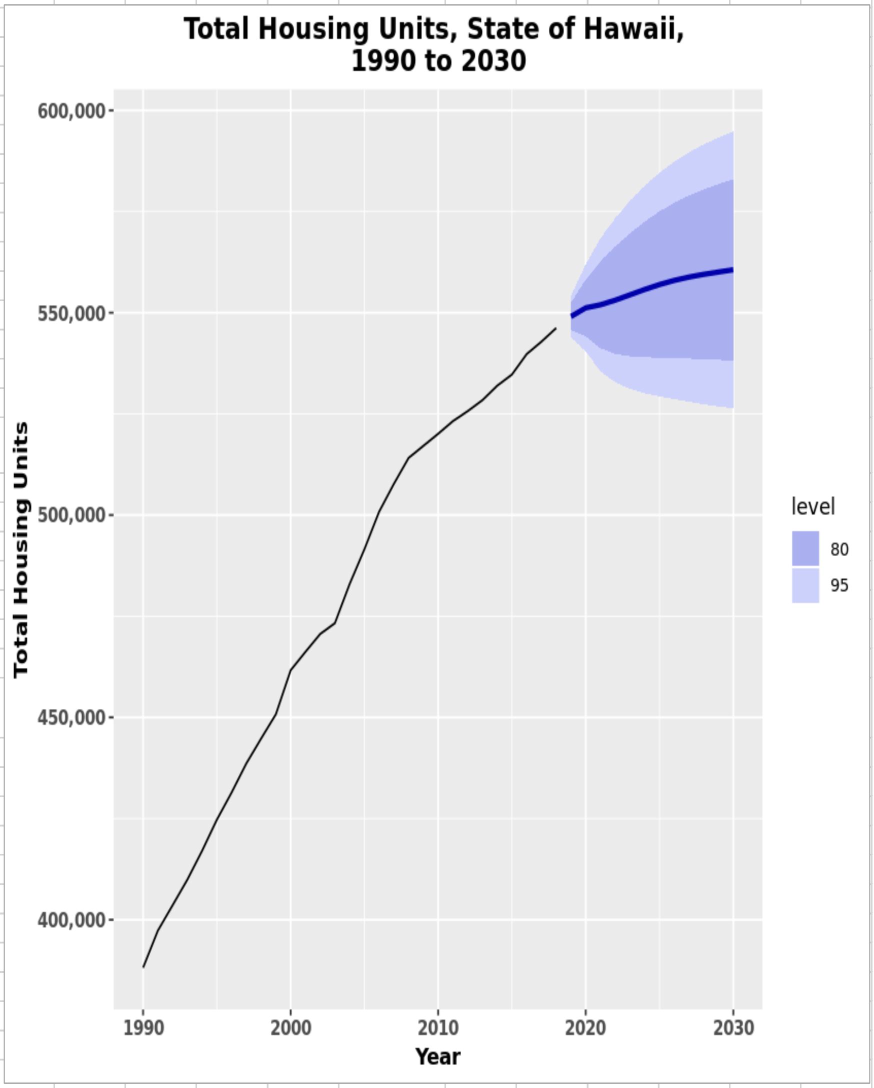
sigma^2 estimated as 6935269: log likelihood=-270.25
AIC=550.5 AICc=553.11 BIC=557.34

z test of coefficients:

	Est. Std. err.	Estimate	Standard Error	z value	Pr(>|z|)
ar1	0.954632	0.052588	18.1531	<2.2e-16	***
ma1	0.872886	0.166920	5.2294	1.7013-07	***
ma2	0.665565	0.187228	3.5548	0.0003782	***
xreg	0.398690	0.013200	28.0209	<2.2e-16	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2019	549,062	545,687	552,437	543,900	554,224
2020	551,197	544,166	558,228	540,445	561,950
2021	551,957	541,205	562,709	535,514	568,400
2022	553,096	539,834	566,359	532,813	573,380
2023	554,417	539,223	569,610	531,180	577,653
2024	555,745	538,984	572,506	530,112	581,379
2025	556,955	538,884	575,026	529,318	584,592
2026	557,980	538,792	577,167	528,635	587,324
2027	558,809	538,658	578,959	527,991	589,627
2028	559,478	538,488	580,469	527,376	591,580
2029	560,054	538,326	581,781	526,825	593,283
2030	560,610	538,233	582,988	526,386	594,834



APPENDIX D: HOUSING AFFORDABILITY ESTIMATES AND RENTS

Table D-1. Housing Affordability Estimates, 2019

	State of Hawai'i	Counties			
		Hawai'i	Honolulu	Kaua'i	Maui
Housing Wage (for 2-bedroom FMR)	$36.82	$25.88	$39.75	$29.44	$32.21
Housing Costs					
2-bedroom fair market rent	$1,914	$1,346	$2,067	$1,531	$1,675
Annual income needed to afford 2BR FMR	$76,577	$53,840	$82,680	$61,240	$67,000
FT jobs at mini wage needed to afford 2BR	3.6	2.6	3.9	2.9	3.2
Area Median Income (AMI)					
Annual AMI	$92,483	$7,010	$99,000	$90,000	$83,800
Monthly rent affordable at AMI	$1,406	$999	$1,483	$1,345	$1,355
30% of AMI	$27,745	$21,030	$29,700	$27,000	$25,140
Monthly rent affordable at 30% of AMI	$694	$526	$743	$675	$629
Renter Households					
Renter households (2010-2014)	190,880	22,112	138,209	8,350	22,158
% of total households (2010-2014)	42%	33%	44%	37%	41%
Estimated hourly mean renter wage (2016)	$16.68	$13.24	$17.65	$14.79	$14.99
Rent affordable with full-time job at mean renter wage	$868	$689	$918	$769	$780
Hours per week at mean renter wage needed to afford 2BR	88	78	90	80	86

Source. National Low-Income Housing Coalition "Out of Reach Report, 2019" Hawai'i data.

Table D-2. Median Rent for SFD and MFD by Number of Bedrooms, State of Hawai'i, 2009-2015

Date	Single Family Dwellings						Condominiums					Apartments				
	1BR	2BR	3BR	4BR	5BR	All SFDs	1BR	2BR	3BR	4BR	All Condos	1BR	2BR	3BR	4BR	All Apts.
Y2009	$1,187	$1,454	$1,933	$2,290	$2,564	$1,885	$1,197	$1,476	$1,950	$2,268	$1,723	$1,135	$1,424	$1,888	$2,241	$1,672
Y2010	$1,186	$1,460	$1,921	$2,307	$2,568	$1,888	$1,161	$1,453	$1,897	$2,264	$1,694	$1,097	$1,397	$1,850	$2,238	$1,646
Y2011	$1,204	$1,488	$1,937	$2,325	$2,585	$1,908	$1,175	$1,468	$1,914	$2,301	$1,714	$1,107	$1,412	$1,868	$2,265	$1,663
Y2012	$1,201	$1,508	$1,954	$2,348	$2,604	$1,923	$1,183	$1,499	$1,939	$2,353	$1,743	$1,130	$1,443	$1,893	$2,323	$1,697
Y2013	$1,183	$1,496	$1,951	$2,356	$2,617	$1,920	$1,194	$1,549	$1,987	$2,384	$1,778	$1,152	$1,489	$1,951	$2,384	$1,744
Y2014	$1,180	$1,521	$1,970	$2,398	$2,651	$1,944	$1,221	$1,602	$2,063	$2,436	$1,831	$1,175	$1,531	$2,029	$2,457	$1,798
Y2015	$1,209	$1,566	$2,056	$2,527	$2,762	$2,024	$1,246	$1,679	$2,156	$2,546	$1,907	$1,183	$1,595	$2,089	$2,539	$1,852
Y2016	$1,271	$1,634	$2,175	$2,664	$2,913	$2,132	$1,316	$1,766	$2,268	$2,665	$2,004	$1,240	$1,684	$2,209	$2,644	$1,945
Y2017	$1,334	$1,709	$2,252	$2,748	$3,030	$2,214	$1,387	$1,815	$2,282	$2,715	$2,050	$1,303	$1,725	$2,236	$2,688	$1,988
Y2018	$1,292	$1,729	$2,295	$2,742	$3,000	$2,212	$1,380	$1,868	$2,268	$2,663	$2,045	$1,276	$1,727	$2,206	$2,631	$1,960
Y2019	$1,282	$1,715	$2,308	$2,790	$3,004	$2,220	$1,367	$1,805	$2,287	$2,637	$2,024	$1,286	$1,730	$2,242	$2,633	$1,973
% change 2011-2016	5.6%	9.8%	12.3%	14.6%	12.7%	11.7%	12.0%	20.3%	18.5%	15.8%	16.9%	12.0%	19.3%	18.3%	16.7%	16.9%
% change 2016-2019	0.9%	5.0%	6.1%	4.7%	3.1%	4.1%	3.8%	2.2%	0.8%	-1.1%	1.0%	3.7%	2.7%	1.5%	-0.4%	1.5%

Source: RentRange®, 2009-2019

Table D-3. Median Rent for SFD and MFD by Number of Bedrooms, City and County of Honolulu, 2009-2019

Date	Single Family Dwellings						Condominiums					Apartments				
	1BR	2BR	3BR	4BR	5BR	All SFDs	1BR	2BR	3BR	4BR	All Condos	1BR	2BR	3BR	4BR	All Apts.
Y2009	$1,358	$1,726	$2,324	$2,759	$3,038	$2,241	$1,263	$1,671	$2,176	$2,630	$1,935	$1,212	$1,610	$2,120	$2,591	$1,883
Y2010	$1,313	$1,698	$2,295	$2,748	$3,011	$2,213	$1,128	$1,578	$2,001	$2,517	$1,806	$1,088	$1,513	$1,953	$2,488	$1,761
Y2011	$1,329	$1,698	$2,326	$2,794	$3,059	$2,241	$1,237	$1,663	$2,132	$2,623	$1,914	$1,172	$1,598	$2,059	$2,578	$1,852
Y2012	$1,350	$1,730	$2,347	$2,850	$3,155	$2,286	$1,315	$1,713	$2,274	$2,755	$2,014	$1,256	$1,668	$2,218	$2,718	$1,965
Y2013	$1,333	$1,736	$2,356	$2,847	$3,206	$2,296	$1,328	$1,768	$2,323	$2,793	$2,053	$1,286	$1,696	$2,278	$2,781	$2,010
Y2014	$1,340	$1,795	$2,438	$2,960	$3,261	$2,359	$1,384	$1,807	$2,419	$2,852	$2,115	$1,320	$1,739	$2,378	$2,830	$2,067
Y2015	$1,400	$1,885	$2,584	$3,149	$3,399	$2,483	$1,433	$1,931	$2,525	$2,992	$2,220	$1,357	$1,842	$2,453	$2,949	$2,150
Y2016	$1,464	$1,957	$2,683	$3,228	$3,542	$2,575	$1,483	$2,005	$2,564	$3,046	$2,274	$1,396	$1,927	$2,520	$2,967	$2,203
Y2017	$1,535	$2,000	$2,704	$3,268	$3,637	$2,629	$1,522	$1,999	$2,559	$3,061	$2,285	$1,442	$1,927	$2,541	$2,985	$2,224
Y2018	$1,519	$2,013	$2,660	$3,141	$3,522	$2,571	$1,553	$2,018	$2,572	$2,907	$2,262	$1,443	$1,903	$2,507	$2,893	$2,186
Y2019	$1,503	$1,989	$2,673	$3,240	$3,563	$2,593	$1,599	$2,004	$2,638	$2,954	$2,298	$1,456	$1,906	$2,565	$2,929	$2,214
% change 2011-2016	10.2%	15.3%	15.4%	15.5%	15.8%	14.9%	19.8%	20.5%	20.3%	16.1%	18.8%	19.1%	20.6%	22.4%	15.1%	18.9%
% change 2016-2019	2.6%	1.6%	-0.4%	0.4%	0.6%	0.7%	7.8%	0.0%	2.9%	-3.0%	1.1%	4.3%	-1.1%	1.8%	-1.3%	0.5%

Source: RentRange®, 2009-2019.

Table D-4. Median Rent for SFD and MFD by Number of Bedrooms, County of Maui, 2009-2019

Date	Single Family Dwellings						Condominiums					Apartments				
	1BR	2BR	3BR	4BR	5BR	All SFDs	1BR	2BR	3BR	4BR	All Condos	1BR	2BR	3BR	4BR	All Apts.
Y2009	$1,278	$1,525	$2,119	$2,480	$2,796	$2,039	$1,333	$1,590	$2,181	$2,460	$1,891	$1,258	$1,538	$2,123	$2,438	$1,839
Y2010	$1,264	$1,527	$2,088	$2,514	$2,824	$2,043	$1,292	$1,549	$2,138	$2,494	$1,868	$1,221	$1,499	$2,120	$2,468	$1,827
Y2011	$1,290	$1,575	$2,080	$2,480	$2,767	$2,038	$1,248	$1,520	$2,116	$2,463	$1,837	$1,186	$1,474	$2,104	$2,424	$1,797
Y2012	$1,235	$1,550	$2,053	$2,366	$2,620	$1,965	$1,221	$1,545	$2,088	$2,359	$1,803	$1,183	$1,490	$2,057	$2,333	$1,766
Y2013	$1,193	$1,517	$2,002	$2,288	$2,542	$1,908	$1,237	$1,612	$2,128	$2,318	$1,824	$1,205	$1,570	$2,121	$2,351	$1,812
Y2014	$1,202	$1,530	$1,993	$2,295	$2,565	$1,917	$1,263	$1,658	$2,213	$2,365	$1,875	$1,226	$1,596	$2,210	$2,480	$1,878
Y2015	$1,228	$1,552	$2,139	$2,471	$2,720	$2,022	$1,290	$1,752	$2,351	$2,533	$1,981	$1,232	$1,662	$2,307	$2,605	$1,951
Y2016	$1,287	$1,642	$2,323	$2,741	$2,986	$2,196	$1,373	$1,882	$2,509	$2,787	$2,138	$1,306	$1,785	$2,454	$2,801	$2,087
Y2017	$1,364	$1,758	$2,488	$2,920	$3,200	$2,346	$1,479	$1,990	$2,568	$2,903	$2,235	$1,371	$1,842	$2,483	$2,890	$2,146
Y2018	$1,368	$1,797	$2,677	$3,090	$3,395	$2,465	$1,590	$2,081	$2,630	$3,031	$2,333	$1,397	$1,910	$2,520	$2,894	$2,180
Y2019	$1,364	$1,824	$2,708	$3,190	$3,405	$2,498	$1,543	$1,994	$2,685	$2,981	$2,301	$1,454	$1,921	$2,539	$2,869	$2,196
% change 2011-2016	-0.2%	4.2%	11.7%	10.6%	7.9%	7.7%	10.0%	23.8%	18.5%	13.2%	16.4%	10.2%	21.1%	16.7%	15.6%	16.1%
% change 2016-2019	6.0%	11.1%	16.6%	16.4%	14.0%	13.8%	12.4%	5.9%	7.0%	7.0%	7.6%	11.3%	7.6%	3.4%	2.4%	5.2%

Source: RentRange®, 2009-2019.

Table D-5. Median Rent for SFD and MFD by Number of Bedrooms, County of Hawai'i, 2009-2019

Date	Single Family Dwellings						Condominiums					Apartments				
	1BR	2BR	3BR	4BR	5BR	All SFDs	1BR	2BR	3BR	4BR	All Condos	1BR	2BR	3BR	4BR	All Apts.
2009	$1,017	$1,155	$1,594	$1,811	$2,053	$1,526	$1,070	$1,234	$1,642	$1,880	$1,456	$1,003	$1,173	$1,606	$1,819	$1,400
2010	$1,031	$1,183	$1,597	$1,846	$2,085	$1,549	$1,068	$1,254	$1,631	$1,921	$1,469	$992	$1,189	$1,607	$1,852	$1,410
2011	$1,033	$1,208	$1,578	$1,888	$2,135	$1,569	$1,038	$1,242	$1,583	$1,964	$1,456	$962	$1,173	$1,551	$1,887	$1,393
2012	$1,005	$1,192	$1,540	$1,920	$2,178	$1,567	$998	$1,226	$1,499	$1,997	$1,430	$937	$1,154	$1,452	$1,922	$1,366
2013	$967	$1,173	$1,494	$1,946	$2,195	$1,555	$994	$1,257	$1,513	$2,021	$1,446	$944	$1,166	$1,484	$1,961	$1,389
2014	$992	$1,219	$1,527	$2,033	$2,287	$1,612	$1,024	$1,366	$1,608	$2,156	$1,539	$989	$1,245	$1,563	$2,078	$1,469
2015	$1,045	$1,292	$1,599	$2,172	$2,434	$1,708	$1,041	$1,455	$1,694	$2,312	$1,625	$971	$1,332	$1,605	$2,205	$1,528
2016	$1,077	$1,342	$1,697	$2,241	$2,509	$1,773	$1,104	$1,549	$1,860	$2,402	$1,729	$1,017	$1,429	$1,797	$2,312	$1,639
2017	$1,115	$1,448	$1,739	$2,260	$2,556	$1,824	$1,179	$1,579	$1,817	$2,388	$1,741	$1,080	$1,451	$1,805	$2,270	$1,652
2018	$1,000	$1,465	$1,685	$2,155	$2,351	$1,731	$1,085	$1,648	$1,635	$2,249	$1,654	$1,030	$1,419	$1,651	$2,133	$1,558
2019	$1,003	$1,420	$1,701	$2,140	$2,299	$1,713	$1,031	$1,551	$1,570	$2,161	$1,578	$1,034	$1,385	$1,655	$2,113	$1,547
% change 2011-2016	4.2%	11.0%	7.5%	18.7%	17.5%	13.0%	6.4%	24.8%	17.5%	22.3%	18.7%	5.7%	21.8%	15.9%	22.5%	17.6%
% change 2016-2019	-6.9%	5.8%	0.3%	-4.5%	-8.4%	-3.4%	-6.6%	0.1%	-15.6%	-10.0%	-8.7%	1.7%	-3.1%	-7.9%	-8.6%	-5.6%

Source: RentRange®, 2009-2019.

Table D-6. Median Rent for SFD and MFD by Number of Bedrooms, County of Kaua'i, 2009-2019

	Single Family Dwellings						Condominiums					Apartments				
Date	1BR	2BR	3BR	4BR	5BR	All SFDs	1BR	2BR	3BR	4BR	All Condos	1BR	2BR	3BR	4BR	All Apts.
2009	$1,094	$1,408	$1,697	$2,110	$2,369	$1,735	$1,122	$1,410	$1,800	$2,103	$1,608	$1,066	$1,377	$1,702	$2,116	$1,565
2010	$1,136	$1,433	$1,705	$2,118	$2,350	$1,749	$1,154	$1,430	$1,819	$2,125	$1,632	$1,088	$1,386	$1,722	$2,143	$1,585
2011	$1,164	$1,472	$1,763	$2,138	$2,378	$1,783	$1,177	$1,446	$1,825	$2,155	$1,651	$1,109	$1,402	$1,760	$2,172	$1,611
2012	$1,214	$1,561	$1,875	$2,253	$2,465	$1,874	$1,198	$1,510	$1,894	$2,302	$1,726	$1,145	$1,460	$1,843	$2,320	$1,692
2013	$1,236	$1,560	$1,951	$2,342	$2,524	$1,923	$1,218	$1,558	$1,986	$2,403	$1,791	$1,174	$1,524	$1,920	$2,445	$1,766
2014	$1,185	$1,541	$1,920	$2,305	$2,491	$1,888	$1,215	$1,577	$2,010	$2,373	$1,794	$1,167	$1,542	$1,966	$2,440	$1,779
2015	$1,164	$1,537	$1,900	$2,315	$2,494	$1,882	$1,222	$1,580	$2,052	$2,347	$1,800	$1,173	$1,543	$1,991	$2,398	$1,776
2016	$1,257	$1,596	$1,999	$2,447	$2,616	$1,983	$1,305	$1,629	$2,140	$2,427	$1,875	$1,242	$1,595	$2,067	$2,497	$1,850
2017	$1,320	$1,629	$2,078	$2,542	$2,726	$2,059	$1,368	$1,693	$2,182	$2,508	$1,938	$1,320	$1,682	$2,114	$2,606	$1,930
2018	$1,282	$1,642	$2,158	$2,582	$2,732	$2,079	$1,294	$1,724	$2,235	$2,465	$1,929	$1,236	$1,675	$2,147	$2,604	$1,915
2019	$1,260	$1,629	$2,150	$2,590	$2,750	$2,076	$1,294	$1,673	$2,254	$2,453	$1,918	$1,200	$1,708	$2,208	$2,624	$1,935
% change 2011-2016	7.9%	8.4%	13.4%	14.5%	10.0%	11.2%	10.9%	12.7%	17.3%	12.6%	13.6%	12.0%	13.8%	17.5%	15.0%	14.9%
% change 2016-2019	0.3%	2.1%	7.5%	5.9%	5.1%	4.7%	-0.9%	2.7%	5.3%	1.1%	2.3%	-3.4%	7.1%	6.8%	5.1%	4.6%

Source: RentRange®, 2009-2019.

Table D-7. Median Sales Price for Single-Family and Condominium Dwellings by County, 2001-2018

	State of Hawai‘i	Counties			
		Honolulu	Hawai‘i	Kaua‘i	Maui
SINGLE FAMILY					
2001	$268,950	$300,000	$187,750	$287,000	$297,500
2002	$310,000	$335,000	$193,500	$327,750	$375,000
2003	$360,000	$385,000	$235,000	$366,375	$440,000
2004	$440,000	$465,000	$290,000	$498,925	$560,000
2005	$560,000	$590,000	$385,000	$639,000	$678,000
2006	$599,133	$630,000	$421,250	$675,000	$690,000
2007	$595,000	$645,000	$395,000	$650,000	$630,137
2008	$560,000	$625,000	$345,000	$615,000	$575,000
2009	$497,750	$580,000	$278,800	$470,000	$498,106
2010	$487,000	$599,950	$260,000	$497,500	$460,000
2011	$470,000	$579,500	$246,450	$455,000	$432,000
2012	$500,000	$625,000	$260,000	$458,750	$470,000
2013	$545,000	$650,000	$295,000	$529,000	$530,000
2014	$575,000	$673,500	$315,000	$533,000	$570,000
2015	$600,000	$700,000	$328,750	$613,500	$580,000
2016	$632,500	$735,000	$330,000	$625,500	$639,000
2017	$660,000	$760,000	$350,000	$660,000	$695,000
2018	$689,000	$790,000	$360,000	$699,500	$710,000
CONDOMINIUM					
2001	$145,000	$132,000	$139,500	$162,500	$197,000
2002	$165,000	$153,000	$165,500	$210,000	$207,000
2003	$185,000	$175,000	$185,000	$287,000	$241,000
2004	$230,000	$208,125	$275,000	$375,000	$310,000
2005	$299,000	$269,000	$369,500	$435,000	$385,000
2006	$339,000	$310,000	$426,498	$405,000	$510,000
2007	$350,000	$325,000	$394,900	$565,000	$550,000
2008	$347,750	$325,000	$370,000	$545,000	$549,500
2009	$319,000	$305,000	$276,550	$330,000	$450,000
2010	$310,000	$305,000	$260,000	$270,000	$377,500
2011	$290,000	$300,000	$212,500	$237,000	$310,000
2012	$317,500	$315,000	$257,750	$290,000	$358,000
2013	$333,000	$332,000	$250,000	$310,000	$374,000
2014	$351,000	$350,000	$280,000	$346,000	$415,000
2015	$363,000	$360,000	$275,000	$360,000	$410,000
2016	$390,000	$390,000	$300,000	$399,000	$415,000
2017	$409,000	$410,000	$312,000	$435,000	$445,000
2018	$430,000	$421,000	$350,000	$461,000	$500,000

Source: The State of Hawai‘i Data Book Time Series, Table 21.36

APPENDIX E: CONSOLIDATED PLAN

Table E-1. Comparison of HHPS 2016 and DBEDT Housing Demand 2015-2025

	Support	Build/Rehab	Financial Assistance	Other Assistance
Hawai'i, Kaua'i and Maui County[162]	Home Ownership	Construct/rehab for-sale housing (1 housing unit) Self-help affordable housing (62 housing units)	Financial assistance to homebuyer (1 household)	
	Low-Income Rentals	Construct new rental units (11 housing units) Rehab rental unit (1 housing unit)	Tenant-based Rental Assistance (TBRA) (100 Households)	
	Homeless		Rapid Rehousing financial assistance (275 households) Prevent homelessness financial assistance (150 persons)	Emergency shelter operations (8,800 persons assisted) Transitioning homeless to permanent housing (1,830 persons) Rapid Rehousing relocation & stabilization services (400 households) Prevent homelessness services (150 persons)
	Special Needs Housing	Construct new special needs rental units (25 housing units) Rehab special needs rental units (3 housing units) Rehab transitional housing units (33 housing units)	HOPWA tenant rental assistance (75 households)	Emergency shelter operations to house victims of DV (3,100 persons assisted) HOPWA supportive services (2,400 persons assisted)
C&C Honolulu[163]	Home Ownership		Financial assistance to homebuyers (50 households) Housing rehab assistance (50 housing units)	
	Low-Income Rentals	Housing development (400 households)		LMI services (50 persons)
	Homeless	Housing First Housing (250 households) Renovate homeless shelters (5 shelters)	Homeless prevention financial assistance (30 persons)	Housing First Services (250 households) Homeless Services (3,750 persons)
	Special Needs Housing			Senior Services (50 persons) Youth Services (50 persons) Domestic Violence Services (50 persons)
Statewide	Home Ownership	1 Affordable for-sale unit 62 self-help affordable housing units	51 financial assistance to homebuyers 50 housing rehab assistance	
	Low-Income Rentals	12 rental housing units 400 Housing development	100 Tenant-based Rental Assistance (TBRA) Households	50 persons LMI services
	Homeless	250 households Housing First 5 homeless shelters renovated	275 Rapid Rehousing households 180 Prevent homeless households	11,900 persons Emergency shelter operations 3,750 Homeless services 1,830 persons and 650 households Transitioning to permanent housing services
	Special Needs Housing		75 HOPWA TBRA households	2,550 persons Other services

162 Based on State of Hawai'i Consolidated Plan for Program Years 2015 through 2019 (primarily focus on Hawai'i, Kaua'i and Maui Counties)
163 Based on City & County of Honolulu Consolidated Plan for Program Years 2015 through 2019

Table E-2. State and Counties Consolidated Plan 2015 Annual Goals

	Support	Build/Rehab	Financial Assistance	Other Assistance
Hawai'i, Kaua'i and Maui County[164]	Home Ownership	Construct new or acquire/rehab of existing affordable for-sale housing (6 housing units) Self-help housing (8 housing units)	Down payment/closing cost assistance and gap loans through homebuyer loan program (1 household)	
	Low-Income Rentals	Construct/rehab affordable rental housing (10 housing units)	Tenant- based rental assistance (20 households)	
	Homeless	Construct/rehab new transitional housing for homeless (32 housing units)	Rapid Rehousing – financial assistance (580 persons) Homeless Prevention – financial assistance to persons/families at risk of homelessness (30 persons)	ES Operations (1,655 persons) Transitioning Homeless to PH (580 persons) Rapid Rehousing – Housing relocation & stabilization services (78 Households)
	Special Needs Housing	Construct/rehab affordable rentals for special needs population – (36 housing units)	HOPWA – financial assistance through tenant-based rental assistance (15 households)	DV ES Operations (620 persons) HOPWA Supportive Services (516 persons)
C&C Honolulu[165]	Home Ownership		Financial assistance to LMI homebuyers (10 housing units) Loan assistance for rehab existing homes (17 housing units)	
	Low-Income Rentals	Construct/rehab affordable and special needs rental housing (52 housing units)	Services to at-risk of homelessness (1,333 persons) Tenant-Based Rental Assistance homeless prevention (497 persons)	Services to benefit LMI (185 persons)
	Homeless	Acquire/rehab building or units to support Housing First	Housing First Tenant-Based Rental Assistance (50 households)	Homeless Services (2,348 persons)
	Special Needs Housing		Tenant-Based Rental Assistance (155 households)	
Statewide	Home Ownership	6 affordable houses 8 self-help	1 housing unit down payment/closing cost assistance 10 housing units financial assistance to LMI 17 housing units loan assistance to rehab existing homes.	
	Low Income Rentals	88 affordable rentals	517 persons tenant based rental assistance	Services (185 persons)
	Homeless	32 transitional housing	835 persons Housing First/Rapid Rehousing Rental financial assistance 3,006 persons Transition services to permanent housing including Rapid Rehousing	4,613 persons and 78 households Homeless Services
	Special Needs Housing	36 affordable rentals 32 transitional housing		DV ES Operations (620 persons) HOPWA Supportive Services (516 persons)

[164] Based on the State of Hawai'i Consolidated Plan for Program Years 2015 through 2019 (primarily focusing on Hawai'i, Kaua'i and Maui Counties)

[165] Based on City & County of Honolulu Consolidated Plan for Program Years 2015 through 2019

APPENDIX F: MISCELLANEOUS DATA

Table F-1. Federal Funding, 2015-2019

HUD Funding for Hawai‘i, 2015 - 2019					
State of Hawai‘i	2015	2016	2017	2018	2019
Rental Assistance Programs	$ 187,275,780	$ 195,637,885	$ 207,123,724	$ 217,122,500	$ 215,655,241
Funding suited to construction	$ 32,942,494	$ 24,476,070	$ 26,592,407	$ 32,297,804	$ 31,746,827
Funding For Homeless Programs	$ 15,771,537	$ 13,972,758	$ 19,208,128	$ 20,499,109	$ 21,485,112
Training and Assistance	$ 1,185,523	$ 714,961	$ 1,100,299	$ 1,031,118	$ 723,728
Operations & Administration	$ 41,276,971	$ 41,807,662	$ 43,513,671	$ 49,497,389	$ 48,724,982
Total	$ 278,452,305	$ 276,609,336	$ 297,538,229	$ 320,447,920	$ 318,335,890
HHFDC	2015	2016	2017	2018	2019
Rental Assistance Programs	$ 26,314,996	$ 28,319,433	$ 31,219,086	$ 36,327,591	$ 35,027,814
Funding suited to construction	$ 11,908,628	$ 3,231,395	$ 5,254,034	$ 8,266,908	$ 8,271,969
Funding For Homeless Programs	$ 2,546,255	$ 2,540,284	$ 6,419,805	$ 6,682,776	$ 7,620,529
Training and Assistance	$ 362,505	$ 132,031	$ 378,031	$ 318,000	$ 72,000
Operations & Administration	$ 35,536,034	$ 35,704,725	$ 36,924,771	$ 42,237,598	$ 41,055,764
Total	$ 76,668,418	$ 69,927,868	$ 80,195,727	$ 93,832,873	$ 92,048,076
City and County of Honolulu	2015	2016	2017	2018	2019
Rental Assistance Programs	$ 74,266,345	$ 76,386,876	$ 80,361,961	$ 85,065,454	$ 86,735,713
Funding suited to construction	$ 9,923,929	$ 10,015,754	$ 9,973,579	$ 11,744,572	$ 11,489,541
Funding For Homeless Programs	$ 11,445,806	$ 9,921,468	$ 10,968,985	$ 11,504,436	$ 11,539,867
Training and Assistance	$ 403,680	$ 189,008	$ 189,008	$ 144,000	$ 144,000
Operations & Administration	$ -	$ -	$ -	$ -	$ -
Total	$ 96,039,760	$ 96,513,106	$ 101,493,533	$ 108,458,462	$ 109,909,121
County of Hawai‘i	2015	2016	2017	2018	2019
Rental Assistance Programs	$ 18,210,429	$ 21,756,896	$ 22,059,684	$ 23,696,508	$ 24,237,850
Funding suited to construction	$ 2,465,271	$ 2,491,306	$ 2,524,362	$ 2,694,402	$ 2,646,713
Funding For Homeless Programs	$ -	$ -	$ -	$ 189,368	$ 192,961
Training and Assistance	$ 65,652	$ 66,204	$ 66,204	$ 66,937	$ 66,937
Operations & Administration	$ -	$ -	$ -	$ -	$ -
Total	$ 20,741,352	$ 24,314,406	$ 24,650,250	$ 26,647,215	$ 27,144,461
County of Maui	2015	2016	2017	2018	2019
Rental Assistance Programs	$ 23,089,994	$ 24,133,589	$ 28,364,705	$ 28,329,400	$ 28,360,041
Funding suited to construction	$ 1,711,591	$ 1,731,191	$ 1,803,099	$ 1,900,669	$ 1,830,988
Funding For Homeless Programs	$ -	$ -	$ -	$ 152,264	$ 156,876
Training and Assistance	$ 164,442	$ 69,000	$ 24,732	$ 60,973	$ 26,957
Operations & Administration	$ 608,895	$ 635,920	$ 635,920	$ 159,140	$ 159,140
Total	$ 25,574,922	$ 26,569,700	$ 30,828,456	$ 30,602,446	$ 30,534,002
County of Kaua‘i	2015	2016	2017	2018	2019
Rental Assistance Programs	$ 7,708,624	$ 7,507,845	$ 8,270,337	$ 8,061,985	$ 8,378,137
Funding suited to construction	$ 705,416	$ 696,697	$ 709,098	$ 708,964	$ 695,071
Funding For Homeless Programs	$ -	$ -	$ -	$ 135,148	$ 66,264
Training and Assistance	$ 133,000	$ 133,000	$ 133,000	$ 132,002	$ 132,002
Operations & Administration	$ -	$ -	$ -	$ -	$ -
Total	$ 8,547,040	$ 8,337,542	$ 9,112,435	$ 9,038,099	$ 9,271,474

Table F-2. Homeless PIT Counts, State and Counties of Hawai'i, 2009-2019

	Year											Pct. Chg. 2016-2019
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Sheltered	3,268	3,535	3,632	3,726	3,745	3,813	3,666	3,613	3,420	3,055	2,810	-22.2%
O'ahu	2,445	2,797	2,912	3,035	3,091	3,079	2,964	2,767	2,635	2,350	2,052	-25.8%
Hawai'i	321	286	229	170	160	211	220	271	275	200	243	-10.3%
Maui	422	392	394	420	421	445	505	484	395	399	420	-13.2%
Kaua'i	80	60	97	101	73	78	88	91	115	106	95	4.4%
Unsheltered	2,514	2,299	2,556	2,520	2,590	3,105	3,843	4,308	3,800	3,475	3,638	-15.6%
O'ahu	1,193	1,374	1,322	1,318	1,465	1,633	2,162	2,173	2,324	2,145	2,401	10.5%
Hawai'i	615	313	337	447	397	658	1,021	1,123	678	669	447	-60.2%
Maui	581	399	658	454	455	514	632	661	501	474	442	-33.1%
Kaua'i	125	213	239	301	273	300	251	351	297	187	348	-0.9%
Total	5,782	5,834	6,188	6,246	6,335	6,918	7,509	7,921	7,220	6,530	6,448	-18.6%
O'ahu	3,638	4,171	4,234	4,353	4,556	4,712	5,126	4,940	4,959	4,495	4,453	-9.9%
Hawai'i	936	599	566	617	557	869	1,241	1,394	953	869	690	-50.5%
Maui	1,003	791	1,052	874	876	959	1,137	1,145	896	873	862	-24.7%
Kaua'i	205	273	336	402	346	378	339	442	412	293	443	0.2%

Source: State of Hawai'i PIT Counts, 2009-2019.

Table F-3. Homeless Service Clients by County, FY 2008-2017

	Year										Pct. Chg. 2015-2017
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Shelter Programs	6,733	7,501	7,649	8,299	8,507	8,699	8,574	8,844	7,313	8,343	-5.7%
O'ahu	5,075	5,311	5,678	6,211	6,305	6,234	6,039	6,364	5,180	5,731	-9.9%
Hawai'i	420	679	623	622	574	565	746	783	612	688	-12.1%
Maui	1,189	1,116	1,017	1,154	1,297	1,557	1,488	1,345	1,191	1,606	19.4%
Kaua'i	49	395	331	312	331	343	341	352	330	318	-9.7%
Unsheltered	6,777	7,506	7,997	8,266	7,804	7,415	7,608	8,030	6,702	7,284	-9.3%
O'ahu	4,167	4,987	5,368	5,225	4,949	4,837	4,391	4,755	3,950	4,981	4.8%
Hawai'i	763	846	1,092	1,098	1,063	832	1,401	1,514	1,078	756	-50.1%
Maui	1,446	1,293	1,163	1,580	1,407	1,328	1,488	1,384	1,511	1,211	-12.5%
Kaua'i	401	380	374	363	385	418	328	377	163	336	-10.9%
Total	12,445	13,717	14,653	14,200	13,980	13,853	14,282	14,954	14,015	15,627	4.5%
O'ahu	8,412	9,422	10432	9,781	9,650	9,693	9,548	10,257	9,130	10,712	4.4%
Hawai'i	1,204	1,421	1,555	1,422	1,336	1,184	1,770	1,829	1,690	1,444	-21.0%
Maui	2,201	2,204	2,069	2,492	2,358	2,277	2,332	2,206	2,702	2,817	27.7%
Kaua'i	618	670	597	595	636	699	632	662	493	654	-1.2%

Source: HMIS, Homeless Service Utilization Report, 2008-2017.

APPENDIX G: GLOSSARY

Adequately Housed: Households that are not classified as at-risk for homelessness or hidden homeless.

50% Hawaiian: An individual is 50 percent Hawaiian if they claimed that status in the Housing Demand Survey. Only Respondents were asked to self-report ethnic status. A household is classified as 50 percent Hawaiian if the household includes at least one adult member who is 50 percent or more Hawaiian. Respondents were asked if there were other members of the household who were 50 percent or more Hawaiian. 50 percent Hawaiian households may or may not be DHHL beneficiaries (lessees or applicants).

ADLs: Activities of Daily Living, which include assistance with eating, bathing, getting dressed, getting in or out of bed, or getting to the toilet.

Acceptable Bathrooms: The number of bathrooms that are absolutely required in a new unit. Typically, an acceptable bathroom is a more accurate measure of housing characteristic for planning than first-choice preferred bedrooms.

Acceptable Bedrooms: The number of bedrooms that are absolutely required in a new unit. Typically, an acceptable bedroom is a more accurate measure of housing characteristic for planning than first-choice preferred bedrooms.

Affordable Housing: refers to the generalized concept of housing that residents have enough income and financial resources to be able to purchase or rent.

In the U.S., commonly accepted guideline for housing affordability is a housing cost that does not exceed 30% of a household's gross income. Housing costs considered in this guideline generally include taxes and insurance for owners, and usually include utility costs. When the monthly carrying costs of a home exceed 30–35 percent of household income, then the housing is considered unaffordable for that household.

Affordable Housing Cost: The average dollar amount that a respondent reported they would be able to pay per month for a new housing unit.

Apartment: Refers to apartment building that contains residential suites in which each individual unit is leased to different occupants.

Applicant Only: Households in which at least one adult member has applied for, but has not yet been awarded, land from the Department of Hawaiian Home Lands.

At-Risk for Homelessness: Households in which members would become homeless is less than three months if they suddenly lost their primary source of income. Also called “precariously housed,” these people are three monthly paychecks away from homelessness.

Available Down Payment: The amount of money available to be used as a cash down payment for new housing.

Churn Rate: For any given period, the number of participants who discontinue their use of a service divided by the average number of total participants. Churn rate provides insight into the growth or decline of the subscriber base, as well as the average length of participation in the service.

COL %: Represents the percentage of the column total for an individual cell in a table [Also referred to as **Count Percent** or vertical percent].

Condominium/Condo: An apartment building with five units or more in which each owner owns a unit and holds a joint ownership in common areas with other owners in the building.

Contract Type: Refers to the two major ownership contracts: leasehold and fee simple.

Count Percent: [See **Col %**].

Crowding Ratio: The average number of household members per bedroom per household.

Crowding Ratio by Bedrooms: Number of persons per bedroom. Does not include any rooms other than bedrooms. Households with more than 1.01 persons per bedroom are considered overcrowded [See also **Overcrowded**].

Crowding Ratio by Rooms: Number of persons per room. Includes all rooms other than closets, hallways, utility rooms, foyers, and lanais.

DHHL: Department of Hawaiian Home Lands. This state agency has been responsible for administering the land trust that, in 1921, established about 200,000 acres of land for homesteading by Native Hawaiians. For more information visit: http://www.Hawai‘i.gov/dhhl/.

Doubled-up: Housing units that are occupied by two or more families or groups of persons who are not related by birth, marriage, or adoption.

Elderly: A person 62 years of age or older.

Elderly Alone: Single-member households, member is 62 years of age or older.

Elderly Couple: Two-member households, male and female, at least one of which is 62 years of age or older.

Emancipated foster youth: Youth who are aging out of the foster care system.

Equity Gap Funding: The amount of money needed to cover development costs for new or existing affordable rental or mixed-use project or projects for economic development activities directly related to affordable housing. These funds are intended to cover the difference between the projected

Exiting offender: Inmates released from the prison system.

Fee Simple: A fee simple estate is the least limited interest and the most complete and absolute ownership option. It is of indefinite duration, freely transferable and inheritable. The phrase "fee simple absolute" came about because the estate is of potentially infinite duration (thus "fee"); there are no limitations on its inheritability (thus "simple"); and it is indefeasible and cannot be divested (thus "absolute").

Frail elderly: Elderly afflicted with physical or mental disabilities that may interfere with the ability to perform activities of daily living independently (i.e., bathing, dressing, toileting, and meal preparation).

Group quarters: A place where people live or stay, in a group living arrangement, that is owned or managed by an entity or organization providing housing and/or services for the residents. This is not a typical household-type living arrangement. Services may include custodial or medical care as well as other types of assistance, and residency is commonly restricted to those receiving these services. People living in group quarters are usually not related to each other. Group quarters include such places as college residence halls, residential treatment centers, skilled nursing facilities, group homes, military barracks, correctional facilities, and workers' dormitories.

Guamanian or Chamorro: Ethnicity of persons from Guam or the Mariana Islands region.

HH: Household, person residing in a housing unit for five or more months of the year.

Hidden Homeless: Households in which more than one family share accommodations. These households include families that are doubled up (two or more families or groups of persons who are related by birth, marriage or adoption) and those that are sharing (two or more families or groups whose members are not related by birth, marriage, or adoption).

Homestead Land: Land entrusted by the Hawaiian Homes Commission Act for homesteading by Native Hawaiians. This trust is current administered by the Department of Hawaiian Homelands

Honolulu PUC: Honolulu Primary Urban Center, census tracts 4.01 thru 72, 75.02, and 75.06. For information on Census Tracts visit: http://factfinder.census.gov/home/saff/main.html?_lang=en.

Housing Stock: The total housing stock includes all occupied housing units plus vacant housing units available for sale or rent. The stock excludes vacant units held for use for seasonal use, migratory workers, and "other" vacant units.

HUD: U.S. Department of Housing and Urban Development. HUD's mission is to increase homeownership, support community development, and increase access to affordable housing free from discrimination. To fulfill this mission, HUD will embrace high standards of ethics, management and accountability and forge new partnerships -- particularly with faith-based and community organizations that leverage resources and improve HUD's ability to be effective on the community level. For more information visit: http://www.hud.gov/

HUD Income Guidelines: [See **HUD Income Limits**]

HUD Income Limits: Calculates income as percentage of the HUD median income for a household of a given size in each geographic area. For information on the HUD median income and HUD income limits visit: http://www.huduser.org/datasets/il/il06/BRIEFING-MATERIALs.pdf

HUD Median Income: The median income for a household of a given size in a specific geographic area. For detailed information on the HUD median income and HUD income limits visit: http://www.huduser.org/datasets/il/il06/BRIEFING-MATERIALs.pdf

IADLs: Instrumental Activities for Daily Living which include preparing meals, taking medications, making phone calls, or managing money.

Imputation: A method of replacing missing values for specific variables in survey work. SMS uses a multivariate regression technique to replace missing values with the best estimate of the value for each case, based on reported values of several other related variables. For the Housing Demand Survey, imputation was applied to age and household income.

In-migration: The number of persons who move to Hawai'i from other areas in the United States.

Income: Self-reported household income for all sources, for all employed persons in the household, estimated before taxes, for the calendar year preceding the survey (2005). [See also **Imputation**].

Income as a % of HUD Median: [See **HUD Income Limits**].

Income Per Household Member: Household income divided by the number of persons living in the household.

Intention to Move: The desire to seek a new housing unit at some time in the future. Includes the desire to seek a new ownership unit and the desire to seek a new rental unit.

Leasehold: A less than freehold estate by which a tenant possesses real property. In a lease situation, the tenant possesses a leasehold and the landlord possesses the reversion estate; i.e., when the lease terminates, the property will revert to the landlord.

Lessee and Applicant: A classification of households used in the Native Hawaiian tabulations and reports referring to a household in which at least one member is a DHHL lessee and at least one is an applicant for a land award from DHHL.

Lessee Only: A households occupied by virtue of a Department of Hawaiian Home Lands lease, and having no adult member who is on a DHHL awards applicant list.

Military Housing Privatization Initiative:

In order to house active duty military personnel and their families, the Department of Defense (DoD) has traditionally relied on two methods. In locations where the local housing supply was adequate, the DoD provided military members with a stipend, the Basic Allowance for Housing (BAH), to defray the cost of residential housing near military installations. For those locations where local housing was extremely expensive or unavailable, quarters were built within the military installations to house military personnel and their dependents.

In 1996, a third option was created through the Military Housing Privatization Initiative (MHPI). Because many of the military family housing properties built during the 1950s and 1960s were old and deteriorating, the DoD partnered with private developers to take on the projects since they had the experience and expertise to do the job faster, cheaper, and better. Under the MHPI, private developers renovate or replace old, substandard military housing and, in some instances, build additional units. The developers then become the owners and managers of those properties and the landlords for the military families in those homes. Most important, military families get updated, repaired, or newly constructed homes that will be maintained for the next fifty years.

The MHPI program has made on-base privatized housing part of the local competitive housing market. Privatized housing operates similarly to any other private rental property business and the resulting competition can impact the local rental market and housing demand.

MFD: Multi-Family Dwelling. This includes townhouses, apartments, duplexes, and multiplexes.

Multi-Generation Household with Elderly Members: Households with at least two generations present and at least one member 62 years of age or older.

Non-Hawaiian: A non-Hawaiian individual is a person that reports no Hawaiian ancestry.
O'ahu SF Ads: The number of advertisements for single-family homes in the City & County of Honolulu.

O'ahu SF Rents: The number of advertisements for single-family homes for rent in the City & County of Honolulu.

Occupy without Payment: A type of tenancy in which the respondent occupies a housing unit without payment of cash rent. Includes persons living in rent-free public units, those living in private sector, family-owned units, property managers occupying units in exchange for services, clerics living in church owner units, military dependents in on-base units, etc. Does not include individuals who have paid off their mortgage.

Other Vacant: This category includes units held for settlement of an estate, units held for occupancy by a caretaker or janitor, and units held for personal reasons of the owner.

Out-migration: The number of Hawai'i residents who move to other locations within the United States.

Overcrowded: A household with more than 1.01 persons per room.

Permanent Supportive Housing: Housing with indefinite leasing or rental with appropriate services for persons with higher acuity.

Persons with Alcohol or Other Drug Addictions: Persons whose impairment or disability is due to alcoholism or drug addiction.

Persons with Developmental Disability: Persons with a severe, chronic disability that: (1) is attributable to a mental or physical impairment or combination of mental and physical impairments; (2) is manifested before the individual attains age 22; (3) is likely to continue indefinitely; (4) results in substantial functional limitations in three or more of the following areas of major life activity: self-care; receptive and expressive language; learning; mobility; self-direction; capacity for independent living; economic self-sufficiency; and (5) reflects the individual's need for a combination and sequence of special interdisciplinary, or generic services, individualized supports, or other forms of assistance that are of lifelong or extended duration and are individually planned and coordinated. An individual from birth to age nine, inclusive, who has a substantial developmental delay or specific congenital or acquired condition, may be considered to have a developmental disability without meeting three or more of the criteria described above, if the individual, without services and supports, has a high probability of meeting those criteria later in life.

Persons with Disabilities: Any person who has a physical or mental impairment that substantially limits one or more major life activities; has a record of such impairment; or is regarded as having such impairment. In general, a physical or mental impairment includes hearing, mobility and visual impairments, chronic alcoholism, chronic mental illness, AIDS, AIDS Related Complex, and mental retardation that substantially limit one or more major life activities. Major life activities include walking, talking, hearing, seeing, breathing, learning, performing manual tasks, and caring for oneself.

Persons with HIV/AIDS: A person with the disease of acquired immunodeficiency syndrome or related diseases, or any conditions arising from the etiologic agent for acquired immunodeficiency syndrome, including infection with the human immunodeficiency virus (HIV).

Persons with severe mental illness: Persons with a severe and persistent mental or emotional impairment that seriously limits his or her ability to live independently, and which impairment could be improved by more suitable housing conditions.

PLANNED HOUSING UNITS: Planned housing units are those that are registered or on record at government agencies as being scheduled for completion by a specified date. The official list of such units usually includes permitted or confirmed units, public and private sector. A major interest in planned units relates to their value in estimating future housing supply, often but not always including its relationship to housing demand.

Potential Movers: Households in which the Housing Demand Survey respondent reported an interested in moving to a new unit in the future.

Potential Owners: Households in which the Housing Demand Survey respondent reported intent to own their next home.

Potential Renters: Households in which the Housing Demand Survey respondent reported intent to rent their next unit.

Private Activity Bond: Private activity bonds (PAB) are tax-exempt bonds issued by or on behalf of a local or state government for the purpose of providing special financing benefits for qualified projects. The financing is most often for projects of a private user, and the government generally does not pledge its credit. Private activity bonds are sometimes referred to as conduit bonds.

Precariously Housed: [See **At Risk for Homelessness**]

Preferred Bathrooms: The number of bathrooms desired in a new unit.

Preferred Bedrooms: The number of bedrooms desired in a new unit.

RentRange: RentRange® is a premier provider of rentals data for the United States. We chose this provider because they provide data for 2019, it has been judged superior in provider comparison studies, they have recently updated their data and software models (June 2019), and they were willing to share their historical data file. See comparative evaluation at https://accidentalrental.com/5-best-rent-estimate-tools/.

Seniors: See **Elderly**

Shelter to Income Ratio: The percentage of total monthly household income that is used to pay for shelter costs (rent or mortgage payments). In this study, a shelter-to-income ratio in excess of .30 is considered to indicate some level of financial disadvantages. A shelter-to-income ratio in excess of .40 indicates severe financial disadvantage.

Short-term Rental: A rental period for a residential unit lasting 30 days or less; also called transient rentals.

Single-family Dwelling (SFD): A single-family detached dwelling unit

Sustainable Housing: Housing that designed to be affordable in perpetuity. Affordability is defined as having a sales or rental price below market values – usually at or below the price affordable to a family with a household income at the median or at specific HUD income qualification levels. Perpetuity is accomplished through limited-equity arrangements incorporated in the deed or lease agreement. [See also: **Sustainable Lease**]

Sustainable Lease: A housing contract that does not include ownership of the land. The perpetuity is accomplished through a lease agreement. Sustainable lease contracts may be used to eliminate high down payments, can allow property to be passed on to heirs, require no ground rent, and typically have a lease term greater than 60 years. [See also **Leasehold** and **Fee Simple**]
Tenancy: There are three types of tenancy: own, rent, and occupy without payment

Townhouse: Side by side housing units that do not meet the definition of single-family dwellings

Unit Condition: Self-reported assessment of the overall condition of the current unit, rated on a scale from excellent to poor.

Unit Type: There several different types of units reported in the Housing Demand Survey including: single-family detached units, duplexes, multiplexes, townhouses, condominiums, and apartments. We note that condominium in an ownership regime and not a unit type. Since nearly all condominiums in Hawaiʻi are multifamily units, this classification allows a distinction between condominium apartments and standard apartments in multi-family buildings.

Victims of Domestic Violence: Victims of felony or misdemeanor crimes of violence committed by a current or former spouse of the victim, by a person with whom the victim shares a child in common, by a person who is cohabitating with or has cohabitated with the victim as a spouse, by a person similarly situated to a spouse of the victim under the domestic or family violence laws of the jurisdiction receiving grant monies, or by any other person against an adult or youth victim who is protected from that person's acts under the domestic, violence or family violence laws of the jurisdiction.

APPENDIX H: BIBLIOGRAPHY

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APPENDIX L: COUNTY AND DISTRICTS TABLES – KAUA'I COUNTY

Tables presented in Appendix L, referred to in prior iterations of HHPS as the "B Tables" or "County Districts Tables," provide detailed demographic and housing-related data for the County and its districts. This data is taken from the Housing Demand Survey 2019.

Table L-1. Unit Descriptions, County and Districts of Kaua'i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Lihue	East Kaua'i	North Shore-Kaua'i	Total
TOTAL HOUSEHOLDS	2,544	2,844	2,260	5,433	6,364	3,118	22,563
TENANCY							
Own	61.6%	72.6%	54.8%	58.0%	65.2%	64.4%	62.9%
Rent	35.8%	27.1%	39.4%	38.6%	32.1%	35.1%	34.6%
Other	2.5%	.4%	5.7%	3.4%	2.7%	.5%	2.5%
UNIT TYPE							
Single-family house	91.0%	89.8%	64.6%	61.2%	84.8%	77.3%	77.4%
Townhouse	0.0%	.6%	0.0%	4.9%	.8%	1.9%	1.8%
Condominium	1.3%	0.0%	11.2%	9.7%	4.5%	7.3%	5.9%
Duplex/multiplex	0.0%	3.3%	2.8%	2.5%	3.7%	2.4%	2.7%
Apartment	3.5%	2.7%	11.1%	16.0%	2.8%	4.3%	7.1%
Co-op	.3%	0.0%	0.0%	.5%	0.0%	1.9%	.4%
Other	4.0%	3.6%	10.3%	5.2%	3.3%	4.9%	4.8%
NUMBER OF BEDROOMS							
Studio or One	8.1%	6.0%	19.6%	18.3%	12.8%	19.4%	14.4%
Two	11.5%	9.9%	20.9%	21.5%	22.0%	21.2%	18.9%
Three	56.4%	57.0%	41.8%	47.6%	47.8%	44.2%	48.8%
Four plus	24.0%	27.1%	17.7%	12.6%	17.4%	15.2%	18.0%
NUMBER OF BATHROOMS							
One	20.9%	19.3%	32.8%	31.2%	31.5%	31.5%	28.8%
One and one-half	7.6%	5.1%	7.6%	7.4%	6.7%	2.1%	6.2%
Two	55.4%	35.9%	29.5%	35.2%	38.1%	30.7%	37.2%
Two and one-half	4.8%	10.4%	9.5%	9.2%	3.5%	6.5%	6.9%
Three	6.5%	21.8%	12.4%	10.0%	14.7%	22.2%	14.3%
Three and one-half	.6%	3.7%	2.2%	1.3%	2.5%	2.2%	2.1%
Four or more	4.2%	3.7%	6.1%	5.7%	3.0%	4.9%	4.4%

Source: Housing Demand Survey, 2019.

Table L-2. Households Demographics, County and Districts of Kaua'i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu'e	East Kaua'i	North Shore-Kaua'i	Total
TOTAL HOUSEHOLDS	2,544	2,844	2,260	5,433	6,364	3,118	22,563
YEARS IN CURRENT UNIT							
Less than 1 year	.8%	1.5%	12.0%	6.1%	6.0%	3.4%	5.1%
1 to 5 years	20.8%	17.6%	22.0%	32.1%	26.2%	44.4%	28.0%
6 to 10 years	13.5%	19.9%	14.1%	15.8%	13.5%	11.6%	14.7%
More than 10 years	64.8%	61.0%	51.9%	46.0%	54.3%	40.6%	52.2%
HOUSEHOLD TYPES							
Single Member	17.3%	19.1%	35.0%	29.8%	19.9%	19.0%	23.3%
Married couple, no children	20.8%	25.8%	33.2%	17.2%	27.4%	35.5%	25.7%
Parent(s) & children	19.7%	8.1%	8.5%	17.4%	10.3%	13.8%	13.1%
Unrelated Roommates	5.4%	6.5%	1.6%	3.1%	7.5%	8.5%	5.6%
Multiple Families	36.4%	39.8%	21.7%	32.5%	34.8%	23.2%	32.1%
Parent(s) and Adult Child(ren)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Undetermined	.3%	.7%	0.0%	0.0%	0.0%	0.0%	.1%
KIDS IN HOUSEHOLD							
No children	65.6%	69.0%	85.1%	62.8%	74.6%	80.4%	71.9%
At least 1 child	34.4%	31.0%	14.9%	37.2%	25.4%	19.6%	28.1%
SENIORS IN HOUSEHOLD							
Single Person HH 60+	16.1%	16.1%	16.7%	16.3%	11.9%	13.6%	14.7%
2+ HH Members, All 60+	27.6%	19.0%	17.2%	10.5%	17.8%	21.8%	17.8%
2+ HH Members, Only Some 60+	24.2%	24.1%	22.0%	21.4%	28.8%	19.8%	24.0%
No HH Members 60+	32.0%	40.8%	44.2%	51.8%	41.5%	44.9%	43.6%

Source: Housing Demand Survey, 2019.

Table L-3. Financial Characteristics, County and Districts of Kaua‘i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu‘e	East Kaua'i	North Shore-Kaua'i	Total
TOTAL HOUSEHOLDS	2,544	2,844	2,260	5,433	6,364	3,118	22,563
HOUSEHOLD INCOME							
Less than $15,000	13.7%	10.1%	7.6%	8.6%	8.1%	7.4%	9.0%
$15,000 to $24,999	4.1%	9.7%	5.4%	5.8%	5.0%	6.6%	5.9%
$25,000 to $49,999	21.3%	15.2%	11.2%	17.0%	22.8%	20.5%	18.9%
$50,000 to $74,999	15.0%	15.4%	16.1%	18.1%	15.5%	14.1%	15.8%
$75,000 to $99,999	11.3%	23.7%	15.7%	14.1%	13.0%	13.8%	14.9%
More than $100,000	34.6%	25.9%	44.0%	36.4%	35.6%	37.5%	35.5%
HUD INCOME LEVELS							
30% or less	21.7%	21.5%	12.7%	19.0%	12.2%	15.3%	16.6%
30-50%	9.5%	5.5%	10.4%	11.5%	13.2%	13.6%	11.2%
50-80%	15.9%	16.9%	7.3%	15.2%	21.2%	17.3%	16.7%
80-120%	11.6%	5.9%	3.6%	7.3%	5.9%	4.3%	6.4%
120-140%	10.3%	20.2%	10.9%	14.4%	12.9%	5.7%	12.7%
Over 140%	30.9%	29.9%	55.1%	32.5%	34.6%	43.9%	36.4%
SHELTER-TO-INCOME RATIO							
No shelter cost	22.3%	23.6%	26.2%	14.0%	14.6%	11.3%	17.2%
Under 30%	36.5%	40.7%	39.0%	39.0%	38.1%	36.3%	38.3%
30-40%	16.8%	8.2%	8.6%	7.6%	9.4%	16.5%	10.5%
Over 40%	12.0%	19.5%	22.0%	24.4%	29.6%	31.0%	24.5%
Not enough info	12.4%	8.1%	4.1%	14.9%	8.3%	4.9%	9.4%

Source: Housing Demand Survey, 2019.

Table L-4. Doubling Up, Crowding, and Hidden Homeless, County and Districts of Kaua‘i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu‘e	East Kaua'i	North Shore-Kaua'i	Total
TOTAL HOUSEHOLDS	2,544	2,844	2,260	5,433	6,364	3,118	22,563
HH THAT ARE DOUBLED UP							
No	81.3%	80.7%	96.3%	83.1%	84.2%	91.9%	85.5%
Yes	18.7%	19.3%	3.7%	16.9%	15.8%	8.1%	14.5%
PERSON PER BEDROOM							
Less than 2 persons per bedroom	92.7%	97.1%	90.0%	80.5%	89.1%	82.9%	87.8%
2 or more persons per bedroom	7.3%	2.9%	10.0%	19.5%	10.9%	17.1%	12.2%
HH THAT ARE CROWDED, DOUBLED UP, OR BOTH							
None of these	75.2%	79.9%	87.6%	76.5%	77.5%	79.7%	78.6%
Crowded, Doubled Up, or Both	24.8%	20.1%	12.4%	23.5%	22.5%	20.3%	21.4%
HIDDEN HOMELESS AND AT RISK OF HOMELESSNESS							
At Risk for Homelessness	15.7%	16.7%	10.3%	11.7%	9.0%	11.7%	11.9%
Hidden Homeless	11.4%	12.5%	7.4%	20.8%	21.3%	12.8%	16.4%
At Risk and Includes Hidden Homeless	3.6%	3.1%	2.2%	1.9%	3.0%	.7%	2.4%
Has Adequate Housing	69.3%	67.8%	80.0%	65.6%	66.7%	74.8%	69.3%

Source: Housing Demand Survey, 2019.

Table L-5. Intention to Move, County and Districts of Kaua‘i, 2019

	Kaua'i County						
	Waimea	**Hanapepe-'Ele'ele**	**Koloa-Po'ipu-Kalaheo**	**Līhu‘e**	**East Kaua'i**	**North Shore-Kaua'i**	**Total**
TOTAL HOUSEHOLDS	2,544	2,844	2,260	5,433	6,364	3,118	22,563
WANT TO MOVE							
Yes	13.8%	26.8%	36.3%	22.7%	34.1%	30.4%	27.8%
No	86.2%	73.2%	63.7%	77.3%	65.9%	69.6%	72.2%
FINAL DEMAND MOVERS	350	761	819	1,233	2,167	947	6,278
SOONEST WILL MOVE							
in one year	26.8%	17.6%	42.4%	21.2%	30.4%	32.4%	28.7%
in two years	19.7%	8.4%	9.0%	22.6%	22.9%	16.4%	18.1%
3 to 5 years	16.2%	27.6%	25.6%	34.4%	27.4%	32.1%	28.7%
more than 5 years	37.2%	46.4%	23.0%	21.8%	19.2%	19.0%	24.5%
Not sure when	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Moving in Hawai'i or Not Sure	70.7%	72.7%	87.5%	79.5%	76.3%	83.1%	78.7%
Moving Out-of-State	29.3%	27.3%	12.5%	20.5%	23.7%	16.9%	21.3%

Source: Housing Demand Survey, 2019

[a] Final Demand Movers are those who will move and have an idea about the time frame of their move.
[b] Effective Demand Movers are those who will move, have an idea about the time frame of their move, and plan to remain in the State of Hawai'i when they move.

Table L-6. Mover Tenancy Preferences, County and Districts of Kaua'i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu'e	East Kaua'i	North Shore-Kaua'i	Total
EFFECTIVE DEMAND MOVERS	256	554	717	980	1,653	787	4,946
PLANNED NEXT TENANCY							
Own	3.3%	66.7%	17.5%	47.0%	44.1%	50.6%	42.3%
Rent	96.7%	33.3%	82.5%	53.0%	55.9%	49.4%	57.7%
CERTAIN TO BUY							
certain to Buy	100.0%	93.9%	38.2%	94.3%	89.0%	84.8%	78.8%
Might Have to Rent	0.0%	6.1%	61.8%	5.7%	11.0%	15.2%	21.2%
Not Sure	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WOULD BUY IF AFFORDABLE							
Yes	58.2%	89.9%	90.5%	100.0%	93.7%	74.7%	89.8%
No	15.0%	10.1%	9.5%	0.0%	2.7%	25.3%	7.0%
Not Sure	26.8%	0.0%	0.0%	0.0%	3.6%	0.0%	3.3%

Source: Housing Demand Survey, 2019
Base for Preferred Next Tenancy is all effective demand households.
Base for Certain to Buy is all effective demand households that prefer to purchase their next home.
Base for Would Buy If Affordable is all effective demand households that prefer to rent their next home.

Table L-7. Buyer Unit Preferences, County and Districts of Kaua'i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu'e	East Kaua'i	North Shore-Kaua'i	Total
TOTAL BUYER HOUSEHOLDS	133	387	503	782	826	686	3317
PREFERRED UNIT TYPE							
SFD	100.0%	57.0%	71.8%	92.4%	76.7%	72.9%	77.5%
Townhouse	0.0%	20.3%	27.0%	0.0%	0.0%	0.0%	6.5%
Condo	0.0%	9.4%	0.0%	1.8%	7.4%	8.3%	5.1%
Apt	0.0%	0.0%	0.0%	2.1%	0.0%	0.0%	.5%
Other	0.0%	0.0%	1.2%	0.0%	6.6%	2.7%	2.4%
DK	0.0%	13.3%	0.0%	3.7%	9.4%	16.1%	8.1%
PREFERRED NUMBER OF BEDROOMS							
0 - None - studio	0.0%	0.0%	0.0%	0.0%	12.3%	0.0%	3.1%
1 - One	0.0%	0.0%	0.0%	2.2%	16.0%	0.0%	4.5%
2 - Two	0.0%	9.4%	66.4%	5.5%	14.8%	29.3%	22.2%
3 - Three	6.4%	49.3%	33.6%	57.8%	46.2%	53.2%	47.2%
4 - Four	93.6%	36.5%	0.0%	26.5%	4.0%	10.5%	17.4%
5 - Five or more	0.0%	4.8%	0.0%	7.9%	6.6%	7.1%	5.5%
MINIMUM ACCEPTABLE BEDROOMS							
0 - None - studio	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1 - One	0.0%	11.2%	0.0%	12.6%	0.0%	22.1%	10.6%
2 - Two	36.2%	24.5%	43.4%	41.9%	62.8%	47.8%	43.7%
3 - Three	24.7%	58.9%	56.6%	42.8%	24.0%	23.9%	38.0%
4 - Four	39.1%	0.0%	0.0%	2.7%	2.7%	6.2%	5.0%
5 - Five or more	0.0%	5.3%	0.0%	0.0%	10.5%	0.0%	2.6%
PREFERRED NUMBER OF BATHROOMS							
1 - One	0.0%	0.0%	0.0%	14.8%	23.0%	13.2%	11.9%
2 - One and one-half	29.8%	10.2%	0.0%	6.4%	13.9%	0.0%	7.3%
3 - Two	31.2%	64.7%	100.0%	33.0%	36.6%	42.5%	49.7%
4 - Two and one-half	0.0%	20.3%	0.0%	25.4%	13.4%	16.8%	15.2%
5 - Three	39.1%	0.0%	0.0%	15.1%	3.9%	24.9%	11.2%
6 - Three and one-half	0.0%	0.0%	0.0%	0.0%	1.5%	0.0%	.4%
7 - Four or more	0.0%	4.8%	0.0%	5.3%	7.8%	2.7%	4.3%
MINIMUM ACCEPTABLE BATHROOMS							
1 - One	64.8%	28.0%	57.4%	32.0%	25.7%	47.8%	40.2%
2 - One and one-half	0.0%	10.5%	0.0%	5.1%	28.5%	17.8%	11.4%
3 - Two	35.2%	56.2%	42.6%	59.4%	26.7%	30.1%	42.7%
4 - Two and one-half	0.0%	5.3%	0.0%	3.5%	2.8%	0.0%	2.0%
5 - Three	0.0%	0.0%	0.0%	0.0%	16.2%	4.3%	3.7%
6 - Three and one-half	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7 - Four or more	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Housing Demand Survey, 2019

Table L-8. Renter Unit Preferences, County and Districts of Kaua'i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu'e	East Kaua'i	North Shore-Kaua'i	Total
TOTAL RENTER HOUSEHOLDS	110	233	167	743	1,063	447	2,764
PREFERRED UNIT TYPE							
SFD	100.0%	57.0%	71.8%	92.4%	76.7%	72.9%	77.5%
Townhouse	0.0%	20.3%	27.0%	0.0%	0.0%	0.0%	6.5%
Condo	0.0%	9.4%	0.0%	1.8%	7.4%	8.3%	5.1%
Apt	0.0%	0.0%	0.0%	2.1%	0.0%	0.0%	.5%
Other	0.0%	0.0%	1.2%	0.0%	6.6%	2.7%	2.4%
DK	0.0%	13.3%	0.0%	3.7%	9.4%	16.1%	8.1%
PREFERRED NUMBER OF BEDROOMS							
0 - None - studio	0.0%	0.0%	0.0%	0.0%	12.3%	0.0%	3.1%
1 - One	0.0%	0.0%	0.0%	2.2%	16.0%	0.0%	4.5%
2 - Two	0.0%	9.4%	66.4%	5.5%	14.8%	29.3%	22.2%
3 - Three	6.4%	49.3%	33.6%	57.8%	46.2%	53.2%	47.2%
4 - Four	93.6%	36.5%	0.0%	26.5%	4.0%	10.5%	17.4%
5 - Five or more	0.0%	4.8%	0.0%	7.9%	6.6%	7.1%	5.5%
MINIMUM ACCEPTABLE BEDROOMS							
0 - None - studio	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1 - One	0.0%	11.2%	0.0%	12.6%	0.0%	22.1%	10.6%
2 - Two	36.2%	24.5%	43.4%	41.9%	62.8%	47.8%	43.7%
3 - Three	24.7%	58.9%	56.6%	42.8%	24.0%	23.9%	38.0%
4 - Four	39.1%	0.0%	0.0%	2.7%	2.7%	6.2%	5.0%
5 - Five or more	0.0%	5.3%	0.0%	0.0%	10.5%	0.0%	2.6%
PREFERRED NUMBER OF BATHROOMS							
1 - One	0.0%	0.0%	0.0%	14.8%	23.0%	13.2%	11.9%
2 - One and one-half	29.8%	10.2%	0.0%	6.4%	13.9%	0.0%	7.3%
3 - Two	31.2%	64.7%	100.0%	33.0%	36.6%	42.5%	49.7%
4 - Two and one-half	0.0%	20.3%	0.0%	25.4%	13.4%	16.8%	15.2%
5 - Three	39.1%	0.0%	0.0%	15.1%	3.9%	24.9%	11.2%
6 - Three and one-half	0.0%	0.0%	0.0%	0.0%	1.5%	0.0%	.4%
7 - Four or more	0.0%	4.8%	0.0%	5.3%	7.8%	2.7%	4.3%
MINIMUM ACCEPTABLE BATHROOMS							
1 - One	64.8%	28.0%	57.4%	32.0%	25.7%	47.8%	40.2%
2 - One and one-half	0.0%	10.5%	0.0%	5.1%	28.5%	17.8%	11.4%
3 - Two	35.2%	56.2%	42.6%	59.4%	26.7%	30.1%	42.7%
4 - Two and one-half	0.0%	5.3%	0.0%	3.5%	2.8%	0.0%	2.0%
5 - Three	0.0%	0.0%	0.0%	0.0%	16.2%	4.3%	3.7%
6 - Three and one-half	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7 - Four or more	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Housing Demand Survey, 2019

Table K-9. Preferred Next Location, BUYERS, County and Districts of Hawai'i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu'e	East Kaua'i	North Shore-Kaua'i	Total
PREFERRED LOCATION OF NEXT UNIT - BUYERS							
Not in designated districts	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Primary Urban Center	0.0%	20.5%	0.0%	9.1%	27.1%	12.8%	13.0%
Central O'ahu	0.0%	0.0%	53.4%	0.0%	0.0%	12.8%	14.2%
East Honolulu	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ewa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Koolauloa-Koolaupoko	0.0%	0.0%	0.0%	9.1%	21.9%	0.0%	6.4%
Rural Oahu	0.0%	0.0%	0.0%	0.0%	24.3%	0.0%	5.3%
Oahu-district unknown	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
South Kona to Ka'u	0.0%	0.0%	25.3%	0.0%	0.0%	0.0%	5.7%
Puna	0.0%	0.0%	0.0%	10.4%	0.0%	0.0%	1.9%
North & South Hilo	0.0%	0.0%	0.0%	10.4%	0.0%	0.0%	1.9%
North Hawai'i	17.8%	0.0%	46.6%	0.0%	0.0%	0.0%	11.2%
North Kona	0.0%	0.0%	0.0%	0.0%	0.0%	27.7%	4.9%
Hawai'i-district unknown	0.0%	0.0%	0.0%	5.6%	0.0%	59.5%	11.6%
Hana	0.0%	0.0%	0.0%	10.3%	0.0%	0.0%	1.9%
Makawao-Pukalani-Kula	0.0%	44.2%	0.0%	43.4%	0.0%	0.0%	14.8%
Wailuku-Kahului	0.0%	44.2%	0.0%	26.6%	3.8%	0.0%	12.6%
Pa'ia-Haiku	0.0%	0.0%	0.0%	14.5%	0.0%	0.0%	2.6%
Kihei-Makena	0.0%	0.0%	21.3%	0.0%	0.0%	0.0%	4.8%
West Maui	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	.0%
Moloka'i	0.0%	0.0%	0.0%	0.0%	0.0%	31.8%	5.6%
Lāna'i	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Maui-district unknown	0.0%	44.2%	0.0%	15.3%	2.3%	31.8%	15.8%
Waimea	0.0%	0.0%	0.0%	0.0%	.0%	0.0%	0.0%
Hanapepe-Eleele	82.2%	0.0%	0.0%	0.0%	24.6%	0.0%	8.8%
Koloa-Poipu-Kalaheo	.0%	0.0%	0.0%	0.0%	24.6%	0.0%	5.4%
Lihue	82.2%	0.0%	0.0%	0.0%	24.6%	27.7%	13.7%
East Kauai	0.0%	0.0%	0.0%	8.6%	17.9%	27.7%	10.4%
North Shore Kauai	0.0%	0.0%	0.0%	8.6%	.0%	0.0%	1.6%
Kauai-district unknown	0.0%	35.3%	0.0%	8.6%	0.0%	0.0%	7.1%
Out-of-State Resident	0.0%	0.0%	0.0%	.0%	0.0%	0.0%	.0%
Refused	0.0%	0.0%	0.0%	.0%	24.3%	0.0%	5.3%
Total Effective Demand Buyers	41	291	503	473	552	393	2,253

Table K-10. Preferred Next Location, RENTERS, County and Districts of Hawai'i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu'e	East Kaua'i	North Shore-Kaua'i	Total
PREFERRED LOCATION OF NEXT UNIT - RENTERS							
Not in designated districts	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Primary Urban Center	0.0%	39.0%	60.3%	24.1%	30.9%	19.5%	25.2%
Central O'ahu	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
East Honolulu	58.4%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%
Ewa	100.0%	0.0%	0.0%	10.7%	0.0%	0.0%	10.5%
Koolauloa-Koolaupoko	58.4%	0.0%	0.0%	0.0%	17.9%	0.0%	6.9%
Rural Oahu	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oahu-district unknown	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
South Kona to Ka'u	0.0%	0.0%	0.0%	0.0%	0.0%	5.3%	1.1%
Puna	0.0%	0.0%	0.0%	11.2%	0.0%	9.6%	6.9%
North & South Hilo	0.0%	0.0%	0.0%	22.7%	31.1%	21.4%	20.5%
North Hawai'i	0.0%	0.0%	0.0%	3.9%	0.0%	11.7%	4.2%
North Kona	0.0%	0.0%	0.0%	12.0%	0.0%	0.0%	5.3%
Hawai'i-district unknown	0.0%	0.0%	0.0%	0.0%	0.0%	19.1%	4.0%
Hana	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	.0%
Makawao-Pukalani-Kula	0.0%	37.5%	0.0%	24.2%	0.0%	16.4%	16.6%
Wailuku-Kahului	0.0%	37.5%	39.7%	24.2%	0.0%	16.4%	17.8%
Pa'ia-Haiku	0.0%	0.0%	39.7%	0.0%	0.0%	18.3%	5.0%
Kihei-Makena	0.0%	0.0%	0.0%	0.0%	17.9%	0.0%	3.5%
West Maui	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	.0%
Moloka'i	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	.0%
Lāna'i	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Maui-district unknown	0.0%	23.6%	0.0%	0.0%	38.0%	0.0%	9.1%
Waimea	0.0%	0.0%	0.0%	0.0%	.0%	0.0%	0.0%
Hanapepe-Eleele	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Koloa-Poipu-Kalaheo	.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lihue	0.0%	0.0%	0.0%	17.7%	0.0%	0.0%	7.8%
East Kauai	0.0%	0.0%	0.0%	17.7%	0.0%	0.0%	7.8%
North Shore Kauai	0.0%	0.0%	0.0%	0.0%	.0%	0.0%	0.0%
Kauai-district unknown	0.0%	0.0%	0.0%	0.0%	0.0%	19.1%	4.0%
Out-of-State Resident	0.0%	0.0%	0.0%	.0%	0.0%	0.0%	.0%
Refused	0.0%	0.0%	0.0%	.0%	0.0%	0.0%	.0%
Total Effective Demand Renters	214	262	214	507	1,101	394	2,692

Source: Housing Demand Survey, 2019

Table L-11. Current and Affordable Housing Payment, County and Districts of Kaua‘i, 2019

	Kaua'i County						
	Waimea	Hanapepe-'Ele'ele	Koloa-Po'ipu-Kalaheo	Līhu‘e	East Kaua'i	North Shore-Kaua'i	Total
AVERAGE CURRENT MORTGAGE AMOUNT							
Single Family	$1,961	$1,645	$2,361	$2,355	$2,232	$2,237	$2,155
Multifamily	$1,550		$2,405	$2,084	$1,415	$1,880	$1,946
Other				$2,500			$2,500
AVERAGE CURRENT RENT AMOUNT							
Studio				$765	$672	$807	$731
One bedroom	$280	$1,114	$1,110	$918	$526	$1,411	$986
Two bedrooms	$725	$1,001	$1,442	$1,749	$1,859	$2,327	$1,673
Three bedrooms	$1,306	$1,604	$2,740	$2,249	$1,560	$3,300	$1,907
Four bedrooms	$2,500	$4,000	$950	$1,415	$2,377	$3,077	$2,363
Five bedrooms	$1,410		$350				$1,219
AFFORDABLE MORTGAGE PAYMENT							
Less than $500				10.1%	17.2%	4.2%	7.5%
$500 to $799			28.4%	5.7%			6.1%
$800 to $1,099			3.1%	2.5%	1.5%	4.2%	2.4%
$1,100 to $1,399				11.0%	12.3%		5.7%
$1,400 to $1,699		19.7%	11.3%	9.3%	8.9%	0.8%	8.3%
$1,700 to $1,999			23.6%	14.6%	4.6%	4.9%	9.8%
$2,000 to $2,999	1000.0%	65.7%	13.5%	38.0%	35.5%	55.8%	42.3%
$3,000 to $3,999		14.6%	200.0%	8.8%	12.0%	25.8%	15.1%
$4,000 or more					8.0%	4.2%	2.7%
AVERAGE AFFORDABLE MORTGAGE	$2,500	$2,458	$1,865	$1,896	$2,140	$2,662	$2,185
AFFORDABLE RENT PAYMENT							
Less than $300			9.5%				0.6%
$300 to $499	26.8%	15.8%		4.5%	5.0%		5.6%
$500 to $799	12.6%		6.3%	8.3%		2.2%	3.3%
$800 to $1,099				16.1%	22.6%	24.3%	17.0%
$1,100 to $1,399		7.1%		15.6%	18.2%		11.7%
$1,400 to $1,699	45.6%	24.2%	12.6%	17.6%	27.6%	14.3%	22.4%
$1,700 to $1,999				23.5%	6.6%	14.0%	10.7%
$2,000 to $2,499			30.7%	2.3%	11.8%	6.3%	8.2%
$2,500 to $2,999		13.0%			2.1%		2.0%
$3,000 to $3,999		10.3%	40.9%	8.2%	3.9%	23.7%	11.0%
$4,000 or more					2.1%		0.8%
Not sure	15.0%	29.7%		3.9%		15.2%	6.7%
AVERAGE AFFORDABLE RENT	$1,053	$1,768	$2,372	$1,525	$1,505	$2,000	$1,645

Source: Housing Demand Survey, 2019

Note. Base for Average Current Mortgage is current owners who specified the amount of their current monthly mortgage payment. Base for Average Current Rent is current renters who specified the amount of their current monthly rent payment. Base for Affordable Mortgage Payment is effective demand movers who plan to purchase their next home. Base for Affordable Rent Payment is effective demand movers who plan to rent their next home.

Table L-12. Down Payment and Real Estate Ownership, County and Districts of Kaua'i, 2019

		Kaua'i County						
		Waimea	Hanapepe-Eleele	Koloa-Poipu-Kalaheo	Lihue	East Kauai	North Shore-Kauai	Total
AMOUNT AVAILABLE FOR DOWN PAYMENT								
	None	0.0%	0.0%	0.0%	14.3%	9.8%	0.0%	5.8%
	Less than $25,000	39.1%	41.1%	27.0%	33.0%	26.0%	4.4%	25.6%
	$25,000 to $49,999	0.0%	0.0%	1.8%	12.2%	0.0%	11.7%	5.6%
	$50,000 to $74,999	24.7%	0.0%	0.0%	10.6%	0.0%	8.9%	5.3%
	$75,000 to $99,999	0.0%	4.4%	52.3%	1.5%	7.3%	18.7%	14.5%
	$100,000 to $149,999	0.0%	0.0%	12.8%	4.1%	6.6%	0.0%	4.5%
	$150,000 to $199,999	0.0%	13.3%	0.0%	5.8%	0.0%	8.0%	4.6%
	$200,000 to $299,999	0.0%	0.0%	0.0%	0.0%	9.3%	8.1%	4.0%
	$300,000 to $399,999	0.0%	14.2%	0.0%	5.1%	1.8%	8.1%	5.0%
	$400,000 or more	0.0%	0.0%	0.0%	10.8%	9.7%	25.1%	10.1%
	Don't know	36.2%	10.2%	6.1%	2.6%	29.5%	7.1%	13.0%
	Refused	0.0%	16.9%	0.0%	0.0%	0.0%	0.0%	2.0%
OWN OTHER RESIDENTIAL PROPERTY								
	Yes	13.6%	16.8%	14.6%	15.6%	11.4%	19.3%	14.7%
	No	86.4%	83.2%	85.4%	82.7%	88.6%	80.7%	84.8%

Source: Housing Demand Survey, 2019