Technical Evaluation, Assessment, and Potential Retasking and Remodeling of The Abalone Farm, Inc.

A Phase 1 Feasibility Analysis Consultation Report

FISHERIES TECHNOLOGY ASSOCIATES, Inc.
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A Phase 1 Feasibility Analysis Consultation Report

by

Paul Curtis and Bill Manci

Fisheries Technology Associates, Inc.
Fisheries and Aquaculture Consultants
506 Wabash St.
Fort Collins, CO 80526-3245, U.S.A.
Telephone: +1-970-225-0150
Internet: www.ftai.com

for

Norah Eddy
Associate Director, CA Oceans Program
The Nature Conservancy, Ventura Field Office
525 E. Main St., Ste. 200
Ventura, CA 93001

The Nature Conservancy
Protecting nature. Preserving life.™

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I. Preliminary Considerations and Project Highlights

- Aquaculture is the fastest growing segment of the world agricultural economy, with strong average annual growth of 5 percent. The future of aquaculture is very bright, as is the integration of aquaculture and plant production, also known as **integrated multi-trophic aquaculture (IMTA).**
- By their nature and by definition, aquaculture and IMTA are **environmentally friendly and sustainable** methods to produce animals and plants.
- Aquaculture and IMTA development must be based on detailed analysis of available resources and reasonable expectations with regard to use of those resources and application of available aquaculture and IMTA technologies.
- The Client is examining the potential to retask and remodel an existing Red Abalone production facility—The Abalone Farm, Cayucos, California—with a focus on **conservation, research, and ecological education and interpretation**, and potential wild stock enhancement.
- The Client is entertaining additional investment in, and expansion of The Abalone Farm and requires independent technical and financial evaluation.
- Aquaculture and IMTA development projects in general must be implemented in several phases. Those phases include
    - **Phase 1**—A preliminary evaluation of the physical and functional status of the facility
    - **Phase 2**—Detailed feasibility analysis and evaluation
    - **Phase 3**—Detailed design
    - **Phase 4**—Construction oversight, training, and management planning
    - **Phase 5**—Facility start-up, management oversight, and marketing and sales
- We are able to provide comprehensive services at each project phase.
- **This proposal describes evaluation services for Phase 1 only.**
- The proposed study requires a broad spectrum of fisheries, engineering, and business expertise. Our team is very qualified and able to accept the challenges this project presents, with **more than 150 years of combined experience, especially in feasibility assessment and analysis**.
- Local support for the consulting team by the Client will be required with respect to knowledge of local and state regulations, site history, and other issues.
- We maintain a **Professional Liability Insurance** policy in the amount of $1 million.

White Abalone.

II. Comprehensive Statement of Need

The Client has long-term goals and needs. Some of these goals and needs include

- Strategies and planning for the successful redevelopment and retasking of aquaculture production with **a focus and priority on marine invertebrates and marine macroalgae**
- Emphasis on **conservation, research, ecological education and interpretation,** and the potential for wild stock enhancement
- An approach that focuses on an inclusive strategy of vertical integration, including
    - Sustainable and more efficient on-site water management, treatment, storage, and disease prevention
    - Feed production, including macroalgae
    - Hatchery production
    - Grow-out
    - Flexible facilities and systems that are appropriate for research purposes and bring new technology to bear that will enhance the health and well-being of the systems' inhabitants, and minimize production and maintenance costs
    - Back-up systems to sustain life during emergencies
    - Ease of operation for use by students and interns with little or no experience
    - A redevelopment strategy and approach that recognizes annual budgetary constraints, and sets forth a plan that can be implemented in stages
- Facilities feasibility analysis and evaluation
    - A site and species strategy and analysis
    - Site status surveys and other site-based analysis services

- Recommendations and direction for upgrade and expansion
- Recommendations for use of new technology (equipment and production approaches such as IMTA), with a new production concept that enhances future production and research
- Cost projections for expansion and remodeling

Kelp (Macrocystis).

III. Consultant Activities: Preliminary Evaluation, Feasibility Analysis, and Investment Due Diligence

The scope of services in Phase 1 will include:
*SWOT—Strengths, weaknesses, opportunities, threats and risks

- **Facility site evaluation**—including a visit to the project location in Cayucos to evaluate water resources and evaluate application of appropriate technologies and management of wastes, and evaluate adjacent activities
- **Infrastructure and support evaluation**—including an evaluation of water intake system, roads and transportation, electrical power and fuels, opportunities for on-site renewable energy, and other infrastructure issues
- **Fish and plant species technical evaluation for conservation, research, and education**—including species technical potential as aquaculture and IMTA candidate species, and preliminary analysis of technical requirements such as space requirements, production timelines, production volumes, and yields, water use and water quality requirements, and other technical issues

- **Equipment remodeling and updating evaluation**—including opportunities for recirculating aquaculture system use, supply-water disinfection, reductions in electrical power requirements, and other potential modern equipment enhancements
- **Aquaculture production SWOT* analysis**—including an analysis of strengths, weaknesses, opportunities, and threats and risks
- **Development of results and potential outcomes**—including a written report that describes our findings and recommendations to date, including basic estimates of future capital costs (**dollars in orders of magnitude** only; more precise capital cost and operating cost information will be developed in Phase 2), and presents a recommended future course of action and potential outcomes—in short, a technical and financial "**path forward**."

Each item includes elements of direct interaction with the Client staff, directors, and employees, and a continual dialogue and interplay between the consulting team and the Client. We will rely on this cooperation to complete our tasks in a timely, accurate manner.

IV. Outcome of the Site Visit

Fisheries Technology Associates (FTAI) Project Associate Paul Curtis visited The Abalone Farm in Cayucos, California, during the afternoon of 10 October and the morning of 11 October, 2019. He began the visit with a list of tasks for completion and items for consideration. Those tasks and items included:

Water supply
- Volume
  - Requirements
  - Potential of system
- Quality
  - Historical data
  - Normal monitoring
- Intake location
  - Elevation
- Intake design
  - Pipe
  - Pump
  - Depth
  - Distance out
  - Screen design and fouling
  - Cleaning
  - Potential improvements
- Pre-treatment
  - Filtration

- Sterilization
- Discharge Water
  - Quality
  - Treatment requirements

Site characteristics
- Age of farm
- Slope
- Drainage
- Access
- Resources available
  - Feed suppliers
  - Repair material supply
  - Professional support (i.e. pump repair, plumbing etc.)
- Power supply
  - Quantity
  - 3-phase or other
- Freshwater supply
  - Quality
  - Quantity

Farms assets
- Tanks
  - Types
  - Volumes
- Buildings
- Broodstock conditioning/holding
- Nursery
- Grow-out
- Aeration
- Drainage System
- Water supply to systems
  - Pumping
    - Pump type
    - Pump size
  - Existing plumbing
    - Pipe size
    - Pipe type

Other
- Disease history
  - Pathogens observed
  - Toxicity issues
- Mortality history
  - Seasonal normal
  - Unexpected spikes

Production history
- Species
- Quantities

Nutrition
- Nursery
- Juvenile
- Sub-adult group

Please note: For the purposes of the preliminary evaluation and this report, not all of the items in this list were scrutinized during and after the site visit in great detail. The next phase, the feasibility study, will examine all of these items (and many others) in much greater detail.

V. Observations, Findings, and Current Status

The Abalone Farm, Inc., is an established Red Abalone farm located on the Pacific Coast of California, approximately 5 miles north of the town of Cayucos. It was established in 1969 and has remained in constant operation. Currently the farm is condensing and is planned to close when abalone in the last-operating grow-out portion of the farm have been harvested. Ultimately, difficulties with spawning and larval production led to the closure.

The Nature Conservancy has shown interest in purchasing the site to provide facilities for marine animal conservation projects such as public education and demonstration, and abalone stock enhancement. FTAI was hired to provide a general overview of the site and comment on the feasibility of creating a conservation- and education-based facility. As described above, we are tasked with suggestions and recommendations for possible reconfigurations for the property and rough budgets to achieve those goals.

Basic Farm Layout Description

The farm site is separated into two sections (see Figure 2 below). To the south are the grow-out tanks/raceways, and to the north are sections dedicated to spawning, and early and late juvenile rearing. Water is supplied from a single intake and discharged via two points. A single aeration system supplies air to the grow-out part of the farm (see Figure 1 below).

Figure 1: Main Water and Aeration Resource Locations

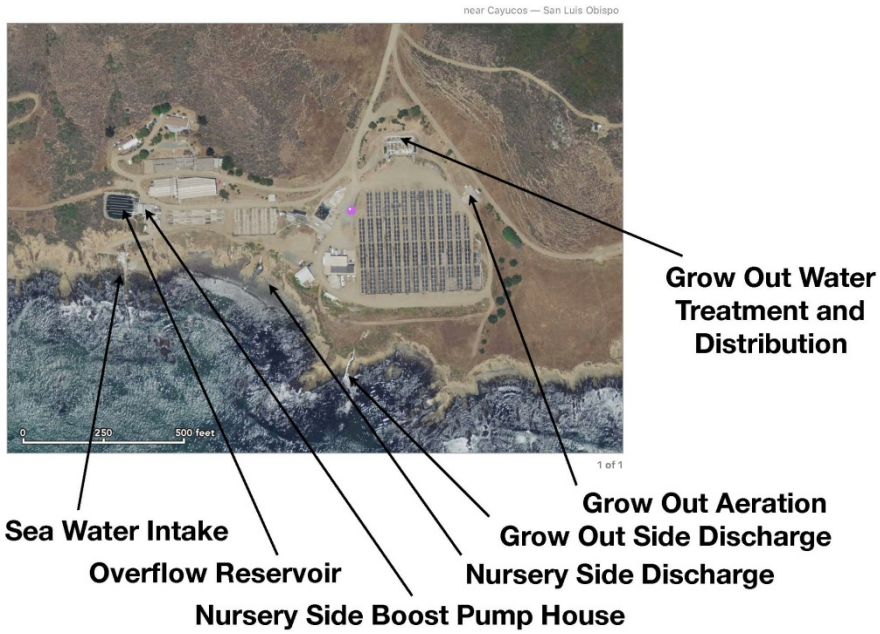
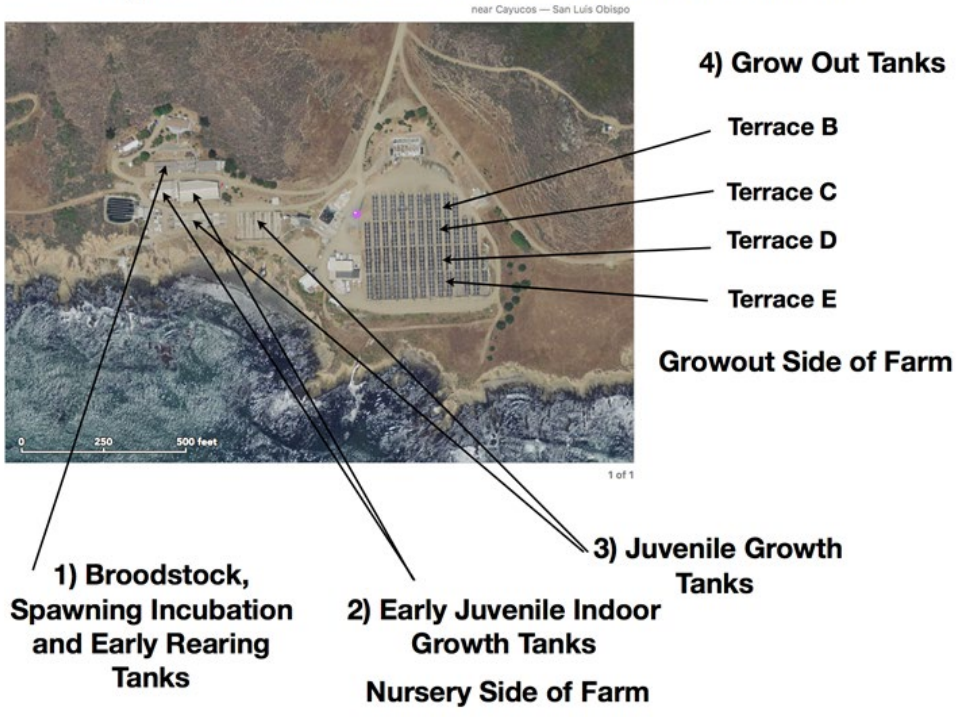


Figure 2: Main Culture Sections of The Abalone Farm Inc.



Water and Air Systems

Site Pump Volume Requirements: The entire farm is configured as a flow-through, single-use system. The grow-out side of the farm requires approximately 4,000 gallons per minute (gpm) and the nursery side approximately 1,300 gpm. Assuming all systems are operating and requiring the maximum amount of water, pumping is designed to meet these needs.

Intake Design**:** All water is pumped from the same location on the northwest portion of the property (see Figure 1) using multiple intake pipes for different parts of the farm using one pump house with multiple pumps. The pump house is elevated approximately 10' above the water line which provides protection from storm events.

The intake area has four PVC intake pipes—two 18-inch, one 10-inch, and one 8-inch—and extend approximately 150 feet from the beach line into the ocean.

The 18-inch pipes supply water to the grow-out side of the farm. Only one pipe is used at a time. The main 18-inch line is powered by a Peerless Model 8175 pump with a 250-hp electric motor. The other 18-inch line is a backup Peerless 8175 pump powered by a diesel engine.

A similar arrangement exists for the nursery side of the farm's one 10-inch and one 8-inch lines, utilizing the same Peerless pumps. The daily-use 10-inch line pump is powered by a 75-hp electric motor, and a diesel engine for the 8-inch backup line.

All the water is drawn up 10 feet to the pumps via suction created by the pump—in other words, they are self-priming.

At the ocean end of the intake pipe, the 18-inch pipe is split into two 15-inch pipes, one of which extends from a T-fitting, and angles down towards the sea floor at approximately 45 degrees. The 15-inch pipe extends out to a 24-inch pipe with slots cut into it to provide a rough screen for water entering the system. There is a concrete collar around the 15-inch pipe where it enters the 24-inch to seal it. The second 15-inch pipe extends from a Y-fitting and angles down 45 degrees into the water. It has a similar 24-inch screen arrangement. There is a blind flange plate on the end of the Y-fitting for cleaning purposes. The screens lie in approximately 6 feet of water.

The ocean-side screens are similar for the 8-inch and 10-inch nursery side intakes, with both utilizing 18-inch slotted pipe with concrete collars in 6 feet of water.

The slotted pipes are cleaned externally with rakes to remove large debris. There is some periodic internal fouling, which is managed and cleaned from the end of the pipes through the blind flange plate on the Y-fitting mentioned above.

***Water Treatment Systems*:** The grow-out water supply is treated first through a series of six approximately 2,000-gallon, 1,200-gpm, cone-bottom swirl separators for primary solids removal. Each swirl separator then empties into a common head tank which feeds six Fresno Valve and Casting Series 1200 SSC gravity screen filters. Each screen filter then supplies water to one head tank dedicated to a terrace of grow-out tanks.

Water is pumped from the common head tank via an older 30-hp pump to a trio of Stark 13.5-square-foot sand filters plumbed in parallel. The pressurized water is used to clean the screens on the gravity screen filters and to provide pressurized water to all of the terraces of grow-out tanks for cleaning and maintaining moisture on the abalone during harvest.

The water for the nursery side of the farm is sent to a filter house situated at the top of the farm near the main nursery buildings (see Figure 1). The first stage of treatment is through a pair of approximately 1,000-gallon, 847-gpm cone-bottom, model 270P swirl separators. From there the water moves to a head tank which supplies water to either a booster pump or an overflow reservoir (see Figure 1).

The overflow reservoir provides water to all of the outdoor concrete tanks on the nursery side of the farm. The booster pump provides water to all of the indoor rearing facilities. The booster pump is a Union model 13A80L HCM 50-hp pump.

All of the boost-pumped water is filtered for solids through a series of two banks of three, 35-square-foot, Stark sand filters. Each of the two banks of filters operates in parallel. Each filter in a series of three contains a different grit size for staged filtration through, first, a coarse sand, and then a fine sand as a finishing step.

As a final step, solids-filtered water destined for the brood holding, spawning, and early rearing sections also passes through cartridge-type pool filters for “solids polishing,” and a 520-watt SafeGuard UV sterilizer to kill water-borne organisms.

Aeration System: On the grow-out side of the farm, there are three Spencer Turbo 454 72-hp low-head fan blowers that provide up to 4,000 cubic feet per minute of air each. The system is designed to provide air to a portion of the grow-out facility at any period in time. An automated system adjusts valves on the supply lines to alter the destination of the air.

Aeration for the nursery side of the farm is supplied by numerous small regenerative blowers.

Water Discharge: The site has two water discharge points, one for the nursery side of the farm and the other for the grow-out side of the farm (see Figure 1). Influent and discharge water is tested quarterly, as per the discharge permit, for grease and oil as well as for total suspended solids (TSS) and turbidity. The effluent water is usually of higher quality than the influent water. As a result, there are no treatment requirements for water leaving the property.

Farm Tank and Building Assets (Figure 2)

Broodstock Holding, Spawning, and Early Rearing Building: A dedicated room is provided for broodstock holding and some basic conditioning. There are eight, 250-gallon, blue polyethylene tanks each with a small untreated recirculating system, with a flow of approximately 10 gpm. There is also a new-water supply line in each tank that runs constantly into each tank at approximately 1 gpm.

Adjacent to the broodstock room is the spawning and incubation room. Tables are used for both spawning and incubation. Eggs are incubated in multiple 2½-gallon translucent plastic containers.

Hatched larvae are transferred to an indoor system of approximately 270 80-gallon tanks where the larvae settle and receive first feeding. These animals remain in this section until they reach 2 to 3 mm in length.

Early Juvenile or Nursery Buildings: Two buildings were constructed for post-grow-out of juveniles to approximately 8 to 10 mm in length for approximately 6 to 12 months. There are approximately 550 80-gal tanks in each building in three levels. The culture capacity originally constructed is much more than is needed and only the top level of 360 tanks was ever used. Water enters through the top tank and trickles down through the bottom two tanks.

Juvenile Grow-out or Basket Tanks (Figure 2): When the juveniles reach 8 to 10 mm, they are moved to a series of outdoor concrete tanks (raceways). There are two systems of tanks.

The first system contains 72 tanks approximately 1,000 gallons each. Three pairs of tanks are situated such that water flows by gravity from the top pair, and moves through the next two pairs in series, and then is discharged.

The second system is composed of 38 tanks approximately 2,000 gal each. These tanks are again in associated pairs where water enters the top pair and gravity-flows to the next pair, and then is discharged.

In both of these systems, the animals are housed in baskets.

Grow-out Systems: The grow-out portion of the farm contains 582 separate outdoor tanks, each approximately 2,000 gal. They are constructed in pairs and in banks of 6 tanks. Each pair in a bank is at a different level so water can move by gravity from one pair to the next. Water does not mix between each pair. The tanks have concrete dividers for use as adhesion substrate for the abalone. The dividers do not extend to the bottom, in an effort to facilitate water and waste movement.

Banks of tanks are divided into four different terraces: B, C, D, and E. Each terrace has its own water supply from the screen filtration described above. Terrace B is the newest and has 118 tanks. Terrace C has 153 tanks; D, 155; and E, 156.

Farm Site Characteristics

Slope and Drainage: The site has an excellent grade for aquaculture allowing the use of gravity to move water through the farm and back to the ocean. The grade also allows for excellent drainage during rain events, preventing flooding.

Site Access and Outside Resource Availability: The farm site is in an ideal location for an aquaculture facility. Although the facility is on the coast, it is very close to the main Highway 1, and also not far from Highway 101—allowing a primary north/south thoroughfare. The towns of Cayucos and Morro Bay are only a few miles away and can provide basic needs for farm operation such as fuel and hardware. The farm is also approximately 4 hours from San Francisco, allowing access to an international airport for product shipping and more specialized and hard-to-find parts such as for pumps and plumbing.

The proximity to San Francisco also allows easier access to bulk items such as feed for future uses. The farm to date has not been dependent on feed deliveries as it utilizes local kelp. The company owns a kelp cutter docked in Morro Bay, so food can be acquired (for abalone and other shellfish that use macroalgae) when needed. A kelp storage tank is on site to hold kelp to reduce harvest frequency, and to have food available during poor weather conditions when the cutter cannot deploy.

Power Supply: The farm has a more-than-adequate supply of 480-volt, 3-phase power for any project proposed for the farm. The farm also has two permanent backup Caterpillar generators and two portable generators to supply power during power outages. Diesel pumps provide water during electrical outages.

Fresh Water Supply: Fresh water for the site originates from a well on the east side of Highway 1. More knowledge is required about an existing agreement with the well owner regarding the supply to the farm with a change in ownership. The water is potable but reverse-osmosis and UV-treatment systems provide drinking water for the site.

Other Farm Considerations

Production History: The only species the farm has ever cultured is Red Abalone. Historically, the site has produced 2,000,000 juveniles per year with a target of 100 mt or 1,000,000 100-g live-weight harvested animals per year.

Mortality History: Over the years of operation, there have been very few incidents of unexplained mortality. It has only been over the last few years where the difficulty in spawning has occurred that has led to the cessation of production.

Disease History: Withering foot disease has been an issue but has been controlled with antibiotics. Oxytetracycline has proven effective as an additive in a prepared food.

The closure of the farm due to effects on spawning has been attributed to an unknown cause. Spawning has been unsuccessful over the last few years with a direct cause not identified. Possible sources hypothesized are increased average water temperature and increased high-temperature water events. Also considered is ocean acidification. No pathogen has been conclusively demonstrated as a cause of mortality.

Nutrition: Nutrition for Red Abalone culture is basic in the use of *Macrocystis* macroalgae for the bulk of the feed needs. As mentioned above, the farm harvests kelp with a company-owned kelp harvesting vessel docked in Morro Bay, with harvested algae then stored in a dedicated tank, on site, for use over several days.

More complex feeding and nutritional optimization is required in the early rearing of the larvae and newly settled juveniles. During the first and early feeding of larvae, it is important to provide nutritionally adequate microalgae. These algae are cultured and then added to the tank. For settling larvae the microalgae must coat the bottom of the tank, thereby allowing newly settled larvae to graze. Microalgae are cultured on site in a dedicated room and in a custom tubing system.

Permits: If The Abalone Farm is purchased by The Nature Conservancy, the transfer of permits will require consideration. The farm has been in operation for a long period of time and has basic permit requirements. With the transfer of ownership, new permit requirements may follow. These may encompass influent water, effluent water, and culture species.

With the reputation of The Nature Conservancy and its conservation and sustainability focus, permit application and facilitation may be easier as compared to a conventional, for-profit business. These issues will be addressed as this process develops into a fully formed feasibility study.

VI. Recommendations

A. What is Salvageable and What Should Be Abandoned

The farm is an excellent site with a lot of potential. It has already proven itself for over 50 years of production. As time has progressed, the climate has changed, and so has technology. It

appears that conditions in the ocean have changed and have accentuated the risks of flow-through or single-pass aquaculture. Modern technology can be used to provide optimal culture conditions for any species. The extreme example of this is the culture of a warmwater tilapia species in Ontario, Canada, where indoor recirculating aquaculture systems allow for the production of warmwater species in temperate and cold-winter environments.

One of the most valuable assets at the site is the presence of a seawater intake system. The Pacific Coast is a very difficult coast on which to develop intake systems. Those used for desalination and power generation can be millions of dollars in development. Couple this resource with the 3-plus acres of area available for culture, and you have an ideal site for aquaculture development.

The suggestion for the reuse or redevelopment of any part of the farm will be dependent on the intended use and/or available funds.

Seawater Intake

The intake is the most valuable part of the farm but also has some liabilities. Due to the nature of the location of the pumps above the water line, there is a great deal of energy utilized to draw water to the pumps before any is moved up hill. Pumps in general do not like to draw water up and will use a lot of power to do this. With the farm in its present form of single-pass water, electrical consumption is very high and expensive. Only high-end-value products can support a system such as this. Modern aquaculture recirculation technology greatly reduces the need for new water, and will then reduce the demand from the seawater intake and reduce power consumption, even with no intake improvements. Under the right circumstances, continuous water pumping rates could be reduced by 90 percent or more, with a proportional reduction in power consumption and cost.

The other weakness of the intake is that it is has a shallow-water draw, meaning that any surface water changes affect the farm. These changes can include rapid temperature shifts, exposure to potentially toxic red tides and other coastal pollutants, and coastal runoff. There is also greater chance of sand and other solids entering the system. Again, recirculation technologies will greatly reduce these impacts and allow greater control of water quality.

There may be improvements in efficiencies possible by providing new pumps and or motors. There would also be benefit in the evaluation and feasibility of extending the intake pipe farther out into deeper water where conditions would be more homogeneous and less variable over longer periods of time.

Water Treatment

Current water treatment is carried out in two different areas. Both systems appear to provide good-quality water to the dedicated systems, but are older and would benefit from an upgrade.

Depending on how the property is developed, a centralized system of water treatment and storage may be more efficient, situated above all of the culture activity, allowing gravity feed to all of the projects on site. With recirculation and reduced new seawater demand, more effort can be placed on new-water treatment and sterilization, providing high-quality water to all systems on site.

Aeration

The aeration system in place now is a major source of electrical consumption. As with water treatment, there are new technologies available for aeration that use much less power. Replacing these existing air blowers should be a high priority in a redevelopment plan.

Buildings and Tanks

Broodstock Holding, Spawn, and Early-Rearing Building: The building is older but has been kept in good repair. It is approximately 5,100 square feet. The brood-holding area would benefit from a complete rebuild to increase holding capacity and develop a closed, recirculating system to provide appropriate conditions for conditioning broodstock to provide high-quality eggs and sperm and larval production. All three sections of the building were designed for abalone culture and the incubation and early-rearing areas will function for this purpose if abalone culture is continued. The water supply should be upgraded to a recirculating system to provide optimal water quality and give the highest probability of larval survival.

If the site reverts to other uses, the building could be gutted and refit or replaced dependent on need.

Early Juvenile or Nursery Buildings: These two buildings are older and cover approximately 7,700 square feet of space, and are not fully enclosed but are, instead, a solid roof with shade-cloth walls. As with the early-rearing building, the system is designed for abalone culture. It is well constructed and well maintained and would suffice for continued abalone culture. There is a great deal of overcapacity and a large portion of the area could be redeveloped and still maintain enough capacity for abalone rearing. There is adequate capacity in the smaller building allowing the larger to be redeveloped or removed and replaced for another project.

Processing Building**:** Providing approximately 1,500 square feet of space, the processing building is older and well maintained and has resources to make a good basic office/laboratory building with remodeling.

Outdoor Grow-out and Juvenile Rearing Tanks**:** The vast majority of these production tanks are very old and should be removed and the land developed for other projects. The only series of tanks that could possibly be retained is the B terrace on the grow-out side of the farm, as these are the newest and in the best state of repair. Any further abalone culture can most likely be carried out in this part of the system allowing the rest of the area to be used for other projects.

Other Structures: Other structures on the property include a single-wide mobile home used as a residence for a manager, and a single-wide mobile home used as an office. Both are well maintained and in good condition.

Species Possibilities

Without a doubt, The Abalone Farm is well suited for the production of bivalve shellfish such as abalone, particularly if its drawbacks (e.g., flow-through configuration, which creates outrageous energy bills and exposes the animals to all types of physical, chemical, and biological threats from the ocean) are corrected. However, also without a doubt, under a new water-use/water-reuse configuration, the facility could very successfully support and produce a whole array of saltwater finfish, shellfish, other marine vertebrates and invertebrates, and marine microalgae and macroalgae. The list is almost endless.

The only species limitations that might be envisioned involve the support and production of freshwater species. However, even under the right economic and cost circumstances (i.e., high-value species and reasonable water-treatment costs) where seawater is desalinated, or additional freshwater can be secured from land-based surface or groundwater sources, freshwater species might be open for consideration. A feasibility study can shed more light on all of these infrastructure-support and species possibilities.

Conclusions

The site has enormous possibilities ranging from minor changes and investment, to a total site overhaul and repurpose. Southern California would benefit from an Aquaculture Park much like the one developed in Hawaii, on the Big Island's western shore just north of Kona. A well-developed and managed park can provide valuable hard-to-acquire resources to many facets of the industry. Interested companies, organizations, and agencies engaged in research and development, and commercial production all could benefit. By providing a high-quality supply of treated seawater and air and overall infrastructure, entities can focus on research, development, and production.

The Nature Conservancy has shown keen interest in conservation aquaculture, and is one of the driving forces in their interest to the purchase of The Abalone Farm. In conversation with The Nature Conservancy managers, species of interest include kelps such as *Macrocystis* as well as mollusks such as Black and White Abalone and various echinoderms.

The use of recirculating technology will make production of any of these species possible. The ability to control water quality and temperature will allow producers to match requirements of selected species. The cost of development will be dependent on the numbers of organisms grown and their size at release.

The Nature Conservancy could redevelop the site with improvements to the seawater and aeration systems and the land providing space and resources to lease-holders. A lessee's project can be situated on site where that party will develop its project through its own funding, and utilize provided resources included in the lease. With the Nature Conservancy controlling activities, you can demonstrate support for education (through your own innovative educational displays and systems) and responsible aquaculture development and sustainable commercial aquaculture production. The Nature Conservancy also can undertake stock enhancement and support for the development of conservation projects for threatened Pacific species.

B. Rough Cost Estimates

Presented in this section are some rough cost estimates for three possible rehabilitation scenarios for the three primary existing structures on the property and the outdoor production features. Within each scenario table, there are three estimates of dollars per square foot. Please notice, they tend to be quite different from each other. This is a result of significant possible differences in development costs per square foot from one species to the next. Some species may require more elaborate and more expensive technology as compared to others. Each species will require an in-depth investigation into costs and requirements.

In all cases, the evaluations were fair, and relied heavily on many years of experience. Additionally, regardless of species, the property as a whole will require investment in new infrastructure to support (1) buildings under the management of The Nature Conservancy, and to support (2) other parts of the property managed by lessees. Investments by The Nature Conservancy in infrastructure will optimize the attractiveness of the property to potential lessees, and maximize rental income.

Demolition of Outdoor Grow-out

As described above, most of the outdoor grow-out tanks (which includes the majority of the acreage on the property) are in poor condition and must be removed for redevelopment. Some may be salvageable, but saving any of them may be a function of the wishes of future lessees and The Nature Conservancy.

Baseline Rehabilitation Scenario

As with the two other scenarios below, baseline rehabilitation costs will depend on (1) the amount of water pumping, conditioning/filtering, and storage infrastructure that is included in the overall redevelopment, and (2) the range of species that may be produced on the property. It is difficult to be "all things to all people"—meaning, limits to the range of species may be required. However, with that in mind, the detailed feasibility phase of the project will clearly uncover an optimal species mix, without the need for unreasonable guesswork after the fact.

Additionally, past experience (e.g., studying the development feasibility of the Rocky Mountain Aquarium and Ecoplex, Seattle Aquarium, Oregon Coast Aquarium, university research facilities, and other high-value developments) has shown that educational displays, research facilities, and specialty production facilities tend to be the most expensive per square foot—sometimes wildly expensive (although, the site will be primarily geared toward practical production). So, real costs can be estimated only after a serious assessment of the numbers and types of educational displays, research facilities, configuration of the water supply intake, and the variety of species that will be included on the property—hence, some of the larger line-item costs and total rehabilitation scenario cost estimates presented here.

Please note, unlike the current configuration of The Abalone Farm as a flow-through production facility, none of the options include a flow-through approach to the new facility. Indeed, all three scenarios include water reuse to one degree or another. This is a function of the enormous direct costs (e.g., electrical power to pump water to the facility) and biological risks (e.g., high risk of exposure to pathogens or inappropriate water temperatures) that are experienced by the current owners of the property. Without a doubt, mitigating these costs and risks are some of the highest priorities for redevelopment.

	Building	Broodstock	Juv./Nurse	Processing		Totals
	Square footage	5,100	7,700	1,500		14,300
Baseline Rehabilitation						
Assume: No water intake extension; RAS systems; solids and temperature control					Cost range:	
Task 1: Demolition						
Demolition of some or all outdoor grow-out						
Task total cost range					$250,000	$400,000
Task 2: Water supply and Aquaculture Park						
Water supply upgrades (pumps, filters, and water storage)						
Water distribution to tenants						
Wastewater collection from tenants and treatment before discharge						
Task total cost range					$200,000	$400,000
Task 3: TNC buildings						
Aeration upgrades (three existing buildings)						
Tank upgrades in three buildings (RAS)						
Three building upgrades and insulation (sealed from outside)						
Power back-up system						
Task total cost range					$2,550,000	$3,200,000
TNC total cost range					$3,000,000	$4,000,000

Fully Functional Rehabilitation Scenario

		Building	Broodstock	Juv./Nurse	Processing	**New**	Totals
		Square footage	5,100	7,700	1,500	**2,500**	16,800
Fully Functional Rehabilitation							
Assume: Water intake extension; RAS systems; solids and temperature control						Cost range:	
Task 1: Demolition							
Demolition of some or all outdoor grow-out							
Task total cost range						$250,000	$400,000
Task 2: Water supply and Aquaculture Park							
Water supply intake extension on seabed							
Water supply upgrades (pumps, filters, and water storage)							
Water distribution to tenants							
Wastewater collection from tenants and treatment before discharge							
Task total cost range						$400,000	$900,000
Task 3: TNC buildings							
Aeration upgrades (three existing buildings)							
Tank upgrades in three buildings (RAS)							
Three building upgrades and insulation (sealed from outside)							
Power back-up system							
New offices and support							
Task total cost range						$4,350,000	$5,700,000
TNC total cost range						$5,000,000	$7,000,000

State-of-the-art Rehabilitation Scenario

		Building	Broodstock	Juv./Nurse	Processing	**New**	Totals
		Square footage	5,100	7,700	1,500	**5,000**	19,300
State-of-the-art Rehabilitation							
Assume: Water intake extension; RAS systems; solids and temperature control						Cost range:	
Task 1: Demolition							
Demolition of some or all outdoor grow-out							
Task total cost range						$250,000	$400,000
Task 2: Water supply and Aquaculture Park							
Water supply intake extension sub-seabed							
Water supply upgrades (pumps, filters, and water storage)							
Water distribution to tenants							
Wastewater collection from tenants and treatment before discharge							
Task total cost range						$950,000	$2,150,000
Task 3: TNC buildings							
Aeration upgrades (three existing buildings)							
Tank upgrades in three buildings (RAS, experimental-quality wet labs)							
Three building upgrades and insulation (sealed from outside)							
Dry labs and water quality lab							
IMTA wastewater treatment before discharge							
Power back-up system							
Liquid oxygen system							
Solar/wind turbine renewable energy system							
Other educational process displays and viewing access							
New offices and education classrooms/conference spaces							
Task total cost range						$9,800,000	$10,450,000
TNC total cost range						$11,000,000	$13,000,000

C. Next Step: Detailed Feasibility Analysis

The next step in the process of investment due diligence for The Abalone Farm is a fully formed feasibility study to uncover all of the technical and financial details The Nature Conservancy will require to make a final "go/no go" decision regarding purchase of the facility.

While this initial investigation has uncovered considerable information about the technical and economic feasibility of purchasing the facility, there remains significant amounts of work to fully answer technical and financial questions, and develop a best-case scenario for the purchase of the facility by The Nature Conservancy. Given what was found during this phase of the project, moving forward is recommended with additional detailed analysis at the heart of the next phase.

Natural Energy Laboratory of Hawaii Authority (NELHA) as a Model

As part of a feasibility study, a site visit is recommended by you and the feasibility consulting team to the west coast of Hawaii's Big Island. Adjacent to the Kona airport is the Natural Energy Laboratory of Hawaii Authority, and its associated aquaculture production park. The successful organization they developed and the infrastructure and opportunity they developed many years ago can be an excellent example and model for redevelopment of The Abalone Farm.

Their facility has withstood the test of time. That is the best measure of success we can imagine, as well as the substantial interest in their facilities as demonstrated by private- and public-sector lessees. The insights they can provide will only enhance your chances for success, and help you avoid some of the mistakes they may have made along the way.

Continuation of the Journey

FTAI is ready to accept this challenge, and to continue to guide you through the possibilities to the optimum outcome. A conference call to fully address this current study and the results, and discuss the detailed feasibility study and its nuances and costs is an obvious next step. In preparation for that call, please consider how much capital The Nature Conservancy is prepared to invest to secure ownership of The Abalone Farm, and the level of development with which you are most comfortable. Your answer to this question (i.e., a specific dollar amount or a range) will help formulate a proposal for the feasibility study and provide a budget that meets your financial sensibilities.

Thank you for your confidence in FTAI. Continuation of this journey is an exciting prospect, and contributing to the success of your mission is of paramount importance!