COMPLETION REPORT

Characterization of Sediment Cycle

with Cesium-137 Dating Techniques

By

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Abstract

The ever increasing demand for utilization of the land resource has generated concern about the potential for accelerated erosion associated with land use activities. Erosion is a natural process; however, land use activities often produce comparatively higher erosion rates. Soil particles detached from the land surface by flowing water can be delivered to nearby channels and transported to man-made water storage structures located downstream. The life spa of municipal, agriculture, and hydroelectric water supply reservoirs is often shortened because of accelerated deposition of sediments produced by increased upslope erosion associated with land use.

Quantification of the rate of detachment, transport, and deposition of sediments, as related to natural and disturbed watershed conditions, is necessary if conservation of the soil resource is to be obtained and existing water reservoirs are to be protected. Continued research efforts are needed to develop and improve existing methods for quantifying the degree of erosion and rate of sediment deposition.

One method of determining the rate of removal and deposition of sediments is to follow the fate of tagged sediments through the sedimentation cycle. A measurable tracer which is present in the existing environment and moves with detached sediment particles can be used to estimate the degree of eroded and deposited sediments on a watershed. Measurement of the concentration of the tracer on disturbed and undisturbed soil surfaces and in deposited reservoir sediments permits an assessment of erosion-deposition as related to degree of land use.

The atmospheric nuclear explosions which occurred in the late 1950's and early 1960's produced fallout of several radioisotopes which were dispersed onto the land surface of the earth. One of these isotopes, Cesium-137, is strongly absorbed by most soil particles (Ritchie et al. 1973). Because of this absorption phenomena and the 330year half-life of this isotope a majority of ^{137}Cs which has fallen to the earth's surface is still present in the upper layers of the soil profile.

The relative location and concentration of ^{137}Cs in the soil or deposited soil profile can be used to assess the rate of soil particle detachment and deposition. Reservoir sediments deposited since the early 1950's would have two distinct peaks of ^{137}Cs accumulation which correspond to the 1959-60 and1962-64 period of maximum cesium fallout (HASL 1977). A third peak should also be present from fallout produced by the Chinese atmospheric nuclear detonation which occurred in 1976 (HASL 1976). Sediments deposited between these peak periods would have ^{137}Cs present, but in lesser quantities. Similar analysis can be applied to watershed surfaces in the context of presence or absence of peak levels of isotope in the soil profile.

Research conducted in the southern portion of the United States by Ritchie et al. (1973) and McHenry et al. (1973) indicate that ^{137}Cs can be detected in soil and sediment profiles. These researchers were able to identify peak periods of ^{137}Cs accumulation in soil and reservoir sediments.

Atmospheric fallout records for Seattle and Forks, Washington, and Helena, Montana (Figure 2), indicate that sufficient levels of ^{137}Cs have accumulated at the earth's surface in the western United States to be quantified by gamma-ray spectrometric analysis (HASL 1977). Cesium-137 was measured in soil in eastern Montana at concentrations ranging from 0.524 to 2.217 nCi/Kg (McHenry et al. 1983).

This project was designed to conduct a preliminary investigation of ^{137}Cs levels in soils and deposited sediments at selected locations in northern Idaho and to assess the feasibility of using ^{137}Cs as a sediment tracer.

The objectives of the study were to:

1. Identify and quantify the distribution of ^{137}Cs in disturbed and undisturbed soil profiles and in lake sediment cores.
2. Assess the feasibility of using ^{137}Cs as a sediment tracer for evaluating the surface movement and storage components of the sedimentation cycle.

Summary and Conclusions

The presence of ^{137}Cs in the upper 10cm of soil on a forested meadow, and forest regeneration sited revealed that the isotope is being retained in the surface layer. The comparatively lower concentration of ^{137}Cs at the regeneration unit and the absence of it at the eroded site indicates that surface erosion has been active in these areas at least since 1976.

An estimate of annual sediment deposition in Brown's Bay and Gasser Point, Lake Coeur d´ Alene, was determined by correlating the peak concentrations of ^{137}Cs and respective depths in the sediment profile with peak radionuclide fallout periods of 1959, 1963, and 1976. The average annual sediment deposition rate was higher in Gasser Point compared to Brown's Bay.

In conclusion, this preliminary investigation for the presence of fallout ^{137}Cs in soils and lake bottom sediments revealed that the radionuclide is present in northern Idaho at concentrations which are readily quantified by standard gamma-ray spectrometric analysis. A surface erosion-deposition sediment budget for a watershed could be developed using ^{137}Cs as a tracer. The conversion of ^{137}Cs concentration in soils and sediments to mass units would provide an estimate of in situ, eroded and deposited volumes of surface material.

This study has also shown that sufficient levels of ^{137}Cs are present in lake bottom sediments to permit an estimation of the amount of sediment deposition that has occurred in recent years. A comprehensive sampling of reservoir bottom sediments with ^{137}Cs dating of specific depths within the sediment profile would provide a method for estimating volumes of deposited sediments for identifiable time periods.

Study Site

This research took place on the Big Meadow Unit of the University of Idaho Experimental Forest, and on the bottom of lake Coeur d´Alene.

Investigator not found in
Library data base June 2006

Date: 8 April 1985

Reseacher/s: Charlie Kessler / Larry Tennyson

Project Title: Monitoring stream discharge and sediment yeild of a small forested watershed in Northern Idaho.

Subject: Stream gauging by means of a weir
Keywords: weir, watershed, stream gauging, discharge
Abstract: A small weir constructed across a 2nd order forest stream will be used to monitor discharge and sediment load. If and when harvest activities take place in the watershed, changes in both discharge and sediment load ~~be~~ will be recorded. Continued monitoring will provide further information on the normal stream activity and any changes that take place.

Location:
Unit of the Forest Big Meadow Creek
T 40N R 4W S 23 SW¼, NE¼
Stand _____ Size of Area _____
General Description of Area Weir creek right off Big Meadow road, about 1.3 miles from Picnic Area.

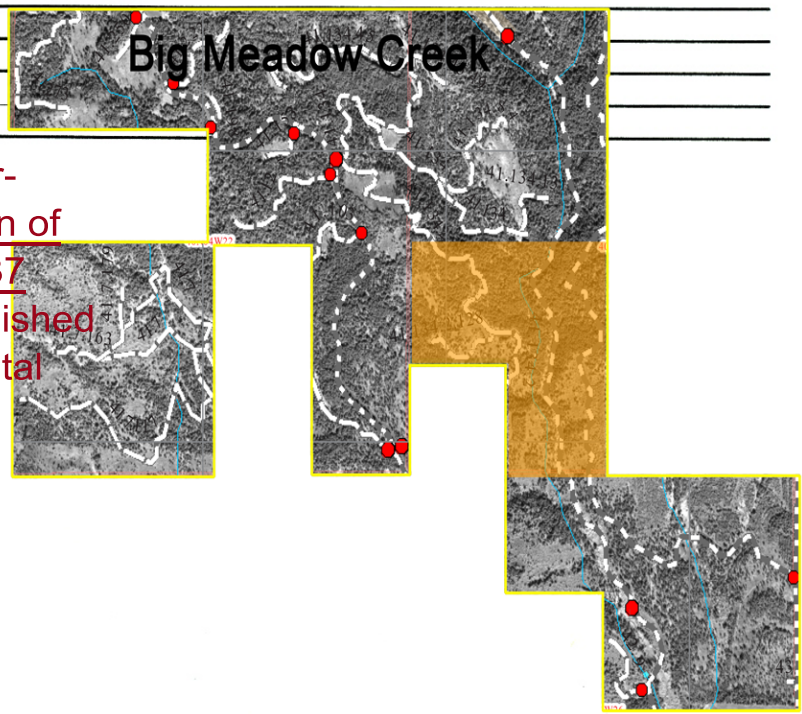
Plot or Area Designation: weir, box with gauging equipment

Date Begun: 1983 Completion date (expected) Continuing indefinitely
Papers or Thesis Resulting: _____

Funding Source: Experimental Forest, For. Res. teaching budget

Future Plans: _____

teaching aid for FWR classes



Tennyson, L.C. Associate Professor-Completion Report, Characterization of the Sediment Cycle with Cesium-137 Dating Techniques (1983)--Not published with the Library data base-have digital copy.

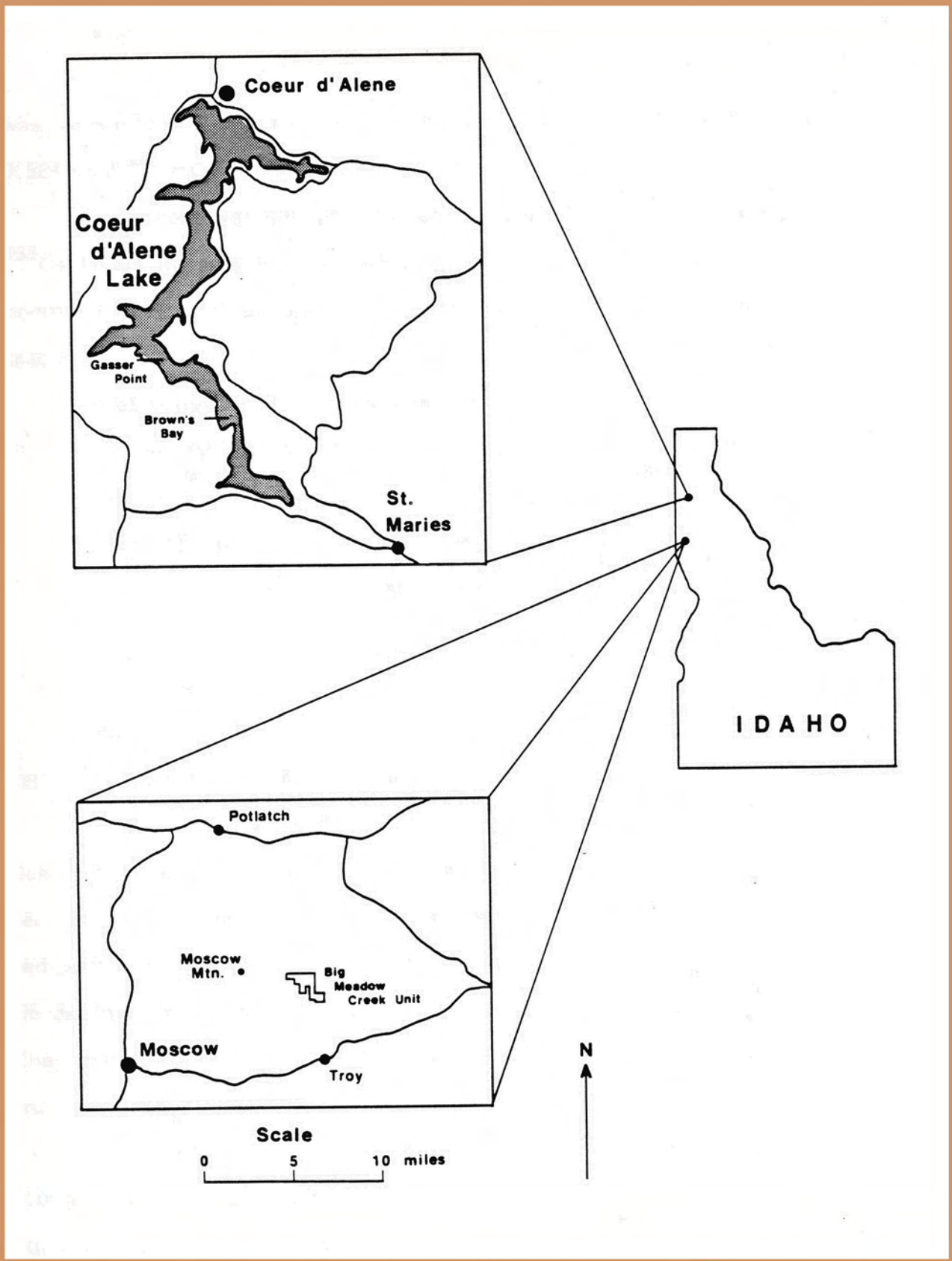
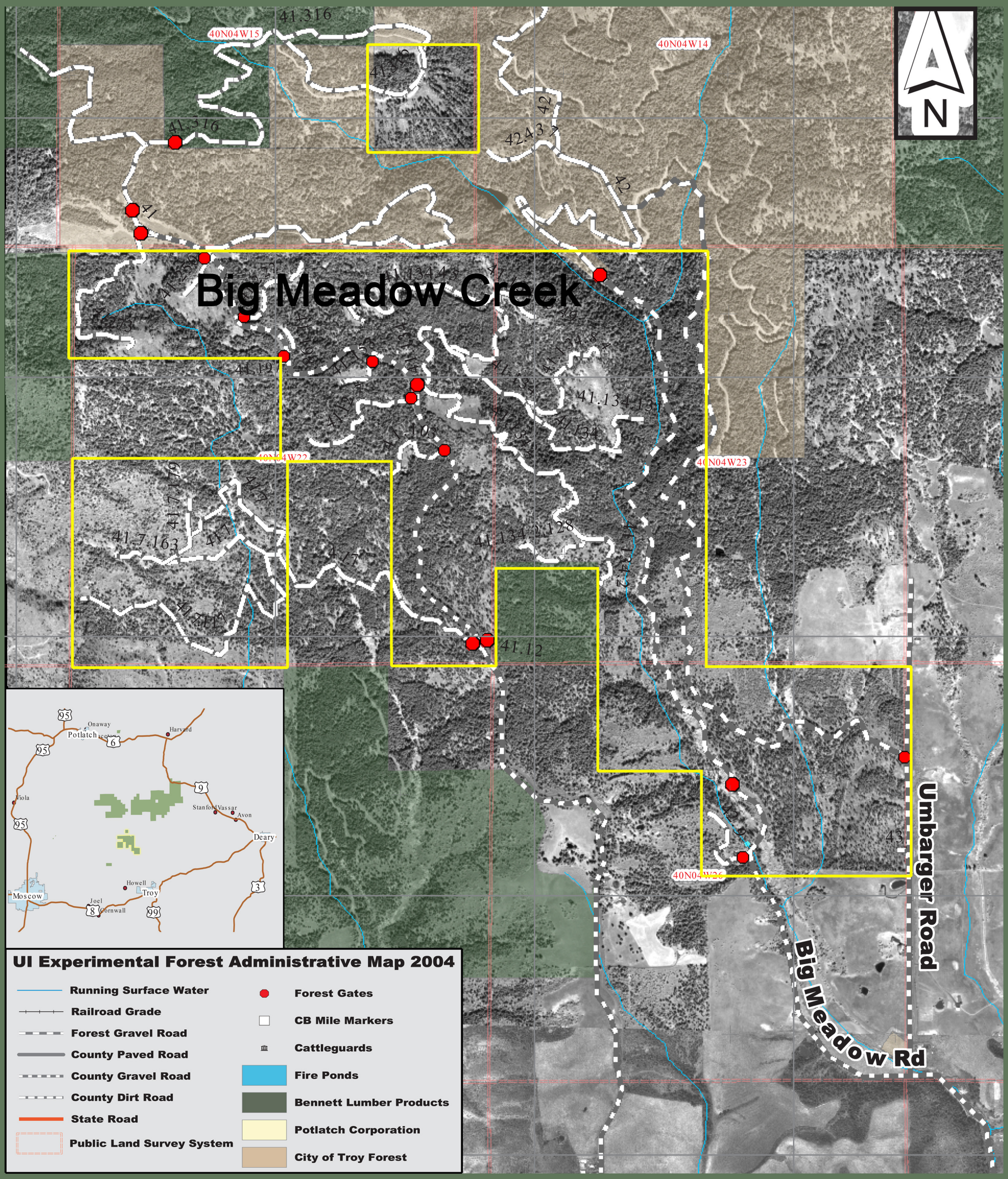


Figure 1. The location of Lake Coeur d'Alene and the Big Meadow Creek Unit of the University of Idaho Experimental Forest.

Big Meadow Creek



UI Experimental Forest Administrative Map 2004

- Running Surface Water
- Railroad Grade
- Forest Gravel Road
- County Paved Road
- County Gravel Road
- County Dirt Road
- State Road
- Public Land Survey System
- Forest Gates
- CB Mile Markers
- Cattleguards
- Fire Ponds
- Bennett Lumber Products
- Potlatch Corporation
- City of Troy Forest

Feet

0 850 1,700 3,400 5,100 6,800

1 inch equals 0.25 miles

520 260 0 520 1,040 1,560

Meters

Location of Complete Research:

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