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CLEAR CREEK MANAGEMENT AREA
GEOGRAPHIC INFORMATION SYSTEM (GIS)
PROJECT PROPOSAL

Background

The Clear Creek Management Area is located in southeastern San Benito and west-central Fresno counties, California. It consists of 50,501 acres of public land administered by the Bureau of Land Management (BLM). Primary users of the area consists of mineral exploration and production, livestock grazing, and recreational pursuits such as: hunting, off-road vehicle (ORV) use, and rock and gem collecting.

Major issues identified through the BLM planning system in the management area include: cultural resources; wildlife habitat; recreation; asbestos hazard; watershed concerns; rare, threatened and endangered (RTE) plant habitat; hobby gem and minerals; and unique soils. Land use planning was completed in 1984 in the Hollister Resource Management Plan/Environmental Impact Statement (RMP/EIS). The Clear Creek ORV Designation and Environmental Assessment (EA) was completed in 1981 and the Clear Creek Management Plan and EA in 1986.

Since 1858, the New Idria Mining District, which includes most of the Clear Creek Management Area, has been known for its mineral production. Commercial quantities of mercury, chromite, asbestos, magnesite, benitonite, jadeite, and gem stones have been produced from this locality. The mercury deposits occur principally in the fractured zones on the borders of the serpentine ore body;

In 1970, the area increased in popularity for motorcycle ORV use, partly due to the closure by the BLM of the Panoche Hills/Mercey Hot Springs area located about 20 air miles to the north. Most ORV use is concentrated in or near Clear Creek Canyon. In 1982, off-road recreation vehicle designations were completed for this area with a "limited" designation in Clear Creek Canyon, riparian areas, and grazing areas (16,000 acres); "open" designation for 25,000 acres (mostly barren areas and brushfields), and 2,000 acres "closed" (San Benito Mountain Natural Area and extension and the open pit mine areas)[1/].

Recreation facilities include pit toilets and garbage dumpsters in the Clear Creek Canyon and interpretive signs in the San Benito Mountain Natural Area. Public access is available along the Clear Creek county road which runs through the area from Idria to the Coalinga Road near Hernandez Reservoir. Foot access is also available at the Fresno-San Benito county line on the Coalinga road. Two previous access routes have been closed to public use by

1/ Limited - vehicle use restricted to designated roads, trails, and areas. In addition to vehicle restrictions, vehicle encroachment into brush fields would be prohibited.

Closed - area designated closed to all vehicle use except on county roads and designated routes.

Open - area opened to off-road vehicle activity.

The presence of airborne asbestos dust presents a serious air quality problem in the Clear Creek Management Area. Two studies by Poperdorf and Wenk, University of California, Berkeley in 1979 and 1980 have found that the vast majority of airborne asbestos in the area is generated by human activities, primarily vehicle use. Natural wind conditions are believed to have a negligible effect on dust production. The studies showed that: (1) the air quality hazard is greatest when soil moisture is below 3 percent, roughly from May 15 to October 15; (2) riding behavior can significantly affect exposure levels; (3) dust clouds produced by vehicles dissipate rapidly, the background level of exposure to asbestos dust in the area averaged to be about one-tenth the average exposure of riders, however, those levels can be increased 3 to 10 times by nearby vehicle use; (4) exposure levels of riders monitored were occasionally above Occupational Safety and Health Administration (OSHA) occupational restrictions for short-term exposure (10 fibers per cubic centimeter of air), when this measurement is prorated over a 40-hour week, most exposures were below OSHA's average working-lifetime permissible exposure limits (0.5 fibers per cubic centimeters of air per 8-hour day); (5) users continue to be exposed to asbestos fibers which they carry home on their clothes and vehicles; (6) people who have used the area over the past few years probably will not develop an abnormal disease pattern, however, continued exposure could result in detectable effects in some individuals from a number of exposures over a number of years.

In 1980 asbestos was detected in the San Luis Canal (California Aqueduct) south of Huron, California. Government studies have shown that, during flood events, asbestos-laden water and sediments flow into the Arroyo Pasajero and sometimes into the San Luis Canal (the California Aqueduct) near Huron. It what risk it may pose. The Feasibility Study which will examine the feasibility of using various options to control and cleanup the asbestos contamination. The types of options which will be considered include:

° Removal - how much, from where and to where, and ways to handle the material;

° Prevention of movement such as on-site sedimentation basins, dust control, diversion ditches, and wind fences; and,

° Containment - such as capping, pavement, or other types of control of the tailings, piles, streambed sediment, and detention basin sediments.

EPA is also required to consider the effects of no further control actions. This option would be selected only if taking no further action will adequately protect human health and the environment. Each of the control options will be evaluated to determine how well it satisfies the objective of a safe, reliable, and cost-effective permanent remedy.

The vegetation in the Clear Creek Management Area is extremely unique and of scientific and aesthetic value. There are two distinct divisions of the flora: (1) vegetation on soils derived from serpentine rock sources; and (2) vegetation on soils derived from sedimentary rock sources. The serpentine endemic vegetation is a complex of plant communities dependent upon the soil mineralogy, soil temperature and precipitation. Dominate tree species include Coulter pine (*Pinus coultri*), Jeffery pine (*P. jefferyi*), incense cedar (*Calocedrus decurrens*), and Coulter-Jeffery pine hybrids. As the soil

The Hernandez Reservoir was constructed as a water conservation project to percolate water back into underground water basins in the southern Santa Clara Valley (Pajaro River Hydrologic Area). It was completed in July 1962 and originally had a capacity of more than 18,500 acre-feet of water. The San Benito County Water Conservation and Flood Control District manages the reservoir. It has been estimated by the San Benito County Water Conservation and Flood Control District that sediment from the upper San Benito River drainage has been filling the reservoir at double the anticipated rate since it was first constructed. The Clear Creek Management Area is one part of the Hernandez Reservoir watershed.

Wildfire occurrence in the area has been historically low with most fires being contained to less than 200 acres in the last 30 years. In 1955, the Burkett Fire burned the lower half of Clear Creek Canyon and most of the Laguna Mountain area on about 9,500 acres (about 3,500 acres was public land). The Los Gatos series fires (#2 & #4) in 1985, consumed more than 26,805 acres (14,850 acres public); and New Idria fire in 1987, burned more than 150 acres of public land. Extensive wildfires can be the cause of increased erosion in the years immediately following the fire until a vegetative cover can be re-established.

Natural erosion has resulted in high sediment loads in various drainages within the area. The region contains outcrops of extremely weathered, fragmented, and decomposed serpentine rock containing chrysotile asbestos minerals. These bare outcrops lack soil or vegetative cover and are often on

Applicability of GIS

With enactment of the Superfund Amendments and Reauthorization Act (SARA) in 1986 and implementation of Executive Order Number 12580 in 1987, BLM is required to proceed with due diligence to address all sites identified on the EPA's National Priorities List. The Atlas Asbestos Mine Remedial Investigation/Feasibility Study (RI/FS) will provide a number of extensive background sampling studies which are designed to provide sufficient data for the development of a set of cleanup strategy alternatives; this data will also be analyzed on effectiveness and cost factors.

The development of a GIS database in conjunction with the RI/FS effort has been identified as a reasonable means to deal with this problem and provide a basis for implementing an "areawide" approach to the asbestos hazard problem in the Clear Creek Management Area. The EPA supports this concept of an "areawide" approach to this problem.

Additional applications would include day-to-day requirements for the management area and documentation of the implementation of the Clear Creek Management Plan.

Geographical Area

The Clear Creek Management Area includes approximately 50,501 acres of public land. The map base for the Management Area is six 7.5 minute (1:24,000) USGS quadrangles. The density of public land on each quadrangle varies. The 7.5 minute quadrangles in the Management Area are:

Map theme data will be digitized from 1:24,000 USGS topography quadrangle maps. All data themes will be mapped on base mylar or paper topographic quadrangles by Hollister Resource Area personnel. Digitization of map data will be completed under contract. The Resource Area will designate a GIS Project Coordinator to facilitate quality control of map data and contract products.

GIS Output Products

The Clear Creek Management Area GIS Project is expected to produce the following tabular and graphic output products:

1. Erosion hazard rating model - a comparative rating based upon input data themes and using the linear Revised Universal Soil Loss Equation (RVUSLE) for analysis (components include: soil erodibility, rainfall and runoff, cover and management, and support practice). See attachment 1 - The RVUSLE/GIS project for details.

2. Delineation of asbestos hazard throughout the serpentine ore body - also a determination of relative percent of asbestos content in soils throughout the ore body.

3. Rehabilitation models for specific sites.

4. Weather/climate data (monitoring network)

Training

<u>FY 88</u> - Data preparation for digitizing

<u>FY 89</u> - GIS/Land Information System (LIS)/Map Overlay and Statistical System (MOSS) training for selected resource specialists. Hollister RA Physical Scientist to be project leader.

<u>FY 90</u> - GIS/LIS/MOSS training for selected resource specialists

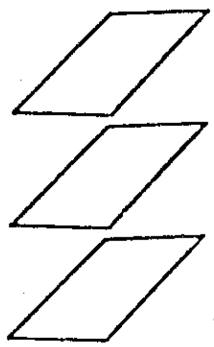
Hardware

Initially, the Hollister RA will require remote GIS capabilities and access to the PRIME Level A (9955-II) at the California State Office in Sacramento. The project is designed so that the early phases will only require that the resource area has graphic terminals and printer to provide the resource specialists with the ability to access the project data base and apply the analytical capabilities of our GIS software. In FY 88 a monochrome graphic terminal with a laser printer is funded for acquisition. The initial data base development will be accomplished by contract with the data stored on the PRIME Level A in Sacramento. Additional support will be available from the Bakersfield District Office, California State Office, and the Denver Service Center where there is more GIS technical capabilities.

Beginning in FY 89 additional GIS equipment will be needed in the Hollister RA. Again the initial need will focus on providing additional access to the GIS database in the Level A in Sacramento. A color terminal with compatible color ink-jet printer included in the FY 89 ADP and Data Communications Plan. The subsequent need will focus on providing full GIS

THE RVUSLE/GIS PROJECT

$$A = R * K * L * S * C * P$$



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discussing erosion control alternatives
with ranchers, farmers and industry.

5. Predicting average annual erosion rates from sheet and rill erosion within particular watersheds.

Calculating soil erosion using the USLE can be very work-intensive, requiring gathering of large amounts of field data, or/and painstaking analytic procedures for determination of various factors from maps and remote sensing data. Consequently, it is very desirable to develop an automated procedure which would permit user flexibility in terms of manipulation of data, that would rely on readily available information, and an end result of which was a digital soil erosion map that could be used in various ways for further analysis. In deciding what approach to take in developing this procedure these considerations were taken into account, together with capabilities of BLM's GIS hardware and software and present day developments in the area of watershed analysis from digital data. The RVUSLE/GIS procedure will therefore serve as an extremely useful analytic tool in a variety of resource management decisions.

OUTLINE OF THE MAIN PROCEDURE

At the heart of the RVUSLE/GIS procedure is the overlaying in form of multiplication of maps that hold spatially distributed values for various factors of the Universal Soil Loss Equation. Therefore, it is the multiplication of a K-factor map, which hold K values of each soil unit, by an LS factor map which holds LS values, probably per cell, by a C and P factor map which holds C and P product per land cover-land use unit, and a single R factor value for the entire area. In this way, it will reflect the structure of the USLE:

$$A = R * K * L * S * C * P$$ [3]

where

A is the computed soil loss per unit area,
R is the rainfall and runoff factor
K is the soil erodibility factor
L is the slope length part of the terrain factor
S is the slope gradient part of the terrain factor

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[3] Wischmeier, Walter H. and Smith, Dwight D., Predicting Rainfall Erosion Losses-A Guide to Conservation Planning, USDA Handbook 537, USDA 1978.

2. THE LS (TERRAIN) FACTOR

The LS factor consists of two components: slope length (L) and slope gradient (S) related together through an empirically derived equation. The slope length and slope gradient can be obtained through geometric analysis of topographic contour maps of the area or through field measurement. Very often slope length data per soil unit is available in soil surveys, although this information can often be incomplete and measure the width of the soil unit rather than actual slope length.[4] Because obtaining L and S information in this fashion is very work-intensive, with the advent digital topographic data in form of Digital Elevation Models (DEM) and Digital Terrain Models (DTM) some work has gone into developing computer algorithms for determining this and other information about watersheds directly from this type of data.

The definition of the L factor is the length of slope from the origination of overland flow to the area where deposition begins or flow enters a well defined channel (gully). The LS value obtained from a table, graph or calculated from the equation always uses this full slope length. If a situation of extensive changes in gradient along a slope length occurs, the average gradient generally used here is not adequate and a slope can be divided into equal segments (usually not more than three) for which percentage of erosion can be easily calculated. The total LS factor is obtained by using the overall slope length as one of the elements, and the particular gradient as the other, multiplying the result by percentage of erosion expected from a particular segment. It is for the same reason of the necessity of using the entire slope length that the L factor information given per soils unit are not adequate and will tend to underestimate erosion. A soil unit usually covers only part of the slope rather than its entire length.

Considering the definition of the L factor, one of the best possible ways to determine slope length was documented by Dennis Phillippi in his USLE For Rangeland (USDA/SCS Technical Note)[5] in which he describes partitioning of a watershed into mini-basins and determining L from measurements within a mini-basin from top of the divide to the channel. Algorithms for determining mini-

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[4]Morris-Jones, D. R., Application of Remote Sensing and Computer Geographic Information System Technology to Estimating Soil Erosion Potential, PhD Thesis, University of Wisconsin, Madison, Wisconsin, 1985, p.140.

[5]Phillippi, Dennis R., USLE for Rangeland, USDA/SCS Technical Note, May 24, 1978.

length values per raster.

Several other considerations exist in using DEM data. Most of the DEMs are Level I which means that they contain raw, unsmoothed data which might contain pits reflective of the digitizing process. Most of the watershed analysis algorithms include smoothing routines which remove the pits before further processing. Another consideration is the presence of microrelief which causes deposition, but which will not show on a DEM. In one study[9], which also used one of Spanner's earlier versions of the slope length algorithm, the number of moves uphill was limited to three upon consultation with an expert on the area of study. Furthermore, presence of channels and roads will probably have to be accounted for. The need for these improvements will partially depend on the accuracy of other data that goes into the RVUSLE.

The S factor can be easily calculated from the already existing slope algorithm in MOSS/MAPS. The LS factor can be than obtained as a value per cell using the appropriate equation. The calculation can be performed using the MATH command or can be put into the Spanner algorithm directly, if that is possible.

3. THE R FACTOR

The R factor will be entered or calculated from latitude and longitude. It will exist only as a single value by which all the cells in each map will be multiplied.

4. THE C AND P FACTORS

The RVUSLE in its present form has a relatively thorough method for calculation of the C factor for rangelands. For areas which are under cultivation a table is used to establish the P factor.

If the C factor is not known the RVUSLE asks for following input: % of canopy cover, average canopy height, surface % of rock, gravel, litter,and vegetation, root mass in the top 4" of soil and roughness values associated with field conditions, and calculates the C value from this input.

The base map for the C and P values will be a digitized land use-land cover map, or a vegetation map. This map will be rasterized and its subjects will be read into a table with their associated values. Repetition of the RVUSLE code concerning C

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[9] Morris-Jones, D.B., Application of Remote Sensing and Computer Geographic Information System Technology to Estimating Soil Erosion Potential, PhD Thesis, University of Wisconsin, Madison, Wisconsin, 1985.

prepared for a large area.

VALIDATION

While the various components of the program will have to be tested for their accuracy, software errors that could occur, user friendliness,etc. it is not within the scope of this project to test the RVUSLE itself. While this method will provide a relatively fast way of testing the RVUSLE for large areas, as discussed above, it is only interfacing the equation with the Geographic Information Systems and therefore making it a more powerful tool. It is not changing anything within the RVUSLE. In that sense, the author is not responsible for proving that the erosion data thus obtained are accurate, but that this method of interfacing with the GIS does not change the RVUSLE structurally in any way. For example, it will be up to the author to compare the accuracy of the automated means of determining the LS factor with the geometric means from topographic maps.