

# TRUE GEOTHERMAL ENERGY COMPANY

CENTRAL PACIFIC PLAZA

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January 28, 1991

Manabu Tagomori, Deputy Director  
Water Resource Management  
State of Hawaii  
Kalanimoku Building, Room 227  
Honolulu, Hawaii 96813

DEPT. OF WATER &  
LAND DEVELOPMENT

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RECEIVED

Dear Mr. Tagomori:

Re: Alien Species Control Program within  
Kilauea Middle East Rift Zone

Previously, True Geothermal Energy Company submitted to your department for review and approval an alien species (weed) control program for the above-stated area. We have recently been granted approval by your department to implement the program outlined within the document **TRUE**

In furtherance of the purposes of the control program, we have initiated hand-removal of selected alien species. Specifically, we have recently hand-pulled many of the pluchea odorata from areas along the access road and drill site. This effort is being undertaken to control the numbers of these plants in the open areas at the roadside.

For your information, Dr. Charles Lamoureux has been conducting quarterly inspections along the cleared areas in the project site as required in the conditions of the Decision and Order of the Land Board dated April 12, 1986. These inspections have been conducted on a regular basis since clearing within the Kilauea Middle East Rift Zone commenced. An annual report summarizing the results of the quarterly inspections will be forwarded to your department under separate cover in the near future.

We are pleased to report that no new alien species have been found on these inspections. The alien species control measures are being undertaken to limit the numbers of species already in the project area and to prevent the introduction of new alien species.

Manabu Tagomori, Deputy Director

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Thus far, no herbicides have been used in the project area. However, employees of True Geothermal Energy Company (including myself) and Campbell Estate have met with a licensed herbicide applicator to discuss the implementation of the measures in the control program.

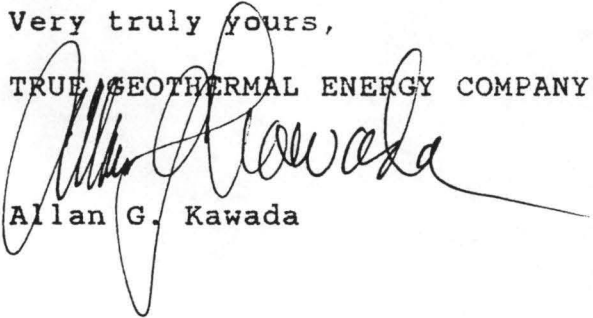
A meeting has already been scheduled with Dr. Charles Lamoureux, Dr. Philip Motooka and the herbicide applicator to consult with them in implementing the control program. As you know, Drs. Lamoureux and Motooka were the authors of that document.

Any action taken in the field by the licensed herbicide applicator or Drs. Lamoureux and Motooka or any employee or agent of True Geothermal Energy Company will be consistent with the terms and requirements of the control program document.

Should you have any questions, please call me at 528-3496.

Very truly yours,

TRUE GEOTHERMAL ENERGY COMPANY

  
Allan G. Kawada

AGK/cys

BOTANICAL SURVEY, MONITORING, CONTROL  
AND ASSESSMENT PROGRAM FOR THE  
BLNR DESIGNATED GEOTHERMAL RESOURCE SUBZONE  
MIDDLE EAST RIFT ZONE OF KILAUEA  
PUNA DISTRICT, ISLAND OF HAWAI'I

February 1990

by

CHARLES H. LAMOUREUX, PH.D

PHILIP S. MOTOOKA, PH.D

Prepared for

TRUE GEOTHERMAL ENERGY COMPANY

and

MID-PACIFIC GEOTHERMAL, INC.

**BOTANICAL SURVEY, MONITORING, CONTROL  
AND ASSESSMENT PROGRAM**

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This program will be implemented in the geothermal resource subzone designated as the Kilauea Middle East Rift Zone, Puna District, Island of Hawaii, on property owned by the Estate of James Campbell. The program was developed as directed by the State Board of Land and Natural Resources in their Decision and Order (CDUA No. Ha-12/20/85-1830) of April 11, 1986.

**I. GENERAL PROGRAM OBJECTIVES**

The objectives of this program are: 1) to establish baseline botanical inventories in the project area; 2) to monitor areas disturbed by geothermal development activities for the introduction of new alien botanical species (Type II) into these areas and the regeneration of the alien species (Type I) that were present in the areas cleared for project facilities; 3) to effect appropriate control measures designed to prevent these plant species from establishing communities that could spread to other areas of the forest; 4) to identify any areas within the subzone that by mutual agreement between the landowner and the Department of Land and Natural Resources are determined to be of such biological quality as to warrant designation as botanical sanctuaries; and 5) to continually assess this program for its effectiveness in achieving stated objectives.

**II. BOTANICAL SURVEYS**

Prior to any areas within the project site being cleared for project facilities, a botanical survey will be conducted of the area to be cleared (two to five times larger than the dimensions of the area to be cleared).

The objectives of the preclearing botanical survey are: 1) to establish a baseline inventory of the type of flora and fauna adjacent to the areas to be cleared for monitoring future impacts that can be attributed to project activities; and 2) to identify species that need to be protected from disturbances by project activities.

A report of the surveys will be submitted to the Department of Land and Natural Resources for review and approval before clearing operations commence.

The preclearing surveys will be followed by periodic monitoring surveys as described below.

**III. MONITORING PROGRAM**

The biological monitoring program will be a continuing program for the areas adjacent to road and facility sites. Monitoring will be conducted by qualified botanists under the direction of Dr. Charles Lamoureux. The plan is designed to make



regularly scheduled visits to the project site at three-month intervals initially and to conduct a botanical monitoring survey along and adjacent to all areas that have been cleared for project facilities. As plant communities may stabilize over time, it may be possible to extend the monitoring interval to six months along older cleared areas of the project site. The reports of each monitoring survey together with the follow-up actions taken to control the growth and spread of the alien species identified in the survey will be submitted to the Department of Land and Natural Resources. Special attention will be given to identify any new alien species in the area.

The approach to be used in the regular botanical monitoring surveys is based in part on earlier surveys of the area in July and December 1989 and January 1990. There is a strip a few feet wide (mostly 10 feet or less) along the roadside and a narrow strip at the edge of the well site where weeds have increased in numbers. However, the weeds here are those which were already growing naturally only a few feet away prior to any clearing. Most of them are plants which occur early in succession and which may well disappear naturally as the roadsides develop more shade. They are primarily small sedges as Cyperus haspan and Pycneus polystachyos, grasses such as Sacciolepis indica, herbs such as Crassocephalum crepidioides, Erechtites valerianaefolia, and Cuphea carthagenensis, shrubs such as Melastoma malabathricum and Pluchea odorata, and seedlings of Psidium cattleianum. Some pioneer native species have also moved into these areas, including, Machaerina mariscoides and Pipturus hawaiensis. Also, some tree ferns which knocked down during clearing have started to resprout.

Thus, the "weed problem" to be expected in this area has two aspects. The first, hereafter called Type I, results when removal of the current vegetation creates newly-formed openings and newly-exposed surfaces onto which weeds already growing in the area will spread.

The Type I problem is of less serious concern because new kinds of weeds are not being brought in. It can be thought of as a process of succession, comparable to but not identical with the sort of succession which takes place on new lava flows in Puna. This process should be monitored and steps taken wherever possible to limit the effects of the problem to the smallest areas feasible.

The second "weed problem", hereafter called Type II, is the spread of weeds into the subzone or new portions of the subzone which are not already growing nearby. This process may be facilitated both by opening new areas which create newly exposed surfaces and by increased traffic, both vehicular and human, which increases the chances of new weeds being carried into the area. (To date, no Type II invaders have been found.) The identification of any Type II species will be reported to management immediately so that quick action can be taken to eradicate such species ahead of routine eradication of Type I species.

The precise methods to be used in the monitoring surveys may vary depending on the site and the nature of the weed problems encountered. Initially, a complete walk-through survey of cleared sites will be conducted to include a 25-foot wide strip of uncleared forest along the roads and the edges of clearings. Notes will be made of weeds encountered and any changes over time; all Type II problems and any Type I problem which would seem to have impact on the uncleared areas will be noted and referred to the person responsible for weed control. As time goes on, it may be necessary to develop more quantitative methods but initially, such methods are not considered necessary in order to monitor and effectively prevent the spread of weeds into the area.

The monitoring program will continue for the life of the project along and adjacent to disturbed areas at intervals to be determined by the degree of botanical stabilization in the area.

#### IV. ALIEN SPECIES CONTROL PROGRAM

The objectives of the control program are: 1) to eradicate any Type II alien species that are discovered along and adjacent to areas that have been cleared or disturbed as a result of project activities; and 2) to selectively control the growth of Type I alien species which appear to be spreading into the forest from the clearing/disturbed areas.

The basis for this approach recognizes that it would be impossible and perhaps not desirable to eradicate all alien species that establish along the edges of cleared areas. Some of these species would have been established early in the succession which develops on newly cleared areas and would disappear by natural process. "Controlling" or eradicating these species may provide new cleared areas for reinvasion. Also, since native species will also reappear in the cleared areas along with the original alien species, eradication of the latter may also destroy the former.

Initially, eradication procedures will be implemented immediately following the monitoring survey and adjusted as experience dictates to achieve the desired level of control. However, a longer term control objective is to replant native plants, e.g., tree ferns, along the edges of cleared areas to shade out the weedy species. This will be undertaken on a trial basis along the access road to the second drill site. If the results are successful, additional planting will be done along other cleared areas. Upon notification of the presence of Type II alien species in the monitored areas, action will be taken to eradicate those plants on a priority basis not to exceed 14 days from the date of notification.

The weed control and eradication program will be directed by weed scientist Dr. Philip S. Motooka, who will train and supervise assistants to apply the various eradication methods that will be most appropriate for the alien species, its density and the surrounding area. Copies of all botanical monitoring surveys will be made available to the weed scientist for review and assessment

of the eradication program. The weed eradication program will be continuous and in concert with the monitoring program.

#### PROCEDURE

New alien plant infestations discovered by the monitoring program will be eradicated by methods that offer the least ecological disruption. In the typical case, herbicidal methods of weed control will be employed because they offer efficacy, economy, and human environmental safety.

The weed scientist will inspect the weed infestation area and develop specific control recommendations: herbicides, rates and methods of application; or, if appropriate, non-chemical methods. Specific herbicides to be used will depend on the weed species found and the situation of its occurrence. Selection criteria will include efficacy and environmental protection, especially non-target plant protection and groundwater protection. For example, glyphosate would be recommended for control of grasses and sedges as it is effective against these species and it poses no risk to groundwater. A broadleaf herbicide such as triclopyr will be suggested for a brush species such as firebush (*Myrica faya*) for the same reason. Where an infestation of weed seed is suspected, e.g., a weed has gone to seed, a preemergence herbicide such as diuron or sulfometuron may be recommended. Diuron has not been found in groundwater in Hawaii despite decades of intensive use on sugarcane and pineapple. Sulfometuron, a new herbicide, is used at low rates, about 2 oz. per acre, which mitigates any risk it poses as a groundwater contaminant, if any at all. In all, there are over 30 herbicides available for use in the geothermal zone which offers a wide range of options to deal with multilateral weed problems.

Likewise, different methods of herbicide application also offer options in dealing with weed problems. Alien plants in the cleared areas will probably be sprayed with small, hand-held sprayers set at low pressures (15-30 psi) to virtually eliminate the risk of drift. In situations where it would be impossible to spray a weed without hitting a non-target plant, the herbicide can be wiped on the weed to preclude non-target injury.

A more effective way to apply certain herbicides is by injecting them into the xylem. A simple way to do this is by cutting notches into the trunk and applying the herbicide into the wound. Such methods would be recommended for alien plants that may be tolerant to foliar applications or for larger plants that would be impossible to spray without hazard to nearby non-target plants. It would also be appropriate against alien plants in remote areas where transport of equipment, supplies and water would be laborious.

The herbicide applicator will treat the alien plants as recommended by the weed scientist. He will be trained to handle and apply herbicides and will work under close supervision initially. After he has demonstrated mastery of weed control



principles and practices, he will be able to work independently with consultation with the botanist and the weed scientist.

Any machinery to be used in the project site shall be thoroughly cleaned before it is taken into the area. Also, workers shall clean boots/shoes before entering if they have been working in other weed-infested areas.

In order to reasonably assure that the above-stated policies are implemented, the following statement shall be included in any bid document or contract sent to the contractors successfully responding to a request for work within the project area. Further, these contractors shall be required to inform their employees and agents in writing of the following requirements:

"All earthmoving and excavation equipment, including bulldozers, backhoes, dump trucks, front loaders, cranes, etc., shall be thoroughly inspected and cleaned of excess dirt, vegetation, seeds and other debris, using water and other prudent means of removal prior to its deployment within the project area. Should any equipment be removed from the project area, the cleaning measures shall be repeated prior to the redeployment of the equipment into the project area.

"Additionally, all contractors, including their employees and agents operating the earthmoving and excavation equipment, shall thoroughly inspect and clean their clothing (including boots and/or shoes) and personal belongings of any dirt, vegetation, seeds and other debris prior to entering the project area.

"The employees and agents of True Geothermal Energy Company shall reserve the right to conduct periodic inspections of the contractors' equipment, prior to such equipment being brought into the project area. Further, visual inspections of the outside clothing of the contractors and its employees or agents can be made prior to any entry into the project area. The inspections shall be for the sole purpose of assuring that the above-stated requirements are complied with. The inspections shall not be carried out in any manner that contravenes the due process rights and privacy of the persons undergoing inspection.

"Any violation of the above conditions and requirements by the contractors and its agents and employees shall be considered a major breach of the terms and covenants of the work contract."

#### WORKER SAFETY AND ENVIRONMENTAL PROTECTION

The primary concerns in developing a weed control program, in addition to the obvious requirements of efficacy and economy, are worker safety and environmental protection, in this



case, non-target plant protection and groundwater protection in particular.

Worker safety. The herbicides registered for use in the geothermal zone are of low chronic toxicity. A far greater hazard to workers are injuries from sharp implements, heavy tools and mechanized equipment. For example, some 135,000 farm workers are injured each year, seriously enough to miss work (at the very least). Pesticide poisoning data are poorly kept; however, most deaths are the result of accidental or deliberate ingestion rather than job-related exposure and involve chemicals more toxic than the herbicides to be used in the geothermal project area. The risk of cancers from all pesticides has been termed "unimportant" in an exhaustive human epidemiological study commissioned by Congressional Office of Technology Assessment. Nevertheless, the applicator is required to adhere to mandated precautions in handling and applying herbicides.

Environmental Protection. The herbicides to be utilized in the geothermal area must be registered for the intended use and must be applied in a manner consistent with the label. With a few exceptions, no special permits are required. Use of the exceptions is not anticipated. The herbicides are of low toxicity and are not bioaccumulated. Moreover, they will be used at low rates, over a limited area, and will be used infrequently. Thus, the amount released into the environment will be minute and environmentally insignificant.

Mechanical methods of control, besides being labor intensive and hazardous to workers, are also more hazardous to the environment than herbicides. Disturbing the soil will stimulate germination of any weed seeds present in the soil. Pulling up well-rooted weeds may also uproot nearby non-target plants. Furthermore, exposed soil may erode, especially in high rainfall areas. Disturbed and eroded areas will be susceptible to new weed invasions.

Occasionally, endangered and other native species in close proximity to target alien plants may be at risk to herbicide injury. However, selection of an appropriate herbicide or method of application or both, or a non-chemical means of control will negate the hazard.

In high rainfall areas, groundwater contamination would be a potential problem. However, in the kind of use envisioned in the geothermal zone, only minute amounts of herbicide would be released into the environment even under a worst case scenario. Hence, groundwater contamination would not be even a remote possibility in this project. Nevertheless, herbicides will be selected based in part on groundwater safety properties, i.e. degradability and poor mobility.

## V. ASSESSMENT PROGRAM

During the periodic botanical reconnaissance surveys conducted prior to clearing any areas in the subzone, special attention will be given towards identifying areas that would be suitable for consideration as botanical sanctuaries. Generally, such areas would be characterized by the presence of rare species or lack of alien species.

An inventory of such proposed areas will be made to assist in the assessment of each area being proposed as a candidate for designation as a botanical sanctuary.

In addition, assessments will be made after every fourth monitoring survey as to overall effectiveness of the program in preventing the spread of aliens due to project activities.

In an effort to establish a larger forest management program, The Estate of James Campbell and True/Mid-Pacific Geothermal are working on a draft strategy. The effort has included discussions and consultations with experts in the fields of biology, ornithology, and alien species control. Consultation has also occurred with pig hunters who are familiar with and have hunted in the Kilauea Middle East Rift Zone and the project area. Further work and data gathering will occur in order to complete the strategy.