2000-2001 BIENNIAL REPORT

Natural Energy Laboratory of Hawaii Authority

An attached agency of the
Department of Business, Economic Development & Tourism
STATE OF HAWAII

JOINT MESSAGE

From the Executive Director and the Chairman of the Board

Jeff L. Smith, Executive Director, and Tom Whittemore, Chairman of the Board.

Since its inception in 1974, the Natural Energy Laboratory of Hawaii Authority (NELHA) has often been touted as a “diamond in the rough.” NELHA has been just that, an asset-rich gem in Hawaii’s economy just needing the right kind of investment and shaping to take best advantage of its potential to shine.

Over the past few years, the individuals serving on the NELHA staff and Board have quietly expended a great amount of focused work behind the scenes to lay the groundwork for polishing that gem. Items requiring state funding, such as infrastructure placement and upgrades, and replacement of aging equipment and systems, have been steadfastly and successfully championed at the Legislature. A major focus of legislative efforts has been on critical Capital Improvement Projects and Special Fund Expenditures to allow NELHA to develop its unique and vital infrastructure. Numerous Strategic Planning Sessions led by the NELHA Board of Directors have been held to help NELHA chart a course towards successful future growth. Many new partnerships have been formed with the academic, business, and professional sectors to aid in NELHA’s development. New marketing strategies have been planned and developed. Unique ideas and concepts for self-sustainability have been explored. As a result, today not only is NELHA positioned for growth–NELHA is bursting with growth.

The Board and the entire NELHA Staff especially thank those visionaries in the Governor’s Office and at the Legislature who have believed in and supported our many requests these past years. That support, and often ‘out of the box’ thinking, has enabled NELHA to catalyze a new era of economic development which will dramatically influence Hawaii’s overall economic growth. That support makes possible NELHA’s current tenants, many of whom are already success stories in their own right. These tenants are continually growing and expanding. Many have developed new and untapped markets around the world, including new food sources, breakthroughs in medicine, improvements in aquaculture and renewable aquatic resources. In the meantime, prospective tenants are approaching NELHA hoping to join this thriving community of economic activity. They see the ultra-clean water, the abundant sunlight, the quality of life in Hawaii, and the pro-business attitude of the State as major factors in locating here at Keahole Point. They bring new ideas, new energies, new investments, and, in turn, create new opportunities.

Where do we go from here? We follow our Strategic Planning. We move toward self-sustainability. We protect our environment and our pure water. We nurture strong partnerships. We teach and educate our school children, our residents, and visitors alike. We fully market and develop NELHA into the local and national asset that we know it is. Are we confident we can do this? Yes, we are. NELHA has a small but well seasoned staff, and a viable and active Board of Directors. With the successful deployment of the 55-inch deep seawater pipeline and onshore distribution system, NELHA will be able to fully open up the HOST Park for development to new tenants and new opportunities. With the issuance of a request for proposals for the Gateway Ocean Center and subsequent development of 75 acres of prime commercial land, the anticipated revenues generated by these developments will offset future request for State funding. The long-awaited NELHA Gateway renewable energy research and outreach center is also underway, with design and construction to commence this Fall. This federally-funded center will truly be the gateway for Hawaii, already attracting educators, commercial enterprises, scientists, universities, non-profit organizations, research activities, and federal offices that all see their need to be part of the NELHA Gateway vision.

The Board of Directors and the NELHA Staff are excited about this forward momentum and dynamic new growth. We expect challenges and, in fact, we welcome challenges. To ensure that NELHA continues to be a major player in local economic development and diversification, we will maintain our pursuit of intelligent growth here at Keahole. Indeed, the polishing of our “diamond” is already well underway.

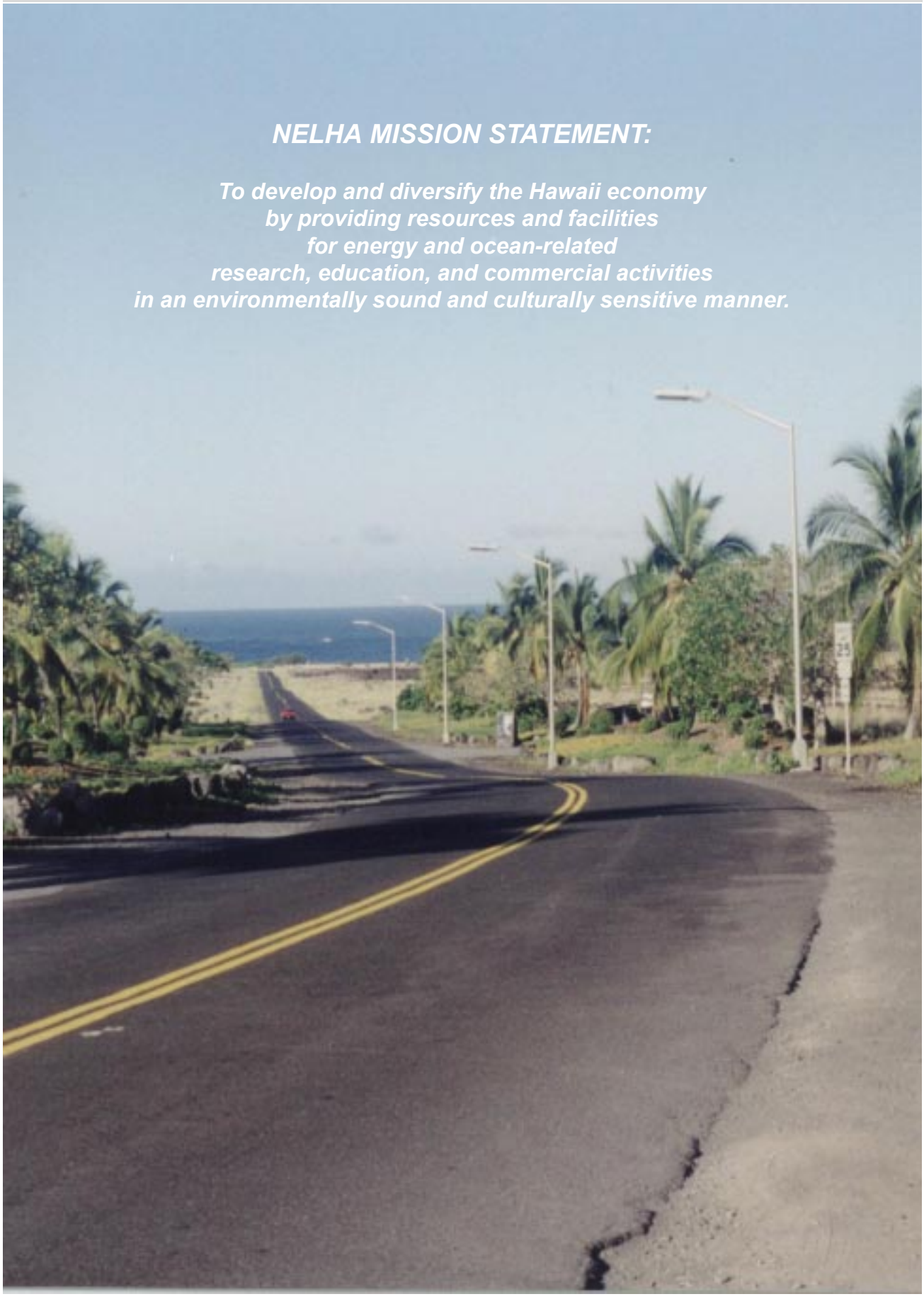
Sincerely,

Jeff L. Smith
Executive Director

Tom Whittemore
Chairman of the Board

NELHA MISSION STATEMENT:

To develop and diversify the Hawaii economy by providing resources and facilities for energy and ocean-related research, education, and commercial activities in an environmentally sound and culturally sensitive manner.



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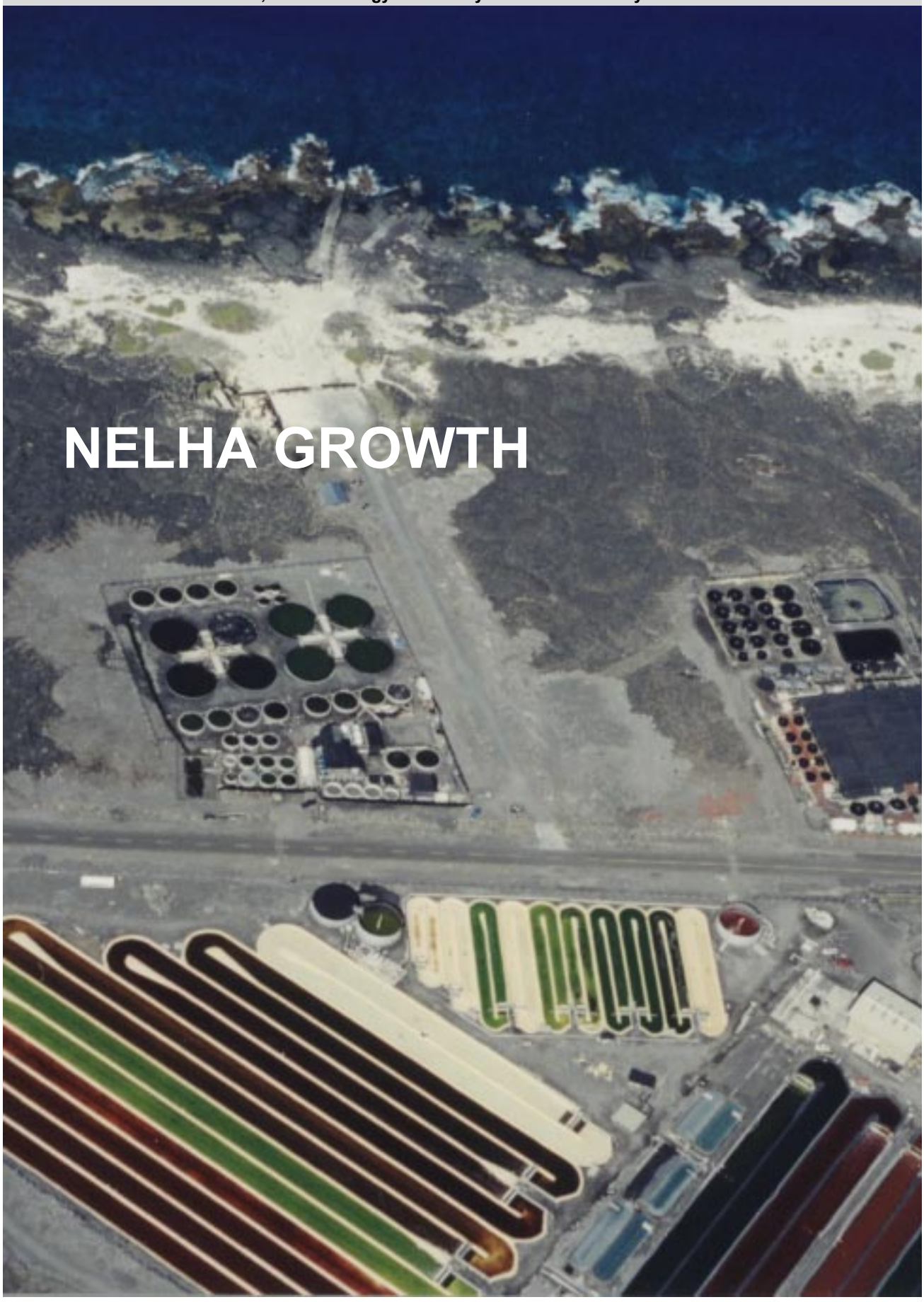


NELHA GROWTH

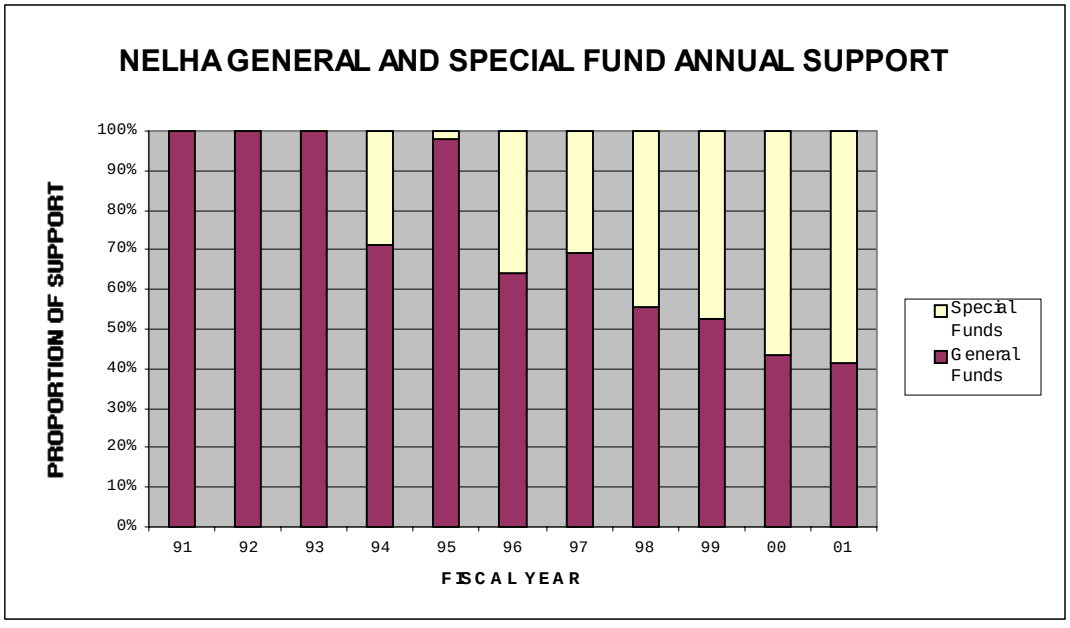
PROGRESS

THE NATURAL ENERGY LABORATORY OF HAWAII AUTHORITY (NELHA) is an ocean science and technology park whose mission is to bring economic development and diversification to West Hawaii. Its assets include a unique complement of support facilities, infrastructure, pristine natural resources, and leasable land for a wide range of tenant research, education, and commercial applications. A dual-temperature seawater system that is the only one of its kind in the world sets NELHA apart from all other technology parks and creates a prime setting for innovation and new industry development in this island coastal setting. The NELHA story now spans 27 years and is an example of public investments initiated by visionary state leaders that have yielded multiple returns for the benefit of all.

CREATED ON THE HEELS OF A NATIONAL ENERGY CRISIS in 1974, NELHA has evolved in multiple stages over its 27-year history to become the successful business development park that it is today. The Hawaii State Legislature first established it as a state corporation, the Natural Energy Laboratory of Hawaii (NELH), on 322 acres of land located at Keahole Point, adjacent to a new state airport facility, both accessed by a newly developing coastal highway. The initial function of the NELH facility was research support, focusing on the development of alternate energy and related technologies, specifically centered around ocean thermal energy conversion (OTEC).

RESEARCH PROJECTS BEGAN offshore with a buoy-mounted biofouling and corrosion project in 1976 and, in 1979, the world's first net power-producing OTEC plant, "Mini-OTEC," on a barge moored off Keahole Point. After six years of permit applications and extensive environmental impact studies, NELH obtained a master lease from the state's Department of Land and Natural Resources (DLNR). This enabled the new agency to construct its first buildings in 1980 to house administration, operations, a power center, and a laboratory. A dual-temperature seawater system using 12-inch diameter pipelines was installed, accessing Class AA ocean waters at depths of 45 and 2000 feet. Onshore OTEC-related as well as aquaculture research quickly ensued.

BY THE END OF THE FIRST DECADE of its existence, research and demonstration activities had firmly established NELH as the premier location for OTEC development and revealed the tremendous economic potential of



The proportion of NELHA's operational dependence on General Funds (GF) has been progressively reduced since FY94 as Special Fund revenues increased. In FY95 NELHA was not granted authority to expend its Special Funds due to a legislative oversight, resulting in a larger proportion of GF support for that year. NELHA's long term goal is to be supported solely by Special Fund revenues.

other seawater-based industries. As a result, in 1984 the Hawaii State Legislature took the next logical step, authorizing commercialization at the state facility and turning NELH into an industrial park. The first commercial tenant signed on in 1984 and would soon be followed by other entrepreneurial interests.

TO ACCOMMODATE THE ANTICIPATED NEED for more commercial space, in 1985 the Legislature created the Hawaii Ocean Science and Technology (HOST) Park on an adjacent property where commercial projects spawned by NELH research activities could grow and mature. The state's High Technology Development Corporation (HTDC) initially administered HOST Park, starting with 421.120 acres of land which was eventually augmented to 548 acres. In addition to over 350 acres of leasable lands, HOST Park assets included a landscaped front entrance, a seawater system installed on NELH property, and a public beach park.

IN 1990, NEW LEGISLATION MELDED NELH AND HOST PARK into one entity and created the Natural Energy Laboratory of Hawaii Authority (NELHA) to oversee operations, maintenance, development, leasing, and administration for the combined 870 acres, including all infrastructure, facilities, tenant leased property, and public beach park. NELHA was also reorganized as a state agency and administratively attached to the Department of Business, Economic Development and Tourism (DBEDT).

IN THE DECADE OF THE 1990'S, NELHA BLOSSOMED in the coastal desert of Keahole, inaugurating a new era of business development for the state of Hawaii. At the beginning of the decade, NELHA operating funds were supported 100% from state General Funds. NELHA began growing its Special Fund through the collection of ground rents and fees for services while nurturing new tenant businesses. By FY00 and FY01, Special Funds provided 56% and 59% of NELHA's operational support, and General Fund dependence had been reduced to 44% and 41%.

THE MOST SIGNIFICANT NEW CONSTRUCTION DURING FY00 was that initiated by NELHA tenant Big Island Abalone Corporation, implementing plans to transition from pre-commercial research to full commercialization on a ten-acre site, the first in NELHA's HOST Park. The abalone farm has plans to buildout to a full 60 acres of production in the next several years. The new commercial expansion activities on the subleased premises were blessed in a dedication ceremony on May 16, 2000. The company immediately proceeded with development work and, by the end of FY01, had relocated its office and begun transferring livestock from its pre-commercial research project in the NELHA Research Compound to its new commercial site.

DURING FY00-01, NELHA CONTINUED TO DEVELOP VITAL INFRASTRUCTURE to support further development of HOST Park. The long-awaited 55-inch pipeline project neared its final stage of development, with its uniquely manufactured pipe supplies ordered and en route to Hawaii from California by the end of June 2001. Final deployment and onshore construction were planned for FY02 to bring the 12-year project to completion.

Big Island Abalone Corporation commenced HOST Park's first commercial land development project during FY00.

IN THE NEW MILLENNIUM, NELHA's tenants continue to mature and develop new high-value products for the global market. New business startups continue to join the NELHA community and invest heavily in Hawaii's economy by developing the lava desert. NELHA's income from base rents is becoming more secure as established tenants make long term commitments through long term subleases. As established tenant businesses realize significant profits from sales of their high-value products, they have begun to pay percentage rents to add to the NELHA revenue stream.

Governor BenjaminCayetano addresses participants at BIAC commercial site during blessing and dedication ceremonies.

A winged visitor observes during BIAC blessing.

Traditional Hawaiian blessing is given to BIAC commercial site during dedication ceremonies.

BIAC Staff confer with Governor Cayetano during dedication ceremonies.

NELHA Scientific/Technical Director Dr. Tom Daniel points out features of live abalone to NELHA Technician Gisela Heatherington.

NELHA Board member Mason Young and former HOST Park planner Kay Yamada (HTDC) at BIAC dedication reception.

A huge D-11 bulldozer used in land preparation for Big Island Abalone Corporation is flanked by dignitaries Governor Benjamin Cayetano, Hawaii County Mayor Steve Yamashiro, Senator Lorraine Inouye, and BIAC and NELHA staff during dedication ceremonies on May 16, 2000.

TO FURTHER BOOST NELHA'S REVENUE STREAM, focused development of the NELHA Gateway Project and the Ocean Center Commercial Area commenced in earnest during FY00-01. These projects will create new venues for research, education and commercial development in renewable energy, ocean sciences, marine biotechnology, and other areas, and grow new profit centers to boost NELHA's overall financial growth.

NELHA TODAY IS A SUCCESSFUL WORK IN PROGRESS and an economic model for other communities around the world. What began as an innovative setting for research and development in ocean science and technology has launched a new era of economic development and diversity for Hawaii and its people.

THE FIGURES SPEAK FOR THEMSELVES. Unlike many other government projects which demand a one-way drain on tax dollars each year, NELHA yields measurable returns to the state in terms of revenues, jobs, and economic activity. The less than $1 million of General Funds annually appropriated for NELHA operations yields approximately double that amount in taxes alone. NELHA special fund revenues continue to rise, allowing increasing Special Fund support of operations and decreasing dependency on annual General Fund allocations.

BY FY01, NELHA TENANT REVENUES TOPPED $15 MILLION per year, demonstrating the success of the innovative tenant business enterprises which shipped unique and valuable products to destinations around the world. New products included health and nutritional supplements, fresh seafood, and new production technologies. In the area of job creation, NELHA and its tenants provided livelihoods for over 220 Kona residents, for whom 176 positions were privately funded. Most importantly, activities generated by NELHA and its tenants together provide an estimated $30-40 million per year in total economic impact, calculated using standard economic multipliers. The NELHA story is a success story, continuing to evolve and bring new economic development and diversification to West Hawaii and this island state.

OUTSTANDING RESOURCES

A unique complement of natural and logistical resources at Keahole Point gives NELHA a decided advantage over other locations and other business development parks.

• SOLAR INSOLATION is consistently high at NELHA, with the rate of incoming natural sunshine ranked above that of any other coastal site in the United States. Rainfall is correspondingly low, less than 15 inches per year, maximizing days of clear, cloudless skies.

• PROXIMITY TO AN INTERNATIONAL AIRPORT allows tenants to export fresh product directly to Asian markets, as well as those of the continental United States and other countries. The Kona International Airport at Keahole expansion plans include an international terminal and a closer working relationship with NELHA and its tenant companies as traffic to the Big Island and particularly West Hawaii increases.

• LOCATION at Keahole Point is an ideal setting for an ocean science facility primarily due to its steep offshore bathymetry and narrow band of coral reef, characteristic of the geologically youthful Big Island. The steep bathymetry affords close proximity to deep ocean water, accessed within a mile from shore at Keahole Point. Contrast this to geologically older locations such as islands with more extensively developed reef systems or continental coasts where access to deep ocean water may typically be 50-100 miles from shore.

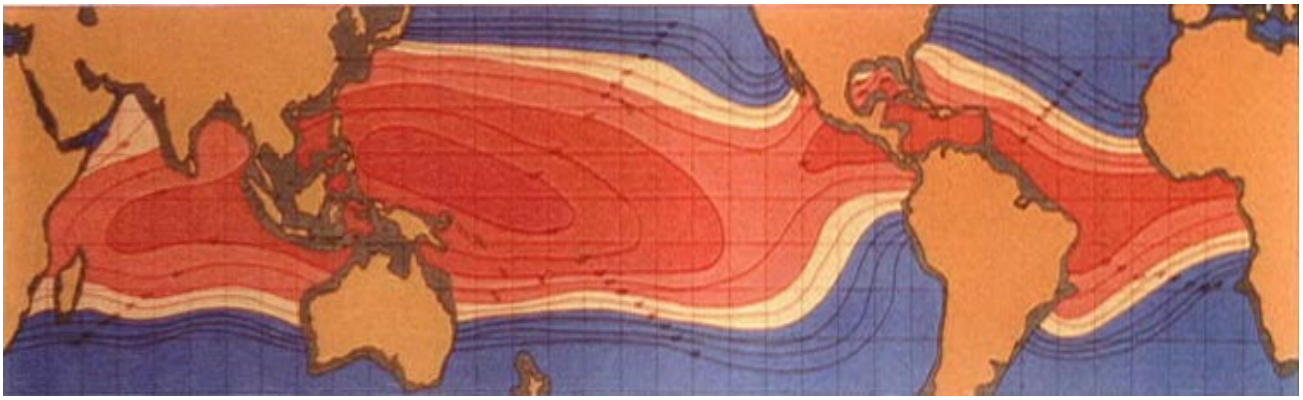
• A CONTINUOUS AND AMPLE SUPPLY of both warm and cold seawater is available at NELHA from the world's deepest and largest seawater pipelines.

• WARM SURFACE SEAWATER (SSW) is pumped onshore continuously, drawing from an inlet pipe located 600 feet offshore at a depth of 45 feet from the surface and 45 feet above the ocean bottom. The waters from which the NELHA SSW is drawn are rated Class AA in water quality and range in temperature from 76° to 82°F (24.5° to 27.5°C) year-'round.

• COLD DEEP SEAWATER (DSW) is continuously pumped from 2,000 foot depths via the world's deepest cold seawater supply pipelines and is distributed onshore through the largest seawater delivery system of its kind. The DSW is drawn from chilly deep ocean water less than a mile from shore at a constant 43°F (6°C), virtually pathogen-free and rich in the inorganic nutrients essential for plant growth.

• SEAWATER SYSTEM EXPANSION plans are in the works, with a new pipeline, pump station, and distribution system to be online providing deep seawater from 3,000 foot depths by the end of CY02.

• THE LARGE TEMPERATURE DIFFERENCE ("DELTA T") BETWEEN SSW AND DSW brought onshore makes NELHA ideal for development of ocean thermal energy conversion (OTEC) technologies. Hawaii is one of the



Regions of Earth where the delta T between surface and deep seawater would allow OTEC and other deep seawater applications to be economical, indicated by the red, orange, and yellow coloration.

few locations in the developed world that is included in the broad band of oceanic waters in which these “delta T” conditions exist, circling the globe within about 23 degrees of latitude to the north and south of the equator.

• LOCATION WITHIN A STABLE POLITICAL CLIMATE is a plus for any business venture weighing options at sites around the world. Other places in the equatorial regions where warm and cold seawater might also be accessible tend to be in politically unstable settings in developing countries. The access to both cold deep and warm surface seawater in one location, with a sufficient “delta T” to make energy production feasible through OTEC-related technologies, is not available elsewhere in a location as ideal as at Keahole.

• LOCATION WITHIN A FRIENDLY COMMUNITY is an added benefit to any business which establishes activities here. Schools, hospitals, and all the components of a highly desirable place to live are here in this community. An added plus is the Hawaiian “Aloha Spirit” which is alive and well in Kona, bringing not only thousands of visitors here again and again from year to year, but also new business ventures who make a conscious choice to include quality of life in the bottom line.

With all of these resources, NELHA offers its existing and potential tenants an ideal setting in which to explore and develop ocean-related research, business and education ventures.

RESOURCE APPLICATIONS

NELHA'S setting with an abundance of natural resources has provided fertile ground for the development of useful applications such as new ways to cool and heat, new ways to produce and save energy, new products to enhance the quality of life. For example, past research projects at NELHA have explored applications using the deep seawater (DSW) resource for energy production by ocean thermal energy conversion (OTEC), low cost energy-saving air conditioning, and thermally controlled environments for the culture of valuable crops through aquaculture and coldwater agriculture methods. The following section describes some of the applications for which cold seawater and other NELHA resources may be used, but this list is by no means complete. There are many other possible uses, some still waiting to be discovered.

• DEEP SEAWATER AIR CONDITIONING. One of the most cost-effective small-scale applications is for air conditioning since traditional methods use energy-hungry technologies. A simple set up using a fan and an automobile radiator, substituting deep cold seawater for the traditional liquid coolant, can provide a surprisingly effective air conditioning unit for a small room. Saltwater-induced corrosion might limit its lifetime, but replacement with use of recycled parts would keep costs minimal. Ideally, a heat exchanger such as flat plate titanium models designed for long term use would provide years of virtually maintenance-free service. Such models are currently in use at a growing number of tenant as well as NELHA facilities at Keahole. Natural coldwater cooling using this application of NELHA's ample deep seawater resource in three NELHA buildings alone saves NELHA and the state of Hawaii up to an estimated $4,000 per month in electrical costs. Deep seawater is used to cool freshwater which is then circulated in the building's cooling system. The seawater is then recycled for other uses, so the cooling capacity is obtained virtually 'cost-free' in an integrated deep ocean water system.

A simple heat exchanger is at the heart of deep seawater-based cooling in the Research Compound.

In 1993, the NELHA Hale He'ena Laboratory Building was built in the Research Compound, a mirror image design of the first Laboratory Building constructed in 1981. Unlike the first Laboratory Building which was originally designed to use a traditional air conditioning system and later retrofitted for DSW cooling, Hale He'ena was engineered specifically to take advantage of the deep seawater cooling technologies developed at NELHA. The building was later nominated for engineering project of the year by the Kona-Kohala Chapter of Hawaii Society of Professional Engineers. The project set the standard against which all future such seawater air-conditioning systems would be judged.

• INDUSTRIAL COOLING APPLICATIONS that use deep seawater to chill storage space can provide significant cost savings to traditional refrigerator or freezer technologies. Studies show that deep seawater air conditioning combined with industrial cooling has tremendous implications for improving economics and decreasing environmental impact of large scale coastal developments in tropical climates. This concept has excellent cost-savings potential especially when used on a large scale such as where a cluster of coastal developments could be supplied with cold deep seawater from a central supply. For further cost savings, freshwater could be chilled using the deep seawater in a centralized heat exchanger, then circulated to a series of users via a closed loop to eliminate seawater-induced corrosion problems at user sites. The capital expended on such a project could be recouped over a relatively short period of time, making it extremely cost-effective.

• RENEWABLE ENERGY PRODUCTION from natural resources inspired the creation of the Natural Energy Laboratory of Hawaii in 1974. Ocean thermal energy conversion (OTEC), the use of ocean thermal differences to make electricity, had first been proposed in 1881, but it took the oil embargo of 1973-4 to catalyze political

interest and commitment to support its research and development. Hawaii was an ideal setting since it is located within the tropical band of oceanic waters where the temperature difference ("delta T") between surface and deep seawater is sufficiently large to make OTEC an economically feasible energy production method. OTEC technologies, inherently large in scale, require correspondingly large scale seawater systems such as are located at NELHA. As a result, all of the world's major OTEC research projects have been located at NELHA since 1979.

The world's first net power producing OTEC plant was constructed and floated offshore of Keahole Point in 1979. The proof-of-concept demonstration system generated up to 52 kW of electricity and was hailed as a major breakthrough in ocean energy development. This successful project was a partnership between the state government and several private companies and heralded the coming of a new wave of research and development based on cold and warm seawater resources. Since that time, the world's largest net power producing plant, rated at 210 kW gross, was built and tested at NELHA through a federally-funded research grant. It was preceded by a series of experiments testing components for the two main OTEC system types: closed-cycle and open-cycle OTEC. The next step in the R&D process will be a scaling up towards commercialization, developing pilot plant designs in the range of 1-10 MW.

NELHA provides an ideal venue for research, development, demonstration and commercialization of a wide range of renewable energy technologies based on solar and other resources. As an island state with no indigenous fossil fuel resources, Hawaii actively seeks investments in practical, economical renewable energy technology development and application aimed at increasing the ratio of indigenous to imported energy resources. In FY00, Hawaii continued to rely on imported fossil fuels which supplied 89% of the State's total energy needs. Since energy is a key factor shaping Hawaii's economy, environment and standard of living, development of a self-sufficient, stable energy supply continues to be vital to assuring continued prosperity and a high standard of living for Hawaii's people.

• DISTRIBUTED ENERGY RESOURCES. According to the DOE's Energy Efficiency and Renewable Energy Network (EREN), DER includes a variety of small (from a few kilowatts up to 50 MW), modular power-generating technologies that can be combined with energy management and storage systems and used to improve the operation of the electricity delivery system, whether or not those technologies are connected to an electricity grid. DER devices can provide opportunities for greater local control of electricity delivery and consumption. On a broader scale, DER technologies are playing an increasingly important role in the nation's energy portfolio. They are aimed at more efficient use of energy and can be used to meet baseload power, peaking power, backup power, remote power, power quality, as well as cooling and heating needs. DER technologies and resources offer a faster, less expensive alternative to the construction of large, central power plants and high-voltage transmission lines to meet the country's need for high-quality, reliable sources of electricity. NELHA and its planned Gateway facility will provide an ideal location for DER technology research, development, demonstration, and commercialization.

Fresh moi from a NELHA farm fill a bamboo basket for seasoning and steaming the delicate meat.

• SOLAR RESOURCES—The same intense sun that warms the surface waters around Keahole Point also provides a ready source of natural energy that can be converted into usable form through the use of photovoltaics, photobioprocessors, and other solar energy-dependent technologies. NELHA's Keahole Point location and low rainfall combine to make the site ideal for research and development of all solar technologies.

• AQUACULTURE PRODUCTS were recognized, early in the development of the NELH facility, as economically profitable co-products of the energy technologies being developed here. With its unique complement of logistical and natural resources, NELHA has become recognized as a premier location for aquaculture devel-

opment. NELHA's abundant supplies of cold, clean, nutrient-rich deep seawater and warm surface seawater combine with the ideal weather conditions to provide optimum growing environments. Since the aquaculture industry is the fastest growing sector of the U.S. federal agriculture program, aquaculture is an attractive area for business development in Hawaii.

NELHA tenant-produced coldwater lobster claws and ogo seaweed fill a buffet platter.

Many of NELHA's tenants are involved in aquaculture, growing various species of high-value marine or aquatic plants and animals. It is a relatively new industry that is growing in importance as world fisheries feel the increasing pressures of over-harvesting. There will be a greater need for alternative sources to replace or supplement the "wild" catch from the world's oceans in the future. NELHA's unique resources are very well-suited for businesses that wish to capitalize on this market potential. From tropical reef fish culture in warm Keahole seawater to Maine lobster culture in Keahole deep seawater, any combination of temperature regimes may be used to create optimum growing conditions for plants and animals at no extra cost. This results in growout system technologies that are more cost-effective than traditional chilling or warming technologies used by the industry elsewhere in the world.

• MICROALGAE or microscopic plants grow extremely fast in the ideal conditions at NELHA. Over 30,000 different species have been identified worldwide, yet only a few have been commercially developed to date. Some of these are being cultured both in commercial production facilities and as experimental research ventures by businesses at NELHA. Products from microalgae include food supplements, pigments used in molecular medical tagging and cosmetic products, natural fertilizers, organic mosquitocides, cancer-inhibiting drugs, and many others. Microalgae can also be a vital link in the early stages of growout of marine animals when larvae are microscopic. Companies such as Taylor Resources, Inc. and Coast Seafoods, Inc. culture large amounts of microalgae to feed clam and oyster spat which are sent after a few months to restock growout areas located at company headquarters in the Pacific Northwest.

• MACROALGAE are larger marine and aquatic plants, also known as seaweed or sea vegetables. These can be used for food, medicinal resources, and other purposes. Like microalgae, macroalgae can be grown optimally at Keahole Point, and a number of businesses at NELHA are taking advantage of this opportunity. The low rainfall rate of about 15 inches per year greatly reduces the possibility of rainfall dilution of the growing medium in land-based ponds or tanks so that they can be left open to receive the free and ample sunshine year-'round.

Temperate macroalgae species can be easily grown using NELHA deep seawater.

• MARINE BIOTECHNOLOGY holds great promise for the companies at NELHA that choose to venture into this area. Both pharmaceutical and nutraceutical products can be obtained through the mass culture of a variety of marine organisms. Through life cycle manipulation, genetic engineering, and selective breeding, the production of both plant and animal species can yield a variety of useful products for commercial applications.

A vast market potential exists for a segment of the biotechnology industry based on the production of microalgae, microscopic one-celled marine and aquatic plants. Researchers point out that microalgae are the fastest growing plants on earth, able to double their weight daily in laboratory cultures, and exceeding

Grapevines at Keahole are grown using deep seawater "cold-ag" methods which allow manipulation of growing and fruiting seasons, maximizing annual crop yields ten-fold over traditional methods.

the average growth of trees by a factor of 100. They grow optimally when provided with the natural resources of sunlight, water, carbon dioxide and nutrients. In turn, they can yield a vast array of high-value pharmaceutical and nutraceutical products, with applications to carbon dioxide mitigation, AIDS research, pharmaceuticals, drug discovery, food supplements, and even alternative energy.

A growing market demand for healthcare products created by the aging of the generation of "baby boomers" nationwide is providing new opportunities for products that can boost and maintain health and help combat the ravages of time. The few microalgae of the 30,000 known species that have been explored in drug discovery research have yielded compounds potentially useful in the treatment of cancer, HIV, and degenerative diseases. For example, a naturally occurring pigment, astaxanthin, obtained from certain microalgae species, is believed to improve human health and immunological support, as well as survival and fertility in fishes, poultry and livestock. Even the roughest estimates of market potential for astaxanthin are impressive. Reliable sources value the annual market at more than $185 million, growing at 8% per year. Emerging markets in poultry and livestock feeds could add another $125 million. World market price is $2,500 per kilogram. Near-term markets for microalgae products in general are estimated in excess of $3 billion per year. For the long term, some estimate these figures may exceed $10 billion per year.

Increasing efficiency is an important element of maintaining market competitiveness for commercial production based on both open pond and closed photobioreactor systems. NELHA provides an ideal location for the development of these technologies, and NELHA-based companies such as Aquasearch Inc. and Cyanotech Corporation are already reaping the benefits of their research and development successes in these areas.

• COLDWATER AGRICULTURE is a new area of development in which cold deep seawater is used to cool soil temperatures to create unique microclimates in a subtropical coastal setting. Test crops at NELHA's Keahole facility have demonstrated immense potential in the manipulation of growing conditions to increase and improve yield and shorten growing times for both temperate and tropical plants. The late Hawaii State Senator Richard Matsuura used the term "blue-green revolution" to describe this new field of agriculture which combines "blue" (ocean) and "green" (agricultural) technologies. He likened it to the "green revolution" of agriculture which increased local production of land-based crops in underdeveloped countries such as India and Thailand several decades ago. NELHA tenant Common Heritage Corp. is capitalizing on this potential, assisting third world countries to develop sustainable coastal communities by adapting integrated seawater systems to support food, water, and energy production.

TENANTS

NELHA's tenants are the key to its success. It takes know-how plus a good dose of persistence, tenacity, and resourcefulness to make a new entrepreneurial venture succeed. NELHA tenants' stellar record speaks volumes for the NELHA model and the business acumen of the long time tenants who maintain steady business activity from year to year.

During the reporting period, 15 NELHA tenants were fully commercialized, 7 were engaged in pre-commercial research, 4 were involved in basic research, and 2 were providing educational services. Of these 28 active tenants, 23 were from the private sector.

ECONOMIC IMPACT OF PRIVATE SECTOR TENANT ACTIVITIES. An analysis of year 2000 data from NELHA's private sector tenants quantified the economic impact of their investments. The DBEDT Research & Economic Analysis Division provided assistance to NELHA by completing an economic impact analysis of the operation of NELHA private tenant businesses using the current review form of the 1997 update of the State of Hawaii Input-Output model. Results are summarized in the table below.

20 private sector tenants in all phases of development reported combined gross sales of $15.392 million gross sales, $7.221 million private sector wages, 176 full time equivalent jobs, and $4.394 million in capital investments for CY2000. The aquaculture industry in the 1997 I-O model was used to approximate the purchases of the NELHA-associated businesses. In the model, labor is purchased as 30 percent of its output value. The data provided on the NELHA firms shows them to pay 47% of their output value for labor. An adjustment was made in the analysis to account for this characteristic of the NELHA firms.

Note that State tax revenue is intended to include all taxes and fees that would accrue to the state as a result of the economic activity estimated in the study. The State tax revenue impact is intended to be total effect, and includes the excise taxes, income taxes and fees paid directly by the NELHA-related businesses and by the businesses and employees that derive sales and incomes indirectly from NELHA tenants production.

Economic impacts can be estimated and reported using several indicators such as output (value of production), income to workers, employment, government revenues, and probably more. In the analysis for NELHA, the impacts on four of these economic indicators were estimated based on the data provided. For each of these indicators (except State revenues), both the direct impacts, those related specifically to the NELHA tenants' activities, and the total impacts were reported. Total impacts include outputs, incomes, employment and taxes generated by Hawaii businesses that sell to NELHA tenants and outputs, incomes, employment and taxes generated by Hawaii businesses that sell to consumers who spend incomes from NELHA tenants and their Hawaii suppliers. Each one of these indicators is "total" for that particular indicator of economic activity.

Table 3. Economic Impact Analysis of NELHA's Private Commercial Tenant Activity in Year 2000

Impact	Business Activity	Construction Activity	Total Economic Impacts
Direct output impact	**$15.4 M** (actual gross sales)	**$4.4M** (actual capital investment)	
Total output impact	$27.0 M	$9.1M	**$36.1M**
Direct income effect	**$7.2 M** (actual wages)	$1.6M	
Total income effect	$12.0 M	$3.0M	**$15.0M**
Direct employment effect	**176 jobs** (actual FTE's)	40 jobs	
Total employment effect	275 jobs	85 jobs	
State Tax Revenue impact	**$1.0M**	**$0.5M**	**$1.5M**

AQUASEARCH, INC.

Aquasearch Inc. has been a tenant at NELHA since 1995. Specializing in marine biotechnology, it is a global leader in the development of proprietary, cost-effective, photobioreactor technology for commercial scale production of pure cultures of microalgal species, and in research and development of high-valued products derived from microalgae. Aquasearch capitalized on its new 3-acre Hawaii Research, Development and Production (HRDP) Facility, constructed during FY99. Sales of AquaXan™ pigment for animal feeds immediately followed during FY00. With the new HRDR facility in place, Aquasearch scientists were able to conduct R&D on new microalgae products on the lab bench and ramp up from laboratory-scale culture flasks to fully computerized mass production, all in the same location. The cornerstone of the microalgae-based business and key to this versatility is Aquasearch's proprietary and economical photobioreactor technology, the Aquaculture Growth Module (AGM). Due to recent research advances, AGM cultures yield ten-fold increases from previous production capacities. Initial product development during FY00-01 focused on the high-value astaxanthin-based human nutraceutical, The AstaFactor™, allowing the company to make its first commercial sales of this promising new product in March 2000.

In October 2000 the Hawaii Technology Technology Association honored Aquasearch as its "Biotechnology Company of the Year." Aquasearch also commenced work on a 30-year, $2.4 million DOE project to develop microalgae products that would help remove carbon dioxide from the atmosphere. During FY01, Aquasearch laid the foundation for a new 10,000 s.f. laboratory to support its exciting drug discovery program, and in January 2001, the company executed a contract with the University of Hawaii for exclusive access to a comprehensive microalgae library.

BIG ISLAND ABALONE CORPORATION

The Big Island Abalone Corporation (BIAC) capitalizes on global demand for fresh abalone products and its expertise and experience in abalone culture and production. The NELHA Board first approved BIAC's proposal in FY97, allowing the company to commence pre-commercial research phase in early FY98. BIAC is commercializing the closed culture of abalone, focusing on production of high-value Japanese northern abalone for the Asian market. The company successfully negotiated for shared costs on installation of an interim surface seawater pump station by NELHA to supply seawater to the commercial site in HOST Park and reservation of 50 additional acres for its future expansion during FY00. The company broke ground at its 10-acre site at the end of FY00 on May 16, and commenced land development soon thereafter, marking the beginning of the first commercial development at HOST Park. By January 16, 2001, BIAC began drawing a continuous supply of cold, deep seawater from the NELHA supply lines to fill its many production tanks. The first order of business was to cultivate enough seaweed fodder to sustain millions of hungry abalone at the new site. BIAC staff devoted themselves to preparing growout facilities at the new site for a gradual transfer of valuable BIAC livestock from the NELHA Research Compound hatchery/nursery to their new homes in HOST Park.

TOP: Baby abalone are dwarfed by macroalgae. BOTTOM: Market-sized abalone with foot facing up to show edible meat.

BLACK PEARLS, INC.

Black Pearls, Inc. (BPI) developed specialized hatchery technology for black-lip pearl oysters, *Pinctada margaritifera*, to allow production of valuable black pearls in Hawaii and the Pacific. BPI pioneered ocean leasing in Hawaii, to prepare the way for the state's first commercial pearl farming efforts. The company sought

to obtain an ocean lease for a site on the island of Oahu which would be stocked with seed provided by the hatchery/nursery facilities at NELHA in Kona, and continues to work towards obtaining a lease, the first of its kind in Hawaii. Using its mobile hatchery methods, The company also operates a commercial pearl farm in the Marshall Islands, and has been working with established pearl farm operations in the Philippines to boost production. During FY 00-01, BPI obtained an option on a one acre lot in the new NELHA Small Business Compound for commercial expansion of its hatchery/nursery and revealed plans to also diversify into marine ornamental and finfish aquaculture.

COAST SEAFOODS

A well-established oyster company originally incorporated in 1946 in Washington state, Coast Seafoods Company has become the largest oyster company in the U.S. Coast Seafoods operates a nursery at NELHA to provide an economical way to grow bivalve spat year-round. The organisms are shipped to Hawaii immediately after settling from the last swimming larval stage, when they are about 1 mm in size, then given a "Hawaiian growout vacation" in the sunny climate of the NELHA facilities. Three and one half months later, they are returned to headquarters in the Pacific Northwest for final planting and growout in the ocean.

At the company's Keahole Point facilities, clam and oyster seed production is the focus, with additional work to research further improvements to the nutritional content of the algae fodder and to optimize processing techniques used to grow the oyster and clam seed.

COMMON HERITAGE CORPORATION

Common Heritage Corp. (CHC) exists to further its mission of the "management of innovation for the benefit of the Common Heritage." To this end CHC maintains a demonstration site at NELHA that incorporates an integrated system of deep ocean water technologies for a state of the art "starter system" that can be applied in coastal communities around the world such as Haiti, the Cape Verde Islands, Curacao, Mexico, and others with access to cold deep ocean water.

CHC President John Craven and grapevines in a coldwater agriculture 'vineyard' at Keahole.

CHC first dedicated its unique DOW demonstration system at NELHA on January 31, 1998, to celebrate its many significant world class breakthroughs in the use of coldwater technologies. The CHC facility has since become known as the birthplace of the blue-green revolution.

The integrated DOW demonstration system employs deep ocean water sequentially to air condition the CHC office, to generate fresh water by condensation, to supplement irrigation, to generate fresh water in a development model of a desalinization device called a "hurricane tower" (patent pending), to cool a chill house and its chill boxes and food preparation area, to provide cold for the coldwater agriculture of wine grapes, to provide cold for the coldwater agriculture of a wide spectrum of agricultural crops normally grown in nontropical climates, to provide cold for coldwater agriculture of superior tropical crops, to provide cold for coldwater agriculture landscaping of the facility, to provide cold and nutrients for the aquaculture of sea vegetables, to provide cold and nutrients for the aquaculture of "fruits de mer," and to provide cold for creature comforts (water fountains, coldwater showers, field tents, and other habitat comforts).

CYANOTECH CORPORATION

Cyanotech Corporation has specialized in developing and commercializing natural microalgae-based products at NELHA since 1984 and has become NELHA's largest and most productive tenant, with 90 acres

currently in production and 30 more slated for development in FY03. The well-established company produces a variety of high-value products for the nutritional supplement and immunological diagnostics markets in addition to microalgae-based products for the aquaculture feed/pigments and food coloring markets.

As NELHA's anchor tenant, Cyanotech's annual revenues are in excess of $15 million, derived principally from sales of products made from unique strains of the microalgae "Spirulina" for the vitamin and supplement market. Spirulina Pacifica® provides a vegetable-based, highly absorbable source of natural beta carotene, mixed carotenoids and other phytonutrients, B vitamins, gamma linolenic acid ("GLA"), protein and essential amino acids. New clinical evidence suggests that Spirulina stimulates the human immune response to cancer. Cyanotech currently markets its products in the United States and thirty other countries through a combination of retail, wholesale and private label channels, and plans to market new products either directly or through strategic alliances where appropriate.

As evidence of its environmentally responsible philosophy, Cyanotech was the first microalgae company in the world to receive third party organic certification as an ISO 9002 Registered Quality System. The company incorporates natural production methods and resources as well as extensive recycling of raw materials and nutrients. The Cyanotech production system operates without the use of pesticides and herbicides, and does not create erosion, fertilizer runoff or water pollution. These methods make good economic as well as environmental sense, resulting in lower operating costs overall.

ENZAMIN USA

Enzamin USA, Inc. is a company with origins in Japan where it has a well-established product line based on *Bacillus natto*. This bacterial strain is derived from fermented soybeans, or *Natto*, a food item reputed to have many health benefits and popularized in Japan since the 17th century. In September 2000 the company received approval to commence pre-commercial research at NELHA to develop health drinks, health foods, dietary supplements and skin care products utilizing water and minerals derived from DSW. Enzamin has a previous record of success in the beauty care business with over $100M annual sales. It is a solid company with an excellent reputation and the financial ability to be a long term asset to NELHA due in part to its strong existing market and distribution network. Currently sells diet drinks, supplements and beauty aids I over 20 major spas and over 6,000 beauty shops . One advantage the company has is its broad base with many products and therefore not vulnerable to whims of a fickle consumer market. Intends to begin R&D in October 00 with commercial operations projected to begin in Jan 2001. Funds are already available to accomplish these plans without the company having to seek external funding. Feels it can enhance NELHA's reputation by developing strong ties to the local community through such avenues as employing 7 to 15 local employers as well as donating health products to hospitals, nursing homes, and other health facilities. R. Takamatsu to f/u with a letter of intent re: intent to have a local company with production facilities on a 3 acre site.

HAWAII DEEP MARINE WATER PRODUCTION PLANT L.P.

Approved in concept by the NELHA Board in October 1999, Japanese-backed tenant Hawaii Deep Marine Water Production Plant L.P. (HDMWPP) commenced pre-commercial research activities at NELHA by December. The Japanese consumer market has developed a fascination with deep ocean water due to research and development activities conducted in Kochi Prefecture and other locations in Japan. HDMWPP was established to tap into the growing beverage and health supplement market that is developing in Japan and Asia centered around the use of deep seawater.

NELHA tenant HDMWPP installed 150-ton reverse osmosis equipment to desalinate deep seawater for a pre-commercial research project.

Renting laboratory, office and outdoor space in the Research Compound, the entrepreneurial company commenced seawater desalination in FY00 using state-of-the-art reverse osmo-

sis (RO) technology. Test marketing activities commenced soon thereafter to optimize production methods and perfect products that could meet the high food and beverage standards in Japan. In FY01, the company also began leasing 4.5 acres of commercial space in the HOST Park, expeditiously grading the property in September 2000 in anticipation of the impending commercialization of the new business. New management and reorganization at the end of FY01 brought additional resources and expertise to serve the company's ambitious development plans.

HIGH HEALTH AQUACULTURE, INC.

High Health Aquaculture (HHA) supplies certified Specific Pathogen-Free (SPF) broodstock to the world's shrimp hatcheries. They operate a first phase facility that includes basic infrastructure (water, air, electrical and security systems) and broodstock rearing tanks and a shrimp reproduction system. During FY00-01, the company continued to work on developing new stocks of certified Specific Pathogen-Free (SPF) stocks of *P. stylirostris* and *P. vannamei*. During FY00-01, HHA sought and obtained expansion area of approximately 1.17 acres to double its production area and obtained a 30-year sublease with NELHA for the entire property. Construction activities on their expansion acreage aim to double their production capacity. The company's motto is: "Healthy shrimp are profitable shrimp."

INDO-PACIFIC SEAFARMS, INC.

Indo-Pacific Sea Farms' mission is to develop and commercialize innovative technologies for sustainable production of reef-dwelling organisms. IPSF's present research and development emphasis is on photosynthetic molluscs and cnidarians, primarily giant tridacnid clams and scleractinian corals. These photosynthetic-capable animals derive nutrition from their association with microscopic algal symbionts called zooxanthellae. The pristine seawater supply at NELHA provides an ideal environment for these organisms. Cultivation requirements for the plant-animal symbionts are similar to those of free-living microalgae and include ample tropical sunlight, warm surface seawater and a carefully controlled concentration of deep seawater to control temperature and supplement essential inorganic nutrients. IPSF uses no commercial feeds and produces no seawater pollution with this novel approach. IPSF products are currently in demand in the seafood and aquarium industries and also have potential biomedical applications.

KONA BAY MARINE RESOURCES, INC.

During the reporting period, KBOSC developed a 2.2 acre commercial grow out operation and began marketing the tasty blue shrimp to local hotels. Reorganization during FY99 further advanced the company's progress and brought in a new CEO. KBOSC looks forward to optimizing its current proprietary production system and is contemplating expansion into the HOST Park early in the new millennium.

Formerly known as Kona Bay Oyster and Shrimp Company, Kona Bay Marine Resources, Inc. (KBMR) produces blue shrimp as well as American and Pacific oysters in a specialized symbiotic polyculture system. The KBMR culture system reduces labor required for operations while increasing product output. This makes a significant difference in projected business development and has contributed to their confidence about the future. During FY00-01, KBMR put forth proposed plans for further expansion to HOST Park for their next stage of development.

KONA COLD LOBSTERS LTD.

Kona Cold Lobsters Ltd. (KCL) utilizes the deep cold seawater supplied by NELHA to create a habitat for live Maine lobsters and live Dungeness crabs. KCL imports live lobsters and crabs from the natural fisheries and rejuvenates them in cold seawater holding pens for distribution throughout the Hawaiian Islands and select Asian destinations. KCL is therefore able to provide the freshest, most stable supply of live Maine lobster in the

Pacific basin. Currently KCL services over 50 customers on five Hawaiian Islands, including supermarkets, restaurants, and resorts, meeting their specific size and quantity requirements on a daily basis.

KCL also has the expertise and experience to culture Maine lobsters in a multidisciplinary system that includes broodstock, husbandry, nutrition, pathology and habitat design. KCL has successfully bred and raised lobsters from egg to sexual maturity for over 20 years. Recovery of the lobster fishery after a long period of decline lowered market prices sufficiently to put production of a high-quality Hawaiian-bred Maine lobster on hold, but KCL maintains the capacity to become operationally independent of the natural fishery should environmental conditions change.

Maine lobster natually occur only in temperate climates, but can thirve in the subtropical coastal desert of Keahole if kept in a supply of chilly, pristine NELHA deep seawater.

MACFARMS OF HAWAII, INC.

A period of drought during 1999 and 2001 when only 16 and 17 inches of rain was recorded for South Kona (as contrasted with a more normal 39 inches in 1997) prompted local agribusiness MacFarms of Hawaii to come to NELHA to conduct some tests. The object of their research was a possible method of treating brackish water for use in irrigation. The short term project was approved by the NELHA Board in August 1999, and tests were run for several months. Access to seawater and freshwater supplies enabled them to evaluate the method using a small scale test with a minimal investment in resources.

MOANA TECHNOLOGIES, INC.

Moana Technologies, Inc. received NELH Board approval in concept in April 2001 for an ambitious commercial project specializing in shrimp brood stock genetics using traditional breeding techniques. The new company came to NELHA with a strong technical team and solid financial backing. Project principals anticipated signing a Facilities Use Agreement for pre-commercial research space in the Fall of 2001. The company also submitted a FinalProposal/Business Plan for NELHA review in June 2001 as the first step towards obtaining approvals for a commercial site in HOST Park where animal grow out cycles will be closely monitored. MTI will receive animals in a coordinated research plan involving strict biosecurity measures. The new company has already commenced development of a facility on Oahu which will serve as a quarantine site to screen all genetic stock prior to introduction at the company's NELHA Keahole sites.

OCEAN RIDER, INC.

Ocean Rider, Inc. came to NELHA in 1998 from Harbor Branch in Florida. Citing the pristine quality of the seawater supply as the primary attractant, the company soon established an active pre-commercial research project in the NELHA Research Compound to optimize proprietary culture systems for the care and feeding of these exotic and beautiful animals. The company is developing proprietary breeding and grow out facilities and methods for the commercial production of seahorses, primarily targeting the live ornamental fish industry outside of Hawaii. In the Fall of 2000, the company sought and obtained an option agreement to reserve a commercial lot in the planned Small Business Compound in preparation for full commercialization.

ONO TAKE, INC.

Ono Take, Inc. has been using deep seawater to create temperature-controlled environments for the cultivation of mycomedicinal mushrooms. The company specializes in production of the highly esteemed *shiitake (Lintinula edodes), reishi* (*Ganoderma lucidum*) and *maitake* (*Grifola frondosa*) mushrooms. These have long had a

reputation in the Far East for support and enhancement of human immunological function. Scientific research suggests the active ingredient in these mushrooms, a polysaccharide compound identified as beta glucan D-fraction, may support healthy levels of macrophage and natural killer cells, inhibiting the growth of certain cancer cells, and may also support production of interferons. During FY00-01, Ono Take continued research and development to produce an encapsulated form of the mycomedicinal mushrooms for test marketing.

Ono Take uses deep seawater to maintain temperature-controlled microclimates preferred by the fruiting bodies of these fungi. Cold ocean water chills fresh water in a small heat exchanger, eliminating potential corrosion in the cooling system. They are able to cool down 12,000 cubic feet of culture room space from 80º to 70º F (ten degrees) using approximately 203Kgal/month of DSW, approximately $15 per month. DSW warms only 6ºF in the heat exchanger, allowing it to be recycled for other uses.

Responsible aquaculture of marine ornamentals such as this live seahorse can help alleviate the impact of overfishing on natural fisheries around the world.

PACIFIC HARVEST, INC.

Pacific Harvest, Inc. (PHI) has established the largest Pacific threadfin (locally known as *moi*) aquafarm in the state at NELHA. *Moi* were so highly prized in ancient Hawaii that they were reserved for consumption only by royalty. In recent years, the natural fishery has been depleted, and commercial *moi* farming now has great market potential as a new industry for Hawaii.
During FY00-01, PHI continued its construction and expansion activities involved further expansion of growout facilities and construction of a hatchery/nursery to provide independence from purchased juveniles. The company continued to develop culture methods for other high value finfish, including *kahala* (amberjack), a highly prized species that, in nature, is plagued by parasites but can be cultured parasite-free. PHI also expanded research activities to include *omilu, mahimahi* and marine ornamental finfish to broaden its capabilities for the future.

ROYAL HAWAIIAN SEA FARMS, INC.

Royal Hawaiian Sea Farms, Inc. (RHSF) has been in business at Keahole since 1987 and commercially produces *limu*, or edible sea vegetables. Sales of these popular nutritious delicacies have consistently reached over two tons per week. A pickled *ogo* (*Gracilaria*) product is being processed under the “Waimanalo Ko-Ko” brand. In addition to *limu*, RHSF also produces salt water tilapia (*Tilapia*) and milkfish (*Chanos*). Intensive applied research is being conducted to investigate the potential of commercially producing edible sea cucumbers (*Stichopus*), the Hawaiian limpet, *opihi* (*Cellana*), and warm water abalone (*Haliotis*).

STATE UNIVERSITY OF NEW YORK MARINE SCIENCE CENTER.

Dr. Jeanette Yen of the State University of New York at Stony Brook Marine Science Center has been conducting research at NELHA periodically for many years. She focuses on the micro-processes involved in the feeding behavior of a type of deep seawater copepod. Living in all the oceans of the world, copepods are small marine crustaceans which form an important link in the oceanic food web, passing nutrients from single-celled plants (phytoplankton) to larger animals such as fish, for whom they serve as food.

Dr. Yen’s research involves the study, on a microscale, of fluid dynamics involved in copepod feeding behaviors. She relies on the supply of experimental organisms obtained by straining the incoming deep seawater supply at NELHA. Obtaining specimens by this method of collection is more economical, less time-consuming, and less

Pacific threadfin, or moi, was once reserved only for Hawaiian royalty. It is a highly prized, delicate fish favored by many.

damaging to the organisms than the traditional method of collecting these types of organisms from research vessels. Dr. Yen prepared to move to a new institution, Georgia Institute of Technology during FY00-01.

STOCKLY'S AQUARIUMS, INC.

A well-established family-run aquarium supply business in Kailua-Kona since 1978, Stockly's Aquariums, Inc. obtained approval for a pre-commercial research project at NELHA in 1999. The company focused on the endemic red shrimp, *Halocaridina rubra*, to see if the tiny animal can be economically cultured as a high quality live food for aquarium fishes and as an ornamental animal for local and export markets. Studies focused on the reproductive potential, food requirements, behavior, and optimum growing conditions for these small red shrimp. The only shrimp species restricted to Hawaii's anchialine ponds, *H. rubra* has become popular as in sealed glass mini-aquaria that are self-sufficient biospheres requiring only the energy input of light. Stockly's investigated the potential for commercial culture using the pristine seawater resources at NELHA and reserved a commercial lot in the planned Small Business Compound with an option agreement during FY00.

TAYLOR SHELLFISH—KONA

Taylor Shellfish–Kona is a subsidiary of Taylor United, a family-owned company reputed to be the largest commercial shellfish producer in the U.S., headquartered in Quilcene, Washington, since the late 1960s. Taylor operates a range of nursery and growout locations for several varieties of shellfish to provide maximum marketing flexibility. One of these sites is a nursery at NELHA where both Manila clams (*Venerupis japonica*) and Pacific oyster (*Crossostrea gigas*) spat enjoy a "Hawaiian growout vacation" during their early months of growth. The company's shellfish "seed" or "spat" start life in a hatchery in the Pacific Northwest. When only about 250 microns in size, soon after settlement from the swimming, or planktonic stage, they are brought to the Kona facility. After about three months of growth on screens and sand-filled raceways, when they are about 5-6 mm, most are returned to Washington state for 1-4 years of growout to market size in Taylor's facilities. The NELHA nursery annually produces 100-120m oyster seed and 200-300m clam seed. Some of these are also sold to other oyster and clam farms around the world, including destinations as far away as South Africa.

The Kona nursery makes good economic sense to Taylor since the unique NELHA dual seawater supply enables the company to maintain the precise temperature regimes required by the delicate early stages of growth for very low cost and Hawaii's winterless climate allows year-round productivity instead of only seasonal production. During FY00-01, Taylor Shellfish–Kona worked on developing an expansion of their facilities to meet growing market demand for their high quality products.

UNIVERSITY OF HAWAII INFRASOUND LABORATORY OF HAWAII

A unique project that collects and analyzes data from infrasonic signals (pressure disturbances whose frequencies are below the hearing range of the human ear) in the atmosphere became a NELHA tenant during FY00-01. Approved by the NELHA Board in August 1999, the Infrasound Laboratory of Hawaii ("ISLA") is a project of the Hawaii Institute of Geophysics and Planetology at the School of Ocean and Earth Sciences and Technology, University of Hawaii at Manoa.

Initially supported through U.S. Department of Defense funds, ISLA is part of an international network dedicated to monitoring compliance with the Comprehensive Nuclear Test Ban Treaty (CTBT). The CTBT seeks to eliminate the proliferation and use of nuclear weapons and to ensure complete global disarmament under strict international control.

ISLA operates and maintains IS59, or KONA, a 4-element infrasound array located on the forested slopes of Mt. Hualalai. The array has exceptionally low ambient noise levels and acoustic detection thresholds and can detect low-frequency atmospheric sound waves generated by natural and man-made sources such as explosions, volcanic eruptions, meteorite impacts, and severe weather and thus may provide advance warning of potential threats to Hawaii.

ISLA can analyze various aspects of infrasonic wave propagation, source characterization, and event location. Ongoing research concentrates on infrasonic tracking of storms systems, modeling sound wave propagation over thousands of kilometers, characterizing the ambient infrasonic field in the Pacific, optimizing wind-noise-reducing systems, and ray-tracing of wave paths from atmospheric meteor entries.

UH-ISLA's IS59 infrasound array is located on the slopes of Mt.Hualalai, an exceptionally quiet setting.

UNIVERSITY OF HAWAII SEA GRANT EXTENSION SERVICE

The national Sea Grant College Program supports an innovative program of research, education and extension services directed to the improved understanding, management, and use of marine resources of the state, region and nation. Sea Grant is a collaborative effort of the public and private sectors that utilizes federal, state and community support. The University of Hawaii at Manoa (UHM) has been a charter Sea Grant college since 1970, and, through its Sea Grant College Program in the School of Ocean and Earth Science & Technology (SOEST), maintains an Extension Service (SGES) office in West Hawaii at NELHA.

The Hawaii Sea Grant College Program serves a geographic area that includes the Hawaiian archipelago and the U.S.-affiliated Pacific islands. Sea Grant funds research in aquaculture, fisheries, shoreline processes, and education. Its Extension Service focuses on technology transfer, coastal resource management, environmental education, sustainable economic development and capacity building and training. Shaping the program offered in West Hawaii is the mission statement: "To raise consciousness about marine and coastal resources, build consensus, understanding and commitment to establish a sustainable resource management ethic."

In the early days of NELH, it was Sea Grant that provided funding for the first aquaculture research projects which explored economically promising uses of deep seawater at Keahole during the 1980s. Results provided the evidence for launching the first NELH tenant aquaculture businesses. UH Sea Grant also funded the first coldwater agriculture experiments at NELH in the 1980's, opening up further terrestrial applications using deep seawater.

Accomplishments by UH SGES in West Hawaii during the reporting period included:
--Data management and training of 47 (FY00) and 23 (FY01) volunteers for Reef Watchers, a community-based coral reef monitoring group operated in collaboration with DLNR/Division of Aquatic Resources and UH Hilo;
--Formation and continuing support of the West Hawaii Fishery Council, a community-based advisory group tasked with compiling recommendations pertaining to aquarium fish collecting for the first Regional Fishery Management Area mandated by Hawaii State law. Efforts provide a model for other Hawaii communities.
--Coordination of monthly ReefTalk public presentations in partnership with non-profit Malama Kai Foundation to provide free educational talks on topics pertaining to marine and coastal ecosystems.
--Coordination of the summer internship program for the MarBEC program of the University of Hawaii at Manoa SOEST in an effort to involve biotechnological industry partners with UH undergraduates. In FY00, twointerns were funded by Aquasearch, Inc. to assist in research trials, and three were funded by MarBEC and Sea Grant to work at Anuenue Fisheries Research Center; in FY01 the program quadrupled as MarBEC partner UC Berkeley joined the program, placing 21 interns with research mentors in California and Hawaii.
--Work with UH SGES and community members to design interpretive signage at Lapakahi State Historical Park, Kekaha Kai at Mahaiula State Park, and Kealakekua Bay.

During FY01, UH SGES Agent Sara Peck (left) coordinated development of a new NELHA outreach volunteer program tosupport NELHA and tenant outreach.

--Continued work on improving signage and educational efforts at Kahaluu Beach Park, working with ReefWatcher volunteers to install instructional mural by Kahakai Elementary School students;
--Continued work with West Hawaii Explorations Academy students on the successful elementary Aloha Kai cross-peer teaching project that supplements NELHA outreach efforts; on Kahaluu Beach Park-based ReefTeach project to promote protection of coral resources,and new grant to restore anchialine ponds at Manaiula in Kona.
Resource materials and data bases in the SGES office are available to tenants and the public upon request.

NELHA OUTREACH SUPPORT. The UH-SGES Agent is responsible for providing at least one NELHA public presentation per week as part of a cooperative agreement with NELHA. During FY00-01, UH-SGES played a pivotal role in implementing a new aspect of NELHA outreach by coordinating the development of a new volunteer docent training course and maintaining the resulting docent program to supplement the existing NELHA outreach services. During FY01, Agent S. Peck worked with Hawaii Community College to develop a proposal for a course to teach presentation and tour guide skills to interested residents. From August to November 2000, the course outline was developed, advertising and logistical details were planned during November and December, and the training course was launched in January 2001. The course was funded through collaborative efforts of HCC, UH Sea Grant and NELHA. A rural development grant from USDA was administered by UH-HCC to hire course instructor Sallie Beavers and provide course materials. Of the16 participants 'graduating' by the end of March 2001, ten accepted the invitation to become Ambassadors for NELHA.

By the end of FY01, much progress had been made; 21 presentations had been provided by the new NELHA docents. In addition, this enthusiastic volunteer group also offered to upgrade and maintain NELHA visitor displays and exhibits. One Ambassador generously donated a set of three wooden easels and assembled a mobile display for a section of the 55-inch diameter HDPE pipe. Special shirts were custom made to provide a uniform for the Ambassadors, and videos about NELHA and its tenants were edited and duplicated for use during presentations. During FY01, a nominal fee for Ambassador-led public presentations was also initiated to help offset the cost of maintaining support materials for the program. By the end of FY01, with the guidance of NELHA's administrative office and UHSGES, the Ambassador volunteers were in the process of forming an independent, not-for-profit corporation, the "Friends of NELHA" (FON), dedicated to telling the NELHA story to visitors and residents, to providing volunteer support for the Ambassador program, and to fostering community support for NELHA's initiatives.

UWAJIMA FISHERIES, INC.

Uwajima Fisheries, Inc. (UFI) operates a facility at NELHA for growing *hirame*, a flounder highly prized by the Japanese for *sashimi* and *sushi*. Uwajima Fisheries markets their 1.5 to 2 pound *hirame* through a Honolulu distributor who supplies the Oahu *sushi* market. UFI manages the maturation and spawning of their broodstock for year-'round production of eggs. UFI also utilizes the NELHA surface and cold deep seawater for the semi-intensive polyculture of marine shrimp, milkfish and the edible seaweed, *Gracilaria spp.*, also known locally as *ogo*. With this system they are able to produce high quality, superior products. Additionally, UFI engages in broodstock management, spawning, larval rearing and commercial production of Pacific threadfin (*moi*) for local markets. UFI continued work to expand its production site, adding nearly two acres to its existing site during FY01, and worked with NELHA to allow preservation of a small archaeological site on its premises.

U.S. COAST GUARD

In June 2000 BOD approved a request from the U.S. Coast Guard to set up a radio direction finding (DF) antenna on the NELHA Laboratory Building at Keahole Point to aid mariners in distress. The Coast Guard uses VHF sites around the island to respond to mariner distress calls. Six sites in Hawaii are monitored from Sand Island, however the site at NELHA would help in determining the mariner's actual location. NELHA is a perfect site due to its unobstructed views, low RF noise, and accessible power and phone lines. The DF antenna they installed is only 35 inches high and weighs approximately 14 pounds. The federal agency has plans to upgrade systems in the year 2005 and, although a site a NELHA may not be necessary at that time, in the interim it is a vital component to ensure mariner safety. NELHA provides electrical service and access for maintenance to the Coast Guard at no cost as a public service. Installation of the new antenna was completed in December 2000.

WEST HAWAII EXPLORATIONS ACADEMY—PUBLIC CHARTER SCHOOL

The West Hawaii Explorations Academy (WHEA) became a new public charter school during in FY00-01. The school began as an integrative educational program of Konawaena High School and the state Department of Education, opening with a presence at NELHA since January 1994. Each year more than 50 students, mostly juniors and seniors, spend a full academic year at NELHA working on projects related to the resources available at Keahole Point.

During FY00-01, a need to accommodate the growing student body led to new construction at the leased site, doubling the size of an existing 30' x 40' pavilion-style shop, installing semi-perimeter fencing, excavating for and completing campus-wide underground electrical service. Plans were also made to expand the existing 30' x 30' classroom/office constructed by the Department of Education. During FY00, the WHEA staff began exploring ways to expand facilities despite severe financial cutbacks to Konawaena High School and DOE satellite programs. Attaining status as a New Century Charter School opened up opportunities for funding from state and federal sources and also increased program autonomy for the innovative school. In May 2000, WHEA became the first charter high school in the State of Hawaii.

WHEA continues to make important contributions to science through student research efforts and to the development of local talent to feed into the human workforce pool. WHEA student projects have included educational presentations to 2500 elementary school students, 300 middle and high school students, 300 adults per year; a solar car prototype; design and construction of an electric car which placed first in a field of 24 high school teams in the annual HELCO-sponsored Electron Marathon championship race with entries from across the state; an environmentally friendly wastewater cleaning project using native *makaloa* grass (sponsored by a collaboration of Bishop Museum, the National Biological Service, and the Amy Greenwell Ethnobotanical Garden); a VOG monitoring project; hydroponic and cold-water agriculture; and one commercial and several research aquaculture projects.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

The Woods Hole Oceanographic Institution (WHOI) website explains that WHOI "is a private, independent, not-for-profit corporation dedicated to research and higher education at the frontiers of ocean science. Its primary mission is to develop and effectively communicate a fundamental understanding of the processes and characteristics governing how the oceans function and how they interact with the Earth as a whole." WHOI researcher Dr. Daniel Repeta traveled from Woods Hole, Massachusetts, to conduct large volume sampling of dissolved organic matter from NELHA's seawater supply in January 2001. In keeping with the WHOI mission, his work focuses on the long term study of natural mechanisms by which the element carbon is sequestered in seawater due to phytoplankton growth, and the chemical composition of organic carbon as it moves through natural oceanic cycles. Use of NELHA resources for studies such as this one saves scientists valuable time and money since the alternative would be booking time on a research vessel, a costly endeavour. Dr. Repeta completed his sampling activities successfully and planned to return in February 2002 for further work.

SUPPORT SERVICES

ADMINISTRATION

NELHA administrative staff provide administrative support, personnel assistance, internal management, fiscal services, leasing and tenant relations, contract management, permit processing, and marketing and outreach services. They also coordinate and implement required procedures with the Departments of Accounting and General Services, Agriculture, Land and Natural Resources, Transportation, Budget and Finance, and the Attorney General, as well as the Governor's Office, the Hawaii State Legislature, and various County and Federal agencies.

PERSONNEL. The administrative staff includes the Executive Director, Gateway Project Manager, Fiscal Officer, Operations Manager, Scientific/Technical Director, Engineering Projects Coordinator, and Leasing & Tenant Relations Specialist. These individuals work closely together to manage the NELHA facilities, plan its infrastructure, recruit new tenant prospects, and maintain the bureaucratic systems and physical plant that allow NELHA to operate as the successful agency that it is.

James Frazier served as Executive Director from 1997 until his retirement in November 2000. Executive Director Jeff L. Smith succeeded him in December 2000 and continues to serve in that role at the close of FY01. In September 2000 six NELHA employees achieved ten years of service with the State of Hawaii: Donna Brown, Tom Daniel, Ernie Galt, Sheryll Kaniho, Bud Placek, and Jan War. Fiscal Clerk Donna Brown retired in September 2000 after 11 years of service to NELHA.

ACTIVITIES. The Executive Director oversees all operations and functions of the NELHA Sections. During FY00-01, major efforts were underway to lay the groundwork for the completion of the new seawater system expansion project at HOST Park, allow new tenant developments to proceed, create a new areas for small business development, coordinate efforts with other agencies to manage the natural environment as well as development within the NELHA properties, and plan ahead for new growth. By FY01, NELHA had 52% of its inventory of available lands leased or optioned to tenants. The Administrative Staff's goal for the remaining 48% is to develop these lands in a manner that maximizes revenue opportunities for NELHA. Board and Staff visioning and strategic planning continued throughout FY00-01 with this in mind.

NELHA Board and Staff representatives participated in a Strategic Planning Workshop in May 2000, called by the Governor's Technology Team to initiate action required by recent legislation. At the workshop, four target work groups were created to focus on high technology related to 1) information and telecommunications, 2) medical and health science, 3) biotechnology, and 4) ocean and space science technology, in which NELHA would be represented.

LEGISLATIVE SUPPORT

NELHA appreciated the support from the many legislators and their staffers who provided vital information before, during and after the 21st and 22nd Sessions of the Hawaii State Legislature.

In FY00, NELHA did not propose any new legislation, but lobbied to protect the allocations, to be spread out over a two year period, for the design and construction of the vital seawater system expansion project to install two 55-inch diameter pipelines. NELHA hosted the House Finance Committee in September 1999 and House Committee on Energy and Environment to apprise them of NELHA's many activities and progress to date. The NELHA Board also formally adopted a position in opposition to proposed legislation for consolidation of NELHA with other high technology agencies "absent a specific plan." The proposed legislation would have reassigned NELHA to the University of Hawaii or to a new Technology category under state government and remove CEROS from NELHA. Without further analysis and clarification as to the long term impacts on NELHA, the NELHA Board could not endorse the proposed reassignments.

In FY00, new legislation addressing the New Economy affected NELHA by increasing its Board of Directors from 9 to 11 members with the addition of one member from HTDC and one from the Hawaii Strategic Develop-

ment Corporation (HSDC). NELHA members would sit on these two boards as voting members in an effort to "cross pollinate" amongst the three agencies.

During FY 01, NELHA submitted an $11 million CIP funding request to support continued development of vital infrastructure. By the end of the 2001 session, all CIP funds had been zeroed out, but NELHA was able to retain $576,000 in Special Funds that had initially been proposed to be taken away.

NELHA OUTREACH

Visitor interest in NELHA and its activities is high, but staff time to provide these services has been extremely limited, particularly since statewide funding and staffing cutbacks in the mid-1990s. In an effort to continue to provide outreach to the general public, an agreement between NELHA and the University of Hawaii Sea Grant Extension Service (UH-SGES) since 1997 allowed the UH-SGES West Hawaii Extension Agent, who also serves the greater West Hawaii community, to exchange certain NELHA outreach services to the public for use of NELHA office space in a mutually beneficial arrangement.

VISITOR COUNTS. During FY00 NELHA was able to service 1,941 visitors in weekly public presentations with the help of the SGES. An additional 1,018 visitors were serviced by NELHA staff alone, bringing the total visitors in small groups to nearly 3,000 for the year. Individual walk-in visitors were not logged. In FY01, the free NELHA weekly presentations were attended by 2,137 visitors, and NELHA staff hosted an additional 711 persons in small group visits, bring the year's total to 2,848.

VISITOR AREA IMPROVEMENTS. NELHA has always welcomed the public to its facilities, and has maintained a modest visitor area in its Research Compound to provide information about NELHA and its tenants for walk-in visitors. In February 2001, UH SGES Extension Agent Sara Peck and a number of volunteers upgraded the static exhibits and small aquaria in the visitor area. NELHA tenant Pacific Harvest, Inc. volunteered to install and maintain a new live display to showcase their farm-raised moi. Additionally, students from the West Hawaii Explorations Academy volunteered to loan NELHA two of their award-winning electric cars for display as examples of the many student-run projects which form the basis for the curriculum at the NELHA-based public charter school.

PUBLIC OUTREACH FACILITY. An agreement with new NELHA tenant Oceanic Institute also promised to further support the outreach efforts at NELHA. State matching funds administered through NELHA for a $400,000 grant from the USDA will support an interim Public Education and Outreach Facility at the new OI site in HOST Park. This facility will provide a temporary home for the NELHA visitor area until the new Gateway facilities are constructed.

Ambassador docent Roy Damron explains NELHA's accomplishments to interested visitors.

DOCENT PROGRAM FUNDING. Through a USDA Rural Development grant administered by Hawaii Community College, NELHA initiated a new docent training program to allow outreach function to be supported by community volunteers with an interest in public presentations and NELHA. By the end of FY00, funds were secured and the program launched. By the end of FY01, 17 docents had been trained and accepted into the new "Ambassador" program and a second training session was being planned, allowing NELHA to boost its visitor services to the general public. Enthused docents contributed many hours of time, skill and even monetary support to restore demonstration gardens, equipment, maintain live exhibits, and deliver presentations in support of NELHA public outreach. As this program develops, it will be moved from the NELH Research Com-

pound out to an interim Public Education and Outreach Facility in the HOST Park and eventually to the developing Gateway Project venue at the NELHA highway entrance.

HO'ONA ARCHAEOLOGICAL PRESERVE.

The NELHA property has two areas designated as archaeological preserves, one of which has been developed and landscaped. NELHA staff maintains the grounds at the NELH preserve, with periodic area cleanups through joint volunteer efforts by the entire NELHA staff, often assisted by WHEA students. Vehicles are not allowed to disturb the pristine area which is located on a sandy area of the coastline. During FY00, NELHA formed a Board sub-committee consisting of three NELHA representative, three Ho'ona Advisory Committee representatives, and one State Historic Preservation Division representative. The subcommittee members were charged with developing a management plan that would be mutually representative of regulatory, operational, and cultural needs of the Ho'ona Archaeological Preserve. The preserve is further protected by NELHA permitting procedures requiring pre-approval which allows limited overnight use for Hawaiian cultural and educational programs with certain qualifications and restrictions.

Ho'ona Archaeological Preserve is located on the coast of the NELHA properties in the NELH section.

WAWALOLI BEACH PARK

NELHA maintains a small beach park for use and enjoyment of the general public. The park improvements include a restroom facility, parking lot, and landscaped grounds. The beach park was created on conservation land associated with the HOST Park, and was transferred along with the rest of HOST Park toNELHA in the early 1990's.

NELHA's Wawaloli Beach Park comfort station and parking lot, maintained by the Operations Section staff.

BOARD OF DIRECTORS

NELHA Board Vision Statement: "Growing sustainable industries for the 21st century"

The Board of Directors (BOD) plays an active role in guiding NELHA's direction and monitoring its progress. Comprised of 11 members, the Board consists of representatives with business, governmental and technical backgrounds from both the public and private sectors. Through its monthly meetings, the Board maintains an ongoing dialog with NELHA Staff to support planned development and continue to grow the facility in the most expedient manner possible.

During FY 00-01, NELHA was tasked by the state administration with becoming more fiscally self-sufficient by embracing high technology as a prime economic driver. Towards this end the NELHA Board and the Boards of the High Technology Development Corporation and the Hawaii Strategic Development Corporation were each statutorily increased by two members from each of the other two agencies. This measure would promote cross-fertilization of ideas and operational insights amongst the three state agencies devoted to economic development and diversification.

During FY00-01 the NELHA Board reexamined the issues, challenges, and opportunities faced by NELHA. Following a study to update the Master Plan, completed by consultant William L. Moore Planning by the end of FY99, in FY00 the BOD moved to accept a general plan as outlined in a map rendering "Proposed HOST Park Land Use" provided by consultant Moore as the basis for determining the general, physical aspects of the master plan for HOST Park.

In March 2001 the Board's Visioning and Strategic Planning Session focused on strategies to help NELHA and the HOST Park continue to grow and succeed in attaining economic self-sufficiency. One of the meeting's main accomplishments was establishment of a new Board standing investigative committee structure to help in streamlining the proposal approval process as well as instituting new procedures and addressing areas of concern. These were the Commercial Activities Committee (Chair, Peter Young), the Strategic Development Committee (Chair Bill Friedl), and the Audit Committee (Chair, Barry Mizuno) which would join the statutorily established Research Advisory Committee (Chair Don Thomas) in providing the Board with valuable review and investigation of specific topics. These committees included Board and community members with expertise in specific areas of relevance to NELHA.

Strategic planning activities by the Board in the latter part of FY01 reaffirmed NELHA's need to continually adapt to the ever-changing economic environment. The highest priority was placed on ongoing infrastructure development, repair and maintenance. The analysis also identified critical external forces driving the economy that affect local business: the burgeoning global population and the aging of significant consumer sectors in the U.S., Japan, and other countries. Accompanying increases in energy demands and interests in alternative, renewable and more efficient energy technologies as well as increased demands for food, health, and wellness products are creating new markets that NELHA and its tenants can well serve. Additionally, the globalization of local markets present tremendous export opportunities to help stimulate the influx of offshore capital into Hawaii

The Strategic Planning efforts also recognized the need to balance fiscal prudence with the ability to offer an attractive business setting for entrepreneurial startups and new industry incubation. Land rental and seawater rates continued to remain low. The Board reiterated the need to attract those tenants who can create higher value products rather than lower value commodities, and also to support ancillary development of education and research efforts to further bolster new industry development.

During FY01, the Board initiated communication with the Department of Transportation Airports Division regarding the process of developing an internal roadway and infrastructure connecting NELHA to the Kona International Airport. To support Gateway commercial center development, the CAC was consulted regarding drafting of an RFP for a marine/ocean center at HOST Park and considered ocean-themed exhibit/aquarium facilities; marine research laboratory and ancillary facilities; marine repository and exhibit facilities; ocean-themed activi-

ties and entertainment facilities which may include restaurant and or retail components); applied research, development and demonstration of emerging marine-themed technologies.

In FY00 the Board also enabled acceptance of stock equity payments from tenants on a case-by-case basis and implemented new interim policy to cap sales of bulk seawater taken offsite in response to the growing interest in NELHA's seawater assets.

BOARD MEMBERS

NELHA Board members provide public service on a voluntary basis. With their expertise and guidance, NELHA and its staff are able to navigate through complex government bureaucracy and make headway in a sea of ever-changing economic challenges. Each Board member serves a finite term, with new terms staggered to ensure long-term continuity.

At the beginning of FY00 in July 1999, Barry Mizuno succeeded Steven Chu in the private sector Director's seat. In September of that year, Raymond Carr succeeded long time Board member and former Chairperson Diane Quitiquit to represent the Mayor of Hawaii County. Board leadership also changed during FY00, with John Corbin ending his term as Chair through December 1999 and Tom Whittemore succeeding him in January 2000. In February 2001, Peter Young became the Mayor's representative on the NELHA Board. In March 2001, Robert Kihune, former Chairman of the Board and former Executive Director, resigned to devote more time to other responsibilities in the community.

In May 2000, significant New Economy legislation increased the NELHA Board from 9 to 11 members. One member each would come from the Boards of the High Technology Development Corporation (HTDC) and the Hawaii Strategic Development Corporation (HSDC). A NELHA Board member would also sit on each these two boards to allow "cross pollination" of ideas among these agencies, each devoted to different aspects of economic development. The new Board members would also have voting rights on the Boards on which they served. Initially, Barry Mizuno was appointed to serve on the HSDC Board and Robert Kihune on HTDC Board. In August 2000, the NELHA Board acquired its initial two new members: William McKillop and John Chock (HSDC). Richard Lim (HSDC) and Ken Koike (HTDC) succeeded them during FY01.

OPERATIONS SECTION

The Operations Section serves a vital function at NELHA: managing the operation and maintenance of all of NELHA's facilities and equipment, including the seawater supply system which operates 'round the clock. The Operations Staff is dedicated to maintaining an efficient and safe working environment, reliable services, and premium quality resources, central to the uniqueness and success of NELHA as an innovative ocean science and technology park. During FY00-01, the Operations Staff were busy with many projects, each one providing vital support to NELHA and its tenants.

INTERIM SURFACE SEAWATER PUMP STATION AND PIPELINE

An Interim Surface Seawater (ISSW) Pump Station was completed in January 2001 to service tenants in the HOST Park, particularly Big Island Abalone Corporation, until the new HOST Park Pump Station and associated distribution system comes online in late 2002. The ISSW Pump Station can supply up to 3,150 gpm of warm (26-28°C or 75-79° F) surface seawater to tenants in the HOST Park.

Makai Ocean Engineering, Inc. designed the system and Bolton, Inc. was contracted to install it. The system draws seawater from the 1,000-ft. long, 63"diameter tunnel installed by NOVA Corporation in 1994 for the new HOST Park Pump Station, still in the pre-design phase during FY01. At the ISSW station, two pumps are mounted on an open 16'x 21' concrete pad and are controlled with variable frequency drive (VFD) units within an enclosed 12' x 16' building. The pump station is constructed next to the "wet pit" where the HOST Park Pump Station will ultimately be constructed. Each pump delivers seawater through a separate distribution pipeline and each provides redundancy for the other. A spare pump is kept in storage as an emergency back up.

ISSW Pipeline "B" exclusively services Big Island Abalone Corporation and is capable of delivering up to a maximum of 1,750 gpm of surface seawater to their facility. BIAC began using seawater from this pipeline in March 2001.

Pipeline "A" of the ISSW system will be utilized to service other tenants at various elevations within the HOST Park with a maximum of 1,400 gpm. The 12-inch diameter ISSW distribution pipelines were laid on the surface of the ground to facilitate easy removal of the temporary lines. The ISSW distribution system is slated to be dismantled once the new HOST Park Pump Station and Distribution System are operational. Some of the ISSW components will be recycled as part of that new seawater supply system.

SEAWATER SYSTEM IMPROVEMENTS

Several important capital improvement projects were funded and constructed during FY00-01. These projects upgraded existing equipment, improved operational efficiencies and reliability, and increased overall pumping capacities in the NELHA seawater supply systems.

DEEP SEAWATER BOOSTER PUMP STATION. The Deep Seawater Booster Pump Station located at HOST Park was upgraded in FY01. Total capacity was increased from 1,200 to 6,500 gpm with the installation of 40 and 100 horsepower pumps and variable frequency drive motor controllers. Of this capacity, 4,000 gpm has been allocated to Big Island Abalone Corporation and the remaining 2,500 gpm is reserved for other tenants in the HOST Park area.

KA'U PUMP STATION. The 24" Ka'u Pump Station was totally upgraded in May 2001 with new intake and discharge manifolds, larger capacity 60 horsepower pumps, variable frequency drive motor controllers, an improved vacuum priming system, and a new monitoring and alarm system. Pumping capacity for this pump station increased from 1,200 to 5,200 gpm of surface seawater.

View of NELHA Booster Pump Station at HOST Park.

DSW BACKUP SYSTEM. NELHA's 18" deep seawater pipeline, which provides backup capacity to the main system, was also upgraded with higher capacity 40 horsepower pumps, new offshore power cables and motor controllers. This upgrade increase pumping capacity from 1,800 to 3,000 gpm of the valuable deep seawater.

MAIN PUMP STATION. In addition to these dramatic upgrades, a planning and design review process commenced to investigate the feasibility of installing higher efficiency dry motor driven pumps at the 40/28 NELHA Main Pump Station.

OPERATIONS STAFF RECEIVE HDPE PIPE FUSION TRAINING

On January 11, 2001, NELHA staff completed a specialized training seminar in HDPE pipe fitting and welding using a "butt fusion" heating machine. The full day seminar was conducted in Kona by Douglas Boe of Pacific Industrial Products from Honolulu. The training also included techniques in electrofusion, a new process that involves fusing high-density polyethylene plastic pipe and fittings together by means of electrically heating copper wires embedded in the fittings. The electrofusion process costs slightly more than using a conventional fusion machine, but offers more versatility for adding fittings or repairing existing pipelines already in service. Operations Section staffers Ernie Galt, Tony Mitchell, Gene Pierce, Justin Pitts, Bud Placek and Jan War successfully earned certifications for both processes from the seminar.

12" PIPELINE RECOVERY

HDPE pipe is very valuable material and has proven to work well for the delivery of seawater at NELHA if properly engineered. Since it has excellent properties for use in seawater environments, it can recycled from one project to another when the initial use is no longer needed. NELHA has a supply of stored pipe in the assets acquired from former NELHA tenant Ocean Farms of Hawaii (OFH). Back in the late 1980s, OFH engineers realized that their 16" deep seawater pipelines were beginning to collapse due to the suction pressure created by the submersible pumps. To remedy the situation, they devised a plan to insert a smaller, more rigid 12" HDPE pipe into the original 16" pipeline to bolster the larger pipe and prevent it from fully collapsing. Although the capacity of each pipeline was severely reduced by this retrofit, the system worked until the demise of the business endeavor in the early 1990s due to other causes. All told, Ocean Farms of Hawaii had inserted nearly two miles of 12" pipe into their two 16" underwater pipelines.

Recovery of these assets directly off the sea floor would be cost-prohibitive, however, in 1997 one of the OFH pipelines floated to the sea surface due to corrosion of the anchoring holdfasts. The buoyant pipe was sunk and moored safely out of the way of maritime traffic, but at a depth at which recovery would later be possible. In May 2000, NELHA successfully tapped into this stored resource, recovering 5,500 feet of 12" HDPE pipe for use in the NELHA Interim Surface Seawater Pump Station distribution system. An additional 2,660 feet of 12" HDPE pipe was subsequently recovered from the former OFH system in September 2000 and then recycled in a new 1,200 foot surface seawater distribution pipeline for NELHA tenant Coast Seafoods. The project cost NELHA $10,000 to recover some $40,000 worth of pipe material.

NEW DELIVERY PIPELINE INSTALLED FOR COAST SEAFOODS

Between January 15 to 23, 2001 NELHA Operations staff installed a new 12" diameter surface seawater distribution pipe to service NELHA tenant Coast Seafoods Company. This involved fusing approximately 1,200 feet of HDPE pipe before routing it under the NELHA access road. The pipeline installation was cost-shared by NELHA and Coast Seafoods and designed to be "self-cleaning." On an "as needed basis" the new distribution pipeline can be isolated and cleaned by shunting a "cleaning pig" through the line with water pressure to scrape off any biofouling that may have formed on the inner pipe walls.

NEW AQUATIC SPECIES HEALTH MANAGEMENT PROGRAM

NELHA's Aquatic Species Health Management Program (ASHMP) was formally approved by the NELHA Board of Directors at its meeting on January 16, 2001. The long-awaited program established guidelines and policies for the management of aquatic animal, plant and microorganism species cultivated by NELHA tenants. NELHA staff worked together with experts from the public and private sectors together with the Keahole Point Tenants Association over the previous three years to develop the program. The new ASHMP provides a common set of procedures for all tenants with the goal of maintaining a healthy and disease-free environment for all concerned. NELHA is aided in the implementation of this program by support from cooperating regulatory agencies such as the Department of Agriculture and the Department of Land and Natural Resources.

1-MEGAWATT EMERGENCY GENERATOR

The reliability of electrical supply at Keahole from the local utility is critical to the well-being of NELHA and its tenants. However, as has been seen in the past, disruptions to the power supply are inevitable and must be anticipated. NELHA tenants are advised to provide their own emergency backup power for their individual facilities. Similarly, NELHA maintains emergency backup power for the NELHA Research Compound and its pump stations.

A major capital improvement project has been the installation of a 1-megawatt emergency generator n the NELHA Power Center Building to provide backup power for the Research Compound. This generator increases NELHA's emergency generation capacities eightfold and enables full flow seawater pumping to continue during electrical power interruptions. Isemoto Construction Co., Inc. was contracted to complete this installation in the latter half of FY01. This project will provide ample emergency power to support NELHA seawater pumping requirements well into the next decade.

Work consisted of removal of the two existing 125KW generators and switchgear, construction of new foundations for a 4,000 gallon fuel tank, the 1-MW generator and an exhaust silencer, installation of those components on that foundation, building of a wall in the existing NELHA Power Center, installation of electrical cables and modifications to the NELHA Pump Control Building controls and switchgear. In addition, all electrical power supply controls were transferred to one centralized location.

Installation of the new switchgear necessitated operation and maintainance by NELHA Operations Staff of two mobile generators for more than 48 hours without interruption to ensure the supply of seawater to NELHA research tenants located in the Research Compound. This was accomplished without a hitch, a testament to the coordination and exemplary execution of this effort by the Operations Staff. At the closing of FY01, work continued on the final steps of the electrical, structural and mechanical components of this job, with testing of the new system scheduled for July and August 2001.

UTILITY EXPANSION PROJECT. In conjunction with the installation of the new 1-MW generator for the NELHA Research Compound, new electrical and telephone service also needed to be routed to NELHA tenants Kona Cold Lobster Ltd., Ono Take Inc. and Common Heritage Corporation, located outside of the Research Compound but historically connected to its systems and sub-metered by NELHA. The new utilities will allow those tenants to obtain services directly from the utilities HELCO and Verizon./GTE in the future, by-passing the

NELHA power supply. Most of the work for this project was completed by the end of FY01, leaving the remaining installation work to the two local utility companies.

HO'ONA ARCHAEOLOGICAL PRESERVE IRRIGATION SYSTEM UPGRADE

NELHA maintains an archaeological preserve north of its Research Compound on the shore of XX Bay. A number of plants propagated by school children and volunteer from the Hawaiian community were planted there and require irrigation. To conserve precious freshwater and save staff maintenance time, the Ho'ona irrigation system was totally upgraded in May 2001 with installation of a new polyethylene main distribution manifold and side branches. Battery-powered irrigation timers were installed in each of the five branch lines. The upgrades reduced total water consumption at the oceanfront site by 50-75%.

SEAWATER RATE AND COST ANALYSIS

NELHA seawater rates are well below operating costs, in essence creating a subsidized situation for NELHA tenant enterprises. These rates have not been changed in many years, although operating costs have significantly risen with the times. It became clear in recent years that seawater rates must be raised, however, the question of 'how much' remained to be determined.

To satisfy tenant and NELHA concerns, an independent study of NELHA seawater costs was commissioned. In FY00, NELHA contracted Pacific Marine Contracting, Inc. and Ross Engineering, Inc. to conduct a formal seawater rate analysis. A final report was presented to the NELHA Board of Directors in May 2000. The report provided data showing how the unit cost for seawater at NELHA initially decreases as the facility size and seawater pumping capacities increase. The study considered costs for electricity, labor, maintenance, and environmental monitoring involved in keeping the seawater flowing 24/7. The final number was found to be $0.1594 per thousand gallons, more than twice the amount of the seawater rates at the time of the study ($0.0628/Kgal and $0.0742/Kgal respectively).

Subsequently, the NELHA Board approved a rate increase of 10%, to commence July 01, 2001. An update of the operational costs involved in seawater delivery at NELHA will occur after the new seawater distribution system expansion projects are completed and more data is obtained.

STORED AMMONIA LEAVES NELHA

In March 2001, a tank containing approximately 750 gallons of anhydrous ammonia left NELHA destined for the power plant operated by Hamakua Energy Partners. The ammonia was originally used in the Closed Cycle OTEC experiment and no longer served any useful purpose at NELHA. The power plant uses ammonia to mitigate sulfur dioxide discharges from its smokestack. It was a relief to see this hazardous material leave the site.

RESEARCH COMPOUND FENCE REFURBISHMENT

Bob's Fencing Corp. completed replacement of approximately 460 feet of fence line along the southern boundary of NELHA's Research Compound in March 2001. Parts of the fence line were replaced in the past and the rest of the fence had been in place since 1979.

SCIENTIFIC/TECHNICAL SECTION

The Scientific/Technical Section provides engineering support for all infrastructure development and land use at NELHA. The section also provides consultation and support services to NELHA tenants on an as-needed, as-available basis. The Scientific/Technical Staff also perform the sample collection, analysis and data reporting for the range of environmental monitoring tasks necessary to maintain the pristine quality of the unique natural resources of Keahole Point on which NELHA and its tenants depend.

ENGINEERING

HOST PARK 55-INCH DIAMETER PIPELINE AND SEAWATER SUPPLY SYSTEM

Planning for a new pipeline and seawater supply system for HOST Park, ongoing since 1989, neared its dramatic climax during FY00-01. Design work had been completed in various stages between 1989 and 1997 to install two 55-in diameter pipelines, NELHA's and the world's largest, which will bring ashore warm surface and cold deep seawater. Unlike NELHA's previous seawater pipelines, the HOST Park system will access deep seawater at a depth of 3,000 feet and utilize micro-tunnels bored under the shoreline to connect an onshore pump station and the pipelines themselves at breakout points 80 feet underwater on the reef. This state-of-the-art engineering was the first project of its kind in Hawaii where an autonomous drill was employed to create twin tunnels to accommodate the deep and surface seawater supply lines. The primary benefit of this engineering method was the minimum environmental impact, in fact, the construction is literally invisible to the public since it passes underground, leaving the shoreline and beach totally intact and undisturbed.

The initial construction phase was the installation of the shore crossing, begun in 1994 and completed in January 1997. Two 55-inch (inside diameter) tunnels begin about 500 ft onshore in a pit about 30 feet below sea level. They both extend about 500 feet offshore, where they break out under the reef at about an 80-foot depth. The tunnels, one currently carrying surface seawater to the ISSW Pump Station and the other to be attached to a deep seawater pipeline extending to a 3000 foot depth, are lined with concrete and fiberglass for long term service.

Funds had been appropriated in 1999 20th Legislative Session for the fiscal biennium beginning July 1, 1999 and ending June 30, 2001 for the planning, design, construction and equipment of the 55-inch pipelines and onshore distribution system in HOST Park.

STATE CIP ALLOCATIONS

	FY00	FY01
Plans	30,000	5,000
Design	60,000	10,000
Construction	1,924,000	4,995,000
Equipment	4,657,000	3,693,000
TOTAL	6,671,000	8,703,000

For the offshore pipeline itself, a total of 9,200 feet of 55-inch diameter high density polyethylene (HDPE) pipe was required. By February 2001, California pipe supplier KWH Pipe in Shafter, California, was given a notice to proceed on the fabrication of the 55- and 60-foot lengths required for this mammoth project. The pipe sections would be shipped by barge from California to NELHA's staging area in Kawaihae Harbor. Sales representative Familian NW of Honolulu served as intermediary, monitoring each stage of manufacture and shipment. The pipe sections would be assembled by special heat fusion into nine 1000-foot lengths at the onshore staging area before deployment in the ocean.

NELHA's unusual application of HDPE pipe to a "suction" line, where pumps will pull the water up from 3,000 ft depth, imposed quite different constraints on the shipping and storage than did its usual usage as a pressurized delivery line for natural gas. Since collapse of the pipe due to differential suction pressure is the primary

limitation on possible pumping volumes, it was very critical that the pipe be kept as round as possible to prevent collapse. Polyethylene has a "memory", so "ovalling" during transport or storage would significantly decrease the pipeline service life. NELHA's pipe material procurement contract, therefore, had to specify in some detail the design of concrete "cradles" required to keep the many segments of pipe round during shipment. The shipper had to develop innovative stacking arrangements in order to fit all of the pipe sections on the two barge shipments that the time schedule allowed.

Pump station interior view.

This seawater system was designed by design/engineering consultant Makai Ocean Engineering. By May 2001, Healy Tibbits, one of the world's leading marine construction firms, had been selected and issued a formal notice to proceed by May 11th, then committed to the $11.2 million contract by May 17th. Their innovative deployment plan showed considerable forethought and attention to detail, both of which are essential to the success of this project. Wasting no time at all, the firm immediately initiated construction of the concrete anchors since completion of the entire deployment before the arrival of winter weather in November was extremely critical.

Once the first shipment arrived in Hawaii, critical offloading began, skillfully accomplished with forklift assistance by Kona Transportation onto three specially prepared flatbed trucks that could accommodate the 55- and 60-foot lengths. Many of the pipe sections weighed more than 6 tons each. After offloading, inspections by NELHA, the shipping company (Hawaii Tug and Barge, Inc,) and engineering/designer Makai Ocean Engineering, Inc. revealed that the shipment had arrived in excellent condition.

Healy Tibbets technicians begin fusing the 55-ft sections of HDPE pipe as soon as the pipe sections were offloaded into the staging area in June 2002. The new deep seawater pipeline, assembled as a 9,200 foot long giant "noodle", was planned to be transported, deployed, and installed in the summer and fall of 2001, with onshore work on the HOST Park Pump Station and seawater distribution system to follow in FY02. Dr. Tom Daniel, NELHA Scientific/Technical Director has been NELHA's pipeline project manager throughout the lengthy development process required for this extraordinary engineering project.

The new HOST Park seawater system, when completed at the end of calendar year 2002, will provide a flow of 40,500 gpm of surface seawater at 76°- 82°F and 27,000 gpm of deep seawater at about 38°F from an unprecedented depth of 3,000 feet.

55-INCH HDPE PIPE STORAGE AREA GRADING

In anticipation of the arrival of the new high density polyethylene (HDPE) pipe for the 55-inch diameter pipeline project in June 2001, a 2-acre staging area was prepared at Kawaihae Harbor, located in the northern Kohala District of the Big Island. The two-acre area of coral sand adjacent to the unloading ramp was prepared, to be used to store the pipe sections until the construction contractor began the task of fusing the pieces together. Minor site grading and compacting work to provide a uniformly smooth, firm surface on which to place the pipe sections was completed by contractor Kiewit Pacific Co. in May 2001.

SMALL BUSINESS COMPOUND DEVELOPMENT

During FY00-01, NELHA prepared to develop a new incubator area, the six-acre Small Business Compound (SBC), in the NELH section of the technical park. Tenant businesses with smaller space requirements will be accommodated here. Special Funds were tapped to support this planned development, with a contractor selected by the end of FY01 who would commence work shortly thereafter. Approximately $200,000 was designated to support the grading of the SBC development.

The SBC was designed as four lots of 1-2 acres each, with a common access roadway from the NELHA Access Road. Subdivision application was submitted to the County Planning Department to define the lot boundaries.

Final acceptance by the County will be dependent on upgrade of freshwater distribution lines to DWS standards, and is pending NELHA obtaining state funding to complete the second phase of this upgrade project.

FRESHWATER MAIN UPGRADE

One of NELHA's goals is to discontinue operating as a private freshwater utility at Keahole Point and transfer this role to the Hawaii County Department of Water Supply (DWS). As a prerequisite to the DWS taking over the freshwater delivery system, the present NELHA freshwater system must be upgraded to current DWS standards. Toward achieving this goal, improvements to the NELHA system were designed and construction scheduled for two phases. NELHA received Capital Improvement Program (CIP) funds from the Hawaii State Legislature for the first construction phase in FY00.

The first phase of the improvements was completed in FY01. Approximately 3,700 feet of 12" ductile iron main and appurtenances such as fire hydrants and water meters were installed. Private contractor Goodfellow Bros., Inc. was contracted to perform the work, which was completed in a timely and professional manner.

A subsequent request to the Legislature during FY01 for the second phase of construction was unsuccessful, delaying the completion of this project and subsequent formal dedication of the upgraded system to DWS. NELHA will continue to seek state funding support to complete this needed project in the coming year.

HOST PARK ELECTRICAL UPGRADES

Another state-funded CIP project that will enhance existing infrastructure at NELHA involves energizing the NELHA Access Road lighting fixtures and guardhouse at the Queen Kaahumanu Highway entrance to NELHA's properties. Work will involve installation of equipment and underground distribution facilities to supply electricity to a secondary access road in HOST Park. During FY01, Wallace T. Oki, P.E., Inc. was contracted to perform the design work for this project, with installation and construction to occur during FY02 subsequent to approval of the construction plans by the affected utility companies.

HOST PARK DEEP SEAWATER AIR CONDITIONING LOOP

NELHA has demonstrated the efficacy of using deep seawater for air conditioning via the simple system that now cools laboratory buildings at a fraction of the operating cost that would be required for a conventional chiller system. NELHA's contractor, Makai Ocean Engineering, Inc. of Waimanalo, has also participated in a much larger demonstration, the Lake Source Cooling project at Cornell University, which provides 16,000 tons of air conditioning for the Cornell campus via a 63-inch diameter pipeline that brings the deep cold waters from Cayuga Lake.

Underwater pumps present maintenance challenges.

NELHA plans to make this exciting cost-saving technology available to HOST Park tenants via a closed chill water loop encircling the park. The fresh water in the loop will be chilled by thermal contact with deep seawater in a heat exchanger mounted near the shoreline. Use of a closed loop will dramatically reduce the energy required to pump the water to the top of the host park area, since the work against gravity is recovered as the water flows back down the loop and the only pumping load will be that required to overcome friction in the pipeline.

Preliminary studies by Makai Ocean Engineering indicate that 400 tons or more of air conditioning could be provided at an operating cost less than 20% of that for conventional systems.

They are now beginning the detailed design of such a system for installation in conjunction with the HOST Park seawater distribution system.

SEAWATER RETURN SYSTEM IMPROVEMENTS

In FY01, NELHA contracted Planning Solutions, Inc. consultants of Honolulu to study NELHA's existing and planned systems for the return of seawater to the environment, with the goal of recommending changes to improve the environmental and economic efficiency of those systems.

The consultants analyzed the efficacy and the impacts of the current mechanism, in which used seawater is discharged into "disposal trenches" excavated near shore. The water then mixes with the naturally occurring groundwater and slowly percolates through the porous lava substrate to eventually return to the ocean. This method of seawater disposal via diposal trenches has worked well for more than 15 years at NELHA, but the dramatic increase in discharge volumes anticipated with use of the new 55-in pipeline system led NELHA to commission the subject study before committing to a similar seawater return system in the HOST Park.

By the end of FY01, drafts of three of the four deliverables from this contract were received by NELHA: 1) a report on the hydrology of NELHA groundwater, primarily derived from detailed measurements in our existing groundwater monitoring wells, 2) a report analyzing the historical data from the NELHA Comprehensive Environmental Monitoring Program and recommending future improvements to that program, and 3) a report summarizing the results of the first two reports and recommending changes for future sea water return and monitoring programs. NELHA reviewed these drafts and submitted recommendations for improvements. The fourth deliverable, an environmental compliance guidebook for NELHA, was still in preparation at the end of FY01. When completed, the reports will be shared with NELHA tenants and appropriate regulatory agencies.

EPA ROUTINE SITE INSPECTION

On April 17, 2001, the Environmental Protection Agency performed a routine site inspection of NELHA. The visiting team of six reviewed NELHA organization and procedures and made many recommendations for improvements, especially in communication with local emergency preparedness agencies and activities. They also collected voluminous information about our facility and activities. NELHA staff corrected the few deficiencies the inspectors noted in storage practices around the facility, and awaited the formal report on the inspection. NELHA also developed a comprehensive list of all hazardous chemicals used at NELHA and requested similar lists from its tenants.

PUNA GEOTHERMAL FACILITY

NELHA has prepared a Request for Proposals for lease of the Puna Geothermal Facility. The HGP-A geothermal well at the facility was plugged and abandoned in 2000, so there is no remaining heat source. Projects requiring geothermal fluids have not been feasible since the power plant and steam flow were discontinued in 1989. There is strong community support for re-initiation of some of the projects, so NELHA is requesting proposals for re-activating the facility.

ANALYTICAL LABORATORY

NELHA's Analytical Laboratory specializes in analytical water chemistry and marine microbiology. Its technicians collect, process, and disseminate the information needed to protect NELHA's valuable seawater and groundwater resources. Environmental monitoring activities include sample collection, analysis, data recording, and testing of incoming and outgoing seawater, as well as of groundwater, anchialine pond water, onshore, benthic and midwater biota, and offshore water quality. Data are also reported in compliance with regulatory requirements of the Hawaii County Planning Department and state government agencies including the Department of Land and Natural Resources, the Office of Environmental Quality Control, and the Department of Health. The NELHA analytical laboratory is well-equipped for these tasks in both equipment and personnel. NELHA has established a forward-looking, multi-disciplinary environmental monitoring program and team of experienced technicians to maintain and operate the laboratory.

COMPREHENSIVE ENVIRONMENTAL MONITORING PROGRAM

Much of the Analytical Laboratory Staff's work involves implementation of NELHA's Comprehensive Environmental Monitoring Program (CEMP), collecting and analyzing samples from more than 100 sites located both onshore and offshore of the Keahole properties. The CEMP allows NELHA to monitor its pristine environment and serves as an early detection system should any leaks or irregularities in onshore effluent disposal occur, protecting and preserving the pristine offshore environmental quality. Throughout FY 00-01, the NELHA Analytical Laboratory Staff continued to perform the essential routine monitoring required to ensure that facility operations have minimal unfavorable environmental impacts and that the pristine quality of the environmental resources are preserved.

DEEP SEAWATER TURBIDITY EVENT

On December 13, 1999, NELHA received a call from several tenants who indicated that the deep seawater they were receiving was "cloudy". A quick check at several locations in the distribution system and within the submerged pump station chamber determined that the deep seawater coming up the 40" pipeline was indeed very turbid and cloudy. A sedimentation tank was set up in the Research Compound and approximately 25-35 gpm of deep seawater was directed through a plankton net. Closer inspection revealed that most of the material that made the seawater cloudy was typical bottom slope sediment with a high number of shallow water tests (shells).

Other reports were received from fishermen up and down the Kona Coast who noticed "weird" surface conditions (turbid, discolored water, strong irregular currents over a large area, etc.) during the same period. Divers in two separate 1-man submersibles reported that while working off Kailua-Kona from 13-16 December they found the water at 1,400 ft. depth to be very turbid and experienced strong upwelling currents. Their dives had to be terminated because of poor visibility and the strong current.

The deep seawater slowly cleared up over a two-week period and returned back to normal by the first week of January 2000. This is the first recorded event of this kind and the cause of it may never be known. One theory is that the West Coast of the Big Island was temporarily subjected to very strong upwelling currents, due to a naturally occurring event that stirred up the bottom sediments and created the cloudy, turbid conditions. No adverse effects were reported by any NELHA tenants.

LEASING & TENANT RELATIONS SECTION

The Leasing and Tenant Relations Section was created during FY00-01 to manage NELHA's tenant and master leases, process land use agreements, and monitor compliance with the terms and conditions of those legal documents. NELHA provides support facilities for research tenants and land and infrastructure for education and commercial tenants. The NELHA standard leases summarize NELHA policy, terms and conditions of land use for those tenants. Throughout FY00-01, a continuing review and streamlining of the leases and lease processing occurred both internally at NELHA and in cooperation with the Land Division of the Department of Land and Natural Resources. NELHA has also been continually aided by legal counsel at the Department of the Attorney General to strengthen the standard leases and ensure alignment with master lease provisions and state regulations.

During FY 00-01 negotiations were completed for a new master lease with DLNR to consolidate NELHA's previous land agreements including two General Leases (S-4717 and S-5157) and an Executive Order 3032. Each of these was canceled by the BLNR and then replaced by General Lease S-5619 in June 2001. DLNR and NELHA staff worked cooperatively on the new master lease, which was approved by the Board of Land and Natural Resources (BLNR) in November 1999. The new master lease was in place by mid-FY01, and, soon thereafter, NELHA and DLNR staff were able to also continue processing two dozen short term and long term leases in the bureaucratic pipeline and proceed with the execution of new leases for incoming tenants using new approval protocol. Through the cooperation of DLNR staff and Board, changes were made to the master lease in June 2001 in an effort to assist NELHA in streamlining lease approval procedures by allowing the BLNR Chairperson (in lieu of the entire BLNR) to provide necessary Lessor approval of NELHA sublease documents.

In June 2001, the NELHA Board was presented with a conceptual proposal by its DLNR representative that the Department's Division of Aquatic Resources (DAR) be allowed to occupy lands at NELHA for a nursery/hatchery similar to the Anuenue Fisheries Research Center on Sand Island. The proposed facility would be used by DAR to conduct research and develop growout, release, and/or restocking of deep ocean fish off West Hawaii. The advantage to DAR would be the availability of land and access to cold deep seawater as well as the prime location. It was proposed that land rents be traded off with NELHA as a credit against future rents to be paid to DLNR. The NELHA Board supported the concept and requested that the matter be pursued further with DLNR. DLNR-DAR and NELHA staff were exploring the many possibilities and alternatives as FY01 came to a close.

Advances from NELHA tenant research will open new markets for Hawaii businesses.
LEFT: Moist, rich soil revealed under dry soil surface of coldwater agriculture beds chilled by deep seawater in the Keahole desert.
CENTER: Plump omilu broodstock may hold promise of new captive-bred finfish.
RIGHT: Hawaii-bred hybrid coldwater lobster could open a new niche market in the future.

GATEWAY PROJECT

During FY00 the Administrative and Projects Manager was reassigned as Gateway Project Manager to allow exclusive focus on development and management of this important NELHA project. Efforts by the Gateway Manager and Board members continued towards developing the NELHA Gateway throughout FY00-01.

The NELHA Gateway project will be located at the entrance to the Hawaii Ocean Science & Technology (HOST) Park and serve as a gateway facility to the NELHA properties. Organizers envision a campus setting intended to serve as a premier center for research and development, demonstration, deployment, education, outreach and techno-tourism. The Gateway facility is being planned to support three focus areas:

1. Distributed Energy Resources (DER)
2. Ocean Sciences, Marine Bio-products, and related fields
3. Education, Outreach, Tourism

DISTRIBUTED ENERGY RESOURCES. Phase One of the NELHA Gateway Project will involve design and construction of the Distributed Energy Resources Center, a facility to support the development of renewable and distributed energy resources and technologies through research and commercial incubation activities.

Through initial construction funding from a $3 million grant from the U.S. Department of Energy (USDOE), the NELHA Gateway will provide the opportunity and foundation for a national test bed dedicated to development, testing, demonstration and deployment of cutting edge distributed energy technologies. In keeping with NELHA's mission and the goals of the statewide energy program to increase the ratio of indigenous to imported energy use, the Gateway will also serve as an incubator for those companies focused on renewable/distributed energy generation and related fields.

A strategic planning session hosted by NELHA was planned for July 2001 to bring prospective partners from public and private sectors including government and academic institutions from across the United States and also British Columbia, Canada, to discuss opportunities in energy research, development and deployment at the NELHA Gateway Distributed Energy Resources Center.

By the end of FY01, the Gateway Project reported the following accomplishments for the first Gateway focus area:

—Federal appropriations of $3 million in construction grants for NELHA Gateway development administered via the U.S. Department of Energy

—Initial design, planning and construction underway for the Gateway DER facility

—Development of strong partnering opportunities with NELHA and other organizations to maximize impact of limited resources.

—Partnering relationship brokered between NELHA and New Mexico Tech (New Mexico Institute of Mining and Technology in Socorro, NM) for an Integrated Distributed Generation Applications and Deployment Program and serving as the basis for a new Congressional initiative. A June 2001 press release by Senator Daniel K. Inouye announced the inclusion of an additional $1 million for this effort by the Senate Appropriations Committee in a FY2002 Appropriations Bill for the Departments of Energy and Water Development.

—A concept proposal entitled "Hawaii Hydrogen Infrastructure Initiative (H2I2)" was also submitted in FY01 to the U.S. Department of Energy by DBEDT-ERTD/UH-HNEI on behalf of NELHA for additional program funding consideration of up to $1.5 million for hydrogen-related research.

—Exploration initiated between NELHA and the Department of Transportation, Airports Division, concerning cooperative development of the NELH –Airport connector road, which will require approximately 0.6 miles of new roadway, in association with national Homeland Security requirements for dual ingress/egress routes for all international airports.

OCEAN SCIENCES, MARINE BIOPRODUCTS AND RELATED FIELDS. For the NELHA Gateway's second focus area, the NELHA Board of Directors issued a Request for Proposals (RFP) in FY01 for an "Ocean Centerpiece" development with commercially-oriented activities with ocean-related themes. Approximately 75 acres

of highway frontage property were reserved for development of this projected commercial profit center for NELHA. Examples of the broad areas of interest for this Ocean Centerpiece may include but are not limited to:

1) Ocean theme exhibit and aquarium facilities and associated commercial activities;
2) Marine research laboratory and support facilities; ocean theme education and outreach facilities;
3) Facilities encompassing applied research, development and demonstration of prominent and/or emerging ocean technologies;
4) Commercially viable enterprises that are compatible with and enhance the Ocean Centerpiece theme

By the end of FY 00-01, accomplishments for the second focus area of the Gateway development included:
—Discussions between NELHA, the Kohala Center, and Cornell University Oceanography & Marine Sciences representatives focusing on the establishment of a marine bio-diversity center and partnering opportunities.
—Discussions between NELHA, National Marine Sanctuary Foundation and Hawaiian Island Humpback Whale National Marine Sanctuary and others including Jean-Michel Cousteau and Ocean Futures Society to identify partnering opportunities.
—A draft concept piece entitled “Integrated Program Proposal - Hawaii Island Humpback Whales” was circulated for review and implementation. The concept is to produce a suite of video productions that will serve as an integrated awareness program designed to serve both promotional and education purposes for multiple NELHA, State and academic interests in both the public and private sector.
—Exploration of partnering opportunities with the University of Hawaii, Marine Bioengineering Center (MarBEC), National Oceanic Atmospheric Administration (NOAA), U.S. Department of Agriculture (USDA), University of California Santa Barbara, and others.

EDUCATION, OUTREACH, TOURISM. The third focus area, education and outreach functions, is incorporated into all aspects of the NELHA Gateway project including pre-construction planning. To support education and outreach services to the general public, K-12 education, and university level audiences, the NELHA Gateway facilities are being planned to include auditorium-style seating for presentations as well as areas for exhibits and interactive displays. In all aspects of the NELHA Gateway, the intent is to allow public and private sector partners the latitude to develop coordinated, cooperatively implemented programs that can offer a higher level of success than might be experienced if developed independently.

By the end of FY01, NELHA was able to cite accomplishments on which to build foundations for education, outreach, and tourism at the Gateway:
—Commencement of docent training program through USDA Rural Development grant
—Formation of an independent Friends of NELHA non-profit group to support outreach at NELHA
—Agreement between NELHA and new tenant Oceanic Institute to provide an interim education and outreach visitor area until the first Gateway facilities are constructed.
—Initiation of interagency partnerships with the Hawaii State and U.S. Departments of Education, several universities, and others were being developed to support outreach and education functions.

LEFT: NELH section (322 acres) of NELHA properties, close to full development on June 01, 2000. NELHA anchor tenant Cyanotech Corporation's colorful microalgae raceways dominate the property.

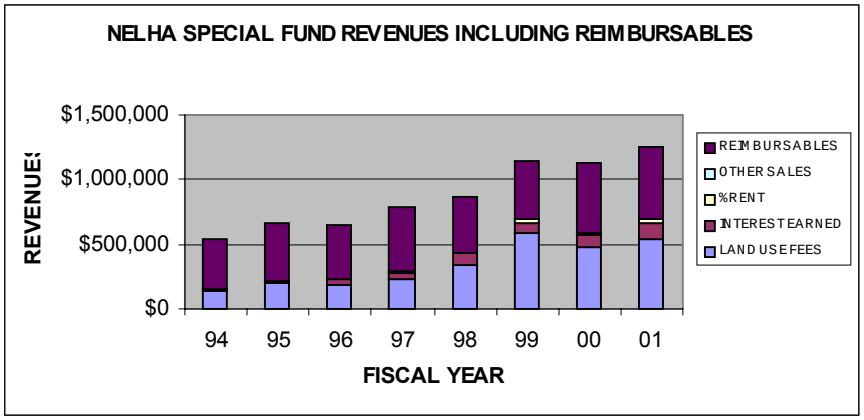
BELOW: HOST Park section (548 acres) of NELHA properties. NELHA tenant Big Island Abalone Corporation had begun grading a subleased 10-acre parcel, visible in foreground, at the time of this photograph on June 01, 2000). Directly makai is a dark spot on coastline marking site of new 55-inch pipe pump station.

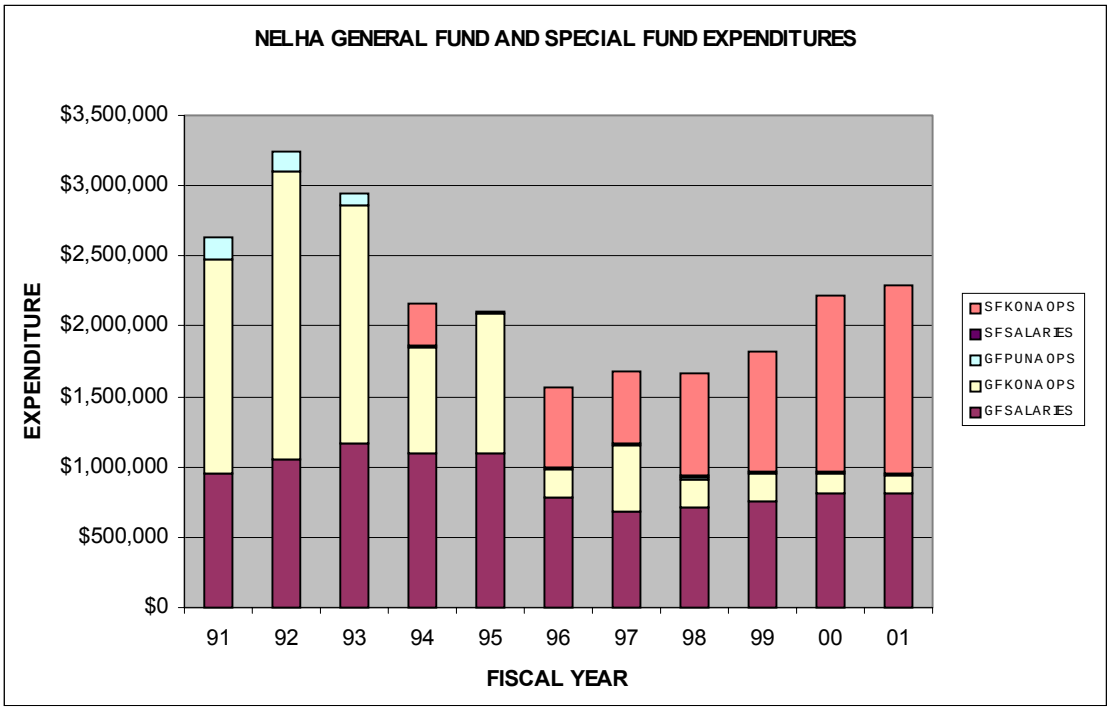
FISCAL SECTION

The NELHA Fiscal Section works closely with the State of Hawaii Department of Budget and Finance, the Department of Accounting and General Services, and Department of Business, Economic Development and Tourism to manage NELHA's financial resources. In addition to responding to the many reporting requirements of these departments, the Fiscal Section's responsibilities also include day-to-day management and oversight of:

—Budgeting
—Inventory of fixed and movable assets
—Petty Cash disbursements
—Purchasing
—Accounts Payable and Accounts Receivable
—Tracking of General, Special, Federal, and State Capital Improvement Funds

NELHA's long term financial goal is to become economically self-sustaining. Managing costs of maintaining its unique facilities and infrastructure to attract and support a variety of tenants who can find economic success is key. As NELHA moves forward to implement this task, the fiscal staff continuously provides critical data and guidance to help the NELHA administration and Board to meet their goals.





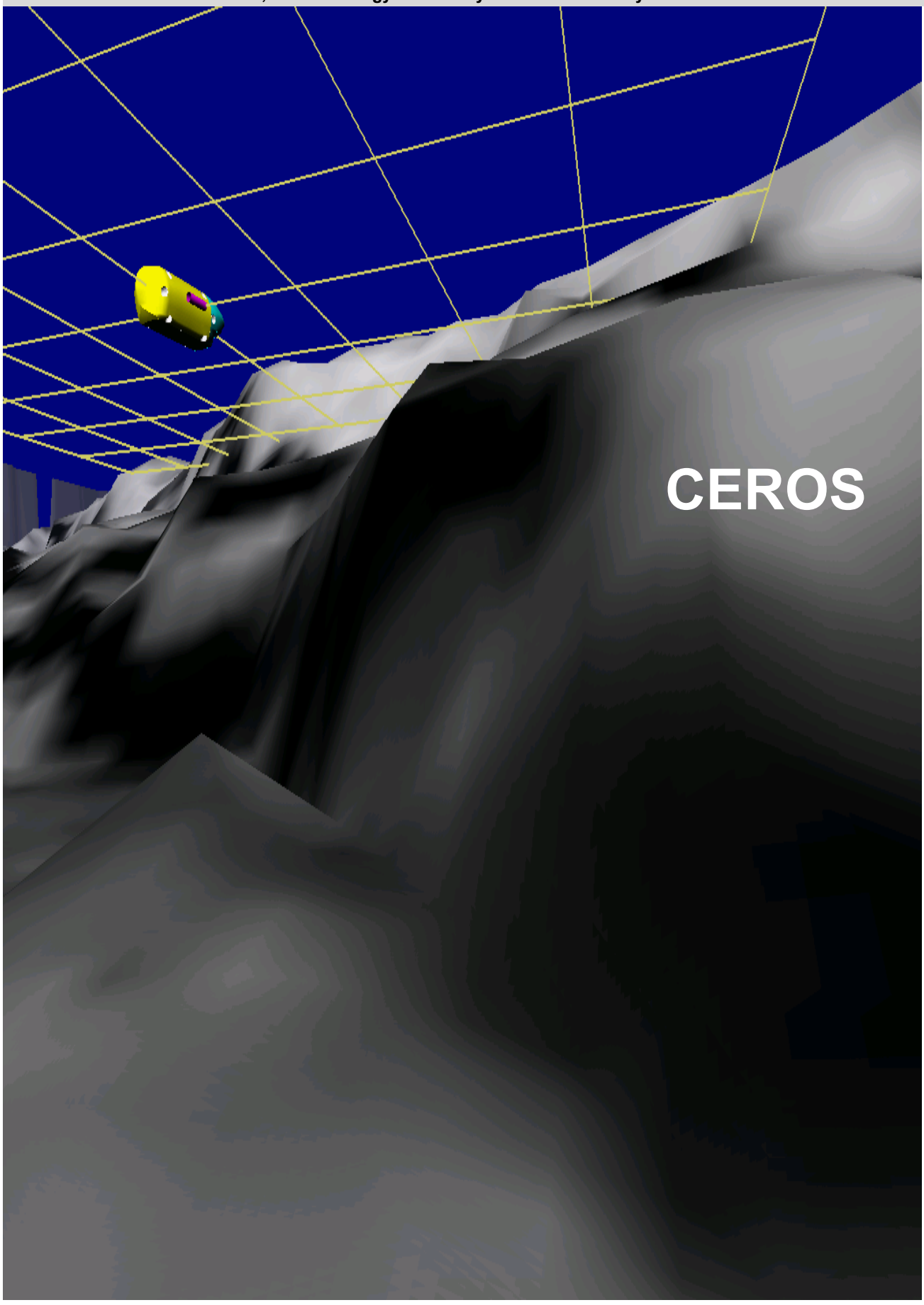
FINANCIAL OVERVIEW

STATEMENT OF OPERATIONS

	FY 00 (July 1, 1999 to June 30, 2000)		**FY 01** (July 1, 2000 to June 30, 2001)	
	REVENUES	**EXPENDITURES**	**REVENUES**	**EXPENDITURES**
General Funds				
State Funds	$966,525.00		$966,525.00	
Restrictions (State)	($2,732.00)		($16,735.00)	
Subtotal	*$963,793.00*		*$949,790.00*	
GF Salaries		$814,401.73		$813,017.89
GF Kona Operations		$141,969.28		$130,571.87
GF Puna Operations		$6,946.82		$3,568.50
Subtotal		*$963,317.83*		*$947,158.26*
Special Funds				
Land Use Fees	$480,070.70		$541,690.45	
Reimbursables	$555,298.51		$558,648.07	
Other Projects				
Interest Received	$88,044.79		$125,563.07	
Vending Machine Sales	$16.46		$0.00	
T-Shirt Sales	$57.00		$99.00	
Percentage Rents	$12,460.87		$26,980.04	
Subtotal	*$1,135,948.33*		*$1,252,980.63*	
Total Revenues	**$2,099,741.33**		**$2,202,770.63**	
SF Salaries		$0.00		$0.00
SF Kona Operations		$1,249,791.36		$1,341,838.09
Subtotal		*$1,249,791.36*		*$1,341,838.09*
Total Expenditures		**$2,213,109.19**		**$2,288,996.35**

FINANCIAL POSITION

	FY 00 (July 1, 1999 to June 30, 2000)	**FY 01** (July 1, 2000 to June 30, 2001)
Special Fund Balance at FY Start	**$1,844,834.28**	**$1,730,991.25**
State General Fund Appropriations	$963,793.00	$949,790.00
Special Fund Revenues	$1,135,948.33	$1,252,980.63
Subtotal	*$3,944,575.61*	*$3,933,761.88*
General Fund Expenditures	$963,317.83	$947,158.26
Special Fund Expenditures/journal entries	$1,249,791.36	$1,341,838.09
Unrequired G/F Returned to St Treasury/DBEDT	$475.17	$2,631.74
Subtotal	*$2,213,584.36*	*$2,291,628.09*
Special fund transfer from previous years		$48,220.78
Ending Special Fund Balance at FY End	**$1,730,991.25**	**$1,690,354.57**


CEROS

CEROS

The National Defense Center of Excellence for Research in Ocean Sciences (CEROS)

New Ocean Technology for Hawaii

CEROS is a unique technology development program between the State of Hawaii and the federal Defense Advanced Research Projects Agency (DARPA). CEROS demonstrates that the State can be responsive to the needs of the Department of Defense for state-of-the-art ocean technology. Complete information about CEROS is on the website, www.ceros.org.

CEROS is a State program entirely supported by federal funds. The program started in 1993, with $5 million appropriated for CEROS in the supplemental federal appropriation for the Department of Defense. Federal support for CEROS comes to the State through a Cooperative Agreement with DARPA, the principal technology development agency for the Department of Defense (the Internet was a DARPA project, for example). DARPA also provides technical and administrative guidance to assure that the program remains responsive to the needs of the federal defense establishment while helping the technical commercial base develop in Hawaii. DARPA has been an excellent partner in this task.

CEROS is in many ways a special federal/state partnership. CEROS started as a project of the High Technology Development Corporation (HTDC) and became part of the Natural Energy Laboratory of Hawaii Authority (NELHA) in 1996. HTDC and NELHA are among the State's "attached agencies" in the Department of Business, Economic Development & Tourism (DBEDT).

Attached agencies act as quasi-corporate entities within the State structure. The NELHA Board of Directors oversees NELHA operations and grants CEROS its authority to issue State contracts for technical development projects. The best depiction of the CEROS/NELHA relationship is as two separate programs joined by a common Board of Directors. NELHA has proven to be a good and appropriate "home" for CEROS.

From the start, DARPA sought an efficient CEROS organization to turn the federal funds, which are appropriated annually, into funded contracts in as short a period as possible. Thus, CEROS runs annual competitive solicitations for technical projects and handles the entire process from initial announcement (in October) to contract negotiation and commitment (usually in the following June). Since 1993 CEROS has funded 130 technical projects for about $50.6 million.

The CEROS program operates on less than 8% administrative overhead (i.e. 92% of the federal funds go into the Core technical program). The CEROS personnel list is 4: Technical Director, Fiscal Assistant, Program Manager for Outreach and Administration, and Contracts and Grants Administrator. CEROS maintains a Projects Office at NELHA headquarters in Kailua-Kona and a Contracts Office in Honolulu.

CEROS point of contact: William A. Friedl, CEROS Technical Director, billf@ceros.org.

PREVIOUS PAGE: OCEAN IMAGING CONSULTANT, INC. Virtual image of ROVer's eye-view of ocean bottom bathymetry.

STRUCTURAL SOLUTIONS, INC. A probe for in-situ characterization of marine

SeeRescue® CORPORATION. Rescue streamer deployed at sea for high vis-

FUNDED PROJECTS

AQUACULTURE TECHNOLOGY, INC.
- Naturally Occurring Antibodies from Marine Algae *Chaetoceros* (FY94) ($171,000)
- Naturally-Occurring Antibacterial and Antifungal Substances from Marine Algae *Chaetoceros*, *Nitzschia* and *Thalassiosira* (FY95) ($207,000)
- Continuous Production of Marine Algae *Chaetoceros spp*. In An Open System (FY97) ($240,000)

BAND, LAVIS & ASSOCIATES, INC.
- Application Of Techniques and Comparative Effectiveness of Non-Toxic Anti-Fouling Surfaces to Immersed Nettings Used In Naval and Aquaculture Industries (FY97) ($227,198) [Subcontractor: Black Pearls, Inc. Holualoa, HI]

BBN TECHNOLOGIES
- Develop HYDROFIST: A Nonexplosive Means for Generating Intense and Focused Underwater Shock Waves (FY99, FY00) ($999,819; $817,969) [Subcontractor: Navatek Ships, Ltd. (a subsidiary of Pacific Marine), Honolulu, HI]
- Implement and Demonstrate ASW Targeting and Weapon Control Using Non – Organic Sensors: Netted Combat Control System (Netted CCS) (FY01) ($881,772)

BLACK PEARLS, INC.
- Probiotic Bacteria: The Key to Expanded Use Of Deep Seawater in Tropical Aquaculture and the Solution to a Growing Industry Problem (FY97) ($121,392)
- A Continuous-Culture Closed-System Deep Seawater Photobioreactor for Microalgal Culture for Hatcheries and Pharmaceuticals (FY00) ($173,201)
- Developing a Sensitive, Sessile Monitor for Non-Point Source Heavy Metal Pollution for Tropical and Sub-Tropical Indo-Pacific Waters (FY01) ($138,097)

BLACK PEARLS, INC. Hawaiian pearl oyster broodstock in wire baskets.

COX ENVIRONMENTAL SYSTEMS COMPANY
- Water Properties Miniature Optical Sensor Project (FY00) ($215,004)

DETECTION LIMIT TECHNOLOGY, INC.
- Development of Fiber-Optic Chemical Sensors (FOCs) For Remote In-Situ Monitoring of pH and Carbon Dioxide in Seawater (FY93) ($237,000)
- Development Of A Fiber-Optic Based Autonomous Buoy for *In-Situ* Monitoring of pH, pCO_2, Temperature, O_2, and Water Quality In Seawater (FY94) ($332,000)
- Solution Plus *In-Situ* Ocean Sediment Chemical Analyzer (FY96, FY97) ($320,000; $360,000)
- PCB Analyzer for Shallow Ocean Water (FY98) ($380,000)
- Automated SERS Immunoassay Detection System: Detection of an Aquaculture Virus and “Dog Nose” Sensor for TNT Detection (FY00) ($439,937)

EDWARD K. NODA & ASSOCIATES, INC.
- Hurricane Risk Analysis and Modeling of Coastal Flooding For The Hawaiian Islands (FY93) ($214,000)
- Modeling of Hurricane-Induced Coastal Flooding for the Hawaiian Islands (FY98) ($182,345)

GATEWAY TECHNOLOGIES INTERNATIONAL, INC.
- Radar/Sensor Signal Processing Research of Shallow Water Surveillance Technologies (FY93) ($386,000)
- HIRADSIM Workstation Development Project - Continuation Of Existing Work Advanced HIRADSIM Small Target - Time Domain - Maritime Radar Mode (FY94) ($250,000)
- Personal Emergency Lifesaving System (PELS) (FY98) ($240,920)

GUIDENET, INC.
- Using Software Agents to Acquire and Visualize Environmental Information for ASW Surveillance (FY98, FY99) ($305,000; $360,000)
- Workflow Paradigm for ASW by Reliable METOC Data and Tasks (FY00) ($397,051)

IBM/LORAL FEDERAL SYSTEMS; KEWALO BASIN MARINE MAMMAL LABORATORY
- Acoustic Analysis Tool Kit (FY 93) ($480,000)

INNOVATIONS HAWAII

- Extended Source Apparent Motion (E-Sam) Lighted Signals For Protection Of The Marine Environment (FY93, FY94) ($241,000; $177,000)

INNOVATIVE TECHNICAL SOLUTIONS, INC.

- Temporally Enhanced Adaptive Multi-Spectral (TEAMS) System for Detection of Underwater Objects (FY01) ($35,000)

MAKAI OCEAN ENGINEERING, INC.

- Cost-Effective GPS-Based Sensor For Measurement Of Heave, Pitch, Roll And Heading On Oceanographic Platforms With O.3 Degree Resolution (FY93, FY94) ($230,000; $235,000)
- vLoop Avoidance Control during the Deployment and Retrieval of Submarine Cables (FY96) ($287,000) [Subcontractor*:* Knapp Engineering, Inc. (new name is Structural Solutions), Aiea, HI]
- An Automated Control System For Deployment of Small Diameter Cables and Towed Bodies—a Cable Lay Simulator (FY94) ($325,000)
- Design, Construction, and Operation of a Fifty Kilowatt Closed Cycle OTEC Plant and Application Of Results To The Design of a One Megawatt OTEC Plant (FY94, FY96) ($450,000; $200,000)
- Internet-Enabled Engineering Tool for Dynamically Analyzing and Planning World-Wide Subsea Cable and Array Installations (FY98) ($379,985)
- Improving Flow from Deep Water Pipeline (FY00) ($388,950)
- Remote Monitoring and Expert Control of Submarine Cable and Array Installations (FY00) ($345,737)

PACIFIC MARINE, INC. Unique hull design of midfoil ship, visible as vessel is suspended from a crane.

MISSION RESEARCH CORPORATION

- Ocean Doppler Lidar (FY95) ($381,000)

NEPTUNE TECHNOLOGIES, INC.

- Diver Homing Device (FY95, FY97) ($200,000; $39,000)

TREX ENTERPRISES, INC. Sensor for Pesticide Monitoring Based on a Porous Silicon Biosensor.

NEXTWAVE ENGINEERING

- Snap-To Amphibious Footwear System (FY01) ($75,700)

OCEAN ENGINEERING CONSULTANTS, INC.

- Swath Motion/Structural Software Development (FY94) ($121,000)
- Swath Motion/Structural Software Development and Verification (FY95) ($168,000)
- Flow Simulation and Visualization for Swath Ships (FY96) ($161,000)
- SWATH Ship Software and Verification (FY00) ($164,954)

OCEANIC IMAGING CONSULTANTS, INC.

- The DiVRS (ROVer's) Eye Terrain Database Visualization as an Aid to Underwater Navigation (FY98, FY99) ($239,652; $275,482)

THE OCEANIC INSTITUTE

- Cultured Fish as Biological Indicators of Pollution (FY99) ($216,766) [Subcontractor: Associated Laboratories, Orange, CA]

OCEANIT LABORATORIES, INC.

- Computational and Physical Modeling of the Hurricane Tower Desalination System (FY97) ($150,000)

q Low-Cost Prebuckled Cylindrical Pressure Hulls (FY93*,* FY94)

SeeRescue® Corporation - LifeFloat™ Survival

($343,000; $91,000)

- Three-Dimensional Cloud Height Indicator for Marine Application (3D-CHIMA) (FY01) ($400,000)

OCEANTEK, INC.

- An Ocean Bottom Span Analyzer for Survey Planning and Installations of Submarine Cables and Pipelines (FY99) ($188,000)

OCEANTRONICS, INC.

- Submarine Electronic Charting System (FY99) ($95,000)
- Electronic Charting Display and Information System (ECDIS-N) for the Navy with Special Emphasis on Submarine Navigation – Phase II (FY00) ($98,000)
- Submarine Electronics Charting System – Final Phase (01) ($200,000)

ORINCON HAWAII, INC.

- Underwater Echolocation for Object Recognition (FY93, FY94, FY95) ($770,000; $653,000; $697,000) [Subcontractor: Hawaii Institute of Marine Biology, Kailua, HI]
- Advanced Real-Time Signal Processor (ARTS) and ASW Commanders Workstations (ADM-3) (FY95, FY96) ($862,000; $872,000)
- An Upgraded ARTS Processor for Maritime Patrol Aircraft Applications (FY98) ($373,000)
- Antisubmarine Warfare Commander's Workstation Upgrades and Advanced Real-Time Signal Processor for CTF-12 Applications (FY97) ($500,000)
- Submarine-Launched, Two-Way, Fiber Optics-Linked Communications Buoy (FY96) ($160,000) [Subcontractor: Sippican, Inc., Marion, MA]
- An Improved Acoustic Intercept Receiver for Submarine Applications (FY97, FY98) ($450,000; $560,000)
- An Integrated System for Detection, Classification, Localization, Tracking and Reporting of Submarine Contact Data (FY97) ($700,000)
- Situation Awareness System (SAS) Processor for Submarine Applications, Phase 2 and At-Sea Evaluation (FY 98, FY99) ($171,777; $775,864)
- Automation and Integration of Environmental Factors into ASW Tracking. (FY99) ($497,415)
- Mission Reconfigurable Signal Processing System (FY00) ($749,504)
- Passive Assured Access System (FY01) ($749,203)
- Theater-Wide Situational Awareness for Decision Wall (FY01) ($150,000)

Ocean Engineering Consultants - SWATH Ship Software and Verification

PACIFIC ENVIRONMENTAL TECHNOLOGIES

- Development of a Miniaturized Mass Spectrometer-Based Sampling System for In Situ Measurements of Dissolved Gas and/or Solutes in Marine Waters, and for Protein Characterization that leads to Microbial Identification (FY99) ($141,743)
- Capillary Electrophoresis-Mass Spectrometry and Other Instrumental Enhancements for In Situ Measurement of Dissolved Gas and Solutes in Marine Waters, Atmospheric Gases and Aerosols and Large Organic Compound Identification (FY00) ($171,864)

PACIFIC MARINE & SUPPLY COMPANY, INC.

- Tri-Strut Ship Research and Development (FY94) ($366,000)
- Design, Construction and Sea Trials of a 30-Foot Manned Test Model of a Midfoil SWAS (FY95, FY96) ($500,000;

ORINCON HAWAII, INC. Situation Awareness System Processor for Submarine Applications

$280,000)

- ❑ CFD Code Validation and Improvement Using Large Scale Tests: Optimization of Design for High Froude Number Underwater Body Operating at Near Surface (Midfoil and Slice) and Subsequent Construction and Testing of Optimized Underwater Body (FY97) ($654,000)
- ❑ Development, Fabrication, and Demonstration of a Patentable Combination Propeller-Pump Jet Integrated Propulsion Pod with Boundary Layer Suction (FY98, FY99) ($300,000; $800,000)
- ❑ Large-Scale Producibility Demonstration of CEROS-Developed Three-Dimensional Lifting Bodies for Use in the U.S. Navy's Littoral Support Craft (LSC) Program (FY00) ($980,000)
- ❑ Flapping Foil Technology for Motion Stabilization of Novel High-Speed Vehicles (FY01) ($250,000)

RAYTHEON SYSTEMS (formerly HUGHES AIRCRAFT, formerly ALLIANT TECHSYSTEMS)

- ❑ High-Resolution Bottom-Penetrating Acoustic Sensors and Signal Processing Algorithms for Reduction of False-Alarm Probability in UXO Hunting (FY 94) ($981,000) [Subcontractors: University of Hawaii School of Ocean and Earth Science Technology (SOEST), INTECH, Inc., Sea Engineering, Inc.]
- ❑ High-Resolution Bottom Penetrating Synthetic Aperture Sonar Using Multi-Vertical Row Array and Subbottom Classifier Sonar (FY95) ($990,000) [Subcontractors: University of Hawaii School of Ocean and Earth Science Technology (SOEST), INTECH, Inc., Sea Engineering, Inc.]
- ❑ High-Resolution Bottom Penetrating Synthetic Aperture Sonar for Use in Buried UXO Hunting (FY96) ($996,000) [Subcontractors: University of Hawaii School of Ocean and Earth Science Technology (SOEST), INTECH, Inc., Sea Engineering, Inc.]
- ❑ Integrated Sensor System for Search and Classification of Subbottom Objects (FY97) ($758,000) [Subcontractors: University of Hawaii School of Ocean and Earth Science Technology (SOEST), INTECH, Inc., Sea Engineering, Inc.]
- ❑ Multi-Spectral, Interferometric Synthetic Aperture Imaging Sonar (FY98) ($550,034) [Subcontractors: University of Hawaii School of Ocean and Earth Science Technology (SOEST), INTECH, Inc., Sea Engineering, Inc.]
- ❑ Frequency Agile Sequential Transmission Synthetic Aperture Sonar (FastSAS) - Risk Reduction Technology Demonstration for NetTORP (FY99) ($865,631) [Subcontractors: University of Hawaii School of Ocean and Earth Science Technology (SOEST), INTECH, Inc., Sea Engineering, Inc., Honolulu Shipyard, Inc.]

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC)

- ❑ Web-Based Processing for State-of-the-Art Large Aperture Multi-Dimensional (SLAM) Array (FY99) ($500,000)
- ❑ Web Based, Propagation & Noise Effects on Signal Processing (FY00) ($650,000)
- ❑ Web Based Simulation, Modeling and Signal Processing (FY01) ($399,868)

SCIENCE & TECHNOLOGY INTERNATIONAL (STI) (formerly SETS Technology, Inc.)

- ❑ Hyperspectral Remote Sensing for Maritime Applications (FY93, FY94) ($692,000; 648,000)
- ❑ Dual Mode Fluorescence Imaging for Maritime Applications (FY95, FY96) ($795,000; $996,000; $100,000) [Subcontractor: SAIC, Woods Hole, MA]
- ❑ Grazing Angle Imaging Lidar For Organic Mine Countermeasures (FY96) ($698,000) [Subcontractor: SAIC, San Diego, CA]
- ❑ Undersea Fanbeam Spectral Imaging (FSI) Risk Reduction Technology Demonstration (FY98) ($398,895)

SCIENTIFIC SOLUTIONS, INC.

- ❑ Implementation of an Ocean Acoustic Laboratory at PMRF (FY01) ($150,392)

SEA ENGINEERING, INC.

- Development of a Technique to Identify Pollutant Sources and Impacts in Coastal and Oceanic Waters (FY94) ($146,000)
- Development of a Broadband FM Sub-Bottom Profiler for Seafloor Imaging and Sediment Classification (FY93, FY94) ($292,000; $224,000) [Subcontractor: Precision Signal, Inc., Boca Raton, FL]
- Development of a 3-D, Forward/Aft Sweeping High Resolution Buried Object Imaging System (FY97, FY98) ($389,000; $421,200) [Subcontractor: Precision Signal, Inc., Boca Raton, FL]
- On-Site, Preliminary Analysis of Sediment Core Samples (FY97) ($103,000) [Subcontractor: Jet Propulsion Laboratory, California Institute of Technology]
- Development of an Ultra-High Resolution Non-Destructive Technique for Stress Detection for Marine Applications (FY98) ($319,154)
- Development of an Enhanced Resolution Filter for Improving Sonar Imagery (FY99) ($148,287) [Subcontractor: MultiSpec Corporation, Cherry Hill, NJ]

SEE/RESCUE CORPORATION

- Life/Float the One-Person Survival Craft (FY98) ($70,000)
- Enhanced Sea and Land Rescue Visibility System (FY99) ($253,839) [Co-contractor: TerraSystems, Inc., Honolulu, HI]

STRUCTURAL SOLUTIONS, INC. (formerly KNAPP ENGINEERING)

- Low-Cost Prebuckled Cylindrical Pressure Hulls (FY93, FY94) ($414,000; $571,000) [Project partner: Oceanit Laboratories, Inc. (Honolulu, HI)]
- 3-D Finite Element Design of Cables (FY 96, FY97) ($145,000; $190,000)
- Smart Scuba (FY98, FY99) ($319,000; $366,000)
- A Probe for In Situ Characterization of Marine Carbonate Sands and Other Sediments (FY98) ($220,000)
- Modeling of Cable Fatigue (FY00) ($190,000)
- Experimental Investigation of Cable Fatigue (FY01) (192,000)

SYNTHETIC TECHNOLOGY CORP.

- Bioactive Marine Isonitrile Compounds from Hawaiian Sponges as Models for Synthetic Nontoxic Antifoulant and Antibiotic Agents (FY 95) ($155,000)
- Bioactive Marine Isonitrile Compounds from Hawaiian Sponges as Models for Synthetic Nontoxic Antifoulant and Antibiotic Agents. Synthetic Analogs, Paint Formulations, and Mechanisms of Action (FY96, FY97) ($327,000; $300,000) [Subcontractor: Pacific Biomedical Research Center of the University of Hawaii]

TERRASYSTEMS, INC.

- Development of an Underwater Video Camera for Optical Contrast and Range Enhancement Using Spectral Stretching (FY96) ($247,000) [Subcontractor: Sea Engineering, Inc. Waimanalo, HI]
- Development of an Underwater Compositional Mapping (UCM) System (FY98) ($351,177) [Subcontractor: Sea Engineering, Inc. Waimanalo, HI]
- Enhanced Sea and Land Rescue Visibility System (FY99) ($253,839) [Co-contractor: SeeRescue Corporation, Honolulu, HI]

- vSAR: Video Search and Rescue (FY01) ($352,123) [Subcontractor 1: vSAR Corporation, Honolulu, HI; Subcontractor 2: ORINCON Corporation, Kailua, HI]
- Reconnaissance of Mines and Obstacles in the Surf Zone (FY01) ($35,000)

THERMAL ENERGY STORAGE, INC.

- Development and Testing of a Clathrate Desalination Research Facility (FY96) ($250,000) [Subcontractor: Makai Ocean Engineering, Kailua, HI]

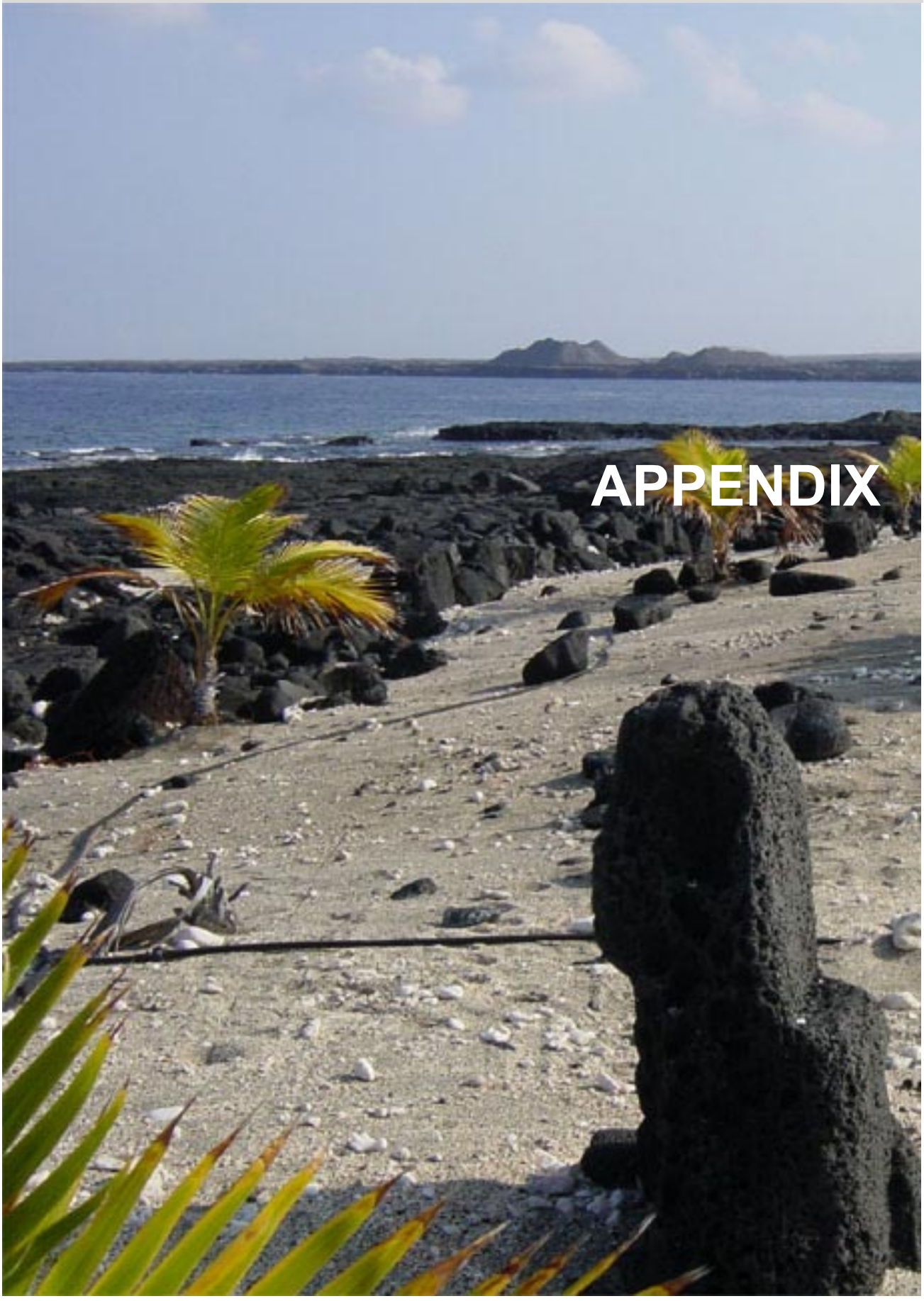
TREX ENTERPRISES

- Development of a Sensor for Pesticide Monitoring Based on Porous Silicon Optical Biosensor (FY00) ($537,000)
- Porous Silicon Biosensor (FY01) ($499,826)

VARIAN ASSOCIATES

- Laser Heterodyne Imaging for Shallow Water Surveillance (FY95, FY97) ($300,000; $396,000) [Subcontractor 1: (FY95): Oceanit Laboratories, Honolulu, HI; Subcontractor 2: (FY97): Detection Limit Technologies, Inc. Honolulu, HI]

NEXT PAGE: View of NELHA Ho'ona Archaeological Preserve beach trail.



APPENDIX

INFORMATION FOR PROSPECTIVE TENANTS

NELHA continues to seek new business, education, and research tenants to join the growing community in this oceanside setting who are offering the Hawaii community a new range of diversified economic alternatives to tourism and traditional agriculture. By laying the groundwork for new industry incubation, NELHA has successfully initiated a new era of economic development and diversification to benefit the West Hawaii community. Tenant activities at NELHA stimulate the economy by engaging in business with local companies to prepare the land for development, carry out construction of new facilities and infrastructure, provide air, land, and sea transport for imported supplies and valuable products for export. New industry development by NELHA tenants provide employment opportunities for residents and new products to enjoy.

NELHA provides a setting to encourage appropriate research, business, education development, including turnkey research facilities, subsidized seawater rates, competitive land and facility rental rates, and the support of its management, technical, and operations staff. Master permits and the existing infrastructure save business start-ups thousands of dollars in capital investment and many months of time. During the first five years of a long term sublease, commercial tenants may earn offsets against percentage rent to further assist them in the early stages of development. Percentage rents are due only after the fifth year, to allow the tenant time to establish the new business and for it to mature. With the payment of percentage rents, NELHA can begin to realize returns on its investments of time and infrastructure support for that new business.

THE APPLICATION PROCESS

NELHA welcomes applications from business, research and educational interests desiring to engage in research, commercial, or educational activities at its Keahole Point facilities. The skilled professional staff at NELHA are available to assist tenants from the initial application stage through establishment of new tenancy, facility planning and development, and long term leasing. Interested parties should consult with NELHA Staff to explore project feasibility and suitability before applying for tenancy.

The application process starts with submission of a Preliminary Proposal following the guidelines in the NELHA Project Initiation Packet (PIP). Applicants may obtain a PIP from the Leasing & Tenant Relations Specialist who will also assist in the application process. Project areas must fit within the guidelines established by legislative mandate, HRS 227D, utilizing the unique resources available on-site, while not harming the environment. All project proposals must be approved by the NELHA Board of Directors, and tenancy begins with the final execution of a land use agreement. Research projects are required to submit a Research Proposal and complete one round of staff review and board approval. Commercial projects must complete a two-stage approval process that involves two rounds of approval, including the submission of a Preliminary Proposal and a Final Proposal/Business plan with financial projections.

NELHA Staff and its Board of Directors seek those projects that can make significant contributions to the advancement of research, education, or economic development for the West Hawaii region. For more information, contact the Executive Director or the Leasing & Tenant Relations Specialist.

PRECEDING PAGE: A view of the Ho'ona Archaeological Preserve, maintained by NELHA Operations Staff.

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