Appendix B

Plans & Methodologies Incorporated and Referenced

Appendix B: Plans & Methodologies Incorporated and Referenced

1) Community Wildfire Protection Plans (CWPP's) See Appendix D
2) Comprehensive Wildlife Conservation Strategy (CWCS)
3) Forest Legacy Amended Assessment of Needs (AON) Hawaii
4) Statewide Comprehensive Outdoor Recreation Plan (SCORP)
5) Spatial Analysis Project (SAP)
6) Forest Stewardship Program National Standards and Guidelines
7) Hawaii Ocean Resources Management Plan (ORMP)
8) Kaulunani 2005--2009 Strategic Plan
9) Hawaii Tourism Authority Natural Resources Assessment Report
10) Gap Analysis of Hawaii: February 2006 Final Report
11) Hawaii Watershed Summit 2009 Summary Report and Methodology for Watershed Prioritization
12) Methodology Report for Development of Conditions of Native Biodiversity GIS Layer

1) Community Wildfire Protection Plans (CWPP's)
Six areas on three of the main Hawaiian Islands have Community Wildfire Protection Plans (CWPP's). All six areas are in the wildland urban interface and have experienced large wildfires that threatened communities and homes. Areas with CWPP's are Kahikinui and Waihee on the island of Maui; Kauai County (the entire island); Ocean View and Volcano on the island of Hawaii and the Northwest portion of Hawaii island encompassing 451,086 acres across 13 communities from North Kohala to North Kona. The plans were summarized by their author, Denise Laitinen, for the Wildfire Assessment and are included in full as APPENDIX D.

2) Comprehensive Wildlife Conservation Strategy (CWCS) Mitchell, C., Christine Ogura, DW. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard and A. McClung (2005). Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS). Honolulu, Department of Land and Natural Resources: 722 pp. http://www.state.hi.us/dlnr/dofaw/cwcs/index.html
Hawaii's Comprehensive Wildlife Comprehensive Strategy was used to build the foundation for the Conservation of Biodiversity Assessment and linked to Strategies. Lead author and wildlife specialist, Christine Ogura recommended key chapters for integration into the Assessment. As the CWCS plan is five years old, data on current populations, trends, threats, and habitats was updated and integrated by DOFAW staff and other Hawaii experts in conservation of biodiversity.

3) Forest Legacy Amended Assessment of Needs (AON) Hawaii. State of Hawaii Department of Land and Natural Resources Division of Forestry (2004). Forest Legacy Amended Assessment of Needs Hawaii. Honolulu: 98pp. Incorporated as per the checkbox on the "Checklist for Statewide Forest Resources Assessment and Strategies" the previously approved AON remains unchanged and is incorporated by reference.

The Hawaii Forest Legacy Program is a Federal program that provides states with acquisition funds that target forest lands as identified in the Hawaii Forest Legacy Program Assessment of Needs (AON) hawaii.gov/dlnr/dofaw/forestry/hflp and contribute to overall program goals:

1. Protect Hawaii's unique and fragile environmental resources
2. Encourage the protection of rare and/or endangered species
3. Promote the preservation of aesthetic beauty in Hawaii
4. Preserve watershed health and protect the sustainable yield of fresh water
5. Protect working forests as economic assets for the state and counties of Hawaii
6. Protect traditional and cultural forest practices and resources
7. Protect recreational forest practices

4) Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2008 Update State of Hawaii, Department of Land and Natural Resources (2009). Hawaii State. Honolulu.
The Hawaii State Comprehensive Outdoor Recreation Plan (SCORP), updated in 2008, provided much of the baseline data used in the Recreation and Tourism Assessment. Quantifiable information relating to economics of recreation and tourism, numbers of visitors to parks and natural areas and trends, for example, contributed to the assessment data. In addition, the five key priorities developed in the SCORP were integrated into the Recreation and Tourism strategies.

5) Spatial Analysis Project (SAP) Conry, P. J., Sheri S. Mann, Ronald J. Cannarella, Yoshiko Akashi (2008). Hawaii Spatial Analysis Project. Honolulu, Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife: 46 pp.
http://www.fs.fed.us/na/sap/products/hi.shtml
SAP has provided the Department of Land and Natural Resources/Division of Forestry and Wildlife (DOFAW) a unique opportunity to collect and adapt disparate data sources into a cohesive data set for doing land suitability analysis. DOFAW is undertaking a review of their internal land management guidelines based on the methodology developed by SAP. We will commence the development of our State Assessment as required in the 2008 Farm Bill, again basing our methodology on SAP. DOFAW staff are being trained in the use of ArcGIS and the Spatial Analyst extension so that they can utilize the models created during our SAP.

6) Forest Stewardship Program National Standards and Guidelines USDA Forest Service, State and Private Forestry, Cooperative Forestry (2005). 10 pp.
www.fs.fed.us/spf/coop/library/fsp_standards&guidelines.pdf
The purpose of the Forest Stewardship Program is to encourage the long-term stewardship of nonindustrial private forest lands, by assisting the owners of such lands to more actively manage their forest and related resources. The Forest Stewardship Program provides assistance to owners of forest land and other lands where good stewardship, including agroforestry applications, will enhance and sustain the long term productivity of multiple forest resources. Special attention is given to landowners in important forest resource areas and those new to, or in the early stages of managing their land in a way that embodies multi-resource stewardship principles. The program provides landowners with the professional planning and technical assistance they need to keep their land in a productive and healthy condition. The planning assistance offered through the Forest Stewardship Program may also provide landowners with enhanced access to other USDA conservation programs and/or forest certification programs. The Hawaii Forest Stewardship Handbook is included at the end of this appendix in its entirety.

7) Hawaii Ocean Resources Management Plan (ORMP) Hawaii Office of Planning, Coastal Zone Management Program (2006). 77 pp.
The underpinnings and guiding perspectives of the Hawaii Ocean Resources Management Plan were integrated throughout the Assessment. In particular the concept of a landscape approach to conservation that connects land and sea; promoting collaboration and stewardship; and adopting a 21st century application of the traditional *ahupuaa* concepts. The Hawaii Ocean Resources Management Plan calls for a change in our approach to natural and cultural management stating that our current sector-based approach is not adequate to address the complex challenges we face now and will face in the future, despite the ongoing and substantive efforts of government agencies, nongovernmental organizations, private sector, communities, and individuals.

8) Kaulunani 2005--2009 Strategic Plan Kaulunani (2009). Hawaii's Urban and

Community Forestry Program :. T. Trueman-Madriaga, Jackie Ralya. Honolulu: 16 pp.
The Urban and Community Forestry (UCF) Strategic Plan was the starting point for the Assessment and Strategy. The UCF Council's participation was important in the development of the goals in the Strategic Plan and they also initiated the UCF portion of the Statewide Assessment and Strategy. While the former Strategic Plan focused on funding, communications, education and urban forestry management, the current Strategy addresses far more complicated and pressing issues. Tropical urban forests have a critical role to play in island communities and should be considered as part of the green infrastructure. The UCF 2010 Strategy is focused on assessing the urban forest canopy, developing a tropical urban and community forestry research plan, mapping the urban forest, developing urban forestry management plans, using new technologies to educate the community about the value of trees, and working with key partners on urban forestry demonstration tree planting projects.
E malama i ka ulula'au -Care for the forest

9) Hawaii Tourism Authority Natural Resources Assessment Report. State of Hawaii, Hawaii Tourism Authority, PBR Hawaii and Associates, (2003). Honolulu. 2010: 274pp.
The Hawaii Tourism Authority Natural Resources Assessment Report provided baseline documentation used in the Assessment of Recreation and Tourism. The report delivers statistics on use and conditions of natural areas, public and private and identifies 23 sites (of 110 analyzed) for in-depth restoration and renovation. Data from this study is also integrated into the strategies for Recreation and Tourism.

10) A Gap Analysis of Hawaii: February 2006 Final Report.
A Geographic Approach to Planning for Biological Diversity. D. S. M. Gon III. Honolulu, University of Hawaii/ Research Corporation of the University of Hawaii: 487. The U.S. Department of the Interior, U. S. G. S. (2006).

11) Hawaii Watershed Summit 2009 Summary Report and Methodology for Watershed Prioritization. Prepared by Marine and Coastal Solutions International, Kamuela, HI for the State of Hawaii, Office of Planning, Coastal Zone Management Program (2009) Honolulu (2010) 64 pp. The Watershed Summit brought together Cabinet level State Agency Directors and Federal Agency partners to review the Watershed Prioritization Process pursuant to National Oceanic and Atmospheric Administration.

12) Methodology Report for Development of Conditions of Native Biodiversity GIS Layer. This layer was produced by a team of ecologists and GIS analysts to assist in the development of Hawaii's Statewide Assessment of Forest Conditions and Resource Strategy, 2010. Honolulu, Hawaii, April 2010. 6 pp.

State of Hawaii

Forest Stewardship Handbook

Department of Land and Natural Resources
Division of Forestry and Wildlife (DOFAW)
1151 Punchbowl Street, Room 325
Honolulu, Hawaii 96813
(808) 587-4172
http://www.state.hi.us/dlnr/dofaw/hfsp/index.html

February 2007

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State Contacts:

FOREST STEWARDSHIP PROGRAM COORDINATOR
DOFAW Cooperative Resource Management Forester – Sheri S. Mann
1151 Punchbowl St., Room 325
Honolulu, HI 96813
808-587-4172
sheri.s.mann@hawaii.gov

SERVICE FORESTERS
DOFAW Branch Offices:

Hawaii Island	**Maui County**	**Kauai**	**Oahu**
19 E. Kawili St.	54 South High St.	3060 Eiwa St.	2135 Makiki Hts. Dr.
Hilo, HI 96720	Wailuku, HI 96793	Lihue, HI 96766	Honolulu, HI 96822
808-974-4221	808-984-8100	808-274-3433	973-9778

State Tree Nursery
66-1220A Lalamilo Rd.
Kamuela, HI
808-887-6061

Forest Stewardship Website:
http://www.state.hi.us/dlnr/dofaw/hfsp/index.html

Division of Forestry & Wildlife Website:
www.dofaw.org

Program Overview

The Hawaii Forest Stewardship Program (FSP) provides technical advice and financial assistance on a cost-share basis to promote the stewardship, enhancement, conservation and restoration of Hawaii's forests. The FSP focuses on the following objectives: timber productivity, native ecosystem health and biodiversity, watershed quality, wildlife habitat and recreation.

The State program began in 1991 through the passage of Act 327 of the Hawaii Legislature. The Federal Forest Stewardship Program provides administrative support. The Forest Stewardship Advisory Committee advises the Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW), which administers the program. The Committee reviews proposals and management plans, recommending those deserving of funding to the State Forester and the Board of Land and Natural Resources for approval. Committee members represent federal and state agencies, professional foresters and resource consultants, conservation organizations, land trust organizations and private landowners. Assistance with the process can be requested from DOFAW staff.

After acceptance in the program and completion of a contract, completion of approved practices is reimbursed at 50% of the allowable cost. The program can also assist with the cost of developing a full management plan, which must cover a period of at least 10 years (the cost share portion of the plan). The term of the contract can vary from an additional 10 or 20 years following the completion of cost-shared management practices to ensure plantings and/or practices are maintained. Participants may only wish to just develop a management plan.

Applicant Eligibility

To be eligible for the FSP, applicants must:

- Own at least 5 contiguous acres of forested or formerly forested land

OR

- Have a lease for a minimum of 10 years on at least 5 contiguous acres of forested or formerly forested land

AND

- Intend to **actively manage at least 5 acres** to enhance forest resource values for *both* private and public benefit

Individuals, joint owners, private groups, associations, leaseholders, or corporations are eligible. Lands that qualify as potential natural area reserves are not eligible (see Appendix A).

Contract Length

FSP contracts generally require a maintenance period beyond the first ten (10) years of cost-share between the landowner and the State. However, the Program allows eligible applicants whose objectives do not include commercial timber production to enter into contracts with term length ranging from 10 to 30 years, including the cost-share period. For applicants interested in commercial timber production, contract term lengths must be at least 30 years and include a payback provision as described in the "*Payback Provision and Taxes*" section below.

Proposal Deadlines

The FSP Coordinator accepts proposals and developing management plans on a rolling basis, which are compiled and reviewed prior to evaluation by the FSP Advisory Committee on a quarterly basis. The Committee generally meets on **February 1st, May 1st, August 1st, and November 1st** of each year. These dates change from time to time so we recommend calling to confirm meeting dates and proposal deadline dates. It is highly recommended that the FSP Coordinator is contacted before submitting a proposal and that a draft is submitted before the due date. By resolving any issues in advance, you will increase your chance of success.

Program Procedures – For Proposals and Plan Development

1. **Submit a proposal** by the quarterly deadlines to the FSP Coordinator. Follow the format on page 11. Proposals are accepted, rejected, or revisions are requested. Once accepted, the cost-share amount for development of the management plan is negotiated.

2. **Develop and submit a management plan** covering at least 10 years of management practices according to the format on page 14. We recommend you seek the assistance of a resource management consultant, a forester, or someone with expertise in management plan development unless you are professionally qualified. Plans must include a letter from the State Historic Preservation Division verifying there are no archeological, burial or historic sites on the property (see Appendix B). Management plans may be approved or the Stewardship committee may request revisions or additional details. Reimbursement for the negotiated cost-share amount for the development of the management plan is made upon execution of the contract.

3. **IF NECESSARY - Other documents may be required: Environmental Assessments** (including a cultural impact assessment) are required if the management plan includes the establishment of timber with the intent of eventual harvesting or the construction of fences (see Appendix C). **Archeological survey**s may be required where there is strong evidence to suggest the existence of archeological or historic resources (see Appendix B). **Grading Permits or Soil Conservation Plans** may be required (Appendix B). If the project is within the conservation district, a **Conservation District Use Permit** may be required (Appendix D). If you plan to collect, propagate or plant **threatened and endangered species** contact the State Botanist at (808) 587-0165.

4. **Arrange a Site Visit** by a DOFAW Service Forester (page 2) to verify practices and cost-share estimates.

5. **Obtain approval from the Board of Land and Natural Resources**. DOFAW submits documents detailing FSP proposals and management plans to the board recommending approval. The Board may approve, deny or request that adjustments be made to management plans and contract agreements to reflect current priorities or budget concerns. If approved, the contract starts on the date of final approval. If you begin your project before all parties sign and prior to State authorized execution of the contract, you will not be reimbursed for expenses incurred before the contract date. You will receive a Forest Stewardship recognition sign to post on your project property.

6. **Submit documents required to complete a contract with the State.** For approved management plans, DOFAW staff prepares a contract, which you review, sign with a notary, and mail back for the State to sign and finalize. Prospective FSP grant recipients must also submit a W-9 Form (assigns a state procurement number). If your contract is more than $25,000 total, you will also need Federal and State tax clearances, a General Excise Tax Number, and evaluation forms that we will provide you. All contracts must follow the State's general conditions, whereas special conditions are somewhat negotiable.

7. **Sharing the cost (cost-share) of Forestry Practices.** Approved practices can be found on page 6.

8. **Submit semi-annual progress reports, invoices, and cost documentation** to DOFAW in the formats provided when your contract is approved. A Service Forester will then visit the project site to verify practice completion and discuss progress or problems. After the site visit, DOFAW will mail a reimbursement payment for completed management practices. Information contained in reports may be shared with the public. See page 7 for information on revisions to plans.

***Please note** it takes at least 9-12 months from when a proposal is submitted to contract execution should the proposal be approved. Cost share funds will not be dispersed until the contract is fully executed and initial management practices have been completed and are ready for inspection.*

General Management Objectives Eligible for Cost-share Assistance

- Forest Stewardship management plan development
- Growth and management of forests for non industrial timber and other forest products
- Native species restoration
- Agroforestry (the forestry component only)
- Windbreaks (to protect forestry project areas)
- Watershed, riparian, and/or wetland protection and improvement
- Forest recreation enhancement
- Native wildlife habitat enhancement
- Native forest conservation

Orchards, agriculture and landscaping are NOT eligible objectives

Cost-sharing and Allowable Rates

You will receive up to a 50% cost-share reimbursement for your management practice expenses, which generally must be within the allowable rates listed in Appendix F. You can include "in-kind" services (non-cash) such as labor costs, your own materials, and the use of your own equipment as part of your 50% cost-share or match (see Appendix G for details).

Allowable reimbursements are subject to a variety of factors including project scale, type, actual project costs, and the anticipated availability of program funding. The FSP Coordinator may allow exceptions to the listed cost-share rates if the requested amounts are justifiable. To date, projects requesting more than $75,000 per year have not been approved.

Pay-back Provisions and Taxes

If landowners/lessees sell or transfer all or part of the stewardship managed property during the term of the approved contract agreement, they are required to pay back to the state all of the cost-share funds received in the past three years (or the portion of funding that corresponds to a pro-rated share of that portion of the managed property that is sold or transferred). *The landowner/lessee or contractor would not be required to reimburse the State for the cost-share assistance received if the new landowner contractually agrees to assume responsibility for the term remaining on the Forest Stewardship contract agreement.*

Cost-share reimbursement payments are considered as income and are thus normally subject to state and local taxes. However, depending upon your management activities, payments may be exempt from taxes. A guide to federal income tax regulations affecting private forests, and other resources are available on line at: http://www.fs.fed.us/spf/coop/programs/loa/tax. In addition, you may be eligible for real property tax reductions or incentives because of your commitment to long-term forest management. For more information, contact your county tax office.

If the purposed stewardship plan includes an objective for commercial timber production, you will be required to pay back to the State a percentage of the funding assistance that is received through the program with each future commercial timber harvests as set forth in the contract. This pay back is typically 5 to 10 percent of total grant funding received, but the amount is negotiable. A payback provision will be included as a special condition of the contract, stipulating that this provision will survive the term length of the contract.

Maintenance Requirements

Participants are required to maintain cost-shared improvements for at least ten years following installation. “Maintain” means the improvements will not be willfully removed or destroyed and routine maintenance will assure that under normal conditions the improvements will serve the purpose intended. Details are given under each relevant management practice description below.

Management Practices Eligible for Cost-share Assistance

1. Forest Stewardship Management Plan Development

All projects must have a plan before they can be approved for cost sharing. Please use the format detailed in this handbook. A professional forest resource consultant or a qualified applicant can write plans. FSP staff work with applicants to cover as much of the costs of the plan development as possible depending on current funding sources.

Revisions: Your plan may be reviewed and revised in the future if deemed necessary. Amendments are subject to approval by DOFAW, the Board of Land and Natural Resources, and the Attorney General’s office. Significant amendments may require that a new contract agreement be drawn up and approved. Keep in mind that this requires additional time and paper work, usually resulting in project delays. Any new non-native species added to your management plan or project site must be reviewed and approved.

2. Site Preparation

All planting projects will require reducing or removing vegetation so seedlings can survive. Heavy or light equipment or hand-labor may be cost-shared if you:

- Follow elevation contours when using heavy soil-moving equipment.
- Do not use equipment in Streamside Management Zones
- Follow Best Management Practices to minimize erosion. See the guide at http://www.state.hi.us/dlnr/dofaw/pubs/BMPs_bestmanagement.pdf

You may need to improve the soil condition for seedling growth or natural regeneration by using tilling and sub-soiling where soil is compacted or where there are hardpans. We highly recommend having the soil tested prior to augmentation. Scarification can be used to promote the regeneration of *Acacia koa* in some places where it once existed. Maximum allowable costs can vary depending on the density of existing vegetation, soil conditions, presence of a hardpan, and the steepness of the slope.

3. Fencing

If seedlings and young trees need protection from feral and/or domestic animals, such as pigs, sheep, deer, cattle, horses and humans, fences and other tree protection measures may be cost-shared. Fence cost-share limits depend on the type of fencing necessary for the site and follow the Natural Resource Conservation Service cost limits and specifications:

General Fence Types

Barbed wire, posts in soil	$2.50/foot
Barbed wire, posts in rock	$5.50/foot
Woven wire, posts in soil	$4.00/foot
Woven wire, posts in rock	$7.00/foot
Electric, posts in soil	$2.00/foot
Electric, posts in rock	$5.00/foot

Contact the FSP Coordinator concerning rates for game proof fences.

Other Tree Protection Practices: Feral pig, cat, rat and mongoose control can be cost-shared. Buffer zones surrounding restoration areas are also eligible for protection. Fences MUST be maintained for at least ten years following installation in a manner that preserves their intended function, such as protecting seedlings from feral or grazing animals.

4. Fertilization/Soil Amendments

Fertilizers and soil amendments may be organic or inorganic. Soil tests and professional recommendation rates for each species are required to cost-share fertilizers. The University of Hawaii's Agricultural Diagnostic Services Center does soil, water and tissue testing. See http://www2.ctahr.hawaii.edu/adsc/downloads/price_list.pdf for more information. Soil amendments to improve the structure and fertility of the soil immediately surrounding the seedling root zone can also be cost-shared, including hydrating polymers.

All amendments must be used in accordance with registered uses, directions on labels, and all other applicable federal, state and local policies. Consider possible induced deficiencies of nutrients due to excessive levels of other nutrients and the effect of soil pH on the availability of plant nutrients. Do not apply inorganic fertilizers near to streams or wetlands where polluted runoff might enter water. Fertilizer applications are generally eligible for cost-share assistance

for a period of up to four years subsequent to the seedling planting date. The highest cost-share limit is applicable only where soil depletion is extreme and is justified by soil tests and recommendations.

5. Seedling Acquisition

You must **c**onsider the current and former plant communities at your site when choosing species. Seedlings should be purchased from local growers who use genetically diverse seeds or stock from as close to your planting location and/or habitat as possible. DOFAW operates a nursery that produces a limited selection of species. Contact your local DOFAW Branch Office to place orders see page 2. It is advised to order plant stock well in advance (three to four months for most species) to get the quantity & species that you desire for your planting date. Use smaller container stock such as dibble tube, airblock, or root-trainer, as opposed to larger, potted stock to reduce site preparation and planting cost, however this may very depending on the species you select. Seedlings should be of good condition, adequate size and "hardened off" before planting. Seedlings that have been in containers for too long may not be healthy. A detailed species list is required in the management plan. Fruit trees are not eligible.

Projects that include invasive species will not be funded unless there is an overriding environmental justification for their use. The following procedures will be used to judge whether a non-native species is considered invasive and is approved or disapproved:

1. No species on the state 'Noxious Weed List' will be funded. See page 11 of the state rules: http://www.hawaiiag.org/hdoa/adminrules/AR-68.pdf
2. Non-native species proposed for planting must be listed in new FSP management plans or submitted as revisions of previously approved management plans. If the landowner is aware that the species may be considered invasive the plan should include a justification of the use of the species. New management plans and associated species lists are always reviewed by the FSP Committee.
3. You can search for the invasiveness status of particular species at the Weed Risk Assessment website: http://www.botany.hawaii.edu/faculty/daehler/WRA/full_table.asp
4. DOFAW FSP staff will gather information and recommendations about non-native species from DOFAW Branch staff and the Weed Risk Assessment scores; if there is no clear consensus, further information will be sought from invasive species experts.
5. For new non-native species added to revised management plans: If the information in step #4 clearly indicates that the species is not invasive, it will be approved by FSP staff without waiting for a FSP Committee meeting. If the information in step #3 indicates that the species may be invasive, the species may not be approved until reviewed by the FSP Committee.
6. If the FSP Committee disagrees about whether to consider the species, the final decision will be made by the DOFAW Invasive Species Coordinator.

These guidelines follow Federal Executive Order #13112, quoted below. In applying the Executive Order to the Hawaii FSP, (a) successful justifications for the use of invasive species will emphasize environmental benefits rather than economic benefits, and (b) new introductions of potentially invasive species carry a high risk of harm and will not be funded. Generally speaking, if there is a lack of information or clear understanding about how the species has or will affect Hawaiian ecosystems, the species in question will not be funded.

> Federal Executive Order #13112 directs that [Federal] agencies "not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United

States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

6. Planting

Seedlings are usually planted at the beginning of the wet season. Clear all weeds and competing vegetation from around newly planted seedlings at the time of planting to an area of at least 3 feet in diameter. Where dibble stock is used, soil is of good structure, and there is adequate rainfall, the planting holes only need to be big enough to accommodate the small dibble. Where larger planting stock is used, holes must be large enough to accommodate freely hanging roots, or root balls. Roots should never be bent or crowded. Where long droughts may threaten seedling survival, larger holes can serve as water storage reservoirs, greatly increasing seedling survival rates. Holes dug through sod or untilled ground should be at least 16 inches square. Do not place the plant so deep into the hole that the stem is buried. Mix soil amendments or additives with soil before planting holes are filled to improve growing environment and soil water holding capacity. Avoid glazing sides of planting holes with digging tools, especially augers, in wet clay. Plantings for native forest restoration and tree plantations should be maintained to assure the survival of a majority of the trees planted.

7. Irrigation

Use mulch where feasible to help maintain soil moisture (see next section). Irrigation systems should be used only in areas where rainfall is not dependable, to enhance seedling survival and growth during early development. Irrigation should not to be used to maintain trees as they become mature. Where feasible please use drip irrigation. Please see a free publication at http://www.ctahr.hawaii.edu/oc/freepubs/pdf/L-2.pdf for assistance in designing irrigation systems. Cost-share assistance is available for system installation only. System maintenance and repairs are the responsibility of the applicant. Irrigation is only eligible for cost-share assistance for a period of up to four years following the seedling planting date. Allowable cost-share rates are for drip irrigation only. For catchment systems and ponds please provide three quotes or contact the FSP Coordinator for allowable cost-share rates. Irrigation systems should be maintained until the plants can survive on their own through a normal dry season.

8. Weed Control and Mulching

Use organic mulch at least 2" thick where feasible to help control weeds after planting. Keep mulch away from plant stems where it can cause rot. Mulch consists of plant residues or other suitable manufactured materials. Use higher planting densities and/or ground covers to shade out weeds. Eliminate or control weeds with herbicides, mechanically or by hand. Use control measures designed specifically for the particular weed species. Minimize adverse environmental impacts when applying herbicides. (Don't spray when it's windy, use the lowest rate of the least toxic alternative possible.) Apply chemicals in accordance with registered uses, directions on labels, and all other applicable federal, state and local policies. Establishment and maintenance of non-invasive ground covers and native understory plants can be cost-shared where there is a tree component in the plan. Buffer zones surrounding planting areas are also eligible for weed control cost-sharing to help stop the spread of weeds before they get to the planted area. Weed control should continue into the 10-year maintenance period to assure tree survival and normal growth. In restoration areas, weeded areas should not be planted with non-natives when at all possible.

9. Special Areas Practices: Stream Bank Revegation, Fire Prevention, etc.

Highly erodible, very steep and/or inaccessible sites may require more intensive methods to establish permanent vegetation, including trees, shrubs, ground covers, and grasses. This includes stream bank areas. Sites that are prone to fire danger or are in need of fire prevention or mitigation measures may be allowable for cost-shared rates. In addition to the practices listed above, the following can be employed in these areas:

- Erosion control matting and/or other erosion control materials such as coir logs or rocks.
- Labor-intensive methods of hand-clearing undesirable vegetation
- Terracing, water diversions, or other grading. *Additional permits will be required.*
- More expensive plants in larger containers
- Other materials as necessary

The applicant must obtain 3 written quotes for the proposed work and/or consult with the FSP Coordinator to determine the allowable cost-share. Due to limited funds, this option may not always be available. Management plans should cover maintenance for 10 years.

10. Trail Construction

Cost-sharing is available for trails in forest areas to enhance their recreational value, and to provide for public access, educational opportunities, and fire protection. Do not eliminate key trees that have scenic value, provide shade, reduce erosion and runoff, provide unique habitat for wildlife, or that add to the aesthetic value of the area. Develop trail grades suited for the intended purposes, consider the topography, and avoid exceeding 10 percent slopes. Wherever possible, trail width should remain between 2 and 4 feet. Cut and fill slopes must be stable. Plans must include provisions for erosion control. Revegetate as soon as practical following trail construction. Design bridges with professional assistance (see Recreation at http://www.dofaw.net/ for guidance). Try to place directional and warning signs, handrails, bridges and culverts as dictated by the site and intended use. Include provisions for maintaining all wearing surfaces, signs and drainage structures for ten years following installation.

11. Non-Commercial Thinning

Where stands of trees are overstocked or over topped by less desirable trees, thinning can increase the growth, health and the future value of desired trees. Consider which species will be favored after thinning and if weeds will take over with more sunlight available? Chose cull (non desirable) trees with the assistance of a professional forester if possible. Plan for slash (biomass waste) disposal after thinning. Determine the best season and method for thinning.

Project Proposal Form – Step One

In order to receive cost-share assistance for the project, you must send us a project proposal. If the Forest Stewardship Committee approves this proposal, you will be invited to develop a full management plan. Once this plan is approved and a long-term contract is developed and executed, you will be eligible to receive cost-share assistance for the cost of developing the management plan. The proposal should be submitted via e-mail to the Forest FSP Coordinator via e-mail or CD to DOFAW/Forest Stewardship Program 1151 Punchbowl St., Room 325, Honolulu, HI 96813.

Applicant and Property Information (add on separate paper if necessary)

Name:
Address:

Email:
Phone:
Fax:

Tax Map Key number and property acreage:
Landowner name:
Lessee name:
State and County Zone designation:
Acres of proposed stewardship management area:

Description of the project property or the land area to be managed

Driving directions from the nearest highway:

Existing vegetation (a paragraph, emphasizing native and/or invasive species present):

Existing wildlife: (a paragraph, emphasizing native and/or invasive species present):

Land Use for the entire property (Place an "X" under all that apply):

	Pasture	Crop land	Sugar cane	Range land	Forest grazed	Forest non-grazed	Other
Historic							
Current							
Proposed							

Maps

1) Please attach a topographic map showing the area. See topozone.com and/or other appropriate maps (soils, roads, etc).
2) If possible, provide a rough sketch of your project area and where the practices will be applied.

Forest management objectives - Please check all objectives that apply to the project:

□ Growth and management of forests for timber and other forest products
□ Native species restoration and habitat improvement
□ Agroforestry (forestry component)
□ Windbreaks (to protect forestry project areas)
□ Watershed, Riparian, and/or Wetland Protection and Improvement
□ Forest Recreation Enhancement

Proposed practices and species selection

Please check all practices that apply to your project:

□ Management Plan (required)
□ Site Preparation
□ Fencing
□ Other Tree Protection
□ Fertilization/Soil Amendments
□ Seedling Acquisition
□ Planting
□ Weed Control/Mulching
□ Irrigation
□ Intensive Revegetation and Special Areas
□ Trail Construction
□ Non-commercial thinning

Attach a draft list of species you propose to plant. Please see page 8 concerning invasive species.

Provide the name of the vendor or location you intend to use for seed or planting stock.

Public benefit - Please check all public benefits that apply to the project:

□ Economic diversification/employment (commercial timber production of a significant scale)
□ Native ecosystem and biodiversity restoration
□ Watershed improvement/protection
□ Native wildlife habitat enhancement
□ Other ecosystem services
□ Provision of educational, recreational or ecotourism opportunities

Organizations that will be involved in the project
Briefly list and describe partnerships with other resource management agencies and organizations. If you will use grants or cost-sharing from other programs to provide your part of the 50% match, please state what funds you expect they will provide.

Estimated costs

This table can help you get a rough idea of how much your project will cost.

Example: If you prepare 10 acres for planting (site prep) at a cost of $800/acre (done only once per acre) then the actual total cost will be $8,000. FSP will pay $400/acre (50% of the actual cost, within the cost-share limits) or a total of $4,000. You will be responsible for $400/acre of labor and/or equipment, which can be in-kind (not cash, your own labor and equipment) or actual cash you pay someone from your own money or other funding sources.

Practice Component	**Acres**	**Cost/Acre (Or plan)**	**Frequency or # of acres**	**Actual Total Cost**	**Estimated Landowner Cost – Share Approx 50%**	**Estimated FSP Cost-Share Approx 50%**
Management Plan	1 plan				Negotiable	
Site Preparation						
Weed Control and Mulching						
Seedling Acquisition						
Planting						
Fencing						
Other Tree Protection						
Irrigation						
Intensive Reveg/Special Areas					Negotiable	
Trail Construction						
Non-commercial thinning						
TOTALS						

Other Information

You may add any photos or other details to this application you think will help us understand the project.

[End of Proposal Form]

Either you will be invited to complete a full management plan, asked to provide more information for a secondary review, or not invited to complete a full management plan.

Forest Stewardship Management Plan Format

After the proposal is accepted, you will develop a detailed and comprehensive Forest Stewardship Management Plan which requires the services of a professional forester or resource management consultant unless you are professionally qualified to write your own. Some of the consultants working in Hawaii are listed on the Hawaii Forest Industry Association website: http://www.hawaii-forest.org/index.html. The management plan must meet standards set by the national and state guidelines and follow the plan format below.

Plan preparation costs generally range from $1,500 to $5,000 depending on the complexity of the plan. The cost-share amount provided by the FSP is negotiated with the coordinator after the proposal is accepted. The cost-share is payable upon receipt of the final management plan, the contract is executed, and a receipt from the consultant's invoice has been received. **All cost-share funds are paid on a reimbursement basis.**

I. Cover Sheet

- Applicant and property information (same as proposal)
  - Name
  - Address
  - Email
  - Phone
  - Fax
  - TMK number:
  - State and County Zoning
  - Total property acreage
  - Acres of proposed stewardship management area
- Consultant's name, title, address, email, fax and phone number
- Date the plan was completed

II. Signature Page (*Appendix H*) with signatures of the applicant, consultant, & State Forester.

III. Introduction

- Description of the property and specific management objectives from the proposal
- A detailed map or diagram showing which practices and/or species will be in different project areas
- A brief history of land uses and a description of present conditions

IV. Land and Resource Description

- Existing vegetation/cover types
- Existing forest health and function including disease problems and fire threat
- Soils and their condition, general slope and aspect
- Water resources and their condition
- Timber resources
- Wetland resources
- Significant historic and cultural resources. State whether an archeological survey has been done. If so, provide a summary.
- Existing wildlife – please provide a list
- Threatened and endangered species existing on property
- Existing recreational and aesthetic values

V. Management Objectives and Practices

Describe the specific management objectives of the project. The following are eligible for cost sharing:

- Growth and management of forests for timber and other forest products
- Native species restoration and habitat improvement
- Agroforestry (forestry component)
- Windbreaks (to protect forestry project areas)
- Watershed, Riparian, and/or Wetland Protection and Improvement
- Forest Recreation Enhancement

Describe specifically how you intend to implement and maintain (for at least 10 years after installation) the following practices in order to achieve your desired forest resource management objectives. A detailed list of all species you will plant must be included. Please review the discussion of invasive species under "Seedling acquisition". Any changes to this list at any time after the contract is executed must be approved by the FSP Coordinator. Please see pages 8 & 9 of this handbook for details.

- Site preparation
- Weed control and mulching
- Seedling acquisition
- Planting
- Fencing
- Other tree protection
- Irrigation
- Fertilization and soil amendments
- Intensive revegetation and special areas
- Trail Construction
- Non-Commercial thinning

VI. Practice Implementation Schedule

Clearly list, in a table, all specific practices, by year, total acreage, projected cost per acre, total cost, state cost-share and your cost-share according to the above. Cover a period of at least 10 years even if there is no cost-share in some of those years. Cost projections can vary widely depending on your site and should be based on relevant, real data and not simply estimated using the allowable cost-share rates provided. It may be that your share of project expense projections will exceed the state's share in cases where real cost estimates turn out to be higher than 50% of the allowable cost-share rate for a particular management practice.

SAMPLE Implementation Schedule Year 1 (use the same format for each consecutive year)

Practice Component	**Units**	**Cost/Unit**	**Total Cost**	**Applicant Share**	**FSP Share**
Management Plan	1 plan	$4,000	$4,000	$1,000	$3,000
Site Preparation	4 acres	$1,000	$4,000	$2,000	$2,000
Weed Control and Mulching	4 acres	$400 max. allowed=$300	$1,600	$1,000	$600
Seedling Acquisition	1000	$4.00	$4,000	$2,000	$2,000
Planting	4 acres	$300	$1,200	$600	$600
TOTALS			$14,800	$6,600	$8,200

VII. Budget Summary

The budget lists your projected cost-share, state share and total project costs per year for the length of the project. Cost-share amounts requested for each management practice to be applied should not exceed the cost-share rates listed in Appendix A unless you have your justification approved by the FSP Coordinator. If you are receiving other private or public funding, please create columns for each source. Please use this format:

SAMPLE BUDGET SUMMARY

YEAR	Total Budget	Landowner Share	State Share	Other funding source
2007	$38,717	$22,177	$16,540	
2008	$24,882	$12,462	$12,420	
2009	$25,844	$13,274	$12,570	
2010	$19,660	$15,260	$4,400	
2011	$23,060	$17,910	$5,150	
2012	$23,060	$17,910	$5,150	
2013	$23,060	$17,910	$5,150	
2014	$14,750	$11,275	$3,475	
2015	$14,750	$11,275	$3,475	
2016	$5,250	$3,740	$1,510	
TOTALS	$213,033	$143,193	$69,840	$0

Year one (1) begins upon contract execution, therefore the years listed in this table need to reflect delays in contract development and may eventually be changed.

Economic Analysis for Commercial Timber Projects

If the management objectives include commercial timber production, the plan must include some basic economic analysis such as a net present value or internal rate of return calculation. You should roughly estimate projected cost and income flows, and consider their sensitivity to changes in economic factors such as price and risks. While it may be impossible to accurately predict financial returns over time or provide precise data on silvicultural systems, it is recommended that you consider possible outcomes in consultation with a qualified resource economist or extension forester. A good resource is "Financial Analysis for Tree Farming in Hawaii" is available at http://www2.ctahr.hawaii.edu/oc/freepubs/pdf/RM-9.pdf. A downloadable model spreadsheet is available on line at http://www2.ctahr.hawaii.edu/oc/freepubs/spreads/RM-9_forest_econ_calc.xls.

VIII. Required Maps

All maps must be of at least a 1:24000 scale and include the following:

Legend and North arrow
Property boundary
Existing and proposed roads
Watercourses

- **Location Map:** Illustrates where the project property/site is on the island and in relation

to towns, major topographic features etc. (same as Pre-proposal)

- **Topographic Map** with property and project boundaries clearly marked. (same as Pre-proposal)

- **Project/Site Map:** Gives the location, orientation and layout of all management practices and other activities on the project property to clearly illustrate what is being done where, in relation to the topography, watercourses and other significant natural and cultural features of the site. The map must also illustrate the layout and orientation of any proposed tree plantings such as windbreaks, forestry plantings, and restoration areas.

- **Photographs of Project Site** clearly showing existing site conditions and vegetation for each proposed project area. Aerial photographs are not required but can be included.

IX. Monitoring activities- Please describe any monitoring to do done and who will do it.

X. Other Attachments if Available (not required)

- Existing forest stand inventories
- Maps: USGS, vegetation, roads/trails/soils, topography, archeological sites
- Sources of assistance and information, bibliography

Any required permits and environmental assessments must be approved and included when the plan is submitted to the Board of Land and Natural Resources for approval.

Best Management Practices (BMP's)

All Forest Stewardship Program participants must adhere to current DOFAW ***Best Management Practices*** that are relevant to the project:
http://www.state.hi.us/dlnr/dofaw/pubs/BMPs_bestmanagement.pdf.

Distribution/use of approved Forest Stewardship Management Plans and Use of Information:

The following information will be available as required by the Freedom of Information Act: name, address, project location, and funding provided. One of the objectives of the FSP is to generate useful information for landowners throughout Hawaii, who may also be considering forest management as a land use alternative. During the course of the project, you will be asked to share your experiences and knowledge, to contribute to the development of data and information sources for others. Once you are enrolled in the FSP your approved management plan will be made available for copy and distribution to the general public upon request. You are thus advised to delete any information that you consider to be proprietary, prior to submitting the management plan to the Forest Stewardship Advisory Committee. You can present relevant proprietary information to the Committee separate from the management plan. As required by the Freedom of Information Act, your name, project location, and funding is available, but will not be actively publicized. Although approved Forest Stewardship Management Plans are available for distribution to the general public, they should be used by potential applicants for informational purposes only. Any management plans that appear to plagiarize previously approved plans will not be accepted.

Appendix A.

Criteria for Potential Natural Area Reserves

If you are wondering if your site can be considered a "potential natural area preserve" please review these criteria. Contact the FSP Coordinator for more information concerning other programs that may apply. The following criteria are adopted as important guides for the Natural Area Reserves Commission in selecting areas for the Natural Area Reserves System. *However, the Commission shall exercise its prerogative* of judgment with regard to these criteria and other criteria in selecting and recommending areas to be included in the Natural Area Reserves System.

Representativeness: Each selected Natural Area shall be representative of one or more major, natural, relatively unmodified ecosystems, geologic or physiographic features, or habitats containing endangered species of fauna or flora. The description of a proposed area shall include details of the features that make the area distinctive, unique, significant, or representative. The term representative as applied to ecosystems shall be interpreted in relation to macroclimatic zonation to ensure a balanced geographic distribution of natural areas as representative ecosystems.

Scientific Value: Each Natural Area shall have significant potential for scientific study, for teaching, for preservation of distinctive biota or other natural features, or for preserving natural genetic material. The description of a proposed area shall include details of the scientific attributes of the area.

Administrative: Each Natural Area shall be identifiable on maps and on the ground. It should be reasonably protectable from pests and from physical damage and, legally, from encroachment. Access to the area should be in conformance with the nature and purpose of the area. Utilities, communication facilities, and other right of way developments should be avoided as much as possible. Administrative or management factors should be detailed in the description of each proposed area.

Size of Areas: Each Natural Area shall be large enough, but no larger than necessary, to accomplish the particular purpose of establishing that Natural Area. A desired size is that which will provide essentially unmodified conditions in the interior portion. The cost and feasibility of protecting the area will have a bearing on the size. Some areas may be less than an acre while others may exceed 10,000 acres, where a special need is demonstrated.

Number of Areas: As many as possible of the major terrestrial and aquatic plant and animal communities and distinctive geologic features on each island should be represented in the Natural Area Reserves System. However, the Natural Area Reserves System shall not include unnecessary duplications of ecosystems or geologic features already protected in Federal Wildlife Refuges, National Parks, or private conservation groups.

Ownership: Natural Areas shall be composed of lands owned or legally controlled by the State in perpetuity. Privately owned areas desired for the Natural Area Reserves System may be obtained by gift, devise, purchase, or eminent domain as specified in the Act. Federal lands shall not be designated as Natural Areas under Act 139.

Appendix B.

Archeological and Historic Sites

As part of creating a management plan, please submit a letter asking that the State Historic Preservation Division verify that for the TMK of the proposed project area there are no archeological, burial or historic sites present. Send to:

Administrator
State Historical Preservation Division (SHPD)
601 Kamokila Blvd. #555
Kapolei, HI 96707

If you believe there may be such sites present on the project property then you must also submit a letter to the same address telling them of your plans and notating the possible sites. SHPD will review your plans to determine whether an archeological inventory survey must be done. If so, permitted archeologists in the state are listed on the SHPD website:
http://www.hawaii.gov/dlnr/hpd/archcon.htm

For more information see: http://www.hawaii.gov/dlnr/hpd/hpgreeting.htm.

Grading Permits and Soil Conservation Plans

Grading, stockpiling, grubbing, and trenching may require permits for soil disturbing work. A Special Management Area permit is required if the planned work is in the Special Management Area, this is mostly work near the coastal areas and is tied to Coastal Zone Management program requirements. **Each county is responsible for issuing this permit.** In some cases, an approved soil conservation plan may be acceptable. Contact NRCS or your local Soil and Water Conservation District for more information or see http://www.hi.nrcs.usda.gov/ .

For more information on County Grading regulations and permits see:

O'ahu http://www.co.honolulu.hi.us/refs/roh/14a10_19.htm
Section 14-14 for ordinances
http://www.honoluludpp.org/download/permits/permitlistings.asp?p_TypeID=4
for applications and information

Hawai'i http://www.hawaii-county.com/directory/dir_pubworks.htm
East Hi: (808) 961-8321 or **West Hi:** (808) 327-3520

Maui http://ordlink.com/codes/maui/index.htm
or call 270-7242.

Kauai http://www.kauai.gov/Default.aspx?tabid=133
(look under Forms, Applications, and Instructions)

Appendix C.

Environmental Assessments (EA)

Plans that include the establishment of timber with the intent of eventual harvesting must be accompanied by an Environmental Assessment (EA), including a cultural impact assessment. The FSP Coordinator can provide you with samples of stewardship plans that have been prepared to meet the EA requirements. Contacting the local community and the cultural assessment should be included within the scope of work and fees paid for the forestry professional who agrees to write the management plan. Please note that all Stewardship Plan EAs that have been submitted to date have had a Finding of No Significant Impact and therefore were not required to submit a full Environmental Impact Statement.

If you are planning to use stewardship funds to establish timber that may be harvested then you should familiarize yourself with the information in a helpful guidebook from the Office of Environmental Quality Control, available on the web at:
http://www.state.hi.us/health/oeqc/publications/guidebook.pdf

From the guidebook:

> *"An EA is an informational document prepared by the proposing agency or the private applicant and used to evaluate the possible environmental effects of a proposed action. The environmental assessment must give a detailed description of the proposed action or project and evaluate direct, indirect and cumulative impacts. The document must consider alternatives to the proposed project and describe any measures proposed to minimize potential impacts. The public has 30 days to review and comment on a draft environmental assessment. After the draft environmental assessment has been finalized and public comments responded to, the agency proposing or approving the action reviews the final assessment and determines if any "significant" environmental impacts are anticipated.*
>
> *If the agency determines that the project will not have a significant environmental impact, it issues a finding of no significant impact (FONSI). This determination allows the project to proceed without further study. Within 30 days of the notice of this finding, the public may challenge an agency's determination by filing suit in circuit court. If the agency determines that the action may have a significant impact, a more detailed environmental impact statement (EIS) be prepared. An EIS preparation notice is then issued and undergoes an additional 30-day comment period to define the scope of the draft EIS. Publication of an EIS preparation notice initiates a 60 day period during which an aggrieved party may challenge the determination in court."*

Safe Harbor Agreements

Environmental Defense and the U.S. Fish and Wildlife Service encourage private landowners to restore and maintain habitat for endangered species without fear of incurring additional regulatory restrictions through initiation of Safe Harbor Agreements. More can be found at http://www.environmentaldefense.org/article.cfm?ContentID=136 or by contacting Bill Standley at DLNR/DOFAW 1151 Punchbowl St., Rm. 325 Honolulu, HI 96813 Telephone (808) 587-4171 Fax (808) 587-0160 Email: William.G.Standley@hawaii.gov

Appendix D.

Conservation District Use Permit

State Land Use Law established the State Land Use Commission (LUC) in 1961, and granted the LUC the power to zone all lands in the State into three districts: Agriculture, Conservation, and Urban (the Rural District was added in 1963). DLNR was given jurisdiction over the Conservation District, formulated subzones and regulates land uses and activities therein.

The Conservation District has five subzones: Protective, Limited, Resource, General and Special. Omitting the Special subzone, the four subzones are arranged in a hierarchy of environmental sensitivity, ranging from the most environmentally sensitive (Protective) to the least sensitive (General); the Special subzone is applied in special cases specifically to allow a unique land use on a specific site. Subzone maps for each island are available on the web: http://www.hawaii.gov/dlnr/occl/.

These subzones define a set of "identified land uses" which may be allowed by discretionary permit. The Office of Conservation and Coastal Lands (OCCL) can only accept a permit application for an identified land use listed under the particular subzone covering the subject property. Most of the identified land uses require a discretionary permit or some sort of approval from the DLNR or BLNR. Major permits are required for land uses, which have the greatest potential impact, and an environmental assessment and/or an EIS is required (and may also require a Public Hearing); minor permits are required for land uses which may have fewer impacts, decision making is delegated to the Board Chairperson (and may not require a Public Hearing) or to the OCCL for other minor uses.
Conservation District Use Application forms and contact information is available on the web at: http://www.hawaii.gov/dlnr/occl/documents.php.

Appendix E.

Threatened and Endangered Species

If you plan to process, collect, propagate, out-plant or sell threatened or endangered species as part of your Forest Stewardship project please contact Hawaii State Botanist for instructions and permits at 587-0165.

Appendix F.

Allowable Cost-Share Rates

When you create your project budget, the following are the total low to high amounts that the State will reimburse for each practice. If you think your costs will be higher than the allowed rates you will need to justify these rates to the FSP Coordinator. This may require documentation such as quotations from existing companies that provide the services or materials. Rates range from Low to High and will depend on the circumstances of each project. In your management plan you will need to justify the use of the high rates or rates for practices that have no rates established. Based on Committee and State approval, your contract will set the rates for your particular project.

Practice	Unit	State Share Low	State Share High
Management Plan	per plan	$1,500	$5,200
Site Preparation	per acre	$400	$1,000
Fencing (types listed under practices)	per foot	$2.50	$7.00
Other Tree Protection	per acre	*	*
Fertilization/Soil Amendments	per acre/year	$100	$350
Seedling Acquisition	per seedling	$0.50	$5.00
Planting	per acre	$150	$500
Irrigation (low=drip, high=other)	per foot	$0.50	*
Weed Control and Mulching	per acre	$100	$300
Ground Cover Establishment	per acre	$800	$1,400
Maintenance of ground covers	per acre	$100	$300
Trail Construction	per foot	$2	$4
Non-Commercial Thinning	per acre	$100	$300
Intensive Revegetation & Special Areas		*	*

*The applicant must obtain at least 3 written quotes for the proposed work and/or consult with the FSP Coordinator to determine the allowable cost-share.

Appendix G.

Allowable In-Kind Rates

In-Kind means non-cash contributions to the project. When calculating your 50% required contribution to the project, you should use these rates to determine labor and equipment cost estimates. If you want to use higher rates, please provide justification (quotes) in your plan and/or contact the FSP Coordinator.

Hourly Rates for In-kind Contributions		
Labor costs include fringe		Current
General Hand Labor	per hour	$21
Specialized Hand Labor	per hour	$27
Line Posts	each	$18
Corner Posts	each	$20
Equipment with Operator		
1/2 and 3/4 ton truck	per hour	$35
1 ton truck	per hour	$40
1 1/2 ton truck	per hour	$45
2 ton truck	per hour	$50
2 1/2 ton truck	per hour	$55
5 ton truck	per hour	$65
20 ton tandem dump truck	per hour	$85
12 ton tandem dump truck	per hour	$75
2 and 4 wheel drive tractor	per hour	$60
2 wheel drive tractor >40 hp	per hour	$70
D-2 or TD6 w/ attachments	per hour	$75
D-4 or TD9 w/ attachments	per hour	$105
D-6 or TD14 w/ attachments	per hour	$120
D-7 or TD18 w/ attachments	per hour	$150
D-8 or TD20 with attachments	per hour	$180
D-9 or TD25 w/ attachments	per hour	$225
Back-hoe	per hour	$85
Loader	per hour	$100
Compressor	per hour	$25
Power saw	per hour	$25
Power post hole digger	per hour	$35
Power sprayer	per hour	$30
Bobcat	per hour	$65
Manlift	per hour	$35
Mulcher	per hour	$25

Appendix H.

Forest Stewardship Plan Signature Page

Professional Resource Consultant Certification: I have prepared (revised) this Forest Stewardship Plan. Resource Professionals have been consulted and/or provided input as appropriate during the preparation of this plan.

Prepared by:

Professional Resource Consultant's Signature/ Date

Professional Resource Consultant's Name

Applicant Certification: I have reviewed this Forest Stewardship Plan and hereby certify that I concur with the recommendations contained within. I agree that resource management activities implemented on the lands described shall be done so in a manner consistent with the practices recommended herein.

Prepared for:

Applicant's Signature/ Date

Applicant’s Name

State Forester's Approval: This plan meets the criteria established for Forest Stewardship Plans by Hawaii's Forest Stewardship Advisory Committee. The practices recommended in the plan are eligible for funding according to state of Hawaii Forest Stewardship Program guidelines and administrative rules.

Approved by:

State Forester's Signature/ Date

State Forester's Name

Appendix I.

Useful Web Sites

Archeological Consultants http://www.hawaii.gov/dlnr/hpd/archcon.htm

Best Management Practices http://www.state.hi.us/dlnr/dofaw/pubs/BMPs_bestmanagement.pdf

Conservation District Use Application http://www.hawaii.gov/dlnr/occl/documents.php.

Economics http://www2.ctahr.hawaii.edu/oc/freepubs/pdf/RM-9.pdf
http://www2.ctahr.hawaii.edu/oc/freepubs/spreads/RM-9_forest_econ_calc.xls

Environmental Assessments http://www.state.hi.us/health/oeqc/publications/guidebook.pdf

Forestry Consultants http://www.hawaii-forest.org/index.html

Forestry in Hawaii (general) http://www.ctahr.hawaii.edu/forestry/

MAPS-

- Tax Maps
  - Hawaii County http://www.hawaii-county.com/maps/tmk/zone.htm
  - Maui County http://www.mauipropertytax.com/
  - Kauai County http://www.kauai.gov/default.aspx?tabid=433
  - Oahu http://gis.hicentral.com/website/parcelzoning/viewer.htm
- Topographic Maps http://www.topozone.com
- Soil Maps http://www.ctahr.hawaii.edu/soilsurvey/soils.htm

Natural Resources Conservation Service http://www.hi.nrcs.usda.gov/

Soil Tests from UH http://www2.ctahr.hawaii.edu/adsc/downloads/price_list.pdf

State Historic Preservation http://www.hawaii.gov/dlnr/hpd/hpgreeting.htm

Taxes (Federal Income) http://www.fs.fed.us/spf/coop/programs/loa/tax

US Fish & Wildlife Service Programs http://pacificislands.fws.gov

WEEDS-

- Noxious Weed List http://www.hawaiiag.org/hdoa/adminrules/AR-68.pdf
- Weed Risk Assessment http://www.botany.hawaii.edu/faculty/daehler/WRA/full_table.asp

Hawaii Watershed Prioritization Process

Prepared by:
John Pipan

for

Marine and Coastal Solutions International
P.O. Box 6882
Kamuela, Hawaii 96743

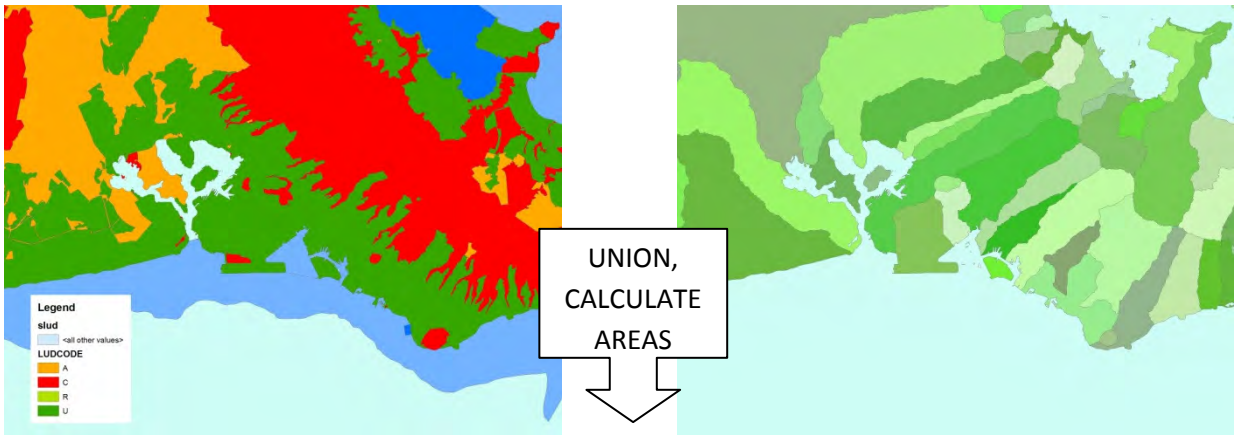
A report of the Hawaii Office of Planning, Coastal Zone Management Program, pursuant to National Oceanic and Atmospheric Administration Award No. NA06NOS4190159, funded in part by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, United States Department of Commerce. The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies.

Hawaii Watershed Prioritization Process

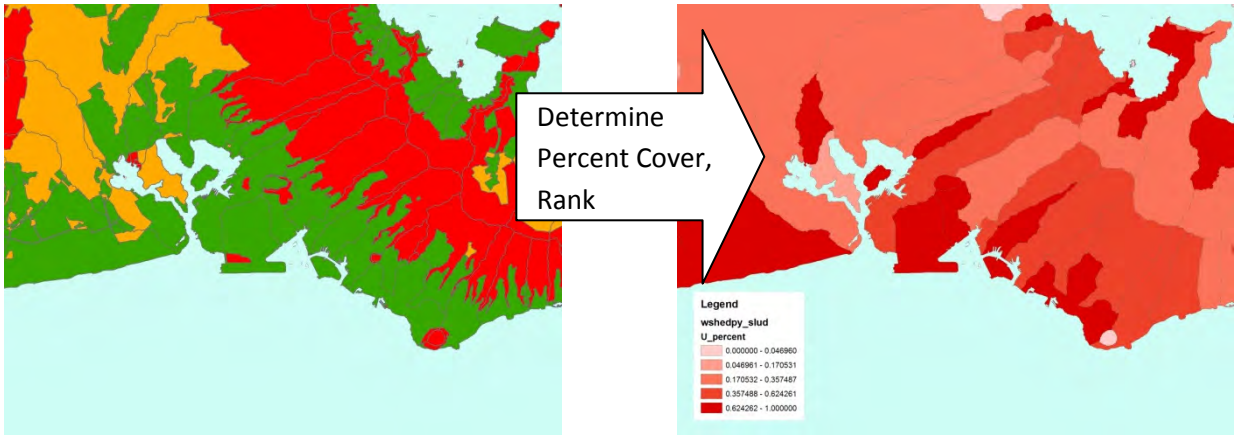
Introduction

In order to prioritize watershed planning efforts statewide a GIS was compiled. GIS systems are instrumental in facilitating the quantitative assessment of landscape influences on aquatic ecosystems and watershed scale studies of water quality. GIS tools allow comparison and processing of many different spatial information layers. Watershed land cover has been shown to be strongly correlated to water quality, especially nutrients (ref). Non-parametric statistical methods were employed to allow direct comparison of different layers with different units and distributions. Similar normalized rank approaches have been used to set restoration priorities in a TMDL context (Stringfellow, 2008).

Schematic illustration of processing steps



Above are representations of source layers for State Land Use District and Watershed areas. In ArcGIS the layers are joined with the command UNION and resulting areas determined with command CALCULATE AREAS.



With State Land Use Districts divided into Watershed Units (left), percent cover and rank of any SLUD classification can be computed.

Criteria development

Since the source data layers representing the different criteria were of several different forms, the criteria had to be developed individually. Using the ArcGIS Spatial Analysis toolbox function 'Union', layers of one type (LUPAG, CCAP, etc.) were divided along watershed boundaries. The Calculate Areas function was then used to determine the area of each new polygon. The resulting attributes associated with each polygon (including data from both Union-ed files) were read into Excel for further processing. Pivot tables were used to summarize polygon areas with different attributes (eg. land covers) for each watershed in the state. The percent cover (area x / total wshed area) of areas in any given class could then be easily calculated.

Since each criterion has different units and different distributions a statistical technique known as rank normalization was used to compare criteria equally. Watersheds were compared to all others for the property of interest and ranked from 1 to 580 essentially ordering watersheds from worst (1) to best (580). All watersheds with 0 or N/A values were assigned the maximum 580 ranking to eliminate bias among minimum values. All ranks were divided by the maximum rank of 580 to generate a score from 0 to 1 (0 to 100%). Similar to a score on an exam, watersheds with lower score are considered more threatened or susceptible and higher priority.

There are currently four broad classes of criteria; stressors, sensitive areas, assets, and indicators. Within each class of criteria more and better source data will serve to improve the utility of the watershed prioritization model. These data, once available, can be easily incorporated into the model.

Stressors are properties of a watershed that could potentially lead to impairment. Watershed geology, hydrology, land cover and human land use are some factors that contribute to a watershed's susceptibility to disturbance. Stressors fell into three main categories: urban, agriculture, and soil. Layers were averaged within the three categories of stressors, then the three categories were averaged to produce the stressor score.

- Urban areas may negatively impact watershed health by altering hydrology, disturbing soil and introducing pollutants
    - The State Land Use District (SLUD) criterion was derived from 2006 State Land Use Commission maps. Watersheds were ranked by percent Urban classified land cover. Watersheds with greater urban percent cover were ranked higher (scored lower).
    - Watersheds were ranked by change in percent cover of Urban classified land. Watersheds with greater increase in urban classified land were ranked higher (scored lower).
    - Coastal Change Analysis Program land cover data (NOAA 2001). Watersheds with greater High Intensity Developed percent cover were ranked higher (scored lower).
    - Coastal Change Analysis Program land cover data (NOAA 2001). Watersheds with greater Low Intensity Developed percent cover were ranked higher (scored lower).
- Soils – Land lacking vegetative cover or having soils particularly sensitive to disturbance may negatively impact watershed health.

  - The HEL (Highly Erodible Land) criterion was derived from NRCS soil survey data SSURGO database. Watersheds were ranked by their percent land area covered by HEL classified soils.
  - Coastal Change Analysis Program land cover data (NOAA 2001). Watersheds with greater Bare Ground percent cover were ranked higher (scored lower).
- Agriculture – Land in agricultural production may negatively impact watershed health by disturbing soil and introducing excess nutrients from fertilizer.
  - The State Land Use District (SLUD) criterion was derived from 2006 State Land Use Commission maps. Watersheds were ranked by percent Agricultural classified land cover. Watersheds with greater agricultural percent cover were ranked higher (scored lower).
  - Coastal Change Analysis Program land cover data (NOAA 2001). Watersheds with greater Cultivated percent cover were ranked higher (scored lower).
  - The Agricultural Lands of Importance to the State of Hawaii criterion (ALISH) was compiled from 1977 DOA and SCS maps. Watersheds were ranked by Important Agricultural Land percent cover. Watersheds with greater percent cover of IAL were ranked higher (scored lower).

Sensitive Areas are areas likely to be harmed by impaired watershed discharge. Recreation areas, MLCDs, and coral reef are all susceptible to watershed disturbance.

  - Class AA marine Waters (presence/absence 0/1). Watersheds draining to class AA coastal water were assigned a score of 0.2 while watersheds draining to class A were assigned 0.8 (mean +/- 1 standard deviation).
  - Coastal Reserves (presence/absence 0/1) was derived from various sources depicting areas with various reserves, preserves, parks, etc.. Watersheds with reserve areas within 500 m of the coastline were assigned a score of 0.2 while those without were assigned 0.8 (mean +/- 1 standard deviation).
  - Coral Cover was derived from NOAA benthic habitat maps (2007). Watersheds with areas of coral cover within 500m of the coastline were assigned a score of 0.2 while those without were assigned 0.8 (mean +/- 1 standard deviation).

Watershed Assets are properties which would serve to protect a watershed from disturbance. Conservation areas may promote watershed health by managing land for conservation and restricting development.

  - The State Land Use District (SLUD) criterion was derived from 2006 State Land Use Commission maps. Watersheds were ranked by percent Conservation classified land cover. Watersheds with greater conservation percent cover were ranked lower (scored higher).
  - The State Land Use District change (SLUD) criterion was derived by comparing land use district percent cover between a) 1995 and 2000 data sets, and b) 2000 and 2006 data sets. Watersheds were ranked by change in percent cover of Conservation classified

land. Watersheds with greater decrease in conservation classified land were ranked higher (scored lower).

- Mauka Reserves was derived from various sources depicting areas with various reserves, preserves, parks, etc.. Watersheds with greater percent cover in reserve land scored ranked lower (scored higher)

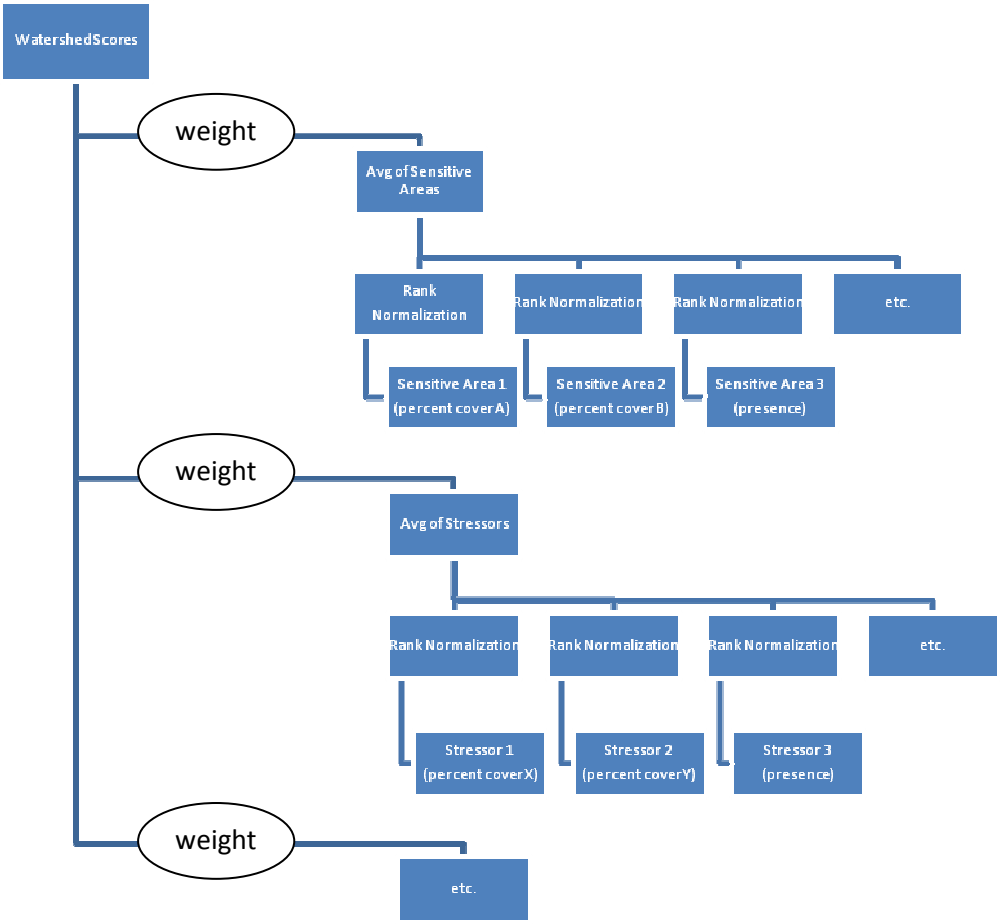
Indicators show those watersheds that are already recognized in need of restoration.

- 303(d) streams 2006 list (presence/absence 0/1). Watersheds containing streams on 303(d) list were assigned 0.2 while watersheds without 303(d) streams were assigned 0.8 (mean +/- 1 standard deviation).
- M. Kido Watershed Health Index (rescaled published index values). Kido's WHI developed a correlation between watershed land cover and the quality of stream habitat for native aquatic species. Higher WHI scores represent watersheds with better aquatic resources.

The DOH list of priority watersheds and Watershed Partnerships was included but not averaged into the total score to compare currently identified areas of priority to the total score prioritization (see following section). Watersheds on the DOH list were assigned 0, while those not on the list were assigned 1.

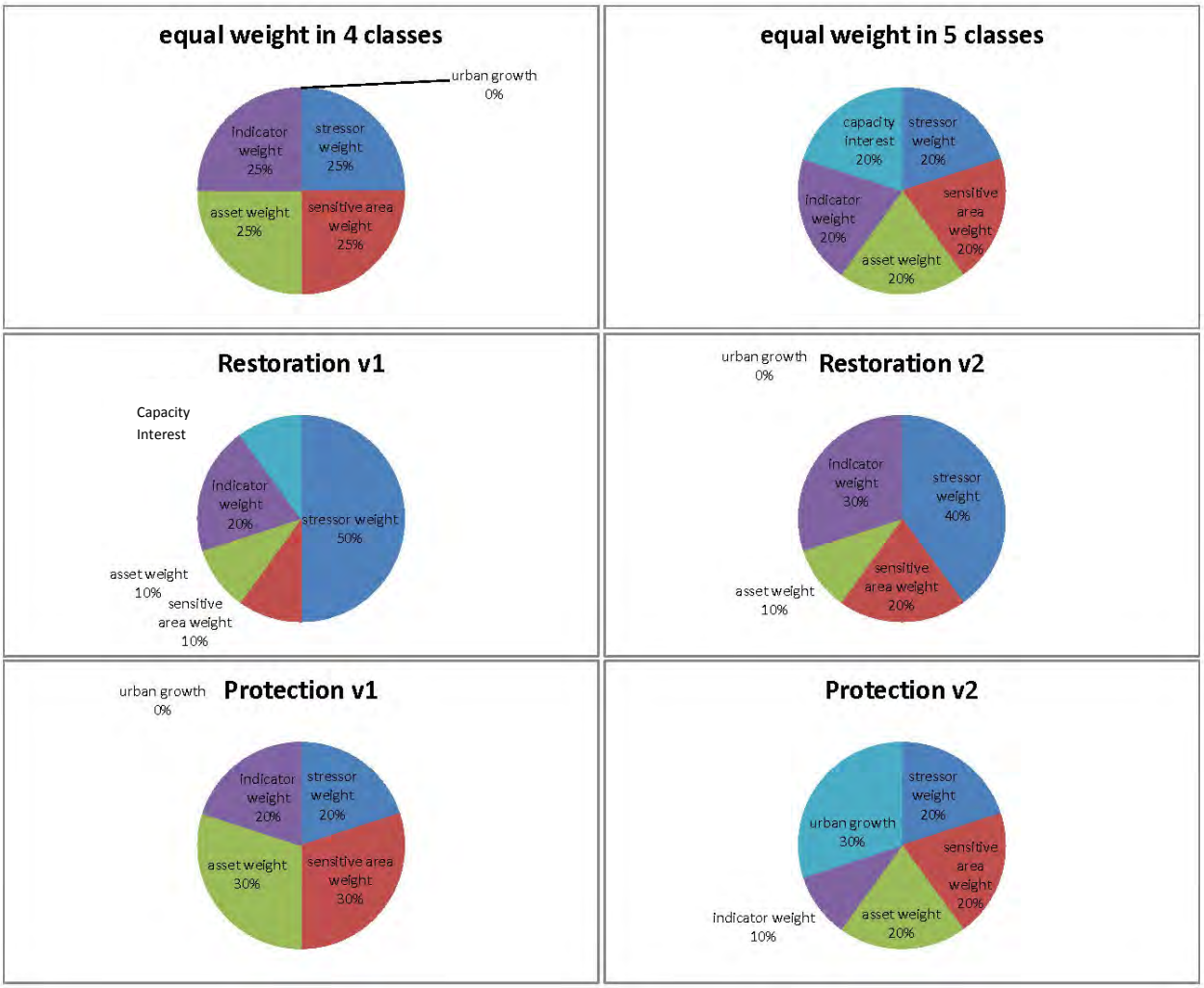
Several more criteria could be useful but due to time constraints were not included in this draft.

- Potential for build out (SLUD – CCAP) urban and cultivated land covers
- Streams with aquatic resources
- Potentially Highly Erodible Land
- 04 and 06 marine 303(d) impaired waters



Results

Several scenarios were evaluated to test the sensitivity of the model to weighting the inputs. The charts shown below depict the different weight scenarios evaluated. There was no effect on the total ranks of incorporating a capacity / interest score derived from the DOH priority watersheds and watersheds belonging to a watershed partnership. Other scenarios weighted stressors or sensitive areas more heavily to develop composite scores reflecting restoration or protection priorities. An urban growth layer was also included in one scenario outside of the other classes. The Urban growth was derived later in the development process from various maps produced by each county depicting areas planned for urban growth. Watersheds with planned urban expansion areas were assigned 0.2 while those not planned for urban expansion were assigned 0.8 (mean +/- 1 standard deviation).



The table below shows watersheds identified in the top 66 (containing the top 50 listed from the restoration 2 scenario) in each weight scenario and in two previous versions of the prioritization process using different layers and grouping methods. On the far right column in the table is the sum of the number of times a watershed appears in the top 50 in the weight scenarios excluding those termed protection. Correlation analyses were performed on the weight scenarios. The Restoration V2 scenario showed the greatest correlation with the other scenarios and with the sum of the different scenarios. The Protection V2 scenario showed less correlation and represents a more independent scenario depicting potential future stressors. Restoration and protection lists based on the Restoration V2 and Protection V2 scenario follow, showing the top 50 watersheds in each. 23 watersheds identified on the restoration list were also identified on the protection list. Of the 77 listed watersheds 52 are DOH priority watersheds and 35 belong to a Watershed Partnership.

ISLAND	WUNAME	Scores_1	Scores_2	Scores_3	equal_25_4	equal_20_5	Restoration	Restoration_2	Protection	Protection_2	Restoration_sum
Kauai	Manoa	1	1	1	1	1	1	1	1	0	7
Kauai	Nawiliwili	1	1	1	1	1	1	1	0	1	7
Kauai	Waikomo	1	1	1	1	1	1	1	1	1	7
Kauai	Mahaulepu	1	1	1	1	1	1	1	1	0	7
Maui	Iao	1	1	1	1	1	1	1	0	1	7
Oahu	Anahulu	1	1	1	1	1	1	1	1	0	7
Oahu	Kahana	1	1	1	1	1	1	1	1	1	7
Oahu	Waiahole	1	1	1	1	1	1	1	1	0	7
Oahu	Kaalaea	1	1	1	1	1	1	1	1	0	7
Oahu	Kawainui	1	1	1	1	1	1	1	1	1	7
Oahu	Heeia	1	1	1	1	1	1	1	1	1	7
Hawaii	Wainaia	0	1	1	1	1	1	1	0	0	6
Hawaii	Kapehu	1	0	1	1	1	1	1	1	0	6
Kauai	Kawailoa	0	1	1	1	1	1	1	1	0	6
Kauai	Wahiawa	0	1	1	1	1	1	1	1	1	6
Kauai	Puali	1	1	1	0	0	1	1	0	1	5
Lanai	Paliamano	0	1	1	1	1	1	1	1	1	6
Maui	Maliko	0	1	1	1	1	1	1	0	1	6
Maui	Waiehu	0	1	1	1	1	1	1	1	1	6
Oahu	Kalunawaikaala	0	1	1	1	1	1	1	1	1	6
Oahu	Paukauila	1	1	1	0	0	1	1	0	0	5
Oahu	Kahaluu segment	1	0	1	1	1	1	1	0	0	6
Oahu	Keaahala	1	0	1	1	1	1	1	1	1	6
Oahu	Kaneohe	1	0	1	1	1	1	1	1	1	6
Oahu	Ala Wai	1	0	1	1	1	1	1	1	1	6
Kauai	Kauapea	0	1	0	1	1	1	1	1	1	5
Maui	Honokowai	0	1	0	1	1	1	1	0	1	5
Maui	Waihee	0	0	1	1	1	1	1	1	0	5
Molokai	Waialua	1	0	1	1	1	0	1	0	0	5
Oahu	Waikane	0	0	1	1	1	1	1	0	0	5
Oahu	Kawa	1	0	1	0	0	1	1	0	0	4
Oahu	Kaelepulu	1	0	1	0	0	1	1	0	0	4
Hawaii	Keahole	0	1	1	1	1	0	0	0	1	4
Kauai	Kilauea	1	0	0	1	1	0	1	0	0	4
Kauai	Hanalei	0	0	1	1	1	0	1	1	0	4
Kauai	Hanamaulu	1	0	0	0	0	1	1	0	1	3
Kauai	Huleia	0	0	0	1	1	1	1	0	1	4
Kauai	Aepo	1	1	1	0	0	0	0	0	0	3
Maui	Kahana	0	1	0	0	0	1	1	0	1	3
Maui	Waikapu	0	0	0	1	1	1	1	0	1	4
Maui	Wailea	0	1	1	1	1	0	0	1	1	4
Molokai	Kaunala	1	1	1	0	0	0	0	1	0	3
Oahu	Waimalu	1	0	1	0	0	0	1	0	0	3
Oahu	Kahawainui	0	0	0	1	1	1	1	1	0	4
Oahu	Keamanea	1	1	1	0	0	0	0	0	0	3
Oahu	Punaluu	0	0	0	1	1	1	1	1	1	4
Oahu	Poamoho	1	1	1	0	0	0	0	0	0	3
Oahu	Waikele	1	0	0	0	0	1	1	0	0	3
Oahu	Kalauao	0	0	0	1	1	1	1	0	0	4
Oahu	Waimanalo	1	0	0	0	0	1	1	0	0	3
Oahu	Nuuanu	0	0	0	1	1	1	1	1	0	4
Oahu	Portlock	0	0	0	1	1	1	1	1	1	4
Hawaii	Hapahapai	0	1	1	0	0	0	0	0	0	2
Hawaii	Waikoloa/Waiulaula	0	1	1	0	0	0	0	0	1	2
Hawaii	Alia	0	1	0	0	0	1	0	1	0	2
Hawaii	Papaikou	0	1	0	0	0	1	0	0	0	2
Hawaii	Kealakekua	0	1	1	0	0	0	0	0	0	2
Kauai	Limahuli	0	0	0	1	1	0	1	0	0	3
Kauai	Lawai	1	0	0	0	0	1	0	0	0	2
Lanai	Naha	0	1	1	0	0	0	0	1	0	2
Molokai	Kolo	0	1	1	0	0	0	0	0	0	2
Oahu	Loko Ea	0	1	1	0	0	0	0	0	0	2
Oahu	Kawaihapai	0	1	1	0	0	0	0	0	0	2
Oahu	Kaaawa	0	0	0	0	0	1	1	0	0	2
Oahu	Waiawa	0	0	0	0	0	1	1	0	0	2
Oahu	Halawa	0	0	0	0	0	1	1	0	0	2

ISLAND	WUNAME	Restoration	Protection
Oahu	Kahana	0.249	0.401
Oahu	Ala Wai	0.252	0.406
Maui	Waiehu	0.282	0.318
Oahu	Kawainui	0.285	0.442
Maui	Iao	0.286	0.349
Oahu	Heeia	0.289	0.315
Oahu	Waiahole	0.312	
Oahu	Kaneohe	0.315	0.450
Oahu	Nuuanu	0.327	
Maui	Waikapu	0.345	0.388
Kauai	Waikomo	0.345	0.458
Oahu	Keaahala	0.346	0.328
Kauai	Kawailoa	0.351	
Kauai	Mahaulepu	0.353	
Kauai	Hanamaulu	0.356	0.413
Kauai	Nawiliwili	0.358	0.384
Oahu	Anahulu	0.360	
Kauai	Manoa	0.367	
Oahu	Kawa	0.368	
Lanai	Paliamano	0.369	0.390
Oahu	Kahaluu seg	0.372	
Maui	Maliko	0.377	0.378
Kauai	Huleia	0.382	0.377
Kauai	Wahiawa	0.384	0.345
Oahu	Kaalaea	0.385	
Maui	Honokowai	0.386	0.374
Oahu	Kaelepulu	0.392	
Oahu	Waikane	0.393	
Maui	Waihee	0.395	
Oahu	Kalunawaikaala	0.396	0.430
Oahu	Portlock	0.397	0.425
Oahu	Kalauao	0.401	
Kauai	Kilauea	0.402	
Maui	Kahana	0.406	0.459
Molokai	Waialua	0.409	
Hawaii	Wainaia	0.409	
Hawaii	Kapehu	0.410	
Oahu	Kahawainui	0.410	
Kauai	Limahuli	0.411	

ISLAND	WUNAME	Restoration	Protection
Oahu	Halawa	0.411	
Oahu	Paukauila	0.411	
Kauai	Hanalei	0.415	
Oahu	Waikele	0.416	
Oahu	Punaluu	0.417	0.463
Kauai	Kauapea	0.417	0.462
Kauai	Puali	0.419	0.422
Oahu	Waiawa	0.423	
Oahu	Waimanalo	0.426	
Oahu	Kaaawa	0.428	
Oahu	Waimalu	0.432	
Maui	Wailea		0.323
Hawaii	Keahole		0.343
Maui	Pohakea		0.344
Kauai	Wailua		0.346
Hawaii	Kauna		0.350
Maui	Mooloa		0.353
Hawaii	Lapakahi		0.373
Kauai	Lihue Airport		0.378
Hawaii	Waiaha		0.386
Hawaii	Wainaku		0.391
Hawaii	Kawaihae		0.392
Maui	Waiakoa		0.395
Hawaii	Pohakuloa		0.400
Maui	Wahikuli		0.407
Hawaii	Kaahakini		0.408
Hawaii	Kiholo		0.415
Hawaii	Waikoloa/Waiulaula		0.417
Hawaii	Wailoa		0.429
Hawaii	Honokohau		0.444
Maui	Kahoma		0.452
Maui	Kanaio		0.453
Maui	Kalialinui		0.455
Lanai	Kaumalapau		0.456
Oahu	Hanauma		0.458
Oahu	Makua		0.459
Oahu	Oio		0.464
Molokai	Kamalo		0.464

References

Silva L, Williams D, (2001) Buffer zone versus whole catchment approaches to studying land use impact on river water quality. Water Res 35:3462-3472

Stringfellow W, (2008) Ranking tributaries for setting remediation priorities in a TMDL context. Chemosphere 71, 1895 - 1908

METHODOLOGY FOR DEVELOPMENT OF THE "CONDITIONS OF NATIVE ECOSYSTEMS 2010" GIS LAYER

April 10, 2010

PRELOGUE: The Division of Forestry and Wildlife is extremely grateful to LANDFIRE, The Nature Conservancy of Hawaii, The University of Hawaii and the US Geological Survey for their dedication and assistance in developing this data layer specifically for use in developing Hawaii's Statewide Assessment of Forest Conditions and Resource Strategy, 2010. When the Clayer that the team developed was reviewed by DOFAW staff, it was decided to rename the classes that were originally developed by the mapping team. For Hawaii SWARS, we used this map as a base layer with new class names as per the table below. Our Priority Areas for Issue 6: Conservation of Native Biodiversity are all areas that are listed as Critical Habitat by the U.S. Fish & Wildlife Service and/or areas identified as Essential Habitat for the recovery of Forest Birds and Waterbirds.

Table 1: Original GIS Data Categories and Renamed Data Categories for Hawaii SWARS

Origianal Class Name	SWARS Class Name
High Priority Maintenance	**Intact Native Ecosystems, Highest Biodiversity**
Secondary Maintenance	**Intact Native Ecosystems, High Biodiversity**
Enhancement	**Threatened Native Ecosystems**
High Priority Restoration	**Rapidly Degrading Ecosystems**
Localized Restoration	**Degraded Ecosystems**
Limited Opportunities	**Native Ecosystems No Longer Exist**

Approach

1. Habitat quality, species richness, and biodiversity uniqueness were identified as important factors for prioritizing areas for conservation.
2. Data sources were identified for each of these factors for as many terrestrial biodiversity components as possible.
3. Breakpoints were identified within each dataset.
4. Categories were created using various combinations of these datasets and breakpoints to set priorities for the large landscapes in which conservation action can be undertaken in Hawai'i.
5. Geoprocessing techniques carefully coded, stacked, joined, and decoded the data into biodiversity management categories.
6. Alternative data sources used to test resulting biodiversity management categories.

Data Layers

Geospatial datasets were found for upland plants, coastal plants, forest birds, and waterbirds to reflect as many aspects of their habitat quality, biological richness, and biodiversity uniqueness. Coastal seabird distributions only include point data and montane seabird distributions are still being developed. Upland and coastal plant data include some populations of montane and coastal seabirds. Statewide invertebrate data was incomplete and not included in this analysis. Important areas for single island endemics and

lineages were mostly identified already by included data layers. Descriptions of the datasets used and alternative datasets considered are listed in the following table 2.

Table 2. Description of data sources used and considered, biodiversity type, factors and data type for plants and birds.

Data Source and notes	Biodiversity Type	Factor	Data Type
Habqual combo[1] Native-dominance of forests is a direct indicator of forest health. Developed areas are low quality areas for native biodiversity. *Alternative Data Sources:* Hawaii Biodiversity Mapping Program rare plant points were not incorporated into habqual combo development as rare point density map because each dot represented many plants or a single plant. Couldn't make accurate density estimates. Also did not use rare plant pts due to incompleteness in Pohakuloa and Kohala, and lack of availability of Army data.	Upland plants, Forest Birds	Habitat quality	Raster 30m cell
Price et al. 2007 predicted plant richness (totdiv)[2] Stacked plant ranges of 331 plant species show areas that support more plants than others. Plant range models are based on climatic moisture, elevation maxs and mins, tolerance of young substrate, and regional presence. Data lacking for Kahoʻolawe, Lanaʻi, & West Molokai. This map is adapted for this project.	Upland plants	Richness	Raster 100m cell
Price et al. 2007 formerly widespread plant ranges (rarehp)[2] The 92 modeled plants with the largest % reduction in their predicted range had their ranges stacked to show concentrations of these downtrodden species. This map is adapted for this project.	Upland plants	Uniqueness	Raster 100m cell
TNC coastal veg distribution[3]**, based on Warshauer et al 2008**[4] Occurrences along the coastline show areas with significant concentrations of coastal vegetation. Richness from Warshauer et al 2008 and viability data from TNC 2008 included.	Coastal plants	Habitat quality, Richness	Polyline
Gorresen et al. 2009 forest bird ranges[5] Stacked forest bird range maps show areas important to many forest bird spp. *Alternative Data Sources:* HIGAP bird ranges and forest bird recovery ranges are based on older data, and do not reflect current biodiversity distributions.	Forest Birds	Richness	Polygon
FWS Hawaiian waterbird habitat[6] Wetlands important for the recovery of the Hawaiian moorhen, Hawaiian stilt, Hawaiian coot, and Hawaiian duck are categorized as core and supporting, following USFWS and DLNR designations.	Waterbirds	Habitat quality	Polygon

Creating Categories

Biodiversity Management Priorities have three main groupings.

[1] Jon Price's habqual based on HIGAP, modified with higher resolution developed areas from LANDFIRE Existing Vegetation Type (EVT) and intensive agriculture areas derived from the State of Hawai'i's alum_n83 shp file. This modified habitat quality layer has many conservation applications.

[2] Price, J.P., S.M. Gon III, J.D. Jacobi, and D. Matsuwaki. 2007. Mapping plant species ranges in the Hawaiian Islands: developing a methodology and associated GIS layers. HCSU Technical Report 008.

[3] The Nature Conservancy. 2008. Hawaii Ecoregional Assessment: Coastal Addendum of Anchialine Pools, Coastal Seabird Nests, and Coastal Vegetation.

[4] Warshauer, F.R., J.D. Jacobi, and J.P. Price 2008. Native coastal flora and plant communities in Hawai'i: Their composition, distribution, and status. Hawai'i Cooperative Studies Unit Technical Report HCSU-xxx. University of Hawai'i at Hilo.

[5] Gorresen, P. M., R. J. Camp, M. H. Reynolds, T. K. Pratt, and B. L. Woodworth. 2009. Status and trends of native Hawaiian songbirds. Pp. 108-136 in Conservation biology of Hawaiian forest birds: Implications for island avifauna (T. K. Pratt, C. T. Atkinson, P. C. Banko, J. D. Jacobi, and B. L. Woodworth, eds.). Yale University Press, New Haven, CT.

[6] U.S. Fish and Wildlife Service 2005. Draft Revised Recovery Plan for Hawaiian Waterbirds, Second Draft of Second Revision. U.S. Fish and Wildlife Service. Portland, OR, USA.

1. Maintenance – high priority maintenance, secondary maintenance, or enhancement
2. Restoration – high priority restoration or localized restoration
3. Limited Opportunities

These main groupings indicate the type of conservation activities needed to steward the natural resources and are based on habitat quality. The categories within the groupings show classification based on richness and uniqueness. Each category is comprised of various combinations of plant and bird data split at specific breakpoints as shown in the following table 3. Details on how these categories were geoprocessed are described in the next section.

Table 3. Plant and bird components of biodiversity management categories.

	Plants, upland	**Plants, coastal**	**Forest birds**	**Waterbirds**
High Priority Maintenance	Native-dominated & >100 plant spp	--	--	--
Secondary Maintenance	Native-dominated & ≤100 plant spp	Good or Very Good viability	--	Core wetlands
Enhancement	Native-dominated & can support 35+ formerly widespread plants	--	--	--
High Priority Restoration	Non-native dominated areas in proximity to native-dominated areas	--	≥3 spp forest birds for Molokai & O‘ahu	--
Localized Restoration	Other non-native dominated	Fair viability	--	Supporting wetlands
Limited Opportunities	Developed areas or intensive agriculture	--	--	--

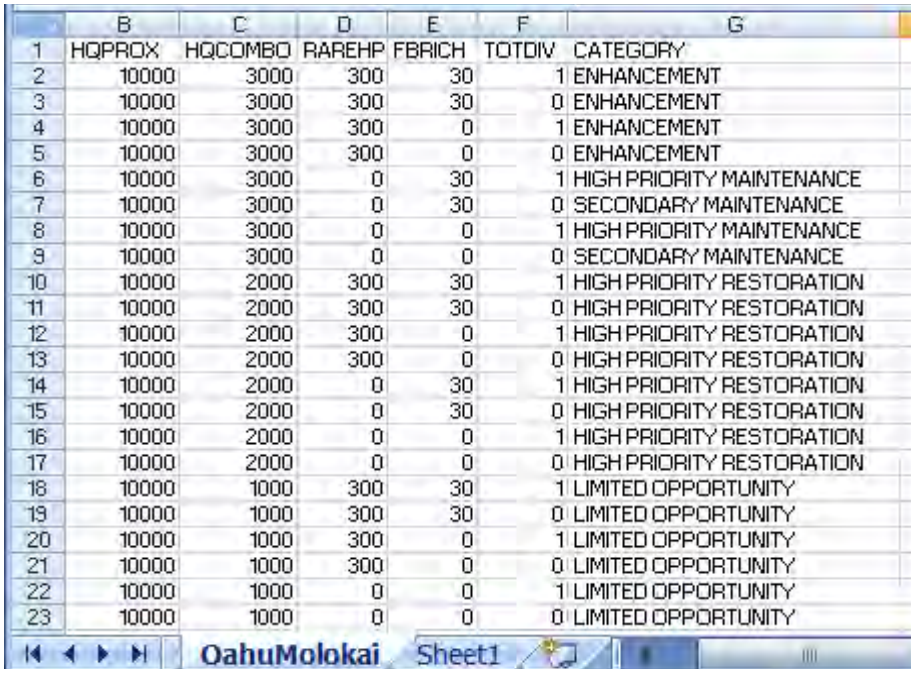
Stacking data layers and assigning categories

The following geoprocessing steps were used to formulate the final product.

1. Prepare raster data stacked to produce rasters with island extent (not stacked statewide because forest bird thresholds differ between islands). When reclassifying each dataset, use codes with different powers of 10 (e.g., 1, 10, 100, 1000, etc.) so you can decode it easily later.
    a. Confirm that each island's habqual combo raster are 30 m cells and is coded high habqual = 3000, medium hq = 2000, and low hq = 1000.
    b. Reclassify formerly widespread plant spp range (rarehp) as 35-92 spp = 300, and <35 spp = 0). This raster has a statewide extent. The 35 spp threshold was determined using the top quantile breaks to determine 3 classes. This would be the top third with the most % reduction of range of the 92 formerly widespread plants selected by Jon Price. The 92 plants may have been the top quarter with the most % reduction of range of all modeled plants. We identified the current ranges of the top $1/12^{th}$ plants with the most % reduction of range of all mapped plants.
    c. Reclassify forest bird ranges as 3 bird spp = 30 and <3 spp = 0. This raster has a statewide extent and is generally drawn so may include some areas that are not as important for forest bird conservation. On Maui, Kaua'i, and Hawai'i Island, 4 spp forest bird were picked as the minimum threshold for bird ranges, and at close inspection most of the areas fell within high habitat quality areas; those areas that did not were generally due to inaccuracies in the data. On O'ahu and Molokai, a lower threshold ,3 spp forest birds, was picked for bird ranges because Oahu has lost so much bird habitat that a filter to only protect areas supporting 4 spp would identify too little remaining habitat to conserve. Ni'ihau, Lana'i, and Kaho'olawe did not have any identified forest bird areas by Gorresen et al. 2009.
    d. Reclassify totaldiv as >100 plant spp = 1; $\leq$ 100 spp = 0. The 100 plant spp threshold was picked because it includes most of the important forest bird habitats. It excludes the very dry and very low elevation areas (some of which is picked up in the Enhance category), as well as the high elevation areas. This raster has a statewide extent.
    e. Identify RESTORATION HIGH PRIORITY areas in proximity to hq = 3000 using a circular focal mean function with radius = 33 cells (~1km). Use display threshold = 2100. See ArcGIS help for formula. Reclassify resulting raster, hqprox, where at least 10% of the area within 1 km is high quality habitat = 10,000; all other data = 0. This raster has a statewide extent.

2. Stack rasters by island using the raster calculator (e.g., ma_bmp1 = [hqprox] + [ma_hq_combo] + [rarehp100] + [forestbirdsp7] + [totaldiv2]).

3. Make an excel table to join to resulting rasters in order to designate categories, as shown in the following snapshot. Directions are below.



	B	C	D	E	F	G
1	HQPROX	HQCOMBO	RAREHP	FBRICH	TOTDIV	CATEGORY
2	10000	3000	300	30	1	ENHANCEMENT
3	10000	3000	300	30	0	ENHANCEMENT
4	10000	3000	300	0	1	ENHANCEMENT
5	10000	3000	300	0	0	ENHANCEMENT
6	10000	3000	0	30	1	HIGH PRIORITY MAINTENANCE
7	10000	3000	0	30	0	SECONDARY MAINTENANCE
8	10000	3000	0	0	1	HIGH PRIORITY MAINTENANCE
9	10000	3000	0	0	0	SECONDARY MAINTENANCE
10	10000	2000	300	30	1	HIGH PRIORITY RESTORATION
11	10000	2000	300	30	0	HIGH PRIORITY RESTORATION
12	10000	2000	300	0	1	HIGH PRIORITY RESTORATION
13	10000	2000	300	0	0	HIGH PRIORITY RESTORATION
14	10000	2000	0	30	1	HIGH PRIORITY RESTORATION
15	10000	2000	0	30	0	HIGH PRIORITY RESTORATION
16	10000	2000	0	0	1	HIGH PRIORITY RESTORATION
17	10000	2000	0	0	0	HIGH PRIORITY RESTORATION
18	10000	1000	300	30	1	LIMITED OPPORTUNITY
19	10000	1000	300	30	0	LIMITED OPPORTUNITY
20	10000	1000	300	0	1	LIMITED OPPORTUNITY
21	10000	1000	300	0	0	LIMITED OPPORTUNITY
22	10000	1000	0	0	1	LIMITED OPPORTUNITY
23	10000	1000	0	0	0	LIMITED OPPORTUNITY

OahuMolokai Sheet1

a. Create the following fields JOIN, HQPROX, HQCOMBO, RAREHP, FBRICH, TOTALDIV, & CATEGORY, on 2 tabs, one for Oahu & Molokai and another for the other islands.
b. Populate the table with all possible combinations of the various datasources' codes. It helps to write in each field's comments what the codes mean. Not all combinations you identify will exist in the raster. See step 5 below to identify combinations that you may miss.
c. In the JOIN field, sum code values across all datasource fields.
d. Fill out the CATEGORY field using the following rules for the decoded values.
    i. If hqcombo = 3000 and rarehp = 300, category = ENHANCEMENT
    ii. If hqcombo = 3000 and rare hp = 0, and totaldiv = 1, category = HIGH PRIORITY MAINTENANCE
    iii. If hqcombo = 3000, rarehp = 0, and totaldiv = 0, category = SECONDARY MAINTENANCE
    iv. If hqprox = 10000 and hqcombo = 2000, category = HIGH PRIORITY RESTORATION
    v. If hqprox = 0 and hqcombo = 2000, category = LOCALIZED RESTORATION
    vi. If hqcombo = 1000, category = LIMITED OPPORTUNITY
    vii. For O'ahu or Molokai, if hqprox = 0, hqcombo = 2000 and fbrich = 30, category = HIGH PRIORITY RESTORATION
    viii. For O'ahu or Molokai, if hqprox = 0, hqcombo = 2000 and fbrich = 0, category = LOCALIZED RESTORATION
e. Save workbook and export 2 tables as values only into 2nd excel workbook. The join won't work if there are any cell comnments, formulas, or extraneous formatting of the spreadsheet.

4. Join stacked raster to exported table via CODE field.

5. Visually check the raster's attribute table to see if there are any blank rows that did not join, indicating combinations you failed to populate the table with, or unusual extents of the data sources. Once you find the missing values, manually add them to both exported tables, if due to oversight in populating the table. Otherwise ignore blanks.

6. Apply symbology to joined rasters using the CATEGORY field.
    a. Enhancement = blue
    b. High Priority Maintenance = dark green
    c. Secondary Maintenance = light green
    d. High Priority Restoration = bright yellow
    e. Localized Restoration = light yellow
    f. Limited Opportunities = grey

7. Prepare and overlay other polygon data onto stacked raster in ArcGIS for final map.
    a. Waterbirds Core = Secondary Maintenance
    b. Waterbirds Supporting = Localized Restoration
    c. Coastal Veg Good & Very Good Viability = Secondary Maintenance
    d. Coastal Veg Fair Viability = Localized Restoration

8. Group stacked raster and polygons. Export a layer for the group for easy sharing (and to minimize risk of using the raster without the polygons).

RESULTS

Table 4. Area of each biodiversity management category.

Categories	Area	% of All Lands
High Priority Maintenance	72,092 acres	18.3%
Secondary Maintenance	90,036 acres	22.9%
Enhancement	10,638 acres	2.7%
High Priority Restoration	48,645 acres	12.3%
Localized Restoration	96,801 acres	24.6%
Limited Opportunities	75,691 acres	19.2%