



# Protecting Forests for Water Supply Sustainability in Molokai, Hawai'i

WaterSMART Cooperative Watershed Management Program Category C Grant Application  
State of Hawai'i, Department of Land and Natural Resources Proposal  
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*Pelekunu valley- The “Pele’s Cough” – East Molokai Watershed.*

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## Executive Summary

February 14, 2023

Applicant: State of Hawai‘i, Department of Land and Natural Resources, Division of Forestry and Wildlife

Location: East Molokai Watershed, County of Maui, State of Hawai‘i

The State of Hawai‘i, Department of Land and Natural Resources (DLNR) will increase water supplies by protecting ecological values on the eastern half of the island of Molokai from feral hooved animals. These forests are threatened by non-native feral pigs, deer, and goats, which roam wild and trample and devour vegetation, and spread weeds. Protecting forest watersheds is the most cost-effective and efficient way to absorb rainwater and replenish groundwater.<sup>1</sup> This is important as these forests help recharge Molokai’s “sole source” aquifer. An emergency declaration for the island of Molokai has been declared for two years in a row due to extreme drought conditions. Molokai’s water is so limited that it is designated as a “groundwater management area” where the State’s Commission of Water Resource Management requires additional regulation and permitting, and withdrawals must meet certain criteria.<sup>2</sup> Forests are important for many other reasons, such as reducing erosion and water quality issues along streams and coasts.

The Department and partners are undertaking an ambitious protection plan to preserve the remaining watershed forests of Molokai. The Bureau of Reclamation is already supporting management planning in Molokai through a WaterSMART planning grant. That grant supports planning for fences, which includes one of the fences proposed to be partially constructed by this grant at Puu O Hoku Ranch. This project extends the area of protection and active management across the northern and eastern portions of the remaining priority forests of Molokai. This project

would build a fence that excludes hooved animals from 3,340 acres in Pelekunu valley, control hooved animals in the Pelekunu fence as well as an additional 12,000 acres, and will support the first phase of an additional fence that will eventually protect an additional 4,225 acres that is critical for the easternmost communities of Molokai. Existing partnerships are key to the success of this project. Since 1999, the East Molokai Watershed Partnership (EMoWP), coordinated by The Nature Conservancy (TNC) of Hawai'i, has united land owners and managers across the watershed with the goal to protect the forests, which, in turn, protects Molokai's fresh water supply. The fencing projects will benefit from the existing long-standing relationships across multiple landowners, community groups, and agencies, ensuring that the placement and design of the project are the most effective and that there will be long-term sustainability to maintain these infrastructure investments.

## Project Location

This application is located on the island of Molokai (USGS Hydrologic Unit 2005000), in the island's north-eastern mountain range. While the East Molokai Watershed Partnership has completed wide-scale fencing along the southern half of the mountain (see green and blue hatched areas in the figure below), Pelekunu valley has largely been unprotected and is the target of this project. The East Molokai Watershed Partnership has been seeking to build a fence that uses the strategic cliffs of the valley, combined with fences, to protect the remaining part of the valley where native forests exist. This 8' tall fence would provide full protection from all hooved animals. These fences target the protection of the remaining native forest, which occurs in higher-elevation tracts of the valley.

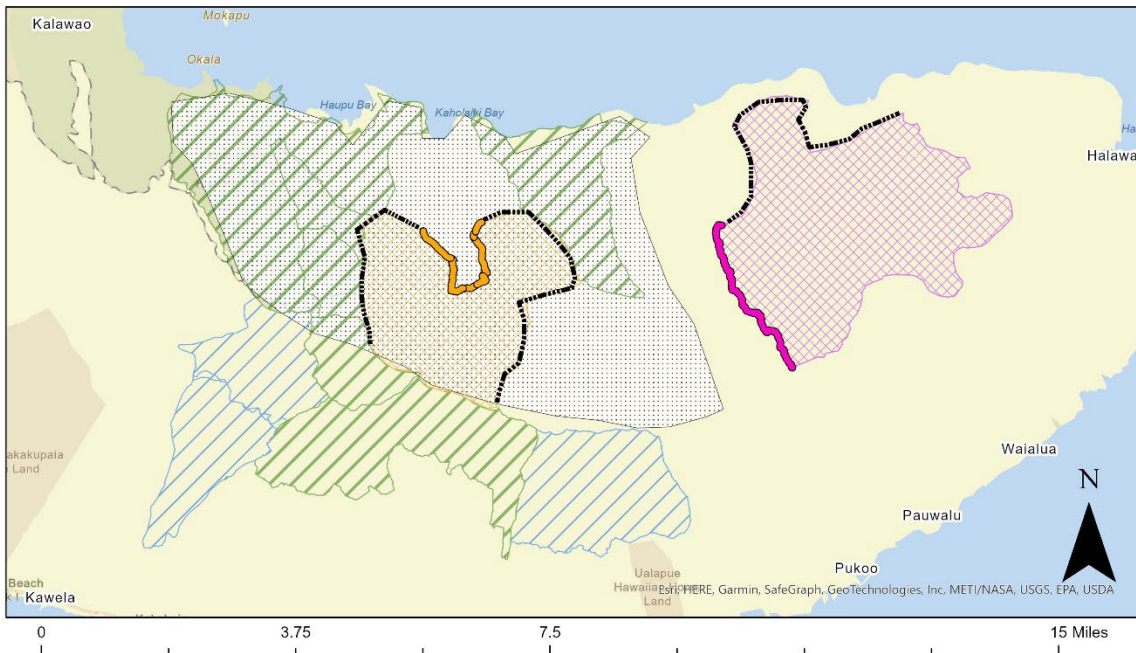
The second part of this project is owned by Puu O Hoku Ranch - the newest member of the East Molokai Watershed Partnership. This project will also use the same parameters of fencing important portions of the watersheds off, removing feral hooved animals, and ensuring the continued recharge of Molokai's aquifer. This extensive, 4,225-acre project will require more than the grant period's three-year time period to complete, so only the first phase of the project will be addressed in this grant proposal. The Department will provide matching funds to purchase the materials needed for 3.34 miles of fence that will complete the westernmost phase of this project.

A third part of this project ties the Pelekunu and Puu O Hoku locations together and expands the overall reach of the project across an even larger part of the watershed. The Department seeks to increase hooved animal removal across an additional 12,000 acres along the north shore of Molokai. These areas contain the highest sea cliffs in the world with extraordinarily steep and difficult terrain. While these areas are impassable for humans to traverse, hooved animals are able to roam across these cliffs and cause significant damage. While the Department prefers to fence areas, which provides long-term protection for hooved animals, some of Hawaii's steep landscapes are impossible to fence. The Department's only option in these areas is to shoot these animals from helicopters (aerial shooting) to cull the populations. Funds for helicopter time to conduct aerial shooting over three years is requested through this grant. This area is labeled the "ACETA" zone on the map for "Aerial Capture, Eradication and Tagging of Animals."

Finally, this project seeks to comprehensively monitor the health of forests and streams, as well as conduct some on-the-ground hooved animal removal, where possible. The Department proposes to contract for these management activities in Pelekunu valley.

# WaterSMART Proposal

- Completed Fence Projects
- In Progress Fence Projects
- Planned Puu O Hoku Fence Unit
- Proposed Pelekunu Fence Unit
- Puu o Hoku Fence Phase 1
- Pelekunu Fence Proposal
- Natural Barrier
- ACETA ZONE



## Technical project description

### **Applicant Category:** Existing Watershed Group

The Department of Land and Natural Resources, Division of Forestry and Wildlife, is applying as a partner of the East Molokai Watershed Partnership. This partnership consists of 15 major landowners and land managers of East Molokai. Watershed alliances are voluntary organizations that pool resources and seek to manage watershed priorities across the entire mountain range, rather than based on landownership boundaries. The partners are united by a Memorandum of Understanding that outlines their shared goals and relationships.

Members of the partnership pool funding for a full-time, 6-person natural resource team led by a field supervisor. This partnership protects and manages 32,983 acres of important watersheds and ecosystems. Collectively, this partnership has been able to fence and protect almost 13,100 acres and has conducted large invasive plant removal, wildfire prevention, and out-planting projects to improve forest health. The long-term nature of the partnership, as well as its impressive accomplishments, provide a promising basis for its capacity to protect these additional areas. These actions are guided by management plans that are approved by all members of the partnership. The first plan was drafted in 2003 and contained conceptual goals and a coarse identification of natural resource priorities. A management plan update was completed in 2020 which provided a summary of the accomplishments, a much more refined identification of natural resource priorities, and a goal to fence additional areas to protect watersheds.<sup>3</sup>

### **Eligibility of Applicant**

The State of Hawai'i is a listed eligible applicant. The State of Hawai'i is able to significantly affect the quality and quantity of water in this watershed by improving watershed forest health. The State of Hawai'i is a member of the existing watershed group of the East Molokai Watershed Partnership, which is grassroots, non-regulatory legal entity.

### **Goals**

A central action that can be taken to increase the water supplies of this region is to maintain the remaining native forest on the mountain.<sup>4</sup> Numerous studies have indicated that native forests significantly increase water recharge as compared to alien forest, grassland, or barren areas in these high elevation sites.<sup>5</sup> The project will maintain these native forests by fencing and removing hooved animals from a vast area. Without fences, it is not feasible to continuously reduce animal populations.<sup>6</sup> Their populations can quickly rebound, even after being reduced by 40%<sup>7</sup>-70%.<sup>8</sup> Specifications for these projects have been approved by the DLNR<sup>9</sup> which will guide fence construction, ongoing maintenance, and hooved animal removal. Statewide, approximately 270,000 acres are fenced from hooved animals. These projects aim to protect the maximum amount possible across 35,000 acres of Molokai's remaining forests.



*Feral pigs uproot, eat, and trample native Hawaiian forests statewide. This area formely was a healthy and biodiverse understory and has been reduced to mineral soil due to ungulate incursions.*



*The Puu O Hoku landscape is covered with barren areas like this that have been destroyed by feral pigs, goats, and deer.*



*This fence line, which protects the left part of the image, allows a fenced forest to survive. The unfenced area to the right has been decimated by goats, cattle, sheep, and pigs. Lupea, Hawaii.*

## **Approach**

Overall, the project contains the following components, which will occur simultaneously.

- **Task 1:** Fence material purchase for the Pelekunu Fence
- **Task 2:** Funding labor to build the 2.6-mile fence in Pelekunu
- **Task 3:** Helicopter operations to get fence material and crews to Pelekunu
- **Task 4:** Support field operations in Pelekunu Valley. Ground-based feral ungulate control, opportunistic weed suppression, and stream monitoring and data analysis
- **Task 5:** Increased population control of hooved animals on Molokai's north shore. This is an approved and ongoing project for the Department
- **Task 6:** Fence material purchase for the westernmost line of this unit that will eventually protect 4,225 acres
- **Task 7:** Project oversight and staff time for fence construction and hooved animal removal

## Evaluation criteria

### **E.1.1 Evaluation Criterion A—Project Benefits**

#### **E.1.1.1: Sub criterion A.1: Project Benefits**

##### **E.1.1.1.1: General Project Benefits**

This project will directly benefit ecological values that have a nexus to water resources.

Numerous studies have indicated that native forests significantly increase water recharge as compared to alien forest, grassland, or barren areas in these high elevation sites.<sup>10</sup> Native Hawaiian forests are highly complex, with canopies, mid-levels, and a well-developed understory and ground cover of ferns and mosses. These are well-adept at capturing fog moisture compared to monotypic alien forests, or grassland or barren areas. Additionally, the well-vegetated ground cover of a native forests increases water infiltration rates, furthering recharge compared to barren areas which can infiltrate up to 15 times slower than forests, greatly increasing runoff and erosion.<sup>11</sup> Further, the most common non-native weed that inhabits this mountain is *Psidium cattleianum*, a small, fast-growing tree that has exhibited the ability to evapotranspire 27%-53% more water than native forests, causing extensive water loss across landscapes.<sup>12</sup> For example, in East Hawai'i invasive plants have already reduced estimated groundwater recharge by 85 million gallons a day (261 acre feet/day).<sup>13</sup> *P. cattleianum* is largely spread by feral pigs.





*Native forest of East Molokai resembles a giant sponge, with mosses, shrubs, and ferns absorbing water.*

Fencing these forests has been a proven strategy to provide long-term protection for these forests.<sup>14</sup> Native Hawaiian forests have evolved without defenses to hooved animals, losing protections such as thorns and poisons. Hooved animals are the main cause of the loss of native forest statewide.<sup>15</sup> Less than half of Hawaii's original forest remains.<sup>16</sup> The project will result in long-term improvements to water quantity and quality by decreasing sediment and nutrient pollution. Studies have shown approximately 20-70% of the ground in a Hawaiian rainforest converted to bare soil due to pig digging.<sup>17,18,19,20,21</sup> (A comprehensive literature review of feral pig effects can be found in Reeser, D., B. Harry. 2005. [Controlling Wild Ungulate Populations in Native Ecosystems in Hawai'i](#). Hawai'i Conservation Alliance.) Potentially hundreds of acres within the project are being exposed by pigs, goats, and deer. Not only do hooved animals

devour, uproot, and trample forests, they spread invasive weeds and are now known to spread an alarming fungal disease called rapid 'ōhi'a death.<sup>22</sup> This disease has caused the death of over a million 'ōhi'a trees, which are the keystone tree species in native forests.

This project will also reduce erosion into the most biologically important streams in Hawai'i. Bare ground in Hawai'i is exponentially more erosive than forests. When these areas recover after feral pig, goat, and deer exclusion, the response is likely to change from annual erosion rates removing up to 0.5 mm of soil per year, versus undisturbed forested areas which have 0.01-0.05mm per year.<sup>23</sup> Thus, this project will result in long-term improvements to water quality through decreases of sediment and nutrient pollution.

This project benefits three large river systems that are important riparian habitat, in addition to many other smaller streams. Pelekunu is well known as the most biologically intact river in the entire state. This 21-mile-long river has been ranked 10 out of 10 for its high native stream animal diversity (shown in table below).<sup>24</sup> The other two rivers protected by this project – Wailau and Halawa, received a 9 and 8 out of 10 for overall ranking, respectively.<sup>25</sup> Protection of these fish and invertebrate species requires restoration of riparian vegetation to help decrease instream heating and reduce sediment loads, as well as increase the consistency of stream flows.<sup>26</sup> This project directly addresses those needs by improving water recharge which improves the consistency and volume of streams and reduces the erosion from feral pig diggings, which are more prevalent alongside stream banks.

## BIOTA INFORMATION

### Species List

#### Native Species

<b>Crustaceans</b>	<i>Atyoida bisulcata</i> <i>Macrobrachium grandimanus</i>
<b>Fish</b>	<i>Awaous guamensis</i> <i>Eleotris sandwicensis</i> Gobiid sp. <i>Kuhlia sandwicensis</i> <i>Kuhlia xenura</i> <i>Lentipes concolor</i> <i>Mugil cephalus</i> <i>Sicyopterus stimpsoni</i> <i>Stenogobius hawaiiensis</i>
<b>Snails</b>	<i>Clithon cariosus</i> <i>Erinna aulacospira</i> <i>Ferrissia sharpi</i> <i>Neritina granosa</i>

#### Native Species

<b>Insects</b>	<i>Anax junius</i> <i>Anax sp.</i> <i>Anax strenuus</i> <i>Campsicnemus ridiculus</i> <i>Campsicnemus sp.</i> <i>Chironomus hawaiiensis</i> <i>Dasyhelea hawaiiensis</i> <i>Dasyhelea platychaeta</i> <i>Dasyhelea sp.</i> <i>Dolichopodid sp.</i> Ephydrid sp. <i>Eurynogaster sp.</i> <i>Hydroptila sp.</i> <i>Hyposmocoma sp</i> <i>Limonia jacobus</i> <i>Megalagrion blackburni</i> <i>Megalagrion calliphya</i> <i>Megalagrion hawaiiense</i> <i>Megalagrion nigrohamatum</i> <i>nigrohamatum</i> <i>Megalagrion pacificum</i> <i>Megalagrion sp.</i> <i>Megalagrion xanthomelas</i> <i>Microvelia vagans</i> <i>Notiphilia insularis</i> <i>Procanace acuminata</i> <i>Procanace confusa</i> <i>Procanace sp.</i> <i>Procanace wirthi</i> <i>Pseudosmittia paraconjugata</i> <i>Saldula exulans</i> <i>Scatella cilipes</i>  <i>Scatella clavipes</i> <i>Scatella hawaiiensis</i> <i>Scatella sp.</i> <i>Scatella warreni</i> <i>Sigmataneurum sp.</i> <i>Telmatogeton torrenticola</i> <i>Thambemyia acrosticalis</i> Tipulid sp.
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The project will also directly benefit terrestrial ecosystems of Hawaiian wet forests, as well as a multitude of endangered species within the project site. Federally listed endangered plant and animal species, some of which exist only in this region. The Fish and Wildlife Service has drafted Recovery Plans for many of these endangered species, which consistently rank hooved animal removal as a top priority for the delisting of these species. Twelve listed plants exist in Pelekunu, as well as a listed damselfly. Additionally, many other highly endangered plants and animals also exist in the Pelekunu that likely would be added to the endangered species list due to their extreme rarity, such as *Partulina* snails. Critical habitat for many of these endangered species is also designated in the project area. A vast majority of these species are plants, whose main threat is hooved animals. The listed animal species also benefit from hooved animal removal because they depend on a healthy native forest for habitat.



*Partulina mighelsiana* is a species of terrestrial tree snails found in the most pristine portions of Pelekunu. There are only a few known individual trees left that this host this species.

#### ***E.1.1.1.3 Water Management and Infrastructure Improvement Benefits***

This project covers an area that provides 8,847.6 million gallons per day (27,252 acre-feet/day) of water into the Molokai aquifer.<sup>27</sup> Keeping these areas forested will dramatically improve recharge. Even without rain, Hawaii's native forests can absorb moisture from passing clouds

that condense on the thick vegetation. Intercepting cloud drip increases water capture by as much as 30% of rainfall, and increases groundwater re-supply by 10-15%.<sup>28</sup> Rainfall collects on the leaves, branches, and understory, allowing it to drop slowly into the ground.

The proposed project is strategic for watershed protection and addresses the top priority issue for many needs including ecological resiliency, water shortages, flooding, water supplies, endangered species, conflicts over water supply, as well as human health issues from degraded water quality.

The project includes some of the highest rainfall sections of the mountain, as well as a groundwater management area, where threats of water scarcity have led to State designation that further restricts permitting water withdrawals.<sup>29</sup> The legal and regulatory battles over water allocation are only set to intensify as climate change is predicted to bring hotter and drier conditions to this region.<sup>30</sup>

Most of Molokai's municipal water comes from this single aquifer, including the main town of Molokai - Kaunakakai. This target aquifer also services agricultural uses critical for Molokai's current and future economic self-sufficiency and food sustainability. As the island of Molokai is predicted in all climate scenarios to become hotter and drier,<sup>31</sup> this vital agricultural region will depend even more heavily on the availability of water coming from the mountains.

This project location is also strategic because it includes almost the entire remaining extent of unprotected native forest on the island of Molokai. Protecting remaining native forests from loss is cost-effective compared with restoring areas after degradation. This is because the management actions needed to restore areas require high-density planting and invasive weed control, in addition to the fencing and hooved animal removal needed in both restoration and protection projects. Thus, protecting forests from damage before they are lost to hooved animals is a top priority, to prevent the costly and difficult efforts to restore the area later. Further, full restoration is not possible because it is not feasible to reintroduce all the components of a healthy native ecosystem, which includes complex interactions between invertebrates, birds, and other little-studied elements such as mosses and fungi. Protection – and restoration – of native forests is not possible in the presence of hooved animals such as goats, and pigs, which roam wild across this watershed.<sup>32</sup>



*The project area has difficult and steep terrain. Pelekunu Valley, Molokai.*

#### ***E.1.1.1.4 Restoration Project Benefits***

**Invasive Species – Vegetation:** Invasive vegetation removal will occur opportunistically in this project as it largely includes intact native forest areas.

**Invasive Species – Other Taxa:** The main objective of this project is to remove invasive hooved animals. Constructing fences is a long-term way to prevent reintroduction of these animals. As explained above, studies have shown approximately 20-70% of the ground in a Hawaiian rainforest converted to bare soil due to pig digging.<sup>33,34,35,36,37</sup>

As these forests degrade and are converted to bare soil, the land is no longer able to collect moisture as effectively. Instead, the passing clouds (cloud drip interception) that can be as much as 30% of rainfall is eliminated. Additionally, the bare soil is estimated at 15 times slower at infiltration of rain than forested areas, which further reduces groundwater recharge while increasing stream runoff, flash floods, and sedimentation.

#### ***E.1.1.2 Multiple Benefits***

The project will benefit water users across Molokai that rely on the groundwater aquifer. It also will increase surface reliability for various downstream users. These forests have spiritual and material importance to the Hawaiian culture.<sup>38</sup> This project feeds rivers which supply communities with water, including Halawa. This valley supports the largest community of taro farmers in Molokai. Taro is the most important food in native Hawaiian culture and farming requires terraces irrigated from canals that divert water from streams. Ample water is critical to continue this agricultural practice and livelihood, but too much water can destroy the taro fields as well as the irreplaceable rock terraces that are still in use today. Ancient Hawaiians understood the importance of forests for their source of water – as evidenced by the saying “hahai nō ka ua i ka ulu la‘au” (the rain follows the forest). This project will help perpetuate the close connection between the forests and the native culture of Hawai‘i. The Nature Conservancy contracted a Cultural Impact Assessment of Pelekunu valley to provide feedback on the proposed weed suppression and ungulate control. The study indicated that these actions preserve archaeological remains by slowing the erosion of surface architecture.<sup>39</sup>

This project also benefits human health. Statewide, 85% of waterbodies sampled by the Department of Health are classified as impaired, and turbidity was by far the largest cause of the substandard sampling results.<sup>40</sup> Erosion from barren slopes is the main cause of turbidity. In addition to causing forest loss, the feral hooved animals targeted in this proposal also spread lethal diseases, such as non-tuberculous mycobacterial (NTM) lung disease and leptospirosis.<sup>41</sup> Hawaii has the highest prevalence of age-adjusted NTM lung disease mortality in the U.S.<sup>42</sup> Pig wastes also spread fecal bacteria (enterococcus).<sup>43</sup> While the State Department of Health has not yet set Total Daily Maximum Load limits for these waters, it is anticipated that the streams within the project area could eventually have TMDLs set due to their consistently impaired status. Thus, the Department of Health has listed multiple streams within this project area as priorities for TMDL designation.<sup>44</sup>



*A view of the devastating uncontrolled terrestrial erosion and its affect on our ocean. Ukumehame, Maui.*

### ***E.1.2. Collaborative Planning***

This project was designed by a watershed group, including multiple stakeholders (listed in the following section “Stakeholder Support”). This project has a long history of community engagement, support, and planning. The Molokai community voted for the protection of a forest adjacent to Pelekunu as top priority project for the USDA’s Molokai Rural Empowerment Zone Application’s strategic plan in 1998. The “EZ” application was awarded a ten-year Molokai “Enterprise Community” (EC) designation in 1999. In November 1999, the EC played an instrumental role in the formation of the EMoWP and became the first “community group” to formally sign into a Hawai’i Watershed Partnership. Since 1999, EMoWP has united landowners and managers to pool resources and manage watershed priorities across the entire mountain range. The partnership has a track record of success to complete many other landscape-scale fencing, firebreak, and invasive species control projects. The long-term nature of the partnership, as well as its impressive accomplishments, provide a promising basis for its capacity to carry out this additional portion and maintain it into the future. The partnership has created a 2030 management plan which proposes protection for these areas, and was approved by all the partners members. EMoWP has also met with community members in the region to gain input on these projects.

The proposed activities of planning for the fencing and hooved animal removal in this region complements the following plans:

1. State of Hawai’i Sustainable Hawai’i Initiative: this goal, announced by Governor Ige in 2016 to the World Conservation Congress, includes a goal to protect 30% of priority watershed forests by 2030. This measure is tracked by the acreage of native forests fenced from hooved animals.<sup>45</sup>
2. Fish and Wildlife Service Recovery Plans: the recovery plans for multiple endangered species that exist in the project area prioritize hooved animal removal.<sup>46</sup>
3. Hawai’i State Water Resource Protection Plan: this plan prioritizes native forest protection for water recharge.<sup>47</sup>
4. Ocean Resources Management Plan: this plan prioritized hooved animal removal and native forest protection for erosion reduction targets.<sup>48</sup>
5. Hawai’i Drought Plan: This plan prioritizes hooved animal removal and native forest protection for securing water supplies.<sup>49</sup>
6. Hawai’i Forest Action Plan: This plan prioritizes hooved animal removal and native forest protection for securing water supplies and many other benefits.<sup>50</sup>
7. Hawai’i State Wildlife Action Plan: This plan identifies multiple endangered species that exist in the project area and prioritizes hooved animal removal.<sup>51</sup>
8. County of Maui Island Water Use & Development Plan: This plan prioritizes watershed forest protection and associated actions to maintain water supplies.<sup>52</sup>
9. Department of Health, Non-Point Source Management Plan: This plan prioritizes hooved animal removal to reduce sedimentation and pollution of animal wastes into waterways.<sup>53</sup>



### ***E.1.3 Stakeholder Support for Proposed Project***

The partners that represent this application have a wide diversity of interests:

#### Governmental agencies:

*State of Hawaii, Department of Land and Natural Resources* (applicant): The State provides funding – both for the watershed partnership, as well as its own natural resource management staff - to protect forested watersheds, as well as streams and marine resources. The State is also responsible for monitoring and managing groundwater withdrawals.

*County of Maui, Department of Water Supply*: This agency provides funding for the watershed partnership, monitors water levels, and delivers water to residential communities served by the project area.

*U.S. Fish and Wildlife Service*: This agency provides funding for habitat protection and develops species recovery plans.

*University of Hawai‘i*: Staff are hired by the University to provide fence construction and hooved animal removal management actions.

#### Private Partners:

*The Nature Conservancy of Hawai‘i*: This non-profit manages Pelekunu Preserve on the northern portion of the watershed and manages the East Molokai Watershed Partnership. The Nature Conservancy is active in the coordination of private landowners, access, and the outreach for this project.

*Puu O Hoku Ranch*: A large portion of the project area is owned by this private company. The DLNR will develop a Right-Of-Entry agreement to fence portions of their lands.

These partners collaborate to plan for the management of these lands, which includes most of the remaining undeveloped lands of conservation value in East Molokai.



*Water that originates from forests supplies water for east Molokai communities. Puu O Hoku, Molokai.*

In Hawai'i, every fence project inevitably has opposition because hunters seek to keep hooved animals in areas so they can have more hunting lands. However, much of the project site is extremely remote and receives little visitation from hunters.

#### ***E.1.4. Readiness to Proceed***

##### **Watershed Fence Construction - Pelekunu**

First, fence material will be purchased. Staff will transport all fence material via helicopter as this area is only accessible via air. All staff are compliant with standards set forth by the U.S. Department of Interior's Office of Aviation Safety. Proper safety protocol and personal protective gear will be used at all times.

Fence construction will be managed by DLNR staff from Molokai who have decades' worth of experience in fence construction in remote areas.

The project area contains rugged terrain of convoluted valleys, with multiple streams. Each stream crossing represents a challenge for fence construction as flash floods often threaten to blow apart these fences. Instead, the field crew have found areas with waterfalls, deep pools, or

other natural barriers that can be used to exclude hooved animals. Using these natural barriers increases both the efficiency of material usage and labor time.

Staff are using ridges and contour areas that provide a feasible place to construct and maintain fences. As natural resource managers visit these potential fence lines, they have conducted botanical surveys to ensure no rare or endangered species will be impacted by construction and to relocate the fence line if these resources are found.

### **Watershed Fence Construction – Puu O Hoku**

This task includes purchasing fence materials to install the first phase of the fence line for this 4,225-acre project. The State will procure these materials via competitive methods. The State has purchased fence materials for hundreds of miles of fence statewide.

The applicant has landowner permission to conduct the work. No conflicts are anticipated for the Puu o Hoku fence as the Site Plan Approval between the State of Hawaii and Puu o Hoku Ranch was signed on March 7, 2023. The Department is also processing a Site Plan Approval for the Pelekunu fence as well. Both fences have already completed their State environmental assessment compliance, and were both deemed exempt from requiring an assessment.



*Watershed forests of the Puu O Hoku fence area.*

For both fence projects, the State will work with BOR to include this in their categorical exemption documentation for NEPA/Section 7. This task has been completed for other BOR – State of Hawaii fence projects and takes only a few months.

## **Aerial Feral Ungulate Removal**

The Department of Land and Natural Resources has an ongoing project utilizing firearms to reduce feral ungulate populations from the air. These types of missions only happen in places where it is unfeasible to do on the ground due to terrain and safety. These operations require public notice posted a month before the shoot, and the areas are closed to the general population on mission days.

Specific staff members who are certified by the Department of Interior's Office of Aviation Safety will carry out these missions. They are well-trained and have the specific credentials to carry out these missions in safe and effective manner.

No additional compliance is required for this portion of the project as an aerial shooting Right-Of-Entry and management plan is already in place, and this is exempt from requiring an environmental assessment and does not result in ground disturbance so does not trigger a review of effects of historical properties. BOR would need to include this in their categorical exemption documentation for NEPA/Section 7.

## **Management of Pelekunu valley including monitoring, invasive vegetation removal, and on-the-ground hooved animal removal**

The Nature Conservancy has owned and managed the total 5,759 acres of Pelekunu Preserve since 1986. The preserve was established to protect the perennial stream system, one of the best remaining in Hawai'i. The Nature Conservancy will likely apply to a competitive solicitation for increased management of this Preserve to complement the higher level of active management needed if this area is fenced. This additional management includes ground-based feral ungulate removal, opportunistic weed suppression, and stream monitoring, with data analysis.

The awarded contractor will organize ground hunts in areas that are accessible and can be done safely.

Currently TNC's weed suppression efforts focuses on preventing the spread of habitat-modifying weeds to where native plant communities are still relatively intact and has four components: 1) developing and implementing a feasible, long-term control strategy for *Melastomes*; 2) identifying, mapping, setting management priorities and implementing control for other established habitat-modifying weeds; 3) Preventing the spread of weeds from adjacent areas into Pelekunu's watershed cliff areas; 4) preventing the establishment of new habitat-modifying weeds.

The Nature Conservancy has monitored the streams in Pelekunu every two years to track the biological and physical resources and critical threats in the preserve and evaluate changes in these resources and threats over time. Besides water samples and turbidity checks, the monitoring includes surveying for diadromous macrofauna (native gobies and mollusks, and native and alien crustaceans) to determine their distribution and abundance along Pelekunu stream and its tributaries.

No additional State compliance is required for this portion of the project as this is exempt from requiring an environmental assessment and does not result in ground disturbance so does not trigger a review of effects of historical properties. BOR would need to include this in their categorical exemption documentation for NEPA/Section 7.

**TABLE 1. SCOPE OF WORK, COST, TIMELINES**

Major Task	Sub Objective	Start Date	End Date	Hours	Cost
<b>Federal Request (70%)</b>					
1. Fence Material Procurement - Pelekunu	Purchase of fence material and tools for Pelekunu fence construction	1/1/2024	7/1/2024	n/a	\$268,000.00
2. Fence Construction - Pelekunu	Oversee contracted labor to build the 2.6-mile fence	7/1/2024	12/31/2026	8,320	\$201,921.60
3. Helicopter Flight Time - Pelekunu	Transport gear and staff to remote sites	1/1/2024	12/31/2026	165	\$199,100.00
4. Field Operations in Pelekunu Valley	Ungulate population reduction, weed suppression, stream monitoring with data analysis	7/1/2024	12/31/2026	n/a	\$177,870.00
5. Aerial Control of Feral Animals	Purchase helicopter time and conduct approximately 3 operations per year	11/1/2024	12/13/2026	70	\$90,000.00
Subtotal					\$936,891.60
<b>Applicant Contribution (30%)</b>					
6. Fence Material Procurement	Purchase of Puu O Hoku fence material and tools for fence construction	12/1/2025	12/31/2026	n/a	\$343,792.00
7. Project oversight and fieldwork (civil service salary and fringe)	Overseeing fence contractors and field operations, conducting purchases,	1/1/2024	12/31/2026	1,749	\$74,382.72

	completing aerial shooting missions				
Subtotal					\$418,174.72
Total					\$1,355,066.32

### E.1.5 Performance Measures

This project will continue to monitor multiple performance measures. Part of the grant would support a contractor to continue collecting data that has been collected annually since 1989 detecting the presence and level of activity of hooved animals. Animal sign data is collected across Pelekunu valley through monitoring transect stations. Eleven transects have been established in the valley and stations are located every 500 meters. Additionally, detailed data is kept on the numbers, location, and species of hooved animals removed from both ground and aerial shooting efforts. This data will be compared to determine trends and progress toward the goal of eliminating hooved animals within the fenced areas as well as decreasing animal numbers in areas of targeted animal culling.

The contractor also will conduct annual invasive plant surveys via air to detect incipient habitat-modifying weeds.

The contractor will also conduct a systematic stream macrofauna survey every other year. This biennial stream monitoring has been occurring since 2002 and focuses on native gobies, mollusks, and native and alien crustaceans to determine their distribution and abundance along Pelekunu stream and its tributaries. This is measured in average density of native stream animals per square foot.



*Surveying in the Pelekunu stream offers the opportunity to engage members of the Molokai community in monitoring stream resources. TNC staff explains monitoring methods to a Molokai High School student.*

The Department will continue these monitoring activities after the grant period is completed, building decades of data. The data on streamflow is monitored by USGS gaging stations at Halawa. The hooved animal and stream monitoring will also continue and will hopefully show a total elimination of hooved animal sign within the fenced area, and an increase in native stream animals. However, it is not advisable to use streamflow trends to indicate results from management because flows are largely determined by a changing climate.

### ***E.1.6 Presidential and DOI Priorities***

#### **E.1.6.1 Climate Change**

The project location is in a period of extreme drought.<sup>54</sup> These conditions are anticipated to be exacerbated by climate change. Drought is already limiting agricultural use in this region. This project will improve water supplies.

In Hawai'i, protecting forests alleviates a wide range of threats from climate change predicted to cause hotter<sup>55</sup> and drier<sup>56</sup> conditions, and rising sea levels<sup>57,58</sup> that infiltrate fresh water systems.<sup>59</sup> Forests will be even more critical for collecting fog drip with less overall rainfall.<sup>60</sup>

This project will reduce greenhouse gas emissions by preventing deforestation. Aboveground carbon data is derived from the U.S. Forest Service and U.S. Geological Service<sup>61</sup> maps of the carbon sequestration detected during LiDAR surveys for the Hawaiian Islands. If future landcover mapping exercises are conducted for these areas, their values can be compared to ensure that the aboveground carbon remains in these areas in the future. If the forests degrade further by hoofed animals and are replaced by invasive weeds, grasses, or barren areas, that existing stored carbon will be partially lost. On Hawai‘i Island, some of the highest standing densities of carbon can be found in old-growth ‘Ōhi‘a forests.<sup>62</sup> ‘Ōhi‘a forests, the dominant type of the remaining native forests, contain anywhere from 19 to 162 tons of carbon per acre; depending on climate and soil variables.<sup>63</sup> Destruction of native forests by hoofed animals can reduce or practically eliminate stored carbon.<sup>64</sup> When invasive plants, such as *P. cattleianum* invade and eventually replace these forests, aboveground biomass can drop by 19-38%.<sup>65</sup>

The proposed project will contribute to climate change resiliency in other ways. Endangered Hawaiian plants are highly vulnerable to climate change as their habitats are specialized, small, and often fragmented.<sup>66</sup> Protecting existing habitats from loss is one of the main ways to mitigate threats from climate change on these species.<sup>67</sup> Controlling the spread of invasive, habitat-modifying species like feral hoofed animals is particularly important as the climate becomes even more conducive to the spread of invasive plants, insects,<sup>68</sup> and diseases.<sup>69,70</sup>

#### **E.1.6.2 Disadvantaged or Underserved Communities**

The island of Molokai qualifies as a “disadvantaged community,” per the state censuses which reports that the region has less than 100 percent of the statewide annual median household income for the state.<sup>71</sup> Over 22% of east Molokai residents are below the poverty line.<sup>72</sup>

The proposed project serves an underserved community as Hawai‘i is the most diverse state in the nation and the island of Molokai is predominantly non-white.<sup>73</sup> As mentioned above, this project will bring increased community benefits for water supply, as well as economic benefits (creating green conservation jobs, as well as expanded agricultural opportunities). Further, it will improve public health by eliminating water-borne diseases spread by feral pigs.

#### **E.1.6.3 Tribal Benefits**

Hawai‘i’s native Hawaiian population particularly benefits from this project. While Hawai‘i does not have any recognized tribes, the Hawaiian Homes Commission Act of 1920 set aside approximately 200,000 acres of land to establish a permanent homeland for native Hawaiians. The project area serves Hawaiian Homes communities that draw water from the sole-source aquifer.<sup>74</sup> Additionally, as mentioned previously, the stream that flows from this area services a community whose main livelihood and cultural identity is tied to the ancient practice of taro cultivation, which is directly impacted by water availability and timing. Groups representing native Hawaiian, and their ability to conduct traditional and customary practices, have organized to stake claims for more water in the region. This project would increase water supplies for all users, including rural communities dominated by native Hawaiian residents.

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## Project Budget

### Budget Proposal

**TABLE 2. OVERALL PROJECT BUDGET**

Total Project Cost Table	
Source	Amount
Costs to be reimbursed with the requested Federal funding	\$ 936,891.60
Costs to be paid by the applicant (30%)	\$ 418,174.72
Value of third-party contributions	\$ 0.00
<b>TOTAL PROJECT COST</b>	<b>\$ 1,355,066.32</b>

### Budget Narrative

#### *Federal Request*

#### **Supplies**

*Fence Materials* – 2.6 miles of fence materials to build the Pelekunu unit is requested. This cost is based on an estimate of the number of t-posts, fence panels, anchors, clips, and other miscellaneous materials needed for the fence project. The Department has competitively-sourced contracts with vendors for these materials that are the basis of these cost estimates.

#### **Contractual**

*Labor to construct fence-* The Department has an established agreement with the Research Corporation of the University of Hawai'i to provide field positions that will implement the project. This includes a projected 40% of five crew members' time over the course of two years to build the Pelekunu fence. This represents a total of approximately 8,320 hours total (or approximately 1,664 hours per person). The fringe rate is approximately 38%. RCUH also charges an indirect cost of approximately 10% on salaries and fringe. The total to be spent on salaries and fringe is \$201,921.60. It is anticipated that this cost will be encumbered on 6/30/2024 and be invoiced monthly in even intervals until the fence construction portion of the project ends. The fence crews will access Pelekunu by helicopter and conduct camping trips (mostly week-long) in difficult terrain and rainy conditions.

*Helicopter services* – Helicopter transport will be required for staff to access the fence construction site. Currently, the State's negotiated helicopter rate per hour is \$1,100, established by a competitive bidding process. This cost is anticipated to be incurred throughout the construction phase of the project beginning 6/30/24 and ending 6/30/2026. This will be essential for the project as certain areas are so steep and rugged that they cannot be accessed on foot.

*Field Operations in Pelekunu Valley-* This includes removing feral hooved animals in the Pelekunu unit, weed suppression efforts, and stream monitoring with data processing and will

occur throughout the project period. This cost is based on previous contracts awarded through competitive bidding processes.

*Helicopter Services for Aerial Control of Feral Animals-* Helicopter services that are for aerial shooting are classified at a higher rate per hour (\$1,250) due to greater risk, a rate established by a competitive bidding process. These operations use firearms to dispatch feral hooved animals from the air due to the inaccessibility on the ground.

*Applicant Contribution*

**Supplies**

Fence Materials for 3.34 miles of fence to build the first phase of the Puu O Hoku Papalaua unit will be required. This cost is based on an estimate of the number of t-posts, fence panels, anchors, clips, and other miscellaneous materials needed for the fence project. The Department has competitively-sourced contracts with vendors for these materials that are the basis of these cost estimates.

**Salary and Fringe**

An estimated 1,749 hours of civil service staff time will contribute to this project, including the costs of salary plus an estimated 52% fringe rate. The staff that will be conducting this work include Watershed Planner Jon Brito and Forestry and Wildlife Technician James Espaniola.

**TABLE 3. STAFF TASKS**

Staff	Task Item (Refer to Table 1)
Watershed Planner – Jon Brito	1, 3, 5, 6, 7
F&W Technician V- James Espaniola	1, 2, 3, 4, 5, 6, 7
Contracted RCUH Watershed Field Assistants	2, 3, 4
Contracted Field Operations in Pelekunu Valley	4

**Environmental and Cultural Resources Compliance and Required Permits or Approvals, Letters of Support, and Official Resolution**

The project will require a NEPA, Section 7, and Section 106 evaluation. The project has been approved for a declaration of exemption from requiring an Environmental Assessment from the State of Hawaii and we anticipate that the NEPA review will also declare the project exempt,

which has been the case with other BOR-funded fences in Hawai'i. The Department will conduct an archaeological survey of the fence route in Pelekunu and will avoid any historic properties and will seek concurrence under Section 106 and the State's historic review laws of "no adverse effect to historic properties."

Letters of support are attached below.

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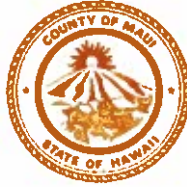
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**RICHARD T. BISSEN, JR.**  
Mayor

**KEKUHAPIO R. AKANA**  
Managing Director

**JOHN STUFFLEBEAN, P.E.**  
Director

**JAMES A. LANDGRAF**  
Deputy Director



**DEPARTMENT OF WATER SUPPLY**  
COUNTY OF MAUI  
200 SOUTH HIGH STREET  
WAILUKU, MAUI, HAWAII 96793  
<http://www.mauicounty.gov/water>

March 24, 2023

Bureau of Reclamation  
Financial Assistance Operations  
P.O. Box 25007, MS 84-27815  
Denver, CO 80225

RE: Grant Application for State of Hawai`i Department of Land and Natural Resources, Division of Forestry and Wildlife, East Moloka`i Watershed, County of Maui, Hawai`i

Dear Bureau of Reclamation,

The County of Maui, Department of Water Supply (DWS) supports the "East Moloka`i Watershed, County of Maui, Hawai`i" grant application.

Department of Land and Natural Resources (DLNR) will increase water supplies by protecting ecological values on the eastern half of the island of Moloka`i from feral hooved animals. These forests are threatened by non-native feral pigs, deer, and goats, which roam wild and trample and devour vegetation, and spread weeds. Protecting forest watersheds is the most cost-effective and efficient way to absorb rainwater and replenish groundwater. This is important as these forests help recharge Molokai's "sole source" aquifer. An emergency declaration for the island of Moloka`i has been declared for two years in a row due to extreme drought conditions. The island's water supply is so limited that it is designated as a "groundwater management area" where additional regulation and permitting by the State's Commission of Water Resource Management apply.

The DLNR and partners are undertaking an ambitious protection plan to preserve the remaining watershed forests of Molokai. This project extends the area of protection and active management across the northern and eastern portions of the remaining priority forests of Moloka`i.

DWS withdraws groundwater from East Molokai` for the communities of Kawela and Ualapue and provide financial assistance for removal of feral hooved animals and invasive plant species. We strongly support this project to improve water supplies in East Moloka`i.

Sincerely,



John Stufflebean, P.E., Director



March 22, 2023

Bureau of Reclamation  
Financial Assistance Operations  
P.O. Box 25007, MS 84-27815  
Denver, CO 80225

To Whom It May Concern:

The Nature Conservancy's (TNC) Molokai program strongly supports the State of Hawai'i, Department of Land and Natural Resource, Division of Forestry and Wildlife's WaterSMART proposal for calendar years 2024-2026.

In 1996, Molokai was designated a "sole source aquifer" under the U.S. Environmental Protection Agency's Safe Drinking Water Act, indicating that on this island, there is *no alternative drinking water source*. In addition, the native ecosystems most efficient at capturing and collecting freshwater have disappeared from all but 15% of the lands they once covered, making the preservation of those that remain critical to the survival of not just those ecosystems, but our island's inhabitants as well.

In 1999, TNC founded the East Molokai Watershed Partnership (EMoWP), an alliance which has grown and now includes over 20 landowners and partners on Molokai Island, dedicated to protecting and managing roughly a third of its lands for their watershed value.

Both TNC and the State are key implementers in the partnership, and the areas outlined in this proposal cover a significant part of Molokai's water lens with some of its best remaining native forest. Simply put, the proposal includes funding for protective fencing and management activities within Partnership areas that are critical to Molokai's long term water sustainability.

We are grateful to be able to offer our support for the State's proposal for 2024-2026 and are grateful for your consideration.

Please feel free to contact me with any questions (808) 954-6589 or [rkallstrom@tnc.org](mailto:rkallstrom@tnc.org)

Sincerely,



Russell Kallstrom  
Molokai Program Manager, The Nature Conservancy

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March 10, 2023

Bureau of Reclamation  
Financial Assistance Operations  
P.O. Box 25007, MS 84-27815  
Denver, CO 80225

To Whom It May Concern,

I support the "Protecting Forests for Water Supply Sustainability in Molokai, Hawai'i" grant application. Funding this project would expand the capacity to work across landowner boundaries to protect the watershed forest that we and many Molokai residents rely by fencing key lands. Conservation fences increase resilience of native forests, which have no defenses against the herds of introduced axis deer that threaten their existence. Impacted forests are more susceptible to incursions of weeds that further impact the ability of the forest to produce water. Molokai has less than 15% of the forest it once had.

Pu'u o Hōkū Ranch's forested lands are headwaters to over 10 different watersheds on the Island of Molokai. Tenants in these watersheds rely on the surface water provided by that forest for home and subsistence farming needs. Yet one of the main streams and valleys, the iconic Hālawa valley known for its waterfalls, has shown decreasing base flow for the last century and the exercise of Hawaiian culture based subsistence taro farming (lo'i) is now being limited there by this reduced flow.

Protecting the forest also is proven to dramatically increase freshwater supplies because the forests collect cloudwater moisture, and improve infiltration rates. Communities on east Molokai depends on these water sources, which are predicted to become increasingly drought stricken in future decades. This project will also provide many additional benefits, including supporting "green" jobs in our rural areas, carbon sequestration, and protection of the unique endangered species and rare ecosystems that exist only in the mountains about Pu'u o Hōkū.

I am pleased to offer my strong support for this important project.

Sincerely,

Rudi Hunke, Ranch Manager

PU'U O HOKU OPERATIONS, LLC  
P. O. BOX 1889, KAUNAKAKAI, HI 96748  
INFO@PUUOHOKU.COM; PHONE: (808) 558-8109

## Budget Narrative

### *Federal Request*

#### **Supplies**

*Fence Materials* – 2.6 miles of fence materials to build the Pelekunu unit is requested. This cost is based on an estimate of the number of t-posts, fence panels, anchors, clips, and other miscellaneous materials needed for the fence project. The Department has competitively-sourced contracts with vendors for these materials that are the basis of these cost estimates.

#### **Contractual**

*Labor to construct fence*- The Department has an established agreement with the Research Corporation of the University of Hawai`i to provide field positions that will implement the project. This includes a projected 40% of five crew members' time over the course of two years to build the Pelekunu fence. This represents a total of approximately 8,320 hours total (or approximately 1,664 hours per person). The fringe rate is approximately 38%. RCUH also charges an indirect cost of approximately 10% on salaries and fringe. The total to be spent on salaries and fringe is \$201,921.60. It is anticipated that this cost will be encumbered on 6/30/2024 and be invoiced monthly in even intervals until the fence construction portion of the project ends. The fence crews will access Pelekunu by helicopter and conduct camping trips (mostly week-long) in difficult terrain and rainy conditions.

*Helicopter services* – Helicopter transport will be required for staff to access the fence construction site. Currently, the State's negotiated helicopter rate per hour is \$1,100, established by a competitive bidding process. This cost is anticipated to be incurred throughout the construction phase of the project beginning 6/30/24 and ending 6/30/2026. This will be essential for the project as certain areas are so steep and rugged that they cannot be accessed on foot.

*Field Operations in Pelekunu Valley*- This includes removing feral hooved animals in the Pelekunu unit, weed suppression efforts, and stream monitoring with data processing and will occur throughout the project period. This cost is based on previous contracts awarded through competitive bidding processes.

*Helicopter Services for Aerial Control of Feral Animals*- Helicopter services that are for aerial shooting are classified at a higher rate per hour (\$1,250) due to greater risk, a rate established by a competitive bidding process. These operations use firearms to dispatch feral hooved animals from the air due to the inaccessibility on the ground.

### *Applicant Contribution*

#### **Supplies**

Fence Materials for 3.34 miles of fence to build the first phase of the Puu O Hoku Papalaua unit will be required. This cost is based on an estimate of the number of t-posts, fence panels, anchors, clips, and other miscellaneous materials needed for the fence project. The Department has competitively-sourced contracts with vendors for these materials that are the basis of these cost estimates.

***Salary and Fringe***

An estimated 1,749 hours of civil service staff time will contribute to this project, including the costs of salary plus an estimated 52% fringe rate. The staff that will be conducting this work include Watershed Planner Jon Brito and Forestry and Wildlife Technician James Espaniola.