Department of Energy

Oak Ridge Field Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

August 16, 1993

Ms. Sandra Waldron
Technical Assistant
U. S. National Regulatory
Commission
101 Marietta Street 2900
Atlanta, GA 30323

Dear Ms. Waldron:

EL VERDE RESEARCH STATION (PUERTO RICO)

On March 12, 1993, a radiological survey was performed at the Cs-137 radioactive contaminated area at El Verde Research Station in Puerto Rico. Wood cores, roots, leaves and soil samples were collected and analyzed to determine the radiation activity. The highest concentrations were found in the soil directly beneath the tree and in the root system.

The Department of Energy had several discussions with representatives from the U.S. Forest Service and the University of Puerto Rico about the facility transfer issues. One of the issues is associated with the NRC license. At present the Environmental Quality and Occupational Safety office of the University of Puerto Rico is responsible for the NRC license for this site. The University of Puerto Rico would like to transfer this responsibility to the landowner, U. S. Forest Service.

A copy of the radiological survey report is provided for your evaluation and recommendations. Should you have any questions or need additional information, do not hesitate to contact me at **(615) 576-6821** or Mildred Ferré at **(615) 576-8018.**

Sincerely,

Clayton S. Gist, Chief
Decommissioning and
Decontamination Branch

EW-913:Ferré

Enclosure

RADIOLOGICAL MEASUREMENTS
STUDY AREA 4
EL VERDE RESEARCH STATION
LUQUILLO FOREST
LUQUILLO, PUERTO RICO

Between 1964 and 1976, the U.S. Atomic Energy Commission (AEC), under an agreement with the U.S. Department of Agriculture, Forest Service (USFS), supported a terrestrial ecology program in a Section of the Luquillo Forest, known as the El Verde Research Station (Figure 1). This program was conducted through the Puerto Rico Nuclear Center (later renamed CEER, the Center for Energy and Environment Research), at the University of Puerto Rico (UPR). In 1976, control of activities at the El Verde site was transferred from the AEC successor, ERDA (presently the Department of Energy (DOE)), to the University of Puerto Rico; the agreement with USFS also was transferred to UPR.

Main study areas were located on the northwest side of the Forest, approximately 200 to 800 m from the Research Station (Figure 2). Most radionuclides used in the projects were of short half-life (physical and/or biological half-life) or were in the form of sealed sources. Sealed radioactive sources have been removed; materials used for labeling (tagging) vegetation have mostly decayed or dispersed to the extent that residual activity levels are at or near ambient background.

One study area which still retains activity in excess of background levels is Study Area 4, about 700 m east of the Research Station. In September 1968, a tree of the species Matayba dominguensis was injected with 0.46 millicuries of Cs-137.[1] At about the same time, a nearby tree of the species Dacryodes excelsa in this Study Area was injected with a mixture of Rb-86 (17.69 mCi), Sr-85 (0.19 mCi), and Mn-54 (0.34 mCi).[2] The purpose of these injections was to study mineral cycling and metabolism. The Rb-86, Sr-85, and Mn-54 have

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relatively short radiological half-lives (maximum of about 300 days for Mn-54); residual activities are, therefore, negligible after almost 25 years of decay. The half-life of Cs-137 is approximately 30 years, and, thus, at this Writing, as much as 55% (0.25 millicuries) could theoretically remain. The residual Cs-137 activity in Study Area 4 is licensed to the University of Puerto Rico by the Nuclear Regulatory Commission (license 52-19434-02). The Nuclear Regulatory Commission has raised questions regarding the future of the residual Cs-137 in the tree and surrounding soil; a major concern is the ultimate fate of the radioactively contaminated vegetation and soil, should the labeled tree die.[3]

Several previous radiological surveys have been performed in Study Area 4.[2,4] These surveys, by UPR and Oak Ridge National Laboratory, indicated that the residual activity was concentrated at the base of the trunk and in the small root system of the Matayba tree. In conjunction with the UPR survey in the late 1970's and early 1980's, about 43 kg of contaminated soil was removed from around the roots of the Matayba tree and disposed of in Oak Ridge, TN; the total activity removed was not determined and, therefore, the balance of Cs-137 at the Study Area cannot be calculated. Both the UPR and the ORNL surveys identified direct gamma radiation levels of about 200 μR/h in contact with the exposed roots and soil, after the soil had been removed. On contact with the tree itself, above ground level, the direct radiation level was up to 15 μR/h. Soil from around the root system of the tree, obtained during the ORNL survey, contained 370 pCi/g of Cs-137; at about 5 m from the tree, the Cs-137 concentration in a soil sample was 2.53 pCi/g. For comparison purposes, background exposure rates in the area typically range from 2 to 3 μR/h, and background Cs-137 ranges up to about 1.5 pCi/g.[4]

On March 12, 1993, at the request of the DOE/Oak Ridge Field Office, personnel from the Environmental Survey and Site Assessment Program of Oak Ridge Institute for Science and Education (ESSAP/ORISE), conducted additional radiological monitoring and sampling in Study Area 4. Gamma scans of the area, using sodium iodide detectors and countrate meters with audible indicators, confirmed that direct radiation is highest at the root system, directly beneath the tree; the highest level identified was about 200 times the background level. At approximately 3 m from the Matayba tree the direct radiation level decreases to background at

both surface contact and at 1 m above the surface. No evidence of "hot-spots" that would suggest migration of activity was noted out to 5 to 10 m beyond the Study Area perimeter. Samples of soil were collected from six locations within several meters of the tree. A sample of litter (leaves) from the general study area, a core boring from the Cs-137 injection site, and a sample of roots from beneath the Matayba tree were also collected. Analyses by solid state gamma spectrometry identified only Cs-137 in detectable concentrations. Concentrations measured are presented in Table 1. Soil from around the root system contained from 181 to 252 pCi/g of Cs-137. At 1 to 2 meters from the tree, surface soil ranged from 10.9 to 15.9 pCi/g. The core from the injection site contained 77.4 pCi/g and roots contained 109 pCi/g. Leaves collected from the surface near the tree contained 5.5 pCi/g. These findings are consistent with previous surveys and results of direct gamma monitoring.

Surveys indicate that the Cs-137 in Study Area 4 is limited to the immediate (within about 3 m) area of the previously injected tree. Only one tree is involved. Of the activity injected approximately half has decayed. Soil excavation and disposal by UPR about 1980 certainly further reduced the quantity of residual Cs-137. It is, therefore, unlikely that more than 200 pCi/g of Cs-137 remain; the actual amount may be considerably less. There is no evidence that the radioactive material is migrating or that there is any disturbance or recreational use of the area by the public. Potential for public exposure appears to be minimal. (The fencing around this Study Area has been knocked down and the radiation warning signs are not readily visible.) Removal at this time would require destruction of the mature tree, and it would be difficult to remove the contaminated soil and wood from the area over existing accesses. Considering the small potential risk from the residual Cs-137 it would seem logical to either continue under the current license agreement, until the quantity of radioactive material can be demonstrated by thorough survey or decay calculation to fall below the licensing level, or to perform a risk assessment and possibly terminate radiological controls. The risk assessment might demonstrate that an acceptable disposition of the tree and soil would be in-situ burial.

TABLE 1
Cs-137 CONCENTRATIONS IN SAMPLES FROM STUDY AREA 4 EL VERDE RESEARCH STATION LUQUILLO FOREST LUQUILLO, PUERTO RICO

sample[a] ID	Cs-137 Concentration (pCi/g)[c]
Bkgd (plot 12-04-23)	1.0 ± 0.2[b]
1S	15.9 ± 0.6
2S	12.7 ± 0.7
3S	10.9 ± 0.6
4S	181 ± 4
5S	240 ± 3
6S	252 ± 3
1V (wood core)	77.4 ± 4.4
2V (roots)	109 ± 3
3V (leaves)	5.5 ± 1.0

[a]Refer to Figure 4.
[b]Uncertainties represent the 95% confidence level, based only on counting statistics.
[c]Net weight.

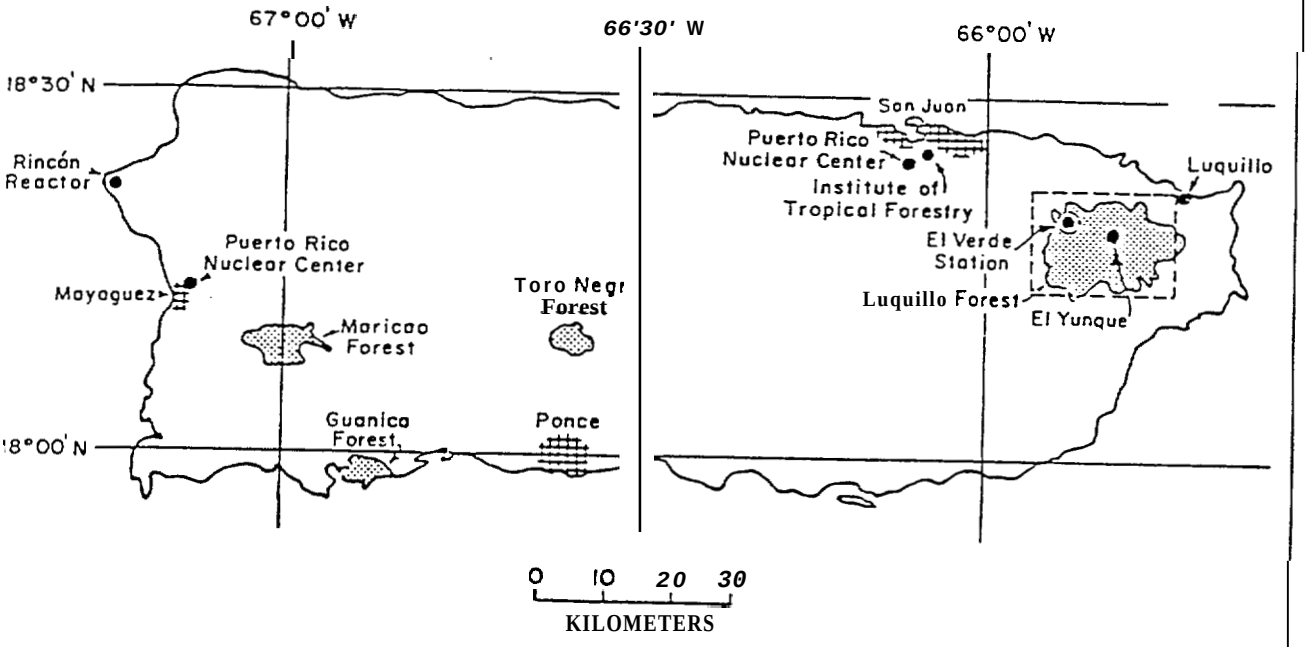

FIGURE 1: **Map** of Puerto Rico – Location of Luquillo **Forest and** El Verde Research Area (From "**Radiological Survey** Report for **El Verde Research** Station," CEER–X–1**15,** Health and Safety **Division, CEER, May 1983 (Revised)**

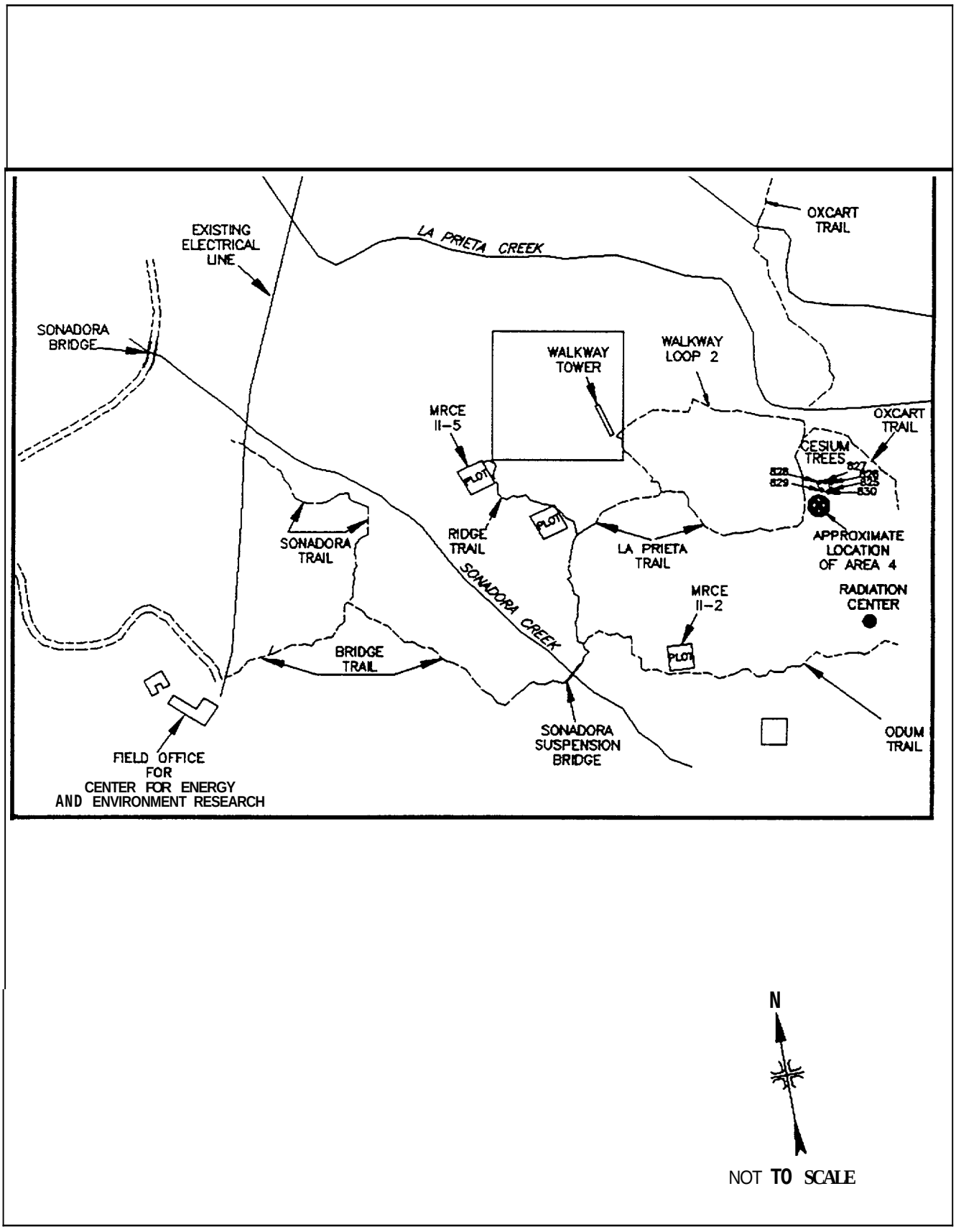

FIGURE 2: El Verde Research Station – Location of Cesium–137–Labeled Tree in Study Area 4

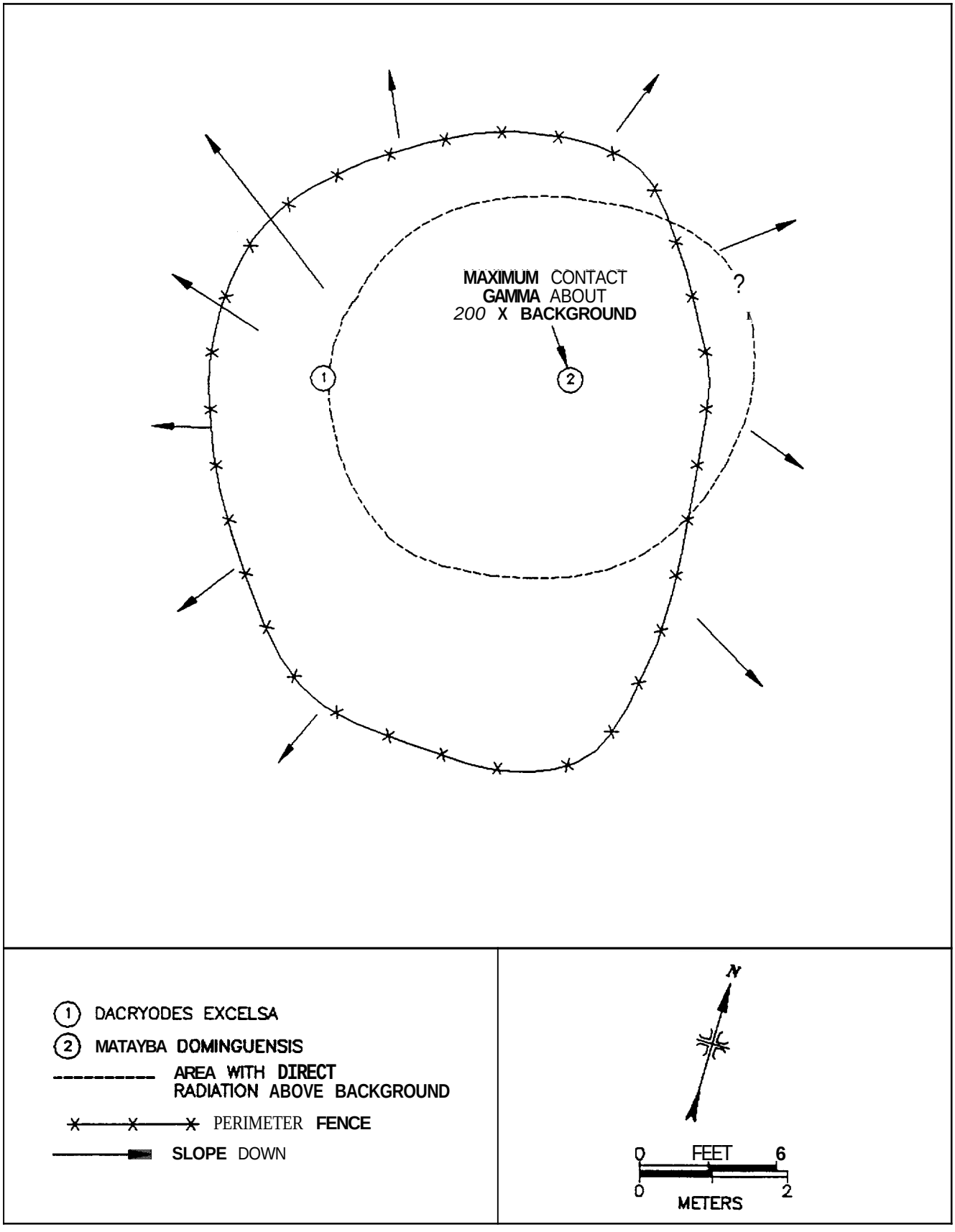

FIGURE 3: Study Area 4 – Location of Experimental Trees and Results of Surface Gamma Scan

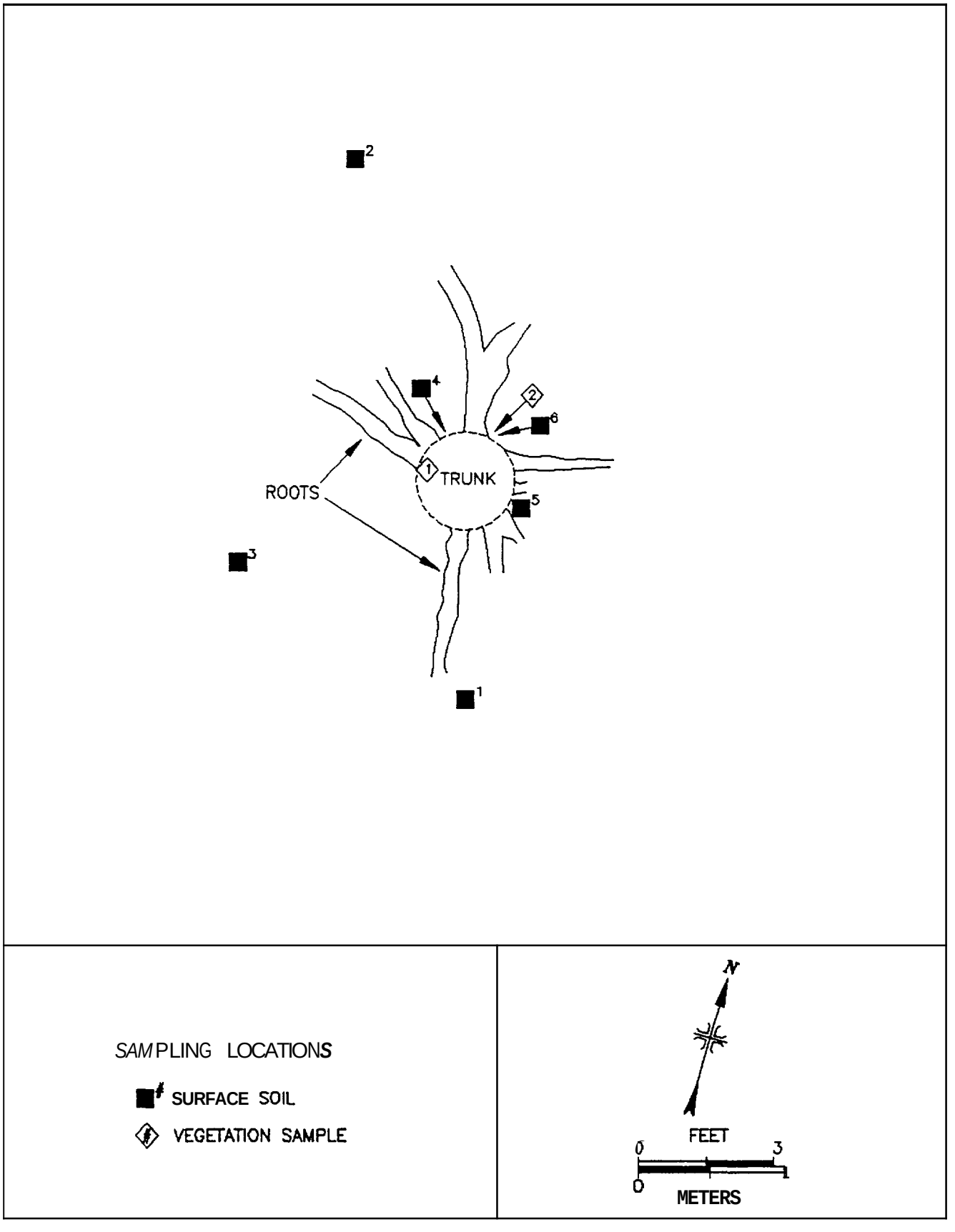

FIGURE 4: **Cs–137–Tagged Matoyba** Dominguensis Tree (Tree 2) – **Sampling** Locations