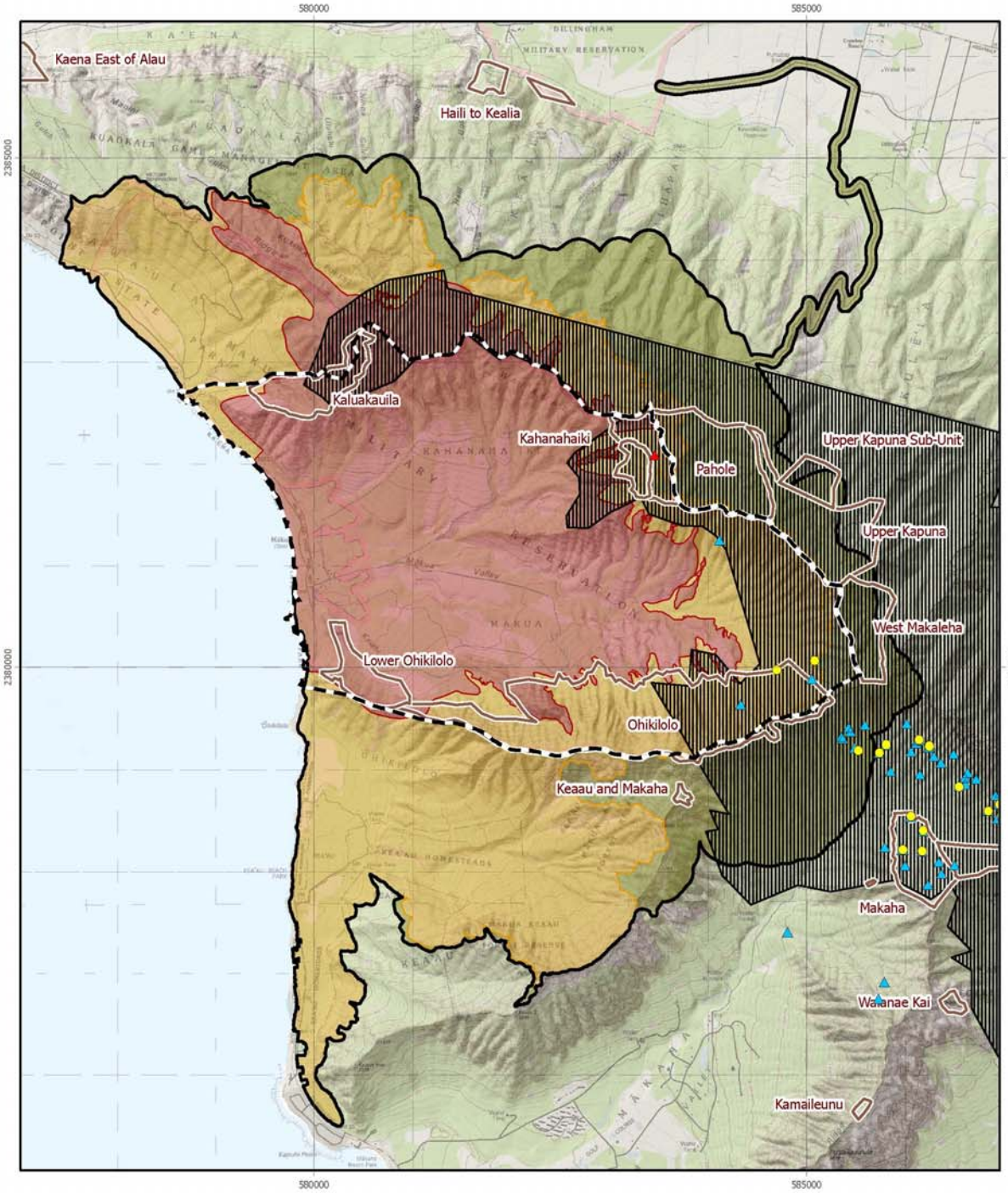

Figure E 61
Chasiempis sandwichensis ibidis

- Single Female
- Single Male
- Pair
- Critical habitat

- High Fire Risk Zone
- Low Fire Risk Zone
- Very Low Fire Risk Zone
- Management Units
- Makua Action Area
- Makua Military Reservation

Island of Oahu

0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

CUMULATIVE EFFECTS

Cumulative effects are those impacts of future State and private actions that are reasonably certain to occur within the area of action subject to consultation. Cumulative effects include the impacts of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Endangered Species Act.

Listed resources in the Makua action area are likely to be exposed to stressors associated with fires ignited by local arson incidents or by human carelessness, if these fires spread to population units, management units, or critical habitat within the action area. Brushfires are common throughout leeward Oahu each summer and are reasonably certain to occur in the future. During June through August 2005, for example, brushfires over approximately 2,327 ha (5,750 ac) in the Waianae area (Waianae Valley, Waianae, Maili, and Lualualei) were attributed to arson or fireworks (*Honolulu Advertiser*, January 2, 2006). Non-military fires of unknown origin burned about 405 ha (1,000 ac) in the Keawaula portion of the action area in July 2006 (*Honolulu Advertiser*, July 14, 2006; U.S. Army Garrison 2006b). Non-military fires also have burned parts of Makua Military Reservation from ignitions along Farrington Highway outside the installation (U.S. Army Corps of Engineers 2005). One such fire in July 2006 spread into the Lower Okikilolo Management Unit of Makua, where it burned within 50 m (165 ft) of *Chamaesyce celastroides* var. *kaenana* plants and within 150 m (495 ft) of *Hibiscus brackenridgei* ssp. *mokuleianus* plants. This fire also burned, and likely destroyed, up to 22 *Melanthera tenuifolia* plants in a unique, low-elevation site for this species (U.S. Army Garrison 2006a). Another July 2006 fire burned from along Farrington Highway up to the Kaluakauila Management Unit, where it impacted more than 81 ha (200 ac) that supported experimental reintroductions of *Hibiscus brackenridgei* ssp. *mokuleianus* and natural occurrences of *Chamaesyce celastroides* var. *kaenana* (U.S. Army Garrison 2006d). Loss of individuals and occurrences within population units outside the action area could significantly reduce the available seed source for propagation and outplanting of target and at-risk taxa both within and outside the action area. Cumulative effects related to non-military wildfire will be minimized by the Army's development and implementation of wildland fire management plans for management units on Army lands and adjacent State lands.

Future State actions in the action area include continued management of State lands according to their current designations as Forest Reserves or Natural Area Reserves. The State will continue to manage threatened and endangered species on their lands to the best of their ability. In addition, there will be continued threats to listed species in the action area from feral ungulates because of State regulated hunting activities in Forest Reserves and Game Management Areas.

CONCLUSION

After reviewing the current status of the species and critical habitats, the environmental baseline for species and critical habitat in the action area, and the effects of military training at Makua, including the cumulative effects, it is our biological opinion that implementation of the proposed action is not likely to jeopardize the continued existence of any species covered in this opinion, or adversely modify or destroy designated critical habitat addressed in this opinion. This

reinitiation was a risk assessment regarding the potential of a fire igniting and burning species or critical habitat.

The no jeopardy conclusions are based on the following: (1) Army conservation and stewardship programs that will increase the baseline number of individuals pursuant to the criteria stipulated in the Makua Implementation Plan and the Makua Implementation Plan Addendum for 28 species; (2) weapons restrictions, fuels management, fire suppression, and construction of fuelbreaks and firebreaks, to minimize the risk of wildland fire; and (3) invasive species control such as rat baiting, ungulate removal and invasive plant management. Please see each of the species specific conclusion sections in the effects analysis for the basis of how we reached these conclusions.

Our determination that implementation of the proposed action would not adversely modify or destroy critical habitat is based largely on the Army's multiple actions to minimize and reduce the risk of fire, minimize introduction and spread of non-native species, increase the current baseline for primary constituent elements of critical habitat. In addition, if a fire should escape the firebreak road, the affected critical habitat will be restored. Any losses that occur after implementation of these actions will be short term in nature and will not result in permanent destruction or alteration of the physical and biological features of critical habitat. Please see each of the species specific critical habitat conclusion sections in the effects analysis for more specific discussion of how we reached these conclusions.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined (50 CFR 17.3) by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service (50 CFR 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Army so that they become binding conditions in order for the exemption in section 7(o)(2) to apply. The Army has a continuing duty to regulate the activity covered by this incidental take statement. If the Army (1) fails to assume and implement the terms and conditions or (2) fails to require any contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit or contract, then the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Army must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law (HRS 195D).

Amount or Extent of Take

This Biological Opinion anticipates the following forms of incidental take:

1. The Service anticipates that take will occur in the form of harm (due to the loss of habitat), harassment, and death as a result of Army activities described in this Biological Opinion. The Service anticipates that the loss of no more than one occurrence of *Achatinella mustelina* comprised of 10 to 40 individuals will occur over the next 30 years.

2. The Service anticipates that take will occur in the form of harm (due to the loss of habitat), harassment, and death as a result of Army activities described in this Biological Opinion. The Service anticipates the take of one (1) Oahu elepaio pair and one (1) nest (which may contain up to 3 eggs or 3 nestlings, or a combination of nestlings and eggs not to exceed a total of 3 will occur over the next 30 years.

The Service will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §703-712), if such take is in compliance with the terms and conditions specified herein.

Effect of Take

In this Biological Opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the *Achatinella mustelina* or Oahu elepaio, or destruction or adverse modification of Oahu elepaio critical habitat.

Reasonable and Prudent Measures

The reasonable and prudent measures given below, with their implementing terms and conditions, are designed to minimize the impacts of incidental take that might otherwise result from the proposed actions. If, during the course of the actions, the level of incidental take is exceeded, the action agency is required to reinitiate consultation and review the reasonable and prudent measures provided in this Biological Opinion. In addition, the Army must cease the activities that caused the taking; must immediately provide an explanation of the causes of the taking; and must review with the Service the need for possible modification of the reasonable and prudent measures. The Army will offset unavoidable impacts through the implementation of the conservation measures as described in the Project Description. The Army will implement the conservation measures as identified in the Project Description of this Biological Opinion.

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize incidental take of *Achatinella mustelina* and Oahu elepaio. The measures described below are non-discretionary and must be implemented.

1. Minimize impacts of military activities and actions on survival and reproduction of *Achatinella mustelina* within the Makua action area.

2. Minimize direct impacts of military activities on survival and reproduction of Oahu elepaio within the Makua action area.

3. Minimize loss of Oahu elepaio habitat within the Makua action area.

4. Minimize threat of alien rats to Oahu elepaio within the Makua action area.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the agency must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Minimize impacts of military activities and actions on survival and reproduction of *Achatinella mustelina* within the Makua action area.

   1.1. All enclosures of known tree snail occurrences must be completed within five years of the issuance of the Biological Opinion.

   1.2. The Army will report in writing on an annual basis to the Service on the following items: (1) status of the known occurrences; (2) number and location of high explosives or pyrotechnics that land outside of the impact area; (3) the extent of damage or fires that result from these high explosives or pyrotechnics; and (4) how close to known tree snail occurrences were the high explosive impacts.

   1.3. The Service shall be notified within one (1) working day of any take of *Achatinella mustelina*.

   1.4. The depository designated to receive specimens of *Achatinella mustelina* or shells that are collected is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P Bishop Museum does not wish to accession the specimens, the permittee should contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/541-2681; fax: 808/541-3062) for instructions on disposition.

2. Minimize direct impacts of military activities on survival and reproduction of Oahu elepaio within the Makua action area.

   2.1. Prior to initiating live-fire training at Makua, an appendix to this Biological Opinion will be prepared, detailing and clarifying, in text format, the weapons restrictions

summarized in Table PD 2. If the Standard Operating Procedures detail the weapons restrictions in text form as well as in tables, completion of revised Standard Operating Procedures would satisfy this provision. The text will be approved by the Service prior to implementation of live-fire training at Makua.

2.2. The Army will notify the Service within 24 hours of any fires that burn any portion of a known elepaio territory and the number of elepaio territories affected.

2.3. The Army will report to the Service quarterly in writing the number of high explosive rounds that land outside the south lobe of the firebreak road, the locations where such rounds land, and whether these locations are within any known elepaio territories

2.4. The depository designated to receive specimens of any Oahu elepaio that are killed is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P Bishop Museum does not wish to accession the specimens, the permittee should contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/541-2681; fax: 808/541-3062) for instructions on disposition.

3. Minimize loss of Oahu elepaio habitat within the Makua action area.

3.1. Army Natural Resource Staff will have adequate access and will implement a rat control program, in all occupied Oahu elepaio breeding territories within the Makua action area. Until aerial dispersal of rodenticide is approved, Natural Resources Staff will bait and set a sufficient number of traps and bait stations every one to two weeks during the breeding season to control rat predation.

3.2. The Army will report annually to the Service in writing the number of elepaio territories in which rats were controlled, the location of each territory in which rats were controlled, the methods by which rats were controlled in each territory, the dates on which rat control activities were conducted in each territory, and the status of elepaio in each territory from the previous year.

4. Minimize threat of alien rats to Oahu elepaio within the Makua action area.

4.1. Construction of an ungulate-proof fence encircling the Makua Military Reservation installation boundary will be completed within three years of the date of completion of this Biological Opinion.

4.2. To prepare for aerial dispersal of rodenticide, ungulates will be removed from Makua Military Reservation within five years of the completion of this Biological Opinion.

4.3. The fence will be maintained and Makua Military Reservation will be kept free of ungulates.

4.4. When aerial rodenticide is approved for use, it will be applied in accordance with its label (e.g., fenced and "ungulate-free") for the control of rats throughout the Makua action area and management units outside the action area.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act (Act) directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The recommendations provided relate only to the proposed action and do not necessarily represent complete fulfillment of the Army's section 7(a)(1) responsibilities for the species. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

1) The Army has an expansive and comprehensive database to document pertinent information regarding each species. We recommend the Army hire an individual to update and maintain the biological database, add additional plant location data, link population unit data with GIS data points.

2) We recommend the Army fund additional invertebrate pest management research to identify effective control or eradication methods for pests of concern such as *Euglandina rosea*, black-twig borer, and slugs.

3) The Army should maintain fire suppression staffing and helicopter availability for rapid deployment to wildland fires in the vicinity of any management unit, inside and outside of the action area, when live herbaceous fuel moisture is below 120 percent. Large fires may develop quickly when the grass is cured and strategic use of limited personnel and helicopter resources will be necessary to ensure the protection of stabilization populations of endangered plants growing in the Waianae Mountains.

4) To facilitate reintroduction and fire suppression planning, Army Natural Resources Staff should add GPS locations of individual plants to their GIS database.

5) To facilitate communications between Makua and wildland firefighters and cooperators stationed outside Makua valley, the Army should install a new radio repeater within range of Makua Valley.

6) The Army should increase nursery facilities with the goal of creating a production-scale facility that is capable of producing large quantities of native plant materials for use in revegetation projects. This native plant stock and seed could be used by the Integrated Training Area Management staff for their revegetation projects. Also, there would be plant materials readily available in case a fire does burn critical habitat and habitat restoration is warranted.

7) The Army should continue to pursue the establishment of shaded fuelbreaks, vegetated by native species, adjacent to existing forest and shrub vegetation, to further minimize fire risk to existing forest areas.

8) The Army should be a Cooperator on the National Environmental Policy Act documents for the registration of the aerial broadcast of a rodenticide for conservation purposes in Hawaii.

9) The Army should establish protocols for hydro-mulching or other large-scale native plant seeding to be used in native habitat restoration efforts.

10) In order to substantially reduce the fire risk associated with live-fire training, close Makua to live-fire training (except for short-range training ammunition blanks used in specified areas) when live herbaceous fuel moisture falls below 100 percent.

REINITIATION STATEMENT

This concludes formal consultation on this action. As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease pending reinitiation. The Army will coordinate with the Service if a fire due to military activities or actions occurs outside of any of the firebreak roads established at Makua. No military training activities with live-fire weaponry, except for those that are addressed in this consultation may be used at this installation without coordination with the Service. As stated in the Conclusion (above), the Service's finding of no adverse modification is based in large part on the conservation measures built into the project by the Army. Should there be a failure to carry out any or all of the described measures, or if the measures are not effective, or if these measures are modified in any way without Service coordination, reinitiation of consultation will be required. If you have any questions regarding this Biological Opinion, please contact Ms. Patrice Ashfield of my staff at (808) 792-9400.

Sincerely,

Patrick Leonard
Field Supervisor

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APPENDICES

TO THE

REINITIATION

OF THE

1999 BIOLOGICAL OPINION

OF THE

U.S. FISHAND WILDLIFE SERVICE

FOR

U.S. ARMY MILITARY TRAINING

AT MAKUA MILITARY RESERVATION

ISLAND of OAHU

June 22, 2007

(1-2-2005-F-356)

Appendix A. Threatened and Endangered Species and Critical Habitat Located in the Makua Action Area

Plants

1. *Abutilon sandwicense* - Endangered
2. *Alectryon macrococcus* var. *macrococcus* - Endangered
3. *Bonamia menziesii* - Endangered
4. *Cenchrus agrimonioides* var. agrimonioides - Endangered
5. *Chamaesyce celastroides* var. *kaenana* - Endangered
6. *Chamaesyce herbstii* - Endangered
7. *Ctenitis squamigera* - Endangered
8. *Cyanea grimesiana* ssp. *obatae* - Endangered
9. *Cyanea longiflora* - Endangered
10. *Cyanea superba* ssp. *superba* - Endangered
11. *Cyrtandra dentata* - Endangered
12. *Delissea subcordata* - Endangered
13. *Diellia falcata* - Endangered
14. *Dubautia herbstobatae* - Endangered
15. *Euphorbia haeleeleana* - Endangered
16. *Flueggea neowawraea* - Endangered
17. *Gouania vitifolia* - Endangered
18. *Hedyotis degeneri var. degeneri* - Endangered
19. *Hedyotis parvula* - Endangered
20. *Hesperomannia arbuscula* - Endangered
21. *Hibiscus brackenridegei* ssp. *mokuleianus* - Endangered
22. *Lobelia niihauensis* - Endangered
23. *Melanthera tenuifolia* (*Lipochaeta tenuifolia*) - Endangered
24. *Neraudia angulata* - Endangered
25. *Nototrichium humile* - Endangered
26. *Peucedanum sandwicense* - Threatened
27. *Phyllostegia kaalaensis* - Endangered
28. *Plantago princeps var. princeps* - Endangered
29. *Pritchardia kaalae* - Endangered
30. *Sanicula mariversa* - Endangered
31. *Schiedea hookeri* - Endangered
32. *Schiedea kaalae* - Endangered
33. *Schiedea nuttallii* - Endangered
34. *Schiedea obovata* (*Alsinidendron obovatum*)- Endangered
35. *Silene lanceolata* - Endangered
36. *Spermolepis hawaiiensis* - Endangered
37. *Tetramolopium filiforme* - Endangered
38. *Viola chamissoniana* ssp. *chamissoniana* - Endangered

Animals

1.	*Achatinella mustelina* - Endangered	Oahu tree snail
2.	*Chasiempis sandwichensis ibidis* - Endangered	Oahu elepaio

Appendix A. continued.

Plant Critical Habitat

1. *Bonamia menziesii*
2. *Cenchrus agrimonioides* var. *agrimonioides*
3. *Chamaesyce celastroides* var. *kaenana*
4. *Chamaesyce herbstii*
5. *Colubrina oppositifolia*
6. *Cyanea grimesiana* ssp. *obatae*
7. *Cyanea longiflora*
8. *Cyanea superba* ssp. *superba*
9. *Cyrtandra dentata*
10. *Delissea subcordata*
11. *Diellia falcata*
12. *Dubautia herbstobatae*
13. *Euphorbia haeleeleana*
14. *Flueggea neowawraea*
15. *Gouania vitifolia*
16. *Hedyotis degeneri* var. *degeneri*
17. *Hedyotis parvula*
18. *Hesperomannia arbuscula*
19. *Hibiscus brackenridgei* ssp. *mokuleianus*
20. *Isodendrion laurifolium*
21. *Isodendrion longifolium*
22. *Isodendrion pyrifolium*
23. *Mariscus pennatiformis*
24. *Melanthera tenuifolia*
25. *Melicope pallida*
26. *Neraudia angulata*
27. *Nototrichium humile*
28. *Phyllostegia kaalaensis*
29. *Plantago princeps* var. *Princeps*
30. *Sanicula mariversa*
31. *Schiedea hookeri*
32. *Schiedea kaalae*
33. *Schiedea nuttallii*
34. *Schiedea obovata*
35. *Solanum sandwicense*
36. *Spermolepis hawaiiensis*

Animal Critical Habitat

1. *Chasiempis sandwichensis ibidis* Oahu elepaio

Appendix B. Name and Agency Affiliation of Makua Consultation Participants

Name	Agency	Title
Ashfield, Patrice	USFWS	Technical Assistant and Section 7 Consultation Program Leader
Beavers, Andrew	Center for Environmental Management of Military Lands	Fire and Ecology Management Specialist
Bennett, Stephanie	USFWS	Fish and Wildlife Biologist
Bergmannis, Colleen	U.S. ARMY	Army ITAM
Borja, Bert	U.S. ARMY	Makua Range Control Supervisor
Boulet, Bill	U.S. ARMY	Installation Fire and Safety Office
Ching, Susan	U.S. ARMY	Army Natural Resources Biologist
Costales, Pat	DLNR, DOFAW	Oahu District Manager
Dang, Charmie	USFWS	Fish and Wildlife Biologist
Enriques, Gayland	U.S. ARMY	Army Fire Chief
Fujioka, Francis M.	USDA Forest Service	Research Meteorologist
Godfrey, Joel	U.S. ARMY	Chief, Environmental Division
Greenlee, Dawn	USFWS	Fish and Wildlife Biologist
Greenlee, Jason	U.S. ARMY	Army Wildlife Fire Management Officer (2005 – 2006)
Houseberg, Sammy	U.S. ARMY	Director, Installation Fire and Safety Office
Huseman, Tom	U.S. ARMY	Makua Range Manager
Kauffman, Boone	USDA Forest Service	Director & Research Ecologist
Kawelo, Kapua	U.S. ARMY	Army Natural Resources Biologist
Killian, Howard J.	U.S. ARMY	Garrison Commander
Mansker, Michelle	U.S. ARMY	Environmental Resource Manger
McBride, Jenness	USFWS	Fish and Wildlife Biologist
Moller, Eric	U.S. ARMY	Army Fire Chief
Oberholtzer, Steve	USFWS	Acting Deputy Field Supervisor
Onaga, Elena	U.S. ARMY	Army Solicitor
Petrovia, Sal	U.S. ARMY	G3 Training
Piskel, Tom	U.S. ARMY	Army Civilian Contractor
Powell, Jeffrey	National Weather Service	Fire Weather Meteorologist
Rubinoff, Ray	U.S. ARMY	Washington Office
Rydell, Nezettte	National Weather Service	Warning Coordination Meteorologist
Shultz, Gina	USFWS	Assistant Field Supervisor
Yuh, Peter	U.S. ARMY	NEPA Coordinator
Walcott, Patty	USFWS	Fish and Wildlife Biologist
Yamasaki, Scott	U.S. ARMY	Army Wildland Fire Management Officer

Appendix C. Plant and Animal Species Mentioned in the Biological Opinion

Scientific Name	Common Nomenclature
Abutilon sandwicense (end)[1]	--
Acacia confusa (nat)[2]	Formosan koa
Acacia koa (end)	koa
Acacia koaia (end)	koaia
Acacia mearnsii (nat)	Black wattle
Achatina fulica (nat)	giant African snail
Achatinella (end)	tree snail
Achatinella mustelina (end)	Oahu tree snail; pupu kani oe
Achatinella bellula (end)	Oahu tree snail; pupu kani oe
Achatinella viridans (end)	Oahu tree snail; pupu kani oe
Achyranthes aspera	Prickly achyranthes
Achyranthes sp. (end)	--
Achyranthes splendens (end)	hinahina ewa
Adoretus sinicus (nat)	Chinese rose beetle
Ageratina riparia (nat)	spreading mist flower; hamakua pamakani
Ageratum conyzoides	maile honohono
Alectryon macrococcus (end)	mahoe
Alectryon macrococcus ssp. *auwahiensis* (end)	mahoe
Alectryon macrococcus ssp. *macrococcus* (end)	mahoe
Aleurites moluccana (pol)[3]	kukui
Aleurodicus dugesii	giant whitefly
Alsinidendron (end)	--
Alsinidendron obovatum (end)	--
Alyxia oliviformis (end)	maile
Andropogon virginicus (nat)	broomsedge
Anoplolepis longipes (nat)	long legged ant
Antidesma platyphyllum (and)	hame
Antidesma platyphyllum var. *hillebrandii* (end)	hame
Antidesma pulvinatum (end)	hame
Antidesma sp. (end)	hame
Araucaria columnaris (nat)	Cook pine
Argemone glauca (end)	prickly poppy, pua-kala
Artemisia australis (end)	ahinahina, hinahina, hinahina kuahiwi
Asplenium kaulfussii (end)	kuau
Asplenium lobulatum (end)	pii pii lau manamana, analii
Asplenium macraei (end)	iwaiwa lau lii
Asplenium unilaterale (end)	pamoho
Astelia sp. (end)	painiu
Axis axis (nat)	axis deer
Bidens amplectens (end)	kookoolau
Bidens cervicatai (end)	kookoolau
Bidens hawaiensis (end)	kookoolau
Bidens sp. (end)	kookoolau
Bidens torta (end)	kookoolau

Appendix C. Continued.

Blechnum appendiculatum (nat)	--
Bobea brevipes (end)	ahakea lau lii, akupa
Bobea elatior (end)	ahakea lau nui
Bobea sp. (end)	ahakea
Boehmeria grandis (end)	akolea
Boerhavia sp. (end)	alena, anena, nena
Boiga irregularis	brown tree snake
Bonamia menziesii (end)	--
Bos taurus (nat)	cattle
Bradybaena similaris (nat)	small garden snail
Canavalia sp. (end)	awikiwiki
Capra hircus (nat)	goat
Carex sp. (end)	--
Carex wahuensis (end)	--
Casuarina glauca (nat)	Longleaf ironwood
Casuarina sp. (nat)	ironwood
Cenchrus agrimonioides (end)	kamanomano
Cenchrus agrimonioides ssp. *agrimonioides* (end)	kamanomano
Chamaesyce celastroides (end)	akoko
Chamaesyce celastroides ssp. *kaenana* (end)	akoko
Chamaesyce celastroides var. *amplectensi* (end)	akoko
Chamaesyce celastroides var. *hanapepensis* (end)	akoko
Chamaesyce celastroides var. *lorifolia* (end)	akoko
Chamaesyce herbstii (end)	akoko
Chamaesyce multiformis (end)	akoko
Chamaesyce sp. (end)	akoko
Charpentiera obovata (end)	papala
Charpentiera sp. (end)	papala
Charpentiera tomentosa (end)	papala
Chasiempis sandwichensis ibidis (end)	Oahu elepaio
Cibotium chamissoi (end)	hapuu
Cibotium sp. (end)	hapuu
Cirsium vulgare (nat)	Bull thistle
Claoxylon sandwicense (end)	poola
Clidemia hirta (nat)	Koster's curse
Cocculus sp. (end)	huehue
Coccus hespericlum(nat)	soft brown scale insect
Colubrina oppositifolia (end)	kauila
Copestylum chalybescens (nat)	(Diptera: Syrphidae); syrphid fly
Coprosma foliosa (end)	pilo
Coprosma granadensis (end)	makole
Coprosma sp. (end)	pilo
Cordyline fruticosa (pol)	ti, ki
Ctenitis squamigera (end)	pauoa
Culex quinquefasciatus (nat)	southern house mosquito, night biters

Appendix C. Continued.

Cyanea grimesiana (end)	haha
Cyanea grimesiana ssp. *grimesiana* (end)	haha
Cyanea grimesiana ssp. *obatae* (end)	haha
Cyanea longiflora (end)	haha
Cyanea membranacea (end)	haha
Cyanea sp. (end)	haha
Cyanea superba (end)	haha
Cyanea superba ssp. *superba* (end)	haha
Cyrtandra calpidicarpa (end)	haiwale
Cyrtandra dentata (end)	haiwale
Cyrtandra grandiflora (end)	haiwale
Cyrtandra sp. (end)	haiwale
Cyrtandra waianaeensis (end)	haiwale
Delissea subcordata (end)	oha
Desmodium intortum (nat)	Tick clover
Dianella sandwicensis (end)	ukiuki
Dicranopteris (end)	uluhe
Dicranopteris linearis (end)	uluhe
Diellia falcata (end)	--
Diellia unisora (end)	--
Diospyros hillebrandii (end)	lama
Diospyros sandwicense (end)	lama
Diospyros sp. (end)	lama
Diplazium arnottii (end)	hoio pahole
Diplazium sandwichianum (end)	hoio, pohole
Dodonaea viscosa (end)	aalii
Doodia kunthiana (end)	okupukupu, pamoho, okupukupu lau ii
Doodia sp. (end)	okupukupu, pamoho, okupukupu lau ii
Doryopteris sp. (end)	--
Dryopteris sp.(end)	--
Dryopteris unidentata (end)	akole
Dubautia herbstobatae (end)	naenae
Dubautia plantaginea (end)	naenae
Dubautia sp. (end)	naenae
Elaeocarpus bifidus (end)	kalia
Ehrharta stipoides	Meadow rice grass
Erigeron karvinskianus (nat)	daisy fleabane
Erythrina sandwicensis (end)	wiliwili
Eucalyptus robusta (nat)	swamp mahogany
Eugenia reinwardtiana (end)	nioi
Eugenia sp. (end)	nioi
Euglandina rosea (nat)	cannibal snail
Euphorbia haeleeleana (end)	akoko
Felis catus (nat)	feral cat
Ficus macrophylla (nat)	Moreton Bay fig

Appendix C. Continued.

Ficus microcarpa (nat)	Chinese banyan
Flueggea neowawraea (end)	mehamehame
Freycinetia arborea (end)	ieie
Fusarium oxysporum f. sp. *koae*	Koa wilt
Gahnia beecheyi (end)	--
Gahnia sp. (end)	--
Geoplana septemlineata	centipede worm, predatory flat worm
Gossypium tomentosum (end)	mao
Gouania hillebrandii (end)	--
Gouania vitifolia (end)	--
Grevillea robusta (nat)	silk oak, silver oak
Hedyotis acuminata (end)	au, pilo
Hedyotis degeneri var. *degeneri* (end)	--
Hedyotis parvula (end)	--
Hedyotis schlechtendahliana (end)	kopa
Hedyotis sp. (end)	--
Hedyotis terminalis (end)	manono
Heliothrips haemorrhoidalis (nat)	greenhouse thrips
Helix aspersa (nat)	brown garden snail
Herpestes auropunctatus (nat)	small Indian mongoose
Hesperomannia arbuscula (end)	--
Hibiscus arnottianus (end)	kokio keokeo, hau hele, kokio kea, pamakani
Hibiscus arnottianus var. *arnottianus* (end)	kokio keokeo, hau hele, kokio kea, pamakani
Hibiscus brackenridgei (end)	mao hau hele
Hibiscus brackenridgei ssp. *brackenridgei* (end)	mao hau hele
Hibiscus brackenridgei ssp. *mokuleianus* (end)	mao hau hele
Hibiscus brackenridgei ssp. *molokaiana* (end)	mao hau hele
Hibiscus sp. (end)	kokio, hibiscus
Homalodisca coagulata	glassy winged sharpshooter
Ilex anomala (end)	kawau
Isachne pallens (end)	--
Isodendrion laurifolium (end)	aupaka
Isodendrion longifolium (end)	aupaka
Isodendrion pyrifolium (end)	aupaka
Jacquemontia ovalifolia ssp. *sandwicensis* (end)	pauohiiaka
Kalanchoe pinnata (nat)	air plant
Lantana camara (nat)	lantana, lakana
Leonotis nepetifolia	lion's ear
Lepidium arbuscula (end)	--
Lepidium bidentatum (end)	anaunau
Leptecophylla tameiameiae (end)	pukiawe
Leptospermum scoparium (nat)	New Zealand tea tree
Leucaena leucocephala (nat)	koa haole

Appendix C. Continued.

Lipochaeta lobata (end)	nehe
Lipochaeta sp. (end)	nehe
Lipochaeta tenuifolia (end)	nehe
Lobelia gaudichaudii	--
Lobelia niihauensis (end)	--
Lobelia yuccoides (end)	panaunau
Lysimachia hillebrandii (end)	kolokolo kuahiwi, pua hekili
Lysimachia sp. (end)	--
Machaerina sp. (end)	uki
Mangifera indica (nat)	mango
Mariscus pennatiformis (end)	--
Melanthera remyi (end)	nehe
Melanthera tenuis (end)	nehe
Melanthera tenuifolia (end)	nehe
Melicope pallida (end)	alani
Melicope sp. (end)	alani
Melinis minutiflora (nat)	molasses grass
Metaleurodicus cardini	Cardin's whitefly
Metrosideros polymorpha (end)	ohia, ohia lehua, lehua
Metrosideros rugosa (end)	lehua papa
Metrosideros sp. (end)	ohia, ohia lehua, lehua
Metrosideros tremuloides (end)	lehua ahihi, ahihi, ahiki ku ma kua
Morinda trimera (end)	noni kuahiwi
Mus domesticus (nat)	mice
Myndus crudus (nat)	sap-sucking plant hopper
Myoporum sandwicense (end)	naio, bastard sandalwood
Myrsine lanaiensis (end)	kolea
Myrsine lessertiana (end)	kolea lau nui
Myrsine linearifolia (end)	kolea
Myrsine sp. (end)	kolea
Nephrolepis exaltata (end)	nianiau, okupukupu
Neraudia angulata (end)	--
Neraudia melastomifolia (end)	maaloa
Neraudia sp. (end)	--
Nestegis sandwicensis (end)	olopua
Nothocestrum longifolium (end)	aiea
Nothocestrum sp. (end)	aiea
Nototrichium humile (end)	kului
Nototrichium sandwicense (end)	kului
Nototrichium sp. (end)	kului
Osteomeles anthyllidifolia (end)	ulei, eluehe
Ovis aries (nat)	sheep
Ovis musimon (nat)	mouflon sheep
Oxychilus alliarius	garlic snail
Panicum maximum (nat)	Guinea grass

Appendix C. Continued.

Partulina sp. (end)	tree snail
Paspalum conjugatum (nat)	Hilo grass, mauu hilo
Passiflora suberosa (nat)	huehue haole
Passiflora tarminiana (nat)	banana poka
Pennisetum setaceum (nat)	fountain grass
Peperomia sp. (end)	ala ala wai nui
Perrottetia sandwicensis (end)	olomea
Peucedanum sandwicense (end)	makou
Phyllostegia kaalaensis (end)	--
Physomerus grossipes (nat)	--
Pilea peploides (end)	--
Pipturus albidus (end)	mamaki
Pipturus sp. (end)	mamaki
Pisonia brunoniana (end)	papala kepau
Pisonia sandwicensis (end)	aulu, kaulu
Pisonia sp. (end)	papala kepau
Pisonia umbellifera (end)	papala kepau
Pittosporum sp. (end)	hoawa
Plantago princeps (end)	laukahi kuahiwi
Plantago princeps var. *anomala* (end)	ale
Plantago princeps var. *laxiflora* (end)	ale
Plantago princeps var. *longibracteata* (end)	ale
Plantago princeps var. *princeps* (end)	ale
Plasmodium relictum (nat)	avian malaria
Platydemus manokwari (nat)	predatory flatworm
Plectranthus parviflorus (end)	alaala wai nui
Pleomele halapepe (end)	hala pepe
Pleomele sp. (end)	hala pepe
Plumbago zeylanica (end)	iliee
Pouteria sandwicensis (end)	alaa
Poxvirus avium (nat)	avian pox
Pritchardia kaalae (end)	loulu
Pritchardia sp. (end)	loulu
Psidium cattleianum (nat)	strawberry guava
Psidium guajava (nat)	common guava
Psidium sp. (nat)	guava
Psilotum nudum (end)	moa
Psychotria hathewayi (end)	kopiko
Psychotria mariniana (end)	kopiko
Psychotria sp. (end)	kopiko
Psydrax odorata (end)	alahee, ohee, walahee
Pteralyxia sp. (end)	kaulu
Pterolepis glomerata (nat)	--
Puccinia psidii	Ohia rust
Pulvinaria psidii	green shield scale insect

Appendix C. Continued.

Quadrastichus erythrinae	Erythrina gall wasp
Rattus exulans (pol)	Polynesian rat, Pacific rat
Rattus norvegicus (nat)	Norway rat, brown rat, sewer rat
Rattus rattus (nat)	black rat, roof rat, ship rat
Rauvolfia sandwicensis (end)	hao
Rivina sp. (nat)	rouge plant
Rubus argutus (nat)	blackberry
Rumex albescens (end)	huahuako
Rumex sp (end)	--
Sanicula mariversa (end)	--
Santalum ellipticum (end)	coastal sandalwood, iliahi
Santalum freycinetianum (end)	iliahi
Santalum sp. (end)	iliahi
Sapindus oahuensis (end)	lonomea
Scaevola glabra (end)	ohe naupaka
Scaevola kilaueae (end)	naupaka
Schiedea hookeri (end)	--
Schiedea kaalae (end)	--
Schiedea mannii (end)	--
Schiedea nuttallii (end)	--
Schiedea obovata (end)	--
Schiedea pentandra (end)	--
Schiedea sp. (end)	--
Schinus terebinthifolius (nat)	Christmas berry
Selaginella arbuscula (end)	lepelepe a moa
Sicyos sp. (end)	anunu
Sida fallax (end)	ilima
Silene lanceolata (end)	--
Smilax melastomifolia (end)	hoi kuahiwi, akaawa
Solanum sandwicense (end)	aieakeakua, popolo
Sophonia rufofascia	two-spotted leafhopper
Sophora chrysophylla (end)	mamane
Spermolepis hawaiiensis (end)	--
Stachytarpheta australis (nat)	oi, owi
Stenogyne sp. (end)	--
Streblus pendulinus (end)	aiai
Sus scrofa (nat)	pig
Syzygium cumini (nat)	Java plum
Syzgium jambos (pol)	Mountain apple
Syzygium sandwicensis (end)	ohia ha
Tecoma capensis (nat)	Cape honeysucke
Tetramolopium filiforme (end)	--
Tetramolopium sp. (end)	--
Tetraplasandra sp. (end)	ohe
Thysanococcus pandani	hala scale insect

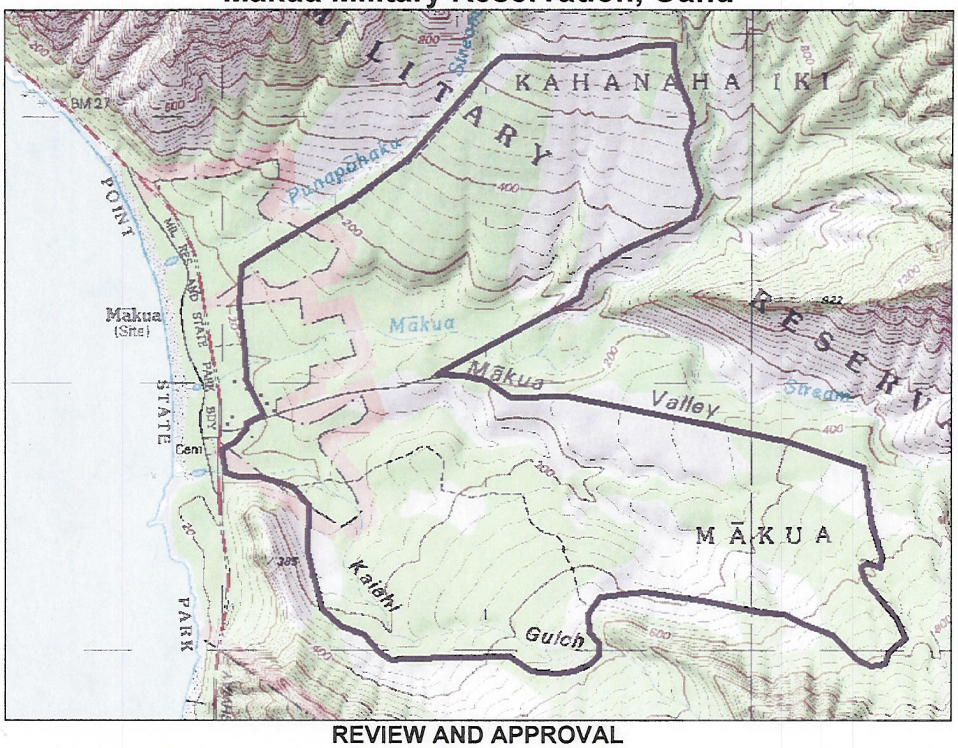
Appendix C. Continued.

Toona ciliata (nat)	Australian red cedar
Triumfetta semitriloba (nat)	Sacramento bur
Urera glabra (end)	opuhe
Vaginulus plebeian (nat)	slug
Veronicella cubensis (nat)	slug
Veronicella leydigi (nat)	black slug
Viola chamissoniana ssp. *chamissoniana* (end)	pamakani
Viola sp. (end)	pamakani
Waltheria indica (end)	uhaloa, alaalapuloa
Wikstroemia oahuensis (end)	akia
Xyleborus affinis (end)	scolytid beetle
Xyleborus crassiusculus (end)	scolytid beetle
Xyleborus fornicatus (end)	scolytid beetle
Xylosandrus compactus (nat)	black twig borer
Xylosma crenatum (end)	--
Xylosma hawaiiense (end)	maua
Xylosma sp. (end)	maua
[1]endemic/ indigenous; [2]naturalized; [3]Polynesian introduced	

Appendix D

PRESCRIBED BURN PLAN MMR 06-03
Makua Military Reservation, Oahu

PRESCRIBED BURN PLAN MMR 06-03
Makua Military Reservation, Oahu



REVIEW AND APPROVAL

As required under Section 4.4.6, Prescribed Fire Requirements, of the Integrated Wildland Fire Management Plan (IWFMP), Dated October 2003, the proposed burn described in this plan is necessary to achieve the specific management objectives of the Wildfire Management Program.

Prepared by: _____ Date December 11, 2006
JASON M. GREENLEE, RXB2
Wildland Fire Management Officer, USARHAW

Reviewed by: _____ Date 12/12/06
ERIC MOLLER
Acting Fire Chief, Installation Fire and Safety Office

Reviewed by: _____ Date 12/12/06
VICTOR GARO, JR.
Range Officer, G3/DPTM, Range Division

Reviewed by: for _____ Date 12/12/06
GLEN DELAURA
Fire Chief, Federal Fire Department

Approved by: _____ Date 12/12/06
SAMMY C. HOUSEBERG
Director, Installation Fire and Safety Office

PRESCRIBED BURN PLAN MMR 06-03
Makua Military Range

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AGENCY ADMINISTRATOR / PRESCRIBED FIRE MANAGER'S GO/NO-GO PRE-IGNITION APPROVAL CHECKLIST

Instructions: The Prescribed Fire Manager's GO/NO-GO Pre-Ignition Approval is completed before a prescribed fire can be implemented. This Approval evaluates whether compliance requirements, Prescribed Burn Plan elements, and internal and external notifications have been completed and expresses the Prescribed Fire Manager's intent to implement the Prescribed Burn Plan. If ignition of the prescribed fire is not initiated prior to expiration date determined by the Prescribed Fire Manager's, a new approval will be required.

Yes	No	Key Element Questions
		Is the Prescribed Burn Plan up to date? *Hints: amendments, seasonality, Service concurrence to alterations.*
		Have all compliance requirements been completed? *Hints: Cultural, threatened and endangered species, smoke management, NEPA.*
		Is risk management in place and the residual risk acceptable? *Hints: Is the Prescribed Fire Complexity Rating Guide completed with rational and mitigation measures identified and documented?*
		Will all elements of the Prescribed Fire Plan be met? *Hints: Preparation work, mitigation, weather, organization, prescription, contingency resources*
		Will all internal and external notifications and media releases be completed? *Hints: Preparedness level restrictions*
		Are key agency staff fully briefed and understand prescribed fire implementation?
		Other:

The approved prescribed fire plan constitutes a delegation of authority to burn. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Actions taken in compliance with the approved plan will be fully supported by management. Personnel will be held accountable for actions taken which are not in compliance with the approved plan regarding execution in a safe and cost-effective manner. The document attached is a complete catalog of all documentation expected other than training records, red cards, and work capacity test records, which will be maintained and kept available at the Army wildland fire office. Trainers will be held accountable for actions taken by trainees in their capacity as a trainee. Contingency forces will be sufficient to contain a fire provided weather forecast and actual weather are in-prescription. The Burn Boss will make every effort to obtain reliable long-range and spot weather forecasts. If a weather event occurs that is not forecast, the resources in this plan may not be able to contain a spot fire and additional resources will be ordered. The approving line officer delegates the responsibility to declare an escape fire to the Prescribed Fire Burn Boss.

Approved by: _____ Date: _____
_____, Agency Administrator

Approval expires (date): _____

TRANSFER OF RESPONSIBILITY

As the prescribed fire progresses from ignition and holding to extended days of mop up, the complexity of the burn decreases and the Burn Boss may transfer responsibility for this burn to a qualified Incident Commander or Burn Boss with NWCG qualifications commensurate with the complexity of the fire. Once the fire is no longer spreading and the outer edges have been mopped up, the fire may be transferred to an NWCG-qualified Incident Commander with qualifications commensurate with the complexity of the fire. The burn will not be transferred to an incident commander or burn boss with qualifications lower than RXB3 or ICT4 until the outer 20 meters of the burn unit have been mopped up 100 percent. The Burn Boss and Incident Commander will always meet all NWCG qualification prerequisites, including training and task book completion. The NWCG incident commander may not necessarily be employed by the US Army, but may be from a cooperating agency which fully participates in the NWCG red-card system (USFS, USFWS, BLM, BIA, NPS). The fire will be attended to by an on-site NWCG-qualified incident commander until the outer 60 meters have been mopped up. The fire will be assigned to an NWCG-qualified red-carded Incident Commander until it is declared out by the Army Wildland Fire Management Officer or Assistant Wildland Fire Management Officer.

Transfer of responsibility for this burn is being made at this time. I have thoroughly briefed the incoming Burn Boss or Incident Commander, and have insured his/her qualifications are current and that it is safe to make this transfer.

Signed: _____ Qualification: _____ Date: _____ Time: _____
Outgoing Burn Boss

Signed: _____ Qualification: _____ Date: _____ Time: _____
Incoming Incident Commander

Signed: _____ Qualification: _____ Date: _____ Time: _____
Incoming Incident Commander

Signed: _____ Qualification: _____ Date: _____ Time: _____
Incoming Incident Commander

Signed: _____ Qualification: _____ Date: _____ Time: _____
Incoming Incident Commander

CERTIFICATION THAT FIRE IS OUT

This certifies that the fire is out. Certification must be done by NWCG RXB2 or ICT4 Army Wildland Fire Management Officer or Assistant Wildland Fire Management Officer.

Signed: _____ Title: _____ Date: _____ Time: _____

SECTION 2
DESCRIPTION OF THE BURN AREA

A. Category

(x) Broadcast burn (natural fuels)
( ) Pile burn
( ) Logging slash
(x) Fuel break maintenance
(x) Fuel reduction burn for fire hazard reduction, and/or ground visibility for archeological and/or UXO surveys
( ) Other (specify)

B. Location Entirely within the north and south lobes of the firebreak road.

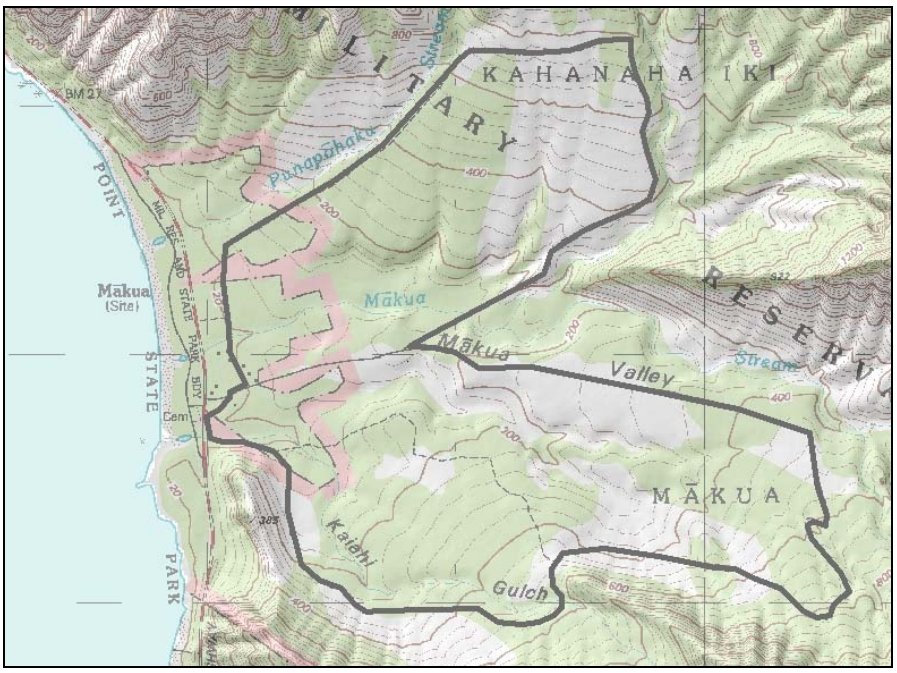

Figure 1: Prescribed Burn Areas: Inside North and South Lobes of the firebreak road system.

C. Size:	800 acres. The burn unit may be partitioned in order to burn smaller blocks.
Elevations:	20-800 feet
Slope:	0 to 45%
Aspect(s):	South and West
F. Vegetation and Fuel	1. <u>Current vegetation:</u> Vegetation to be burned is desiccated guinea grass (*Panicum maximum)*. Surrounding vegetation is also guinea grass, plus molasses grass and haole koa. The National Fire Behavior Fuel Model NFDRS model N has been adapted into a custom guinea grass fuel model called Grass2. Total fuel loading is approximately 10 tons/acre

	Vegetation	Fuel Model
Inside burn area:	Desiccated Gr.	Grass2 (custom)
Outside burn area:	Green Grass	Grass2 (custom)

Canopy height: 3-10 feet

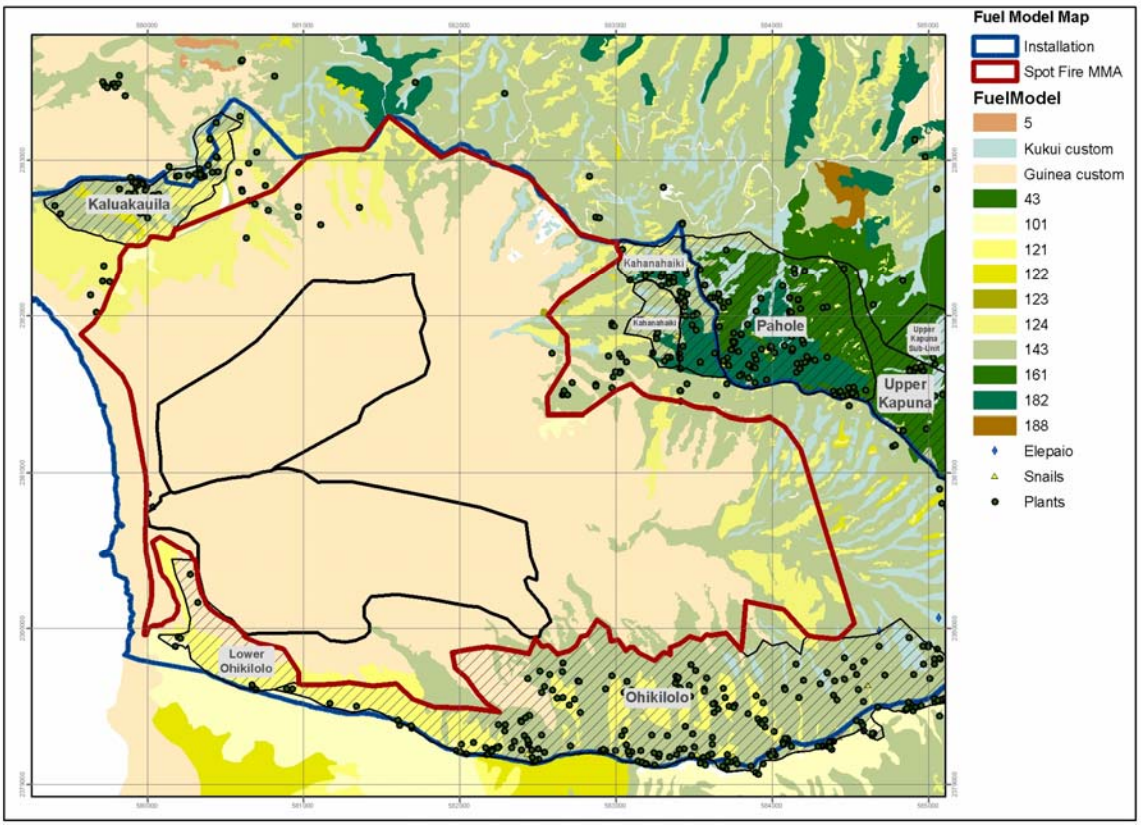

Figure 2. Fuel Model Map.

2. <u>Past environmental and land management history that has impacted the past and present vegetation.</u>

Hawaii has a fire history that is characterized by infrequent lightning fires. *Panicum maximum* (guinea grass) was introduced as a forage grass for cattle ranching. The grass dominates the burn unit and the contingency areas adjacent to the burn unit.

3. <u>Fuel</u>

Fuel inside and outside the firebreak road is dominated by guinea grass. Fuel model parameters for the custom guinea grass fuel model are described in the prescription element of this plan. A custom Kukui fuel model, developed by Beavers, is also used in the vicinity of the burn unit. Other fuel models are standard models described in Scott and Burgan (2005). Areas within the burn unit may be treated with herbicide or otherwise pre-treated to better ensure that treatment objectives are met under relatively cool prescribed burning conditions.

G. Unit Description

Burn units lie entirely within well maintained firebreak roads. The firebreaks are bare mineral soil to a width of six meters. The south lobe of the firebreak road is bisected by several secondary roads. On the slopes and ridges above the burn area, a number of endangered species, both plant and animal, are known to occur. A spot fire which burns any endangered species or forested vegetation within any Management Unit (for instance Ohikilolo, Lower Ohikilolo, Kaluakauila, or Kahanahaiki) or designated critical habitat area would be considered an escaped prescribed burn and would require expensive post-fire restoration work. Measures will be taken to minimize the potential for spot fire occurrence and to minimize spot fire size. However, the Maximum Manageable Area (MMA) does provide for a potential maximum spot fire size of 88 acres. This spot fire would burn in grass fuels outside the firebreak road and would not burn endangered species or critical habitats within Management Units.

I. Endangered Species and Designated Critical Habitat

Figure 3 shows the threatened and endangered species, management units, and designated critical habitat areas to be protected from fire.

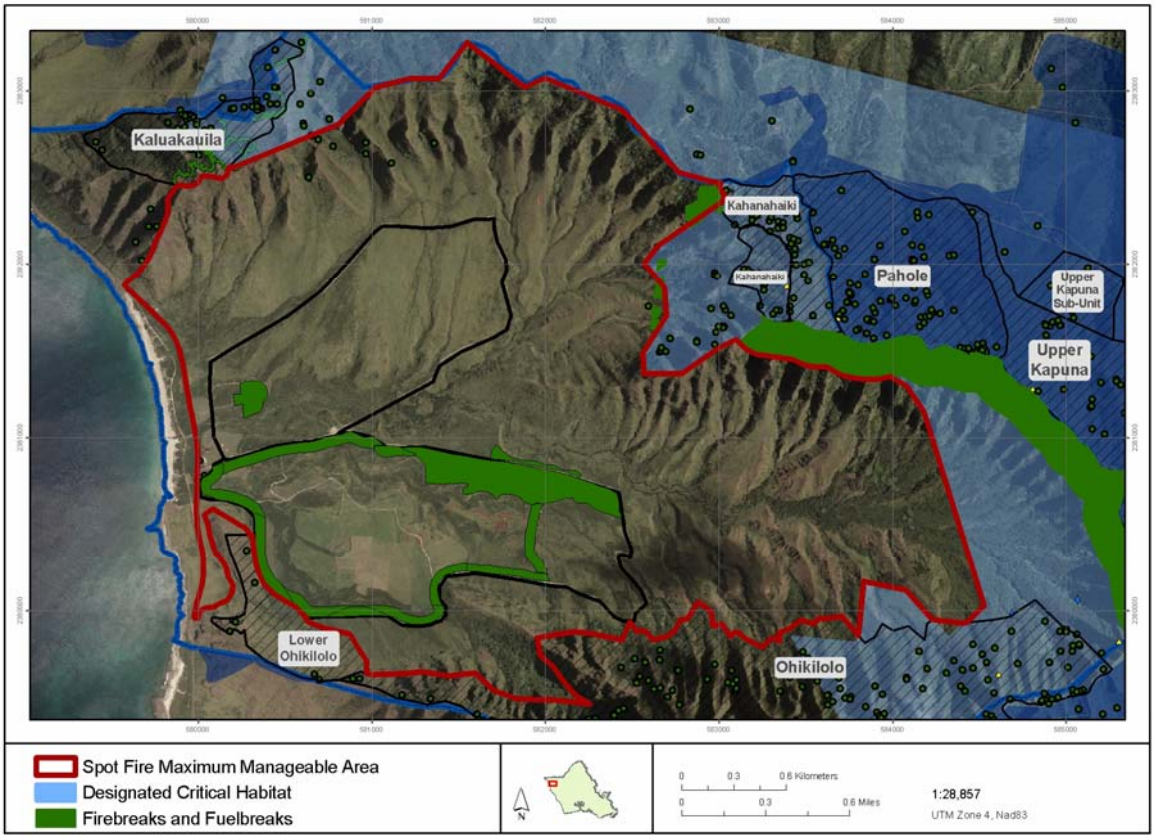

Figure 3: MMA: Prevent fire from burning into Rare Species Management Units, cross-hatched areas and shaded designated critical habitat areas.

There is slightly higher risk associated with burning within the north lobe of the firebreak road because the firebreak is not as wide and slopes are steeper adjacent to the burn unit. There is less risk associated

with burning the South Lobe, but some mitigation is necessary because of the close proximity of three endangered plant populations located within the Lower Olikilolo Management Unit (Figure 4). These must be protected from spot fires by fuel treatments or other measures. All standing live and dead grass will be removed from within two meters of all *Hibiscus brackenridegei* ssp. *mokuleianus* and *Chamaesyce celastroides* var. *kaenana* plants growing in the Lower Ohikilolo Management Unit, prior to ignition of a prescribed burn within any area of the prescribed burn unit, or other measures, coordinated with the USFWS, will be in place to ensure that these plants will be adequately protected from a spot fire.

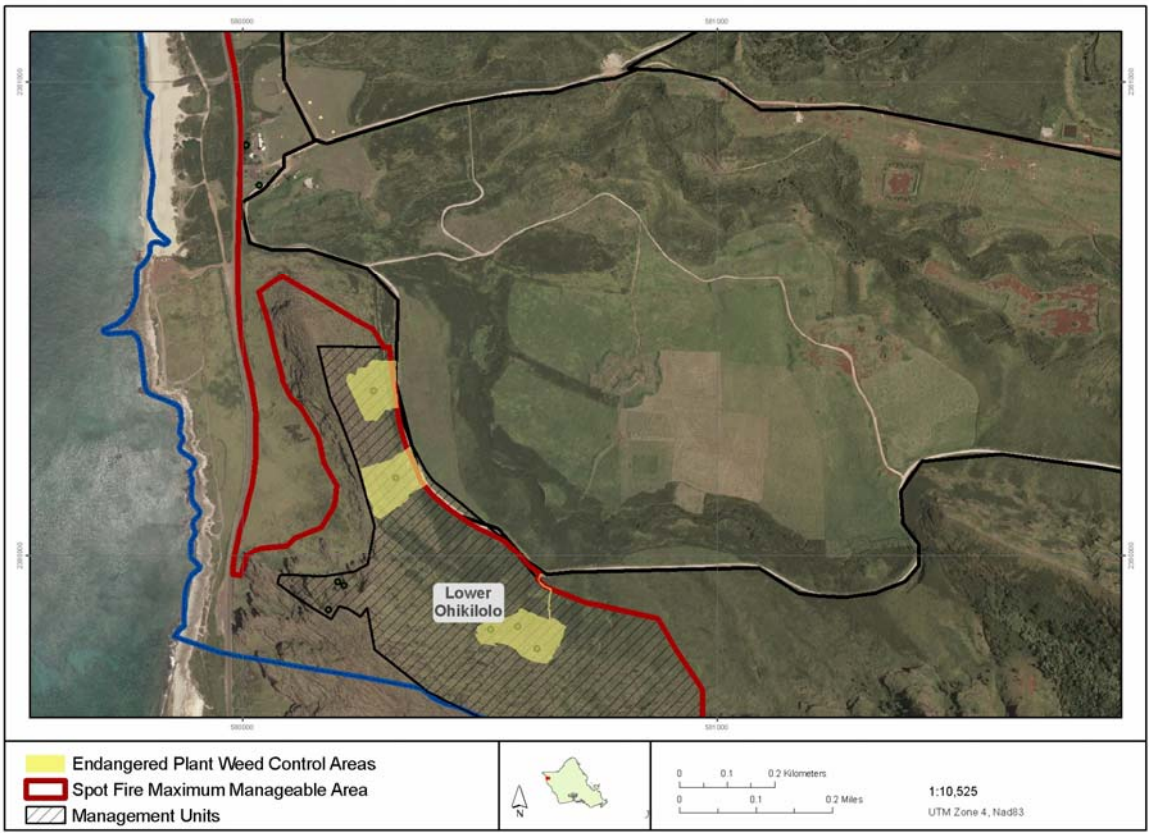

Figure 4: *Chamaesyce herbstii* and *Hibiscus Brackenridgei* subsp. *mokuleianus* occurring within the Lower Ohikilolo Management Unit which will have assigned ground fire resource protection.

No prescribed burning will be done unless all grass is cleared (to less than one percent cover) from within two meters of all individuals of *Chamaesyce herbstii* and *Hibiscus Brackenridgei* subsp. *mokuleianus* occurring within the Lower Ohikilolo Management Unit or other plans, approved by the USFWS are made to ensure that these plants are protected from fire, are implemented. Regardless of progress on grass clearing, resources will be tasked to protect these three areas on the burn day. Equipment that may be used to protect the areas may include heavy brush engines with with hose and personnel capable of reaching the endangered species populations. Because the life of this plan is 30 years, an adaptive management strategy will be employed, to determine the changing needs of the plants. The Army may update this prescribed burn plan at any time and submit it to the Service at any time for review and concurrence that the new plan provides protection to endangered species and critical habitats that is equal to or greater than the protections provided by the current plan. Given the written concurrence of the Service, the updated plan(s) can replace outdated version(s) of the plan.

SECTION 3
GOALS AND OBJECTIVES

A. Purpose of burn

The burn units, historic ranch land, are dominated by the exotic grass, guinea grass (*Panicum maximum)*. This grass grows very tall and dense, creating a fuel complex that is among the heaviest grass fuels documented, comparable in mass to heavy shrub fuels. In order to reduce the intensity of wildfires, and to periodically provide for ground visibility and access to particular sites, prescribed burns are conducted to reduce guinea grass fuel loading and ground cover.

B. Goals

(x) Reduce fuel loading to prevent catastrophic fire
(x) Firefighter and public safety
(x) Protection of endangered species and habit
(x) Fuel break maintenance
( ) Wildland/urban interface, structure protection
( ) Ecological restoration or maintenance of critical plant and animal species
( ) Part of logging/thinning operations
( ) Hazard fuel reduction away from interface areas and not associated with ecological restoration or silvicultural activities
(x) Protection of archeological or current cultural use sites
( ) Destruction of exotic species
( ) Management/restoration of T&E species habitat
( ) Training burn
(x) Provide vegetation clearance to allow cultural survey and UXO clearance
( ) Other. Explain:

C. Objectives

Check one or more	**Measure of success (Section 17 records whether objectives were successfully met):**
(**x**) Protect life and property during and after the burn	No one is injured; no private property is damaged, all the burn equipment is accounted for in good condition, after the burn; no damage to archeological sites or other cultural resources.
( ) Reintroduce fire to the ecosystem	"Successful" if burn is completed; "unsuccessful" if burn does not occur
(**x**) Reduce fuel load	Reduce fuel loading by 80-100% to reduce future flame lengths or create or maintain fuel breaks to enable easier suppression of future wildfires.

	Acceptable Final Range (tons)
1 hr fuels	0-2
10 hr fuels	0-2
100 hr fuels	n/a

(**x**) Monitoring	Measurable success would be that the forms attached to the burn plan are completed and properly filed. Collect fire behavior and helicopter productivity data to enable future refinement of prescriptions and fire danger ratings.
(**x**) Smoke management	Manage smoke emissions through best available mitigation measures. Measurable success will be both the lack of complaints and the lack of observed smoke impacting sites to be avoided.

(**x**) Archsite/UXO visibility	Remove 80% or more of ground cover to enhance visibility and expose suspected UXO in particular areas specified.
(**x**) Protect Rare and Endangered Habitat	See map below for areas that must be avoided. Burn will provide future protection to listed species because it will reduce fuels in the vicinity of the firebreak roads.
( ) Other _____	Indicate a measure of success that can be quantified.

SECTION 4
BURN PRESCRIPTION

A. Area to be burned

The area covered by this burn plan is the 322 hectares (796 acres) inside the north and south lobe of the firebreak roads at Makua displayed below. The prescription will be valid for use for a period of 30 years. The burn unit is partitioned by roads. The entire 322 hectare (796 acre) area would not be burned in a single day.

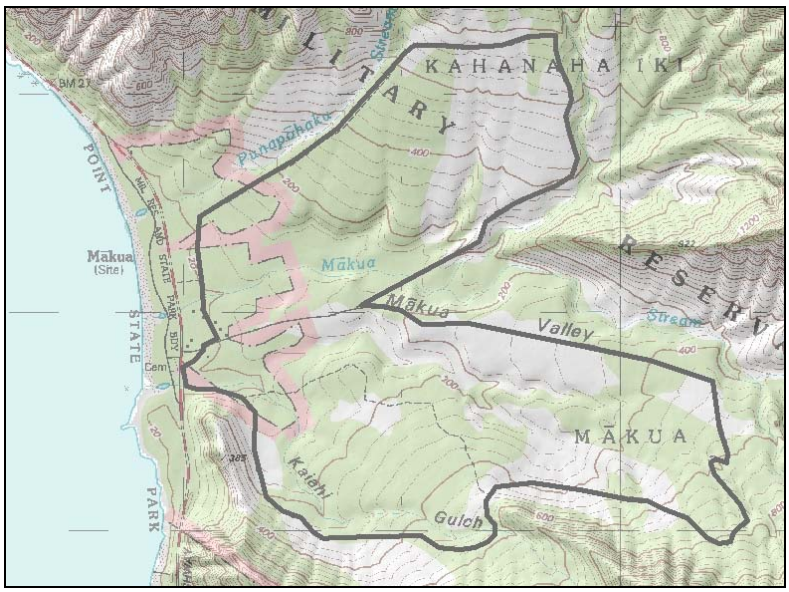

Figure 5: Overall area that will be managed with prescribed burning

B. Schedule

Proposed Ignition Date:	These areas will be burned under this prescription during the lifetime of the Biological Opinion.
Proposed Ignition Duration:	Ignition and active fire spread will be done during periods of optimal fuel moisture and wind conditions, as specified by this plan. If the objectives are not being met or if weather conditions go out of prescription, we will extinguish and postpone the burn. It will take approximately one hour for the helicopters on site to extinguish the burning edge of the fire, partitioning it from the unburned portion of the burn.
Criteria for On-Site Fire Supervisor:	There will be an on-site assigned NWCG –qualified Red Carded RXB2 Burn Boss or an NWCG Red Carded IC Type 4 or Type 5 Qualified Incident Commander responsible for the fire until mop-up operations have extinguished all heat within 60 meters of the firebreak road.
Criteria for declaring the burn out:	There is not a lot of heavy fuel within the burn unit which will hold heat for long periods of time. Any heavy fuel may either be allowed to burn out or it may be mopped

up, possibly with helicopters, to expedite extinguishment of the fire. Because MMR frequently experiences high winds, any burning material, even smoldering fuel in the middle of the burn unit, will be considered at risk of causing a spot fire outside the firebreak road. The burn will only be declared out, or safe to leave, when it is completely out. As a general rule, assurance of a fire being out only occurs after no heat or smokes have been observed in the burned area during windy conditions. The burn will only be declared out by the Army Wildland Fire Management Officer or Assistant Wildland Fire Management Officer. This should eliminate "restart" as a cause of fire at MMR.

C. Desired fire behavior

BehavePlus runs for fuels inside the burn unit and in the contingency areas are summarized for fires burning on a 60 percent slope with upslope winds.

1. The Army is burning live or desiccated guinea grass in the interior of the range and dead and downed fuel along the firebreak road to prepare and maintain the range for training activities. There are therefore no ecological constraints on desired fire behavior within the burn unit.

2. The objectives of the burn include burning combustible fuels inside the firebreak road. In the event a fire does spot, a secondary objective is to burn under fuel and weather conditions in which a spot fire will not be able to reach rare species or critical habitat before being extinguished by the aerial assets available.

3. Any endangered species designated critical habitat burned by a spot fire must be restored pursuant to the specifications in the Biological Opinion.

D. Fuel pre-treatment

The grass and shrub fuels within the target burn area may be treated with herbicide prior to burning in order to facilitate burning when the grass is green. Grass areas inside the burn may be treated with herbicide approximately three weeks prior to the burn date, unless such action will not accomplish the goal of providing dry fuels inside the burn and wet fuels outside the burn. An example of such an exception would be when a burn is scheduled for a time that Guinea grass is already dry enough inside the burn area to accomplish burn objectives. In such a case, there would be no reason to use herbicide.

E. Cumulative effects of drought

Initiating a burn is contingent on an assessment of not only the apparent weather and fuel conditions, but also on the cumulative effects of drought and severe weather conditions. The burn boss will use the following criteria to determine whether drought or severe weather could have an effect on fire behavior:

( ) ERC
( ) KBDI (reference: Pat Costales 973-9787)
( ) Palmer Drought Index
( ) Discussion with professional fire weather forecaster at the following number: _____
(x) Live herbaceous fuel moisture: The burn is limited to a minimum live fuel moisture of 100%, as calculated by WIMS for MMR Range RAWS station (490301). Live herbaceous fuel moisture can be over 250 percent in fresh growth and falls to 30 percent when grass is fully cured. When herbaceous fuel moisture is over 100 percent, it serves as an important heat sink which will slow the rate of spread of a spot fire.

Because this prescribed burn is scheduled for periods when the guinea grass is relatively green, the burn will not be occurring during a drought period.

F. Weather forecasts

A spot weather forecast will be obtained from the National Weather Service for the prescribed fire area. The spot weather forecast will provide, at minimum, the predicted wind speed, relative humidity, and temperature in one hour increments for the entire duration of ignition and any additional periods of active surface fire spread. A fire weather specialist will calculate the forecasted hourly 1-hour fuel moisture conditions for the burn period, utilizing the Fireline Handbook Appendix B. Burning will stop one hour before the spot weather forecast indicates that the burn will be out of prescription and the outer 60 meters of the burning area will be mopped up. If conditions during the burn are not representative of the conditions forecasted, an update to the spot weather forecast will be requested.

G. Capabilities of the resources that are planned to support the burn

Aircraft will be fueled on site, or sufficient aircraft will be on site to cover for helicopters refueling elsewhere. Planning must ensure that there will be sufficient numbers of helicopters on site at all times of various sizes and capabilities to keep an escaped fire from being able to reach rare species habitat. Using the BehavePlus model, the response time of each helicopter is gauged by the time that it would take for the helicopters to respond from a standby position on the ground, and the time it would take the ignition and command/control helicopters to change their missions, exchange equipment, and respond. Refueling time, whether on-site or at Wheeler AAF, is also taken into account in the model.

H. Go-no-go and stop-burning decisions

A go-no-go decision will be made based on a final spot weather forecast issued by NOAA the afternoon before the burn. During the burn, a stop-burning order will be issued if the weather goes out of prescription based on on-site weather observations made by the lookout or designated fire weather/fire behavior officer. Weather observations will be taken every ½ hour and announced over the radio. Weather observations will also be made during wind gust events.

I. Documentation of the burn and fire behavior

The test burn and other events during the burn will be documented by the lookout or designated officer using a video camera.

J. BehavePlus fire behavior computer model

BehavePlus is the national computer model used to calculate predicted fire behavior. The user is able to select from a number of BehavePlus fuel model parameters. The Grass2 Guinea grass fuel model is continually being updated as new fire behavior information becomes available. Army wildland fire management is collaborating with fire behavior researchers from the US Forest Service Pacific Southwest Research Station, the State, and the Center for Environmental Management of Military Lands to gather rate of spread data for headfires burning in mature guinea grass under various live herbaceous fuel moisture, wind, and 1-hour fuel moisture conditions. As new fire behavior data is collected, the Army will work with the Service to develop updated fire suppression helicopter staffing requirements which provide for the containment of fires outside the firebreak road at acreages equal to or smaller than those which would be obtained by the current helicopter staffing requirements, using the current fuel model parameters (Table 1).

Table 1
Live Herbaceous fuel moisture as related to wind adjustment factor and fuel depth in current guinea grass fuel model used in BehavePlus CONTAIN fire behavior simulations.

Live Herbaceous Fuel Moisture (WIMS HRB, Station 490301)	Wind adjustment factor	Fuel bed depth (input into current BehavePlus Guinea grass fuel model)
200+	.5	1.88
150-199	.5	2.4
100-149	.5	2.71
99 and lower	.5	4.11

Fire rate of spread is the most important variable contributing to the ability of helicopters to contain the growing fire. Rate of spread, as predicted by BehavePlus is sensitive to 1-hour timelag dead fuel moisture, which will vary through the day. The burn prescription is written for 1-hour timelag fuel moistures ranging from 7 to 13 and higher (Table 2 below). We are not proposing to conduct prescribed burns when 1-hour fuel moisture is below 7 percent. Wind and live herbaceous fuel moisture make up the balance of the primary variables driving the prescription. The CONTAIN module of BehavePlus was used to determine how many fire suppression helicopters would be assigned to staff the prescribed burn in order to contain spot fires under various prescribed fuel moisture and wind conditions. (Tables 2A, 2B, and 2C below).

I. Weather prescription for the burn

Live herbaceous fuel moisture, wind, and 1-hour fuel moisture are the most important variables affecting ease of control of spot fires. This prescription covers prescribed burning on days when the WIMS-calculated live herbaceous fuel moisture (HRB) at the Makua Range Weather Station # 490301 is 100 percent or greater. Three matrices of acceptable combinations of wind speed and 1-hour fuel moisture were developed for burning at Makua: one for burning under under WIMS-calculated live herbaceous fuel moisture conditions between 100 percent and 119 percent; a second for burning under WIMS-calculated live herbaceous fuel moisture conditions between 120 percent and 149 percent, and a third for burning when WIMS-calcluated live herbaceous fuel moisture is 150 percent or higher (Tables 2 – 4). Fire suppression helicopter staffing requirements are specified for each combination of live herbaceous fuel moisture, wind, and 1-hour fuel moisture condition.

BEHAVE runs predict the rate of spread, and the minute-by-minute perimeter of a spot fire starting under various levels of wind below 15 mph and various 1 hour timelag fuel moistures. Tables 2A and 2B provide the amount of fireline, expressed in chains (1 chain=66 feet), that must be produced by ground or aerial resources to stop a fire. Since UXO prohibit use of ground resources on spot fires outside the firebreak road, the tables show how many chains of fireline helicopters must be able to extinguish under each set of 1 hour fuel moisture and wind speed.

Table 2A. Chains/hour fireline production required of helicopters, on site and on call when live herbaceous fuel moisture calculated by Makua Range WIMS weather station # 490301 is 100% or greater.

10 Minute Average 20 Foot Wind Speed (mph) (Makua Range Weather Station #490301) in both Spot Weather Forecast and hourly observed weather for all periods necessary to complete all active burning and mopup of outer 20 meters, Wind Direction: Any	Fire Suppression Helicopter Staffing Requirements(*1): Minimum Fire Suppression Capability (*2) of Fire Suppression Helicopters Assigned for Water Drops During Prescribed Burns at Makua When Live Herbaceous Fuel Moisture calculated in WIMS (Station 490301) is 100 percent or higher (*3)					
	1 Hour Fuel Moisture (%)					
	8%	9%	10%	11%	12%	13% and higher
0 mph	37 chains/hr (19 on-site / 18 1hr standby)	36 chains/hr (18 on-site / 18 1hr standby)	35 chains/hr (18 on-site / 17 1hr standby)	34 chains/hr (17 on-site / 17 1hr standby)	33 chains/hr (17 on-site / 16 1hr standby)	33 chains/hr (17 on-site / 16 1hr standby)
1 mph	42 chains/hr (21 on-site / 21 1hr standby)	40 chains/hr (20 on-site / 20 1hr standby)	39 chains/hr (20 on-site / 19 1hr standby)	38 chains/hr 19 on-site / 19 1hr standby)	38 chains/hr (19 on-site / 19 1hr standby)	37 chains/hr (19 on-site / 18 1hr standby)
2 mph	47 chains/hr (24 on-site, 23 1hr standby)	45 chains/hr (23 on-site / 22 1hr standby)	44 chains/hr (22 on-site/ 22 1hr standby)	43 chains/hr (22 on-site / 21 1hr standby)	42 chains/ hr (21 on-site / 21 1hr standby)	41 chains/hr (21 on-site / 20 1hr standby)
3 mph	52 chains/hr (26 on-site / 26 1hr standby)	51 chains/hr 26 on-site / 25 1hr standby)	49 chains/hr (25 on-site / 24 1hr standby)	48 chains/hr (24 on-site / 24 1hr standby)	47 chains/hr (24 on-site / 24 1hr standby)	46 chains/hr (23 on-site / 23 1hr standby)
4 mph	57 chains/hr (29 on-site / 28 1hr standby)	56 chains/hr (28 on-site / 28 1hr standby)	54 chains/hr (27 on-site / 27 1hr standby)	53 chains/hr (27 on-site / 26 1hr standby)	52 chains/hr (26 on-site / 26 1hr standby)	51 chains/hr (26 on-site / 25 1hr standby)
5 mph	62 chains/hr (31 on-site / 31 1hr standby)	61 chains/hr (31 on-site / 30 1hr standby)	60 chains/hr (30 on-site / 30 1hr standby)	58 chains/hr (29 on-site / 29 1hr standby)	57 chains/hr (29 on-site / 28 1hr standby)	56 chains/hr (28 on-site / 28 1hr standby)
6 mph	69 chains/hr (35 on-site / 34 1hr standby)	67 chains/hr (34 on-site / 33 1hr standby)	65 chains/hr (33 on-site / 32 1hr standby)	63 chains/hr (32 on-site / 31 1hr standby)	62 chains/hr (31 on-site / 31 1hr standby)	61 chains/hr (31 on-site / 30 1hr standby)
7 mph	74 chains/hr (37 on-site / 37: 1hr standby)	72 chains/hr (36 on-site / 36 1hr standby)	70 chains/hr (35 on-site / 35 1hr standby)	69 chains/hr (35 on-site / 34 1hr standby)	67 chains/hr (34 on-site / 33 1hr standby)	66 chains/hr (33 on-site / 33 1hr standby)
8 mph	80 chains/hr (40 on-site / 40: 1hr standby)	78 chains/hr (39 on-site / 39 1hr standby)	76 chains/hr (38 on-site / 38 1hr standby)	74 chains/hr (37 on-site / 37 1hr standby)	72 chains/hr 36 on-site / 36 1hr standby)	71 chains/hr (36 on-site / 35 1hr standby)
9 mph	86 chains/hr (43 on-site / 43: 1hr standby)	84 chains/hour (42 on-site / 42: 1hr standby)	81 chains/hr (41 on-site / 40 1hr standby)	79 chains/hr (40 on-site / 39 1hr standby)	78 chains/hr (39 on-site / 39 1hr standby)	76 chains/hr (38 on-site / 38 1hr standby)
10 mph		90 chains/hour (45 on-site / 45: 1hr standby)	87 chains/hr (44 on-site / 44: 1hr standby)	85 chains/hr (43 on-site / 42: 1hr standby)	83 chains/hr (42 on-site / 41 1hr standby)	81 chains/hr (41 on-site / 40 1hr standby)
11 mph				91 chains/hr (46 on-site / 45: 1hr standby)	88 chains/hr (44 on-site / 44: 1hr standby)	87 chains/hr (44 on-site / 43: 1hr standby)
12 mph						92 chains/hr (46 on-site / 46: 1hr standby)
13 mph						97 chains/hr (49 on-site / 48: 1hr standby)

(*1) On-site helicopters will have buckets attached and tested so that their first full load of water is dropped on the fire's perimeter within 15 minutes of a spot fire's ignition. Standby helicopter response time will be one hour. Blacked out combinations of 1-hr fuel moisture and wind are out of prescription.

(*2) Fire suppression capability, or fireline construction rate of all fire suppression helicopters is rated in chains/hour. Chains/hour indicates the continuous helicopter fireline construction rate in dense, long-unburned guinea grass at Makua and is a function of turnaround time, length of fire perimeter each water drop extinguishes, and percent of time that is unproductive due to refueling. Refer to Helicopter Productivity Table or individual pilot qualifications card for helicopter productivity rates. Additional aircraft may be assigned to Makua for other purposes including air attack and military operations.

(*3) Fire suppression helicopter staffing requirements may be updated in the future as more research is conducted on the guinea grass fuel model. Acreage of spot fires, as predicted by BehavePlus/CONTAIN would be equal to or less than acreages predicted using the current fuel model parameters and helicopter staffing. No changes to helicopter staffing requirements would be made without the written approval of the USFWS.

Head Fire Rate of Spread, 60% slope: 25 - 69 chains/hour in guinea grass,
Head Fire Flame Length, 60% slope: 4 - 21 feet

Table 2B. Chains/hour fireline production required of helicopters, on site and on call when live herbaceous fuel moisture calculated by Makua Range WIMS weather station # 490301 is 120% or greater.

10 Minute Average 20 Foot Wind Speed (mph) (Makua Range Weather Station #490301) in both Spot Weather Forecast and for all hourly observed weather, for all periods necessary to complete all active burning and mopup of outer 20 meters, Wind Direction: Any	Fire Suppression Helicopter Staffing Requirements(*1): Minimum Fire Suppression Capability (*2) of Fire Suppression Helicopters Assigned for Water Drops During Prescribed Burns at Makua When Live Herbaceous Fuel Moisture calculated in WIMS (Station 490301) is 120 percent or higher (*3)				
	1 Hour Fuel Moisture (%)				
	8%	9%	10%	11%	12% or higher
0-5 mph	48 chains/hr (24 on-site / 24 1hr standby)	47 chains/hr (24 on-site / 23 1hr standby)	46 chains/hr (23 on-site / 23 1hr standby)	45 chains/hr (23 on-site / 22 1hr standby)	44 chains/hr (22 on-site / 22 1hr standby)
6 mph	53 chains/hr (27 on-site / 26 1hr standby)	52 chains/hr (26 on-site / 26 1hr standby)	50 chains/hr (25 on-site / 25 1hr standby)	49 chains/hr (25 on-site / 24 1hr standby)	48 chains/hr (24 on-site / 24 1hr standby)
7 mph	58 chains/hr (29 on-site / 29 1hr standby)	56 chains/hr (28 on-site / 28 1hr standby)	55 chains/hr (28 on-site / 27 1hr standby)	54 chains/hr (27 on-site / 27 1hr standby)	53 chains/hr (27 on-site / 26 1hr standby)
8 mph	63 chains/hr (32 on-site / 31 1hr standby)	61 chains/hr (31 on-site / 30 1hr standby)	60 chains/hr (30 on-site / 30 1hr standby)	58 chains/hr (29 on-site / 29 1hr standby)	57 chains/hr 29 on-site / 28 1hr standby)
9 mph	68 chains/hr (34 on-site / 34 1hr standby)	66 chains/hour (33 on-site / 33 1hr standby)	64 chains/hr (32 on-site / 32 1hr standby)	63 chains/hr (32 on-site / 31 1hr standby)	61 chains/hr (31 on-site / 30 1hr standby)
10 mph	74 chains/hr (37 on-site / 37: 1hr standby)	71 chains/hour (36 on-site / 35: 1hr standby)	69 chains/hr (35 on-site / 34 1hr standby)	67 chains/hr (34 on-site / 33 1hr standby)	66 chains/hr (33 on-site / 33 1hr standby)
11 mph			74 chains/hour (37 on-site / 37: 1hr standby)	72 chains/hr (36 on-site / 36: 1hr standby)	71 chains/hr (36 on-site / 35 1hr standby)
12 mph				77 chains/hr (39 on-site / 38: 1hr standby)	75 chains/hr (38 on-site / 37: 1hr standby)
13 mph					80 chains/hr (40 on-site / 40: 1hr standby)
14 mph					85 chains/hr (43 on-site / 42: 1hr standby)

(*1) Total Helicopter Staffing Requirements in this table apply to all burns conducted at Makua when live herbaceous fuel moisture is 120 percent and higher. On-site productivity rates in this table refer to burns conducted within the North Lobe of the Firebreak Road. For burns conducted entirely within the south lobe of the firebreak road, when live herbaceous fuel moisture calculated by WIMS for weather station 490301 is 120 percent and greater, a minimum of one helicopter, with a minimum fire suppression productivity rate of 12 chains/hour is required to be on-site at Makua with a minimum of a fifteen minute response time to a spot fire and a minimum of one hour of fuel on board. Standby helicopter response time will be one hour. Blacked out combinations of 1-hr fuel moisture and wind are out of prescription.

(*2) Fire suppression capability, or fireline construction rate of all fire suppression helicopters is rated in chains/hour. Chains/hour indicates the continuous helicopter fireline construction rate in dense, long-unburned guinea grass at Makua and is a function of turnaround time, length of fire perimeter each water drop extinguishes, and percent of time that is unproductive due to refueling. Refer to Helicopter Productivity Table or individual pilot qualifications card for helicopter productivity rates. Additional aircraft may be assigned to Makua for other purposes including air attack and military operations.

(*3) Fire suppression helicopter staffing requirements may be updated in the future as more research is conducted on the guinea grass fuel model. Acreage of spot fires, as predicted by Behave/Contain would be equal to or less than acreages predicted using the current fuel model parameters and helicopter staffing. No changes to helicopter staffing requirements would be made without the written approval of the USFWS.

Table 2C. Chains/hour fireline production required of helicopters, on site and on call when live herbaceous fuel moisture calculated by Makua Range WIMS weather station # 490301 is 120% or greater.

10 Minute Average 20 Foot Wind Speed (mph) (Makua Range Weather Station #490301) in both Spot Weather Forecast and observed hourly observations for all periods necessary to complete all active burning and mopup of outer 20 meters, Wind Direction: Any	Fire Suppression Helicopter Staffing Requirements(*1): Minimum Fire Suppression Capability (*2) of Fire Suppression Helicopters Assigned for Water Drops During Prescribed Burns at Makua When Live Herbaceous Fuel Moisture calculated in WIMS (Station 490301) is 150 percent or higher (*3)		
	1 Hour Fuel Moisture (%)		
	7%	8%	9% and higher
0-5 mph	37 chains/hr (9 on-site / 28: standby)	36 chains/hr (9 on-site / 27: standby)	35 chains/hr (9 on-site / 26: standby)
6 mph	41 chains/hr (10 on-site / 31: standby)	40 chains/hr (10 on-site / 30: standby)	39 chains/hr (10 on-site / 29: standby)
7 mph	44 chains/hr (11 on-site / 33: standby)	43 chains/hr (11 on-site / 32: standby)	42 chains/hr (10 on-site / 32: standby)
8 mph	48 chains/hr (12 on-site / 36: standby)	48 chains/hr (12 on-site / 36: standby)	45 chains/hr (11 on-site / 34: standby)
9 mph	52 chains/hr (13 on-site / 39: standby)	50 chains/hr (13 on-site / 37: standby)	49 chains/hr (12 on-site / 37: standby)
10 mph	55 chains/hr (14 on-site / 41: standby)	54 chains/hr (14 on-site / 40: standby)	52 chains/hr (13 on-site / 39: standby)
11 mph		58 chains/hr (15 on-site / 43: standby)	56 chains/hr (14 on-site / 42: standby)
12 mph		61 chains/hr (15 on-site / 46: standby)	60 chains/hr (15 on-site / 45: standby)
13 mph		65 chains/hr (16 on-site / 49: standby)	63 chains/hr (16 on-site / 47: standby)
14 mph			67 chains/hr (17 on-site / 50: standby)

(*1) Total Helicopter Staffing Requirements in this table apply to all burns conducted at Makua when live herbaceous fuel moisture is 150 percent and higher. On-site productivity rates in this table refer to burns conducted within the North Lobe of the Firebreak Road. For burns conducted entirely within the south lobe of the firebreak road, when live herbaceous fuel moisture calculated by WIMS for weather station 490301 is 150 percent and greater, a minimum of one helicopter, with a minimum fire suppression productivity rate of 12 chains/hour (unless less staffing is required in the table, whichever is lower) is required to be on-site at Makua with a minimum of a fifteen minute response time to a spot fire and a minimum of one hour of fuel on board. Standby helicopter response time will be one hour. Blacked out combinations of 1-hr fuel moisture and wind are out of prescription.

(*2) Fire suppression capability, or fireline construction rate of all fire suppression helicopters is rated in chains/hour. Chains/hour indicates the continuous helicopter fireline construction rate in dense, long-unburned guinea grass at Makua and is a function of turnaround time, length of fire perimeter each water drop extinguishes, and percent of time that is unproductive due to refueling. Refer to Helicopter Productivity Table or individual pilot qualifications card for helicopter productivity rates. Additional aircraft may be assigned to Makua for other purposes including air attack and military operations.

(*3) Fire suppression helicopter staffing requirements may be updated in the future as more research is conducted on the guinea grass fuel model. Acreage of spot fires, as predicted by Behave/Contain would be equal to or less than acreages predicted using the current fuel model parameters and helicopter staffing. No changes to helicopter staffing requirements would be made without the written approval of the USFWS.

Head Fire Rate of Spread, 60% slope: 9 - 32 chains/hour
Head Fire Flame Length, 60% slope: 4 - 14 feet

Other Prescribed Fire Weather, Fire Danger, and Fuel Moisture Parameters:

1-hour fuel moisture: Acceptable 1-hour fuel moisture and wind speed combinations have assigned fire suppression helicopter staffing assignments shown in white and grey shaded boxes in Tables 2A and 2B. Blacked out combinations of 1-hour fuel moisture and wind in these tables are not in prescription. Beavers (2001) and Scott and Burgan (2005) estimate that the moisture of extinction for guinea grass is 30 to 40 percent. Maximum prescribed 1-hour fuel moisture is 40 percent.
10-hour fuel moisture: 8 to 30 percent.
Wind Speed: Acceptable 1-hour fuel moisture and wind speed combinations have assigned fire suppression helicopter staffing assignments shown in white and grey shaded boxes in Tables 2A and 2B. Blacked out combinations of 1-hour fuel moisture and wind in these tables are not in prescription.
Wind Direction: Wind direction is not constrained. All midflame, 20-foot, and transport wind directions are in prescription.
Mixing Height: Mixing height is not constrained. All mixing heights are in prescription.
Temperature: 40 degrees F to 100 degrees F.
Relative Humidity: Relative humidity is not a primary prescription parameter. But it is the primary factor driving the prescription parameter 1-hr fuel moisture. When a spot weather forecast is obtained, the Fireline Handbook, Appendix B, Table 2 through 5 will be used to calculate each hour's predicted 1-hr fuel moisture. Aspect South, will always be used for 1-hr fuel moisture forecasting using the Fireline Handbook method. Relative Humidity values between 40 percent and 100 percent MAY produce 1-hr fuel moistures which are in prescription, depending on the temperature, time of day, month, and forecasted cloud cover. The National Weather Service may be capable of providing F-type observations in WIMS, so that 1-hr fuel moisture forecast values could be automatically calculated. Relative humidity of 40 percent would be out of prescription if calculated 1-hour fuel moisture is out of prescription.

Live Herbaceous Fuel Moisture: 100 percent or higher, as calculated by WIMS for Makua Range WIMS weather station number 490301.
Live Woody Fuel Moisture: Not constrained.
Burning Index: Burning Index is not constrained. Burning is permitted when fire danger is high (Red).

J. Helicopter Support Requirements

1. Sufficient helicopters must be present to extinguish the amount of fireline displayed in Tables 2A, 2B, and 2C (see Helicopter productivity in the discussion below). As the guinea grass fuel model is updated, the helicopter staffing guidelines will be revised concurrently. The Army fire staff will present updated helicopter staffing guidelines to the USFWS for approval prior to use for prescribed burn staffing at Makua.

2. Normally one helicopter will be used for ignition, one for command and control, and sufficient additional helicopters will be available to provide the fireline productivity required in Tables 2A or 2B. All helicopters will cease their ignition or command missions and be used for bucket support if a spot fire occurs outside the firebreak road. The helicopters used for ignition and command may be included in fireline productivity calculations. It was assumed that it would take 15 minutes for them to switch missions.

3. Helicopters will be staffed in accordance with tables 2A, 2B, and 2C. On-site helicopters will have buckets attached and tested so that their first full load of water is dropped on the fire's perimeter within 15 minutes of a spot fire's ignition. Standby helicopter response time will be one hour. Additional call when needed military or civilian helicopters, above and beyond those assigned to duty at Makua, will be available to respond within four hours of being requested, in the event of an escaped prescribed burn.

4. All helicopters will have a minimum of one hour of fuel on board and, if possible, there should be fuel on site at Makua. If on-site fuel is not available, the turn-around time for refueling substantially reduces a helicopter's productivity (Table 5). Currently, fuel trucks are the only source of helicopter fuel at Makua. A permanent fuel tank for helicopter fuel may be installed at Makua. Regardless of whether fueling will be done on-site or back at Wheeler, the on-site assigned fire suppression helicopters standing by during exercises at Makua will maintain enough fuel on board to provide one hour of continuous fire bucket operation in addition to any fuel needed to fly to the refueling site after the first hour of work is done. On-site fire suppression helicopters may fly other burn missions including ignition and reconnaissance, as long as they maintain the minimum onboard fuel necessary to fulfill this 1-hour fire suppression flight time requirement.

K. Fire Suppression Aircraft Productivity

Helicopter and air tanker productivity is not something you can look up in a book, because it is a product many factors – including the fire intensity, size of the helicopter bucket or aircraft internal tank, refueling time, turn-around time from the water source to the fire, and pilot experience. The U.S. Fish and Wildlife Service and the U.S. Army are cooperating in studies to determine the fireline productivity of various types of bucket-carrying helicopters and other aircraft and pilots of varying experience in guinea grass in Hawaii. Current helicopter productivity rates (Table 3) are considered preliminary and conservative. The number of chains per hour outlined in Table 3 represents average chains per hour which can be expected. These estimates shall not be utilized if better data, through practical demonstration, can be obtained and assigned to individual pilots or specific aircraft. Productivity rates will not be assigned to individual pilots or specific aircraft for the purposes of satisfying Makua fire suppression staffing requirements without the approval of the U.S. Fish and Wildlife Service.

Table 3. Productivity of various helicopters and other aircraft.

Day Time Aircraft Productivity Estimates for Fire Suppression at Makua Military Reservation

Aircraft Type	Pilot Type	Water Capacity	Not Fueled at Makua	Fueled at Makua	
			All Pilots and All Wind Conditions	20-foot wind speed 11 mph or higher OR No "F"-Type WIMS forecast for wind speed for all hours of scheduled use OR Pilots not yet approved by Army and Fish and Wildlife Service for Higher Productivity Rates	20-foot wind speed "F"-type WIMS forecast: 10 mph or lower AND Expert Pilots Approved by Army and Fish and Wildlife Service at These Productivity Rates
CL415	Contractor	1,800 gallons	**n.a.**	**57 ch/hr**	**114 ch/hr**
S61N or similar	Contractor	1,000 gallons	**13 ch/hr**	**45 ch/hr**	**90 ch/hr**
S61N or similar	Contractor	800 gallons	**10 ch/hr**	**36 ch/hr**	**72 ch/hr**
CH-47 Chinook	Military / Contractor	2000 gallons	**9 ch/hr**	**35 ch/hr**	**n.a.**
UH-60 Blackhawk	Military	660 gallons	**9 ch/hr**	**30 ch/hr**	**n.a.**
CH-46 Sea Knight	Military	400 gallons	**5 ch/hr**	**18 ch/hr**	**n.a.**
CH-53 Sea Stallion	Military	400 gallons	**5 ch/hr**	**18 ch/hr**	**n.a.**
UH-1H Huey	Contractor	340 gallons	**5 ch/hr**	**16 ch/hr**	**32 ch/hr**
Bell 407	Contractor	210 gallons	**3 ch/hr**	**10 ch/hr**	**20 ch/hr**
Bell 206 Long Ranger	Contractor	200 gallons	**3 ch/hr**	**10 ch/hr**	**20 ch/hr**
Bell Jet Ranger	Contractor	120 gallons	**2 ch/hr**	**6 ch/hr**	**13 ch/hr**
Hughes 500	Contractor	110 gallons	**2 ch/hr**	**6 ch/hr**	**12 ch/hr**

L. Management of the Burn

1. Dip ponds will be filled, at a minimum, to 75 percent of total capacity (the 7 ½ -foot mark) prior to ignition. The retardant tank will be filled and retardant will be recirculated.

2. Rare species sites on Lower Olikilolo will be checked to confirm 2 meter grass clearance around plants.

3. All single resource bosses will receive a daytime site visit to view the endangered species protection areas located on Lower Ohikilolo prior to ignition. Pilots will be shown this area and the critical habitat and management unit areas from the air.

4. Ignition of the burn units will generally commence early in the day, when burning conditions are coolest in order to minimize risk. A test fire will be lit by ground crews at a location representative of the fuel. If fire will carry when lit from the ground, we are assured of a good burn in the interior guinea grass. The test burn will not be ignited prior to one hour before sunrise. Ignition of the burn unit will not occur prior to thirty minutes before sunrise, or whenever the helicopters are able to lift off with their first bucket of water. If night time helicopter fire suppression is authorized, night fire suppression guidelines, which provide for protection equal to that of the day time suppression, will be submitted to the USFWS for approval prior to use.

5. If the burn unit takes longer to complete than expected, or if weather and fuel moisture conditions exceed the limits set in the prescription earlier than predicted, the burn will be cut off immediately using direct attack by helicopters. This strategy helps to ensure that no spot fires will ignite under conditions other than those in the prescription.

6. Until the burn is contained (200 feet mopped up around the perimeter), it will be supervised by an on-site Burn Boss or Incident Commander Type 5 with skills and qualifications commensurate with the complexity of a fire at MMR. Until the burn is declared out, it will be monitored during the day by an on-site Burn Boss or Incident Commander Type 5 with skills and qualifications commensurate with the complexity of a fire at MMR.

SECTION 5
ORGANIZATION AND EQUIPMENT

Army regulations require that all personnel on a prescribed burn meet or exceed National Wildfire Coordinating Group standards for qualifications by 2009. This means that all personnel will hold valid "red cards" showing they are qualified to be in the position assigned. Because the Army is not yet able to field qualified personnel, the Director of Fire and Safety has given a directive allowing persons not qualified by NWCG to fill certain fireline positions prior to 2009.

The Burn Boss and Incident Commander positions will always be filled by an NWCG-qualified, red-carded firefighters. For the protection of firefighters assisting from NWCG-agencies (ie. NPS, USFWS, USFS, BLM, BIA and some State personnel), the burn boss will ensure that these cooperators' firefighters are supervised entirely by only NWCG-qualified personnel within their chain of command. Army personnel who are not yet Engine Boss qualified, would not supervise lesser qualified personnel from NWCG agencies (ie. NPS, USFWS, USFS, BLM, BIA and some State personnel).

Federal standards permit the Army to acknowledge the standards and qualifications of cooperators as determined by those cooperators, including Navy, volunteer fire departments, Honolulu Fire Department, and The Nature Conservancy.

Staffing requirements are indicated in the table below and in the organization chart on the next page. The names of individuals filling those positions will be determined and put on the Incident Action Plan, which is attached to specific burn plans.

Table 4. Minimum personnel required during the ignition, mop-up and patrol phases of the project (these personnel can not fill collateral duty positions)

Position	Ignition Phase	Mop-Up Phase	Patrol Phase
Prescribed Fire Administrator	1[1]		
Prescribed Fire Manager	1[1]		
RxB2 or RxB1 (must be NWCG qualified)[2]	1		
ICT4		1 (or RXB2)	1 (or RXB2)
Ground Safety Officer[3]	1		
UXO Safety Officer	1		
Aircraft Safety Officer	1		
Ignition Boss	1[4]		
PLDO (if utilizing PSD)	1		
Fire Weather Monitor	1[5]		
Federal Fire Holding Bosses	1[6]		
Army Engine Bosses	2[7]	2	
Federal Fire Engine Bosses	3[8]		
Federal Fire Engine Crew	3[8]		
Army Engine Crew	4+	3	1
Helicopter Pilots	Combination of helicopters to meet productivity in ch/hr		

[1] Required only if more than one burn is occurring at one time, including ignition of a new burn when another burn has not been declared out. (The north and south lobe of the firebreak roads at Makua would never be burned on the same day.)
[2] NWCG Red-Carded RxB2 required for Moderate Complexity burns, including South Lobe burns. RxB1 is required for complex burns, as would occur if the North Lobe is burned.
[3] SOF3 or higher is required on High Complexity burns or when one of the three factors of the Safety element of the Complexity Analysis is High, including this burn

[4] RXI2, Ignition Boss qualification is not required for personnel filling Ignition Boss assignments in the Organization Chart
[5] FFT1 or higher with S-290 completed and good communications with national weather service.
[6] Division / Holding Boss positions do not need to be filled by DIVS or Holding Boss-qualified personnel. Beginning on January 1, 2009, the minimum qualification required for personnel in this position on the organization chart will be NWCG-qualified Engine Boss (ENGB). Prior to 2009, the position may be filled by a Firefighter Type 1 with local engine experience.
[7] Beginning on January 1, 2009, the minimum qualification required for personnel in this position on the organization chart will be NWCG-qualified Engine Boss (ENGB). Prior to 2009, the position may be filled by a Firefighter Type 1 with local engine experience.
[7] Engines from cooperating agencies may never meet NWCG requirements.

B. Equipment required during the ignition, mop-up and patrol phases of the project. Minimum and maximum number permitted with this prescribed burn plan are indicated. If the minimum numbers of equipment are not available on day of burn, the burn will be postponed.

Table 5. Minimum equipment required during the ignition, mop-up and patrol phases of the project

Equipment	Ignition Phase	Mop-Up Phase	Patrol Phase
T6 engines (150-400 gal)	5	2	1
T4 engines (750+ gallons, 50 gpm)	1	0	
T3 engines (500+ gallons, 150 gpm)			
Tenders/tankers	2	1	
T1 Helicopter (700 gallons)	worksheet attached indicating helicopters meet ch/hr		
T2 helicopter (300 gallons)	worksheet attached indicating helicopters meet ch/hr		
T3 Helicopter (100 gallons)	worksheet attached indicating helicopters meet ch/hr		
ATV	0-2		

Table 6
Minimum helicopters required during the ignition phase of the project

Live Herbaceous Fuel Moisture %, Calculated for Makua Range Weather Station (WIMS 490301)	**_____%**
Using Table 2A, 2B, or 2C (Circle one)	**Using: Table 2A Table 2B Table 2C**
Total Helicopter Productivity Required (Chains/Hour) from Tables 2A, 2B, or 2C	**_____Total chains/hour**

Tail #	Pilot Name, Phone #	Fuel on site?	Helo. Productivity
On-site:		Yes / No	_____chains/hr
On-site:		Yes / No	_____chains/hr
On-site:		Yes / No	_____chains/hr
On-site:		Yes / No	_____chains/hr
Subtotal: On-site chains/hour (must be at least 1/2 of total required):			_____
On Call:		Yes / No	_____chains/hr
On Call:		Yes / No	_____chains/hr
On Call:		Yes / No	_____chains/hr
Subtotal: standby helicopter productivity (chains/hour):			_____
Total helicopter productivity assigned (On-site + Standby):			**_____chains/hr**

SECTION 6
COMPLEXITY ANALYSIS

Two complexity analyses were completed below because burning the North Loop of the firebreak road is more complex than burning the South Loop. Refer to the appropriate Complexity Analysis when writing a specific plan for either of these areas.

SECTION 6A
COMPLEXITY ANALYSIS FOR SOUTH LOBE OF FIREBREAK ROAD

This burn was rated for complexity using the worksheets attached. Exceptions to qualifications requirements below must be approved by the Installation Safety Director.

Type	Complexity	Qualification of Burn Boss
( ) Type 1	High Complexity	RxB1
(**X**) Type 2	Moderate Complexity	RxB2
( ) Type 3	Low Complexity	RxB2
( ) Type 3	Very Low Complexity (all 42 elements of the Complexity rating are low; no possibility of spread or spotting, only one fuel model involved; no aerial operations, and less than 6 personnel involved)	RxB3

Minimum qualifications determined by prescribed fire complexity are listed below. Exceptions must be approved by the Installation Safety Director.

Position	Type 1 Burn	**Type 2 Burn**	Type 3 Burn
Agency Administrator	Required	**Required**	Required
Safety Officer (T1,2,or 3)	Recommended	Optional	Optional
RxM1	Optional	Optional	Optional
RxM2	Not allowed	Optional	Optional
RxB1	Required	Optional	Optional
RxB2	Not allowed	**Required**	Optional
RxB3	Not allowed	Not allowed	Required
RxI1	Required	Optional	Not applicable
RxI2	Not allowed	Optional	Not applicable

Holding specialist: Holding functions will be managed by personnel qualified at the appropriate ICS wildland fire operations position as required by complexity, assigned resources and operational span of control. For some projects, there may be no holding requirements or the holding duties are assumed by the Burn Boss.

Prescribed Fire Complexity Rating System Guide Worksheet

Project Name: MMR 06-03 (South Lobe of Firebreak Road)

1. Potential for Escape

Risk	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	All targeted burn areas are inside the lobes of the firebreak road. Measures will be taken to minimize the potential for spot fire occurrence and to minimize spot fire size. Effectiveness of engines and ground personnel is limited to road edges and other areas cleared of UXO. Based on BEHAVE/CONTAIN runs, effective helicopter support will be critical in containing spot fires outside the prescribed burn area.
Final Rating: *Low* ***Moderate*** *High*	Koa haole shrubs are particularly prone to causing spot fires and this shrub grows in the burn units, but the probability of a lit firebrand traveling to the maximum spotting distance is low. Historically, spot fires have occurred within several feet of the firebreak road, not any farther upslope. Ninety five percent of all spot fires are expected to occur within 60 meters of the burn perimeter. However, long range spotting may occur. Although maximum spotting distance increases as wind speed increases, the prescribed 1-hour fuel moisture decreases, and subsequently probability of ignition of a spot fire decreases. The maximum spotting distance, give a 14 mph wind, is 805 meters, but burning is only prescribed for high live herbaceous and 1-hour fuel moistures at such high wind speeds. It is unlikely that firebrand will stay ignited 805 meters and land on receptive fuel (as this type of long-range spotting has not previously been observed in guinea grass), but if it does, the probability of ignition of a spot fire at a 1-hour fuel moisture of 12% is 26 percent. Although the probability of ignition of a short-range spot fire remains moderate (at 1-hour fuel moisture of 8%, probability of ignition is 46%), the ignition protocols are conservative and the holding forces are adequate. Because spot fires are possible, helicopter suppression support has been prescribed which will limit the size of any spot fire occurring in guinea grass, on a 60% slope with direct upslope winds to between four and 88 acres. Fire spread is predicted to be much slower, and helicopter suppression is predicted to be much more effective, once the fire spreads into the lighter molasses grass areas, higher on the slope. The Maximum Manageable Area (MMA) does provide for a potential maximum spot fire size of 88 acres. Spot fire size would be limited by 1-hour response time of standby helicopters. As implementation of these plans progresses and fuel breaks become better developed, risk to the Management Units and critical habitats will decrease. The largest spot fire within the forest fuels would be 0.3 acres. Previous prescribed burns conducted within the south lobe of the firebreak road have not escaped.
Potential Consequences	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	Federally listed fire-sensitive endangered and threatened plants and animals, and substantial areas of critical habitat are located upslope of the burn unit, outside the main firebreak road.

Final Rating: *Low Moderate* ***<u>High</u>***	All personnel will be familiar with the locations of critical resources which could be damaged by fire so that suppression actions can be prioritized in order to better ensure that these resources or the shrub vegetation protecting them are protected from fire.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low Moderate* ***<u>High</u>***	Ignition is scheduled to be completed when all of the spot weather forecast hourly parameters and fuel moisture conditions are predicted to be in prescription during all hours of the burn. Ignition will not commence until early twilight, approximately 30 minutes prior to sunrise, or whenever fire suppression helicopters are available for fire suppression work.
Final Rating: *Low* ***<u>Moderate</u>*** *High*	While the use of engines and helicopters ensures the adequacy of holding operations, the presence of UXO will still limit the effectiveness of ground-based resources off the perimeter roads. A skilled weather observer and/or IMET will be necessary in order to monitor all of the current and expected weather and fuel moisture conditions to better ensure that burning conditions remain within prescribed limits during the burn.

2. The Number and Dependency of Activities

Risk	**Rationale**
Preliminary Rating: *Low* ***<u>Moderate</u>*** *High*	Coordination and cooperation between various parties on the burn will is complicated by the use of personnel from several agencies and fire suppression organizations. Multiple aircraft will be assigned to the burn.
Final Rating: *Low* ***<u>Moderate</u>*** *High*	This will be mitigated by briefings and ensuring that all resources are able to communicate via a common radio frequency. Multiple aircraft increase the complexity of the burn.
Potential Consequences	**Rationale**
Preliminary Rating: *Low Moderate* ***<u>High</u>***	Failure to communicate can be result in an escaped prescribed burn or a fatality. Coordination and a coordinated and timely response will be necessary to prevent spot fires and ensure inefficient response to spot fires.
Final Rating: *Low Moderate* ***<u>High</u>***	Briefings will be thorough and will incorporate coordination and communication.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low* ***<u>Moderate</u>*** *High*	Continuous coordination and communication is critical to the success of holding and contingency actions.
Final Rating: *Low* ***<u>Moderate</u>*** *High*	Multiple aircraft increase the complexity of the burn. Air attack may be necessary. Radio, telephone, and internet communications will be established and maintained.

3. Off-Site Values

Risk	Rationale
Preliminary Rating: *Low Moderate* ***High***	Cultural resources, endangered species critical habitat, and endangered species could be threatened by a spot fire.
Final Rating: *Low* ***Moderate*** *High*	The parameters in this prescription were developed to minimize the risk of loss of off-site values in a spot fire.
Potential Consequences	**Rationale**
Preliminary Rating: *Low Moderate* ***High***	The consequence of damaging critical habitat would be very high if an escape damages habitat. All existing wild individuals of some plant species may be extirpated by a large escaped prescribed burn.
Final Rating: *Low Moderate* ***High***	The Army is implementing stabilization plans for the listed species in the Makua area. Even when listed species in the Makua Action Area are stabilized, many "manage for stability" populations will remain in the vicinity of the burn. Loss of individuals in these target populations due to an escaped prescribed burn would be unacceptable. Loss of listed plants growing outside the Management Units, although not preferable, may occur. Furthermore, the implementation of grass removal in the vicinity of listed species, as well as landscape scale conversion of grass areas into firebreaks and shaded fuel breaks will ensure that listed species inside the Management Units and critical habitat areas will not be impacted by a spot fire. Burned designated critical habitat areas or forested areas within the Management Units would be restored pursuant to the specifications in the Biological Opinion.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low Moderate* ***High***	Steep slopes, flammable exotic grass fuels, unexploded ordinance, and multiple aircraft give suppression of spot fires high technical difficulty.
Final Rating: *Low Moderate* ***High***	Technical difficulty of utilization of multiple aircraft to suppress spot fires in heavy grass fuels on steep slopes is high, although our experience suggests that when the grass is green (live herbaceous fuel moisture 100 percent and higher), it may be less difficult. Many factors affecting technical difficulties associated with control of spot fires can not be mitigated, although pre-ignition checks will ensure a high reliability organization operates in the event of a spot fire.

4. On-Site Values

Risk	Rationale
Preliminary Rating: *Low* ***Moderate*** *High*	Fire could threaten certain aspects of archeological and cultural resources within the burn units.
Final Rating: ***Low*** *Moderate High*	Grass fuels will be cleared back from around all known archeological resources which could be injured by fire prior to burning.

Potential Consequences	Rationale
Preliminary Rating: *Low* ***Moderate*** *High*	Fire could threaten certain aspects of archeological and cultural resources within the burn units.
Final Rating: ***Low*** *Moderate* *High*	Grass fuels will be cleared back from around all known archeological resources which could be injured by fire prior to burning.
Technical Difficulty	**Rationale**
Preliminary Rating: ***Low*** *Moderate* *High*	Grass fuels can be cleared by hand crews using weed eaters.
Final Rating: ***Low*** *Moderate* *High*	Grass fuels can be cleared by hand crews using weed eaters.

5. Fire Behavior

Risk	Rationale
Preliminary Rating: *Low* *Moderate* ***High***	Adequate consumption of fuels inside the unit, particularly around the edges and any other area targeted for fuel reduction would require burning under conditions where the potential for a rapidly growing spot fire also exist. Guinea grass burns with approximately three times the flame length as FBPS Fuel Model 3 (tall grass, including sawgrass).
Final Rating: *Low* ***Moderate*** *High*	In order to take advantage of cooler burning conditions when a spot fire's growth would be slowed by fuel moisture conditions, areas specifically targeted for fuel reduction within the burn units may be browned by herbicide treatment prior to burning and the burn will only be conducted when live herbaceous fuel moisture outside the burn unit is calculated to be 100% or higher at the Makua Range weather station (WIMS 490301). To ensure that herbicide does not drift from the targeted areas to any areas outside the burn units, herbicide will only be applied by skilled pilots on days when wind conditions are conducive to application accuracy. The herbicided grass is highly flammable and will burn with high flame lengths and rates of spread, even under cool burning conditions early in the morning. Guinea grass, even with live fuel moistures over 100% and high dead fuel moistures, is still capable of producing flame lengths over 10 feet and high rates of spread so sufficient suppression force will be required to contain spot fires. Burned grass areas remain hot and inaccessible to firefighters long after the fire front has passed.
Potential Consequences	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	Spot fires are a substantial concern at Makua. Maximum spotting distance and spot fire size are minimized by burning under light wind conditions.

Final Rating: *Low* ***Moderate*** *High*	Koa howlie shrubs are particularly prone to causing spot fires and this shrub grows in the burn units.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	Need to mitigate for potential extreme fire behavior by burning under relatively cool burning conditions. Need to protect listed species from fire by managing grass fuels.
Final Rating: *Low* ***Moderate*** *High*	To better ensure a high reliability organization during the implementation of the prescribed burn, several issues will be dealt with prior to ignition, including hooking up and testing all helicopter water buckets, testing communications, and completing grass control efforts in the vicinity of "manage for stability" populations of listed species in Lower Ohikilolo Management Unit.

6. Management Organization

Risk	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	Burn requires substantial coordination with National Weather Service fire desk forecasters, military and civilian contract helicopters, Army fire staff, and other Army and interagency fire personnel.
Final Rating: *Low* ***Moderate*** *High*	Several agencies will participate in the prescribed burn. Highly skilled NWCG – qualified personnel and personnel from other fire agencies with substantial local experience will be assisting with the burn.
Potential Consequences	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	Lack of coordination resulting in the lack of a detailed spot weather forecast, poor road maintenance, or the lack of sufficient qualified ignition and holding resources would result in a no-go decision for burning. Poor press coverage would hamper the Army's credibility and future ability to manage the site successfully.
Final Rating: *Low* *Moderate* ***High***	Rescheduling the burn due to a no-go decision may require additional herbicide if previously treated areas have greened up. Poor press coverage can be mitigated by working with Public Information Officer.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	Substantial coordination will occur prior to and during the burn to ensure that all necessary activities are coordinated.
Final Rating: *Low* ***Moderate*** *High*	Substantial coordination will occur prior to and during the burn to ensure that all necessary activities are coordinated.

7. Public and Political Interest

Risk	**Rationale**

Preliminary Rating: *Low* *Moderate* ***High***	This area is very controversial, and a burn will be controversial. Escapes have occurred in the past, and were major media events.
Final Rating: *Low* *Moderate* ***High***	Successful, professionally conducted prescribed burns will result in increased trust in the Army's work at Makua. Regardless of the success of prescribed burns, Army activity in Makua valley is likely to remain a concern to many interest groups.

Potential Consequences	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	Escaped prescribed burns damage cultural, scenic, aesthetic, and natural resources.
Final Rating: *Low* *Moderate* ***High***	Successful, professionally conducted prescribed burns will result in increased trust in the Army's work at Makua. Regardless of the success of prescribed burns, Army activity in Makua valley is likely to remain a concern to many interest groups.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	The Army public relations office can work with the public and media to engender support for the prescribed burn. Prescribed weather and fuel moisture conditions must be substantially limited, and suppression forces must be substantial to ensure that resources are protected.
Final Rating: *Low* *Moderate* ***High***	Public relations and coordination of substantial suppression resources are scheduled to ensure that resources are not damaged by the prescribed burn.

8. Fire Treatment Objectives

Risk	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	The continuous grass fuel burns readily, however, at high live herbaceous fuel moistures, burns have historically been patchy.
Final Rating: *Low* ***Moderate*** *High*	Herbicide may be applied to areas which must burn to ensure complete consumption and to further aid in grass fuel reduction on the site.
Potential Consequences	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	If we miss burning any targeted burn areas, they can be re-treated with herbicide and burned after three to four weeks.
Final Rating: *Low* ***Moderate*** *High*	Because all holding forces would be necessary for the second burn, the second burn would approximately double the cost of the burn. The financial costs associated with this burn are substantial.
Technical Difficulty	**Rationale**

Preliminary Rating: *Low* ***Moderate*** *High*	It is not difficult to identify dried areas from the air or ground, so the target burn areas will be easy to find. Depending on fuel moisture and weather conditions, it may be moderately difficult to burn the unit.
Final Rating: *Low* ***Moderate*** *High*	It is not difficult to identify dried areas from the air or ground, so the target burn areas will be easy to find. Depending on fuel moisture and weather conditions, it may be moderately difficult to burn the unit.

9. Constraints

Risk	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	Endangered species stabilization, fuelbreaks and firebreaks, and fire suppression contingency force planning, and burn preparation are expensive and require substantial commitments from Army environmental and fire staffs.
Final Rating: *Low* ***Moderate*** *High*	A spot weather forecast with forecasted weather for each hour during the burn will enable the procurement of the appropriate contingent of air support for suppression of a spot fire to minimize costs. Fuelbreak and firebreak completion will further reduce costs.
Potential Consequences	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	If the objectives are not being met or if weather conditions go out of prescription, we will extinguish and postpone the burn. It will take approximately one hour for the helicopters on site to extinguish the burning edge of the fire, partitioning it from the unburned portion of the burn.
Final Rating: *Low* ***Moderate*** *High*	If the spot weather forecast called for all weather conditions to be in prescription for the duration of the burn and one hour after ignition, and the fire escapes due to an unexpected weather event, the Army does not bear such a burden of blame for the escape.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low* ***Moderate*** *High*	Funding, spot weather forecast requests, and resource ordering will be moderately difficult to coordinate.
Final Rating: *Low* ***Moderate*** *High*	Funding, spot weather forecast requests, and resource ordering will be moderately difficult to coordinate.

10. Safety

Risk	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	Unexploded ordinance (UXO) may detonate when it is burned. Air and ground resources are on different radio frequencies. Herbicided grass may be hazardous to firefighter health.
Final Rating: *Low* *Moderate* ***High***	Firefighters and helicopters must follow standard operating procedures when igniting burn unit and fighting spot fires in order to reduce exposure to unexploded ordinance. Firefighters will be positioned to limit exposure to smoke from herbicided grass.

Potential Consequences	Rationale
Preliminary Rating: *Low* *Moderate* ***High***	The consequences of a UXO detonation could be hearing loss, trauma, or fatality if a firefighter is in the burst radius.
Final Rating: *Low* *Moderate* ***High***	Briefings will be provided to all resources to ensure understanding of the mitigation measures needed to minimize risk associated with UXO and herbicide.
Technical Difficulty	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	Substantial mitigation measures need to be instituted in order to reduce firefighter exposure to UXO and herbicide smoke.
Final Rating: *Low* ***Moderate*** *High*	Standard operating procedures have been developed ahead of time so that all resources can be briefed on limiting exposure to UXO and herbicide smoke. Use of helicopters substantially reduces firefighter exposure to UXO.

11. Ignition Procedures/Methods

Risk	Rationale
Preliminary Rating: *Low* ***Moderate*** *High*	Technical expertise has been specified by the plan in order to control ignition sequence in order to prevent spot fires. The burn will be cut off when weather parameters hit prescribed limits to ensure that no spot fire is ignited under other than the prescribed conditions. In order to reduce the chance of fire spread if weather parameters go out of prescription, the interior of any large expanses within the burn unit will be ignited to keep it relatively even with the edges. This may require the use of flare guns or aerial ignition in the interior of the burn units.
Final Rating: *Low* ***Moderate*** *High*	If grass is treated with herbicide it will not be difficult to black line by hand. No ignition of the burn area perimeter will be conducted from the air unless there is an area 60 meters or wider between the burn area and the firebreak road which is either mowed grass with live herbaceous fuel moisture content over 200% or otherwise treated vegetation that is not likely to burn. Aerial ignition will not be conducted immediately adjacent to any perimeter firebreak road until the firebreak road has been blacklined by hand.
Potential Consequences	**Rationale**
Preliminary Rating: *Low* *Moderate* ***High***	The results of a mistake in ignition could be a spot fire and a threat to endangered species.
Final Rating: *Low* *Moderate* ***High***	The results of a mistake in ignition may be a spot fire and a threat to endangered species.
Technical Difficulty	**Rationale**