# Annual Report 1997
## Research, Inventory, and Monitoring
### Mineral King Risk Reduction Project

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June 1998

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# 1997 Annual Report - Research, Inventory, and Monitoring: Mineral King Risk Reduction Project

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## *Executive Summary*

The Mineral King Risk Reduction Project (MKRRP) was initiated out of a need to assess the operational requirements and cost effectiveness of large scale prescribed burning for wildland management in a setting altered by a century of fire suppression. The local objectives of the project are to initiate the reduction of unnatural fuel accumulations (these accumulations can create hazardous conditions for visitors, developments, and natural resources) and begin restoration of ecosystem structure and function within the East Fork drainage of Sequoia and Kings Canyon National Parks. However, because the scale of the project is unprecedented, a number of integrated monitoring and research projects were also initiated to assess the impacts and responses of key components of the watershed to prescribed fire. Additional projects have also been initiated to utilize this opportunity to gain additional insights into fire's role in Sierran ecosystems. These projects and their results are important in providing information about short- or long-term resource responses and impacts when burning at this scale, a relatively new management strategy, and whether the planned objectives for the MKRRP are being met. This information will feed back into management planning and permit modification and fine tuning of the burn program in addition to providing information to the public and policy makers.

Support for the monitoring and research projects is coming from a variety of sources. Projects funded directly out of the Mineral King Risk Reduction Project include fire effects monitoring, fuel and wildlife inventories, and a study on the relationship between fuel loads and fire impacts on giant sequoia fire scars. Other projects are using resources from within and the Sequoia and Kings Canyon Field Station (Biological Resources Division of the USGS). These include natural resource inventory, watershed hydrology, stream chemistry, resampling old vegetation plots, and fire history. Cooperative research projects are also underway using the dedication, energy, and support of graduate students from several universities (University of California, Davis; University of California, Berkeley). New research projects being initiated during 1997 include a fire effects/remote sensing study of red fir forest (UC Berkeley) and a watershed sediment transport study (BRD/USGS).

Several noteworthy observations or findings were made by the monitoring/research projects from 1995 to 1997. The small mammal trapping project found that small mammal populations roughly doubled in the burned sequoia plot compared to preburn population densities. Fire effects plots showed overstory tree mortality varied by vegetation type: 22% red fir forest (ABMA), 50% sequoia mixed-conifer forest (no mortality of overstory sequoias was noted), and 98% in low elevation mixed-conifer forest (CADE). These plots also showed total fuel reductions of 72% (CADE) to 94% (ABMA). A significant increase in giant sequoia seedlings was noted in the burned Atwell sequoia plots. Watershed sampling completed its first full water year of sampling, providing preburn data on trends within the East Fork. Initial results suggest similar annual shifts in flow, pH, and ANC (acid neutralization capacity) when compared to other unburned Sierran watersheds.

Burning in the watershed during 1997 amounted to 375 ha (925 ac). Most of the critical Redwood Segment (segment #4) was burned during the fall. This created a buffer of reduced fuels across the East Fork below Silver City and Cabin Cove. Additional burning along the Tar Gap Trail in Tar Gap Segment (segment #10) created a break in the continuous fuels across this segment.

The MKRRP area encompasses 21,202 ha (52,369 ac) within the East Fork watershed with elevations ranging from 874 m (2,884 ft) to 3,767 m (12,432 ft). Vegetation of the area is diverse, varying from foothills chaparral and hardwood forests at lower elevations to alpine vegetation at elevations above about 3,100 m (10-11,000 ft). About 80% of the watershed is vegetated with most of the remainder being rock outcrops located on steep slopes and at high elevations.

# 1. Project Year Synopsis: Accomplishments for 1997 projects.

- **Fire Effects Plots** - Fire effects plots are being established within the Mineral King Risk Reduction Project (MKRRP) area to allow park staff to monitor both the short- and long-term effects of the management ignited prescribed burns on park vegetation and fuels (primary emphasis is placed on fuel loads and tree density). These plots provide important feedback to park managers on how well they are meeting their management goals and will help refine the goals of future burn plans. A total of 18 fire effects plots have been set up in the East Fork since 1995. These include seven forest plots (five in segment #3, three in segment #10, and a control plot adjacent to segment #3) and nine brush plots (located on the north side of the East Fork). Five forest plots burned following the ignition of segment #3 during the fall of 1995 with one and two year postburn rechecks completed during 1996 and 1997. The rechecks showed overstory tree mortality varied by vegetation type: 22% red fir forest, 50% sequoia-mixed conifer forest (no mortality of overstory sequoias was noted), and 98% in ponderosa pine forest. Total fuel reductions of 72% were found in ponderosa pine forest, 89% in sequoia-mixed conifer forest, and 94% in red fir forest. Additionally, giant sequoia seedlings increased from no seedlings preburn to 88,300 seedlings • $ha^{-1}$ postburned in the Atwell sequoia plots.

- **Wildlife Monitoring** - Four permanent small mammal live-trapping plots have been established and sampled between 1995 and 1997. Understanding changes in the composition and numbers of common small mammals is important because they represent an important component in the food chain for less-common wildlife species and thus make good indicators of habitat status. Rodent populations respond readily to changes in vegetation structure and composition due to fire, they are easy to handle, and are a cost-effective tool for monitoring fire effects. The plots are located in sequoia/mixed-conifer forest (Atwell), chaparral/oak shrubland (Traugers), in ponderosa pine/black oak transition forest (Camp Conifer), and Jeffery pine (Mineral King). The mid-elevation sequoia plot, located in segment #3, burned during November 1995 and was resampled in 1996 and 1997. Initial results indicate a doubling of small mammal biomass since the burn. The ponderosa plot burned during November 1997 and will be resampled during 1998. Serendipity trapping (non-permanent trap locations) was also carried out at a number of locations in the Mineral King Valley and Oriole Lake watershed.

- **Watershed Sampling: Stream Chemistry and Hydrology** - Stream chemistry and hydrological information have been sampled by staff of the Biological Resource Division of the USGS at regular intervals (weekly) since May 1995. Three sites are being sampled in the East Fork (the East Fork itself and two tributary creeks, one in chaparral and one in mixed-conifer forest) which will provide data to help assess the effects of watershed scale prescribed fire on important chemical components and flow characteristics. Data will be compared to the "reference" unburned Log Creek watershed in Giant Forest, sampled as part of another long-term watershed study. Watershed sampling completed its first full water year of sampling, providing preburn data on trends within the East Fork. Initial results suggest similar annual shifts in flow, pH, and ANC (acid neutralization capacity) when compared to other Sierran watersheds.

- **Watershed Sampling: Benthic Macro-Invertebrate Survey** - Ian Chan, Don Erman, Nancy Erman (UC Davis) are conducting a pre- and postburn survey of benthic macro-invertebrates in the East Fork. This study will assess the effects of prescribed fire on the structure of aquatic macro-invertebrate communities and provide baseline inventory of composition, abundance, and diversity. Six treatment streams (situated in areas that will be burned) and four non-treatment reference streams (which will remain unburned) have been located and sampled in the Middle Fork watershed. Benthic macro-invertebrates are collected through a combination of quantitative sampling and qualitative description in three habitat types: riffles, pools, and slickrock glides. In addition, several artificial substrates (unglazed clay tiles) were placed in slickrock area to help quantify colonization

rates. The initial postfire sampling has been completed on the Redwood and Atwell Creek sites that burned during 1995.

- **Fire History** - Fire history samples were obtained from Atwell, Lookout, Redwood, Tar Gap, Oriole Lake, Eden Grove, Mineral King, and Purple Haze segments from 1995 to 1997. These samples will become part of an effort to reconstruct the spatial scale and pattern of pre-European settlement fire events from throughout the East Fork watershed and to provide baseline data on past fire occurrence in a variety of habitats, vegetation types, and aspects in the drainage. Predictions of past fire occurrence in the Sierra Nevada based on computer models suggest differences in burn patterns/frequencies on different aspects with these differences most notable between south and north slopes. However, at this time almost no data exists on pre-European settlement fire history for north aspect forests in the southern Sierra Nevada. Thus information collected in the East Fork will be important in verifying these models, in addition to providing park staff with better information about fire over the landscape.

- **Giant Sequoia Fire Scars and Fuel Loading** - A total of 60 giant sequoia trees (30 scarred and 30 unscarred) have been measured in the Atwell Grove to help determine the effects of prescribed burning on fire scar formation and how changes in fire scar dimensions and bark charring relate to the fuel accumulations and consumption of the fuels surrounding trees by prescribed burning. All trees examined within the study area burned during November 1995 and were resampled during 1996 with fuels remeasured during 1997. No sequoia mortality resulted from the fire although small new fire scars were noted on some trees by the field crew doing the postburn sampling.

- **Fuel Inventory and Monitoring** - Fuel-load sampling was carried out during 1995 and early summer of 1996 to obtain field information on forest fuels (tons per acre) that are available to forest fires. During 1997 permanent fuel plots were established This information will provide improved fuel model data for input into the FARSITE fire spread model which will be used to more accurately predict fire spread following an ignition. Most sampling has concentrated on the south aspect of the East Fork and in segment #10. To date over 580 plots have been sampled including 44 permanent fuel plots established during 1997. In addition to estimating fuel loads at each plot, additional forest attribute measurements were obtained on tree height, basal area, height to lowest branches, and on litter and duff depths.

- **Red Fir (Pitcher) Plots** - In the late 1970's Donald Pitcher (graduate student at UC Berkeley) established three permanent plots in red fir forest along the Tar Gap Trail near Mineral King to study forest structure and composition (what species are present and how are they arranged in a forest), and fuel dynamics (fuels available for burning). These plots were relocated in 1995 and are now being resampled prior to the burning of segment #10 (sampling of two plots is complete). Because of little long-term data from red fir forest these plots will provide important information to park managers on changes in forest structure and composition, and fuel loads over a 20 year period. Initial estimates indicate a significant increase in fuel loads and 22% mortality of all saplings/trees in the plots (most mortality, 75%, is a result of the death of young seedling and sapling as the forest naturally thins itself over time). Postburn sampling of these plots will also provide detailed information on forest changes and fire effects which has been little studied in this forest type.

- **Landscape Analysis - Fire and Forest Structure** - Kurt Menning's (graduate student at UC Berkeley) research will address questions revolving around the means and the landscape-scale consequences of selecting differing mechanisms for restoring forest structure to something near pre-Euroamerican conditions. Using high resolution aerial imagery and field sampling he will describe the current structure and pattern of mixed conifer forest over the landscape and then how the qualities of these change as fire is restored to the ecosystem. Field sampling was carried out this past summer in the Redwood, Tar Gap, Purple Haze, Deadwood, High Bridge, and Eden Grove Segments. Plots burned during 1997 will be resampled in 1998. High resolution digital multispectral imagery was recently

acquired by an overflight over the East Fork. The imagery will have high enough resolution (one meter) that individual tree crowns should be discernable, allowing detailed observations on tree health and species to be made.

- **Natural Resource Inventory** - The Natural Resource Inventory (NRI) staff of the Biological Resources Division of the USGS (formerly NBS) have been establishing permanent inventory plots within the drainage. The general purpose of the NRI plots is to provide a systematic, plot-based inventory for detecting and describing the distribution of vascular plants, vertebrate animals, and soils throughout the Sequoia and Kings Canyon National Parks. Within the East Fork, the plots document the preburn floristic composition and structure of vegetation. Since 1995, 18 plots have been established as part of the MKRRP. These supplement 32 plots that already existed in the watershed. Plots that burned during 1995 have been revisited during 1996 (seven of nine were relocated) to assess burn impacts and first year postburn vegetation responses. An effort was made to also sample locations falling within the little known, dense chaparral vegetation of the East Fork. Plots burned during November 1997 will be resampled during 1998.

# 2. Overview of Project

## 2.1 - Objectives

The direct objectives of the Mineral King Risk Reduction Project (MKRRP) for Sequoia and Kings Canyon National Parks (SEKI) focus on reducing unnatural fuel accumulations that have resulted from a century of both direct and indirect fire suppression activities in southern Sierran ecosystems (NPS 1995, Stephenson 1995). In many instances these fuel accumulations create hazardous conditions for visitors, developments, and natural resources. The overall objectives of the project are to assess the operational requirements and cost effectiveness of large scale prescribed burning for wildland management (NPS 1995). The latter evaluation will be accomplished through the use of information derived from the field operations and their outcome within SEKI.

The conditions resulting from unnatural fuel accumulations have resulted in wildland managers being called upon to modify fuels in order to reduce wildland fire hazard and restore ecosystems to some semblance of pre-Euroamerican conditions. Current national management issues are forcing land managers to use two main tools for fuels management: mechanical removal (cutting) and/or prescribed burning. However, both of these tools remain controversial and managers are being asked to justify their choices. These issues motivated a major effort by the National Interagency Fire Center (NIFC) to begin an assessment of the operational requirements and cost effectiveness of using large-scale prescribed burning as a tool in fuels management. As part of this effort NIFC funded Sequoia and Kings Canyon National Parks to carry out a watershed-scale burn program with an objective of prescribed burning about 30,000 acres over a five year period (1995-2000) in the East Fork of the Kaweah River (**Fig. 2.1-1**). A collateral objective of the burn project is to evaluate the cost effectiveness of a hazard fuel reduction program of this magnitude by Colorado State University.

Since the scale of the burn project is unprecedented a number of integrated resource related studies are being undertaken and are an integral part of the project. These research, inventory, and monitoring projects in the Mineral King burn are designed to meet the following objectives (Stephenson 1995) :

> ***To supply the information needed to practice adaptive management*** *(1) by determining whether the burn program's objectives are being met, (2) by identifying unexpected consequences of the program on the ecosystem, and (3) if objectives are not being met, by suggesting appropriate program changes.*
>
> ***To provide information for public education, response to public and governmental inquiries, and to document legal compliance.***

These research and monitoring objectives are particularly important because SEKI's watershed scale burn program will be one of the first national attempts at using fire on a watershed scale for fuels management. The various research and monitoring studies are being integrated with the project's management objectives. Support for new studies that compliment or enhance the currently implemented studies are being sought (for example, proposals for funding for a watershed sediment transport study are being developed by the Biological Resource Division of the USGS). Additionally, unsolicited studies by non-MKRRP funded researchers (primarily from universities) are also integrated with the overall project goals to the greatest degree possible

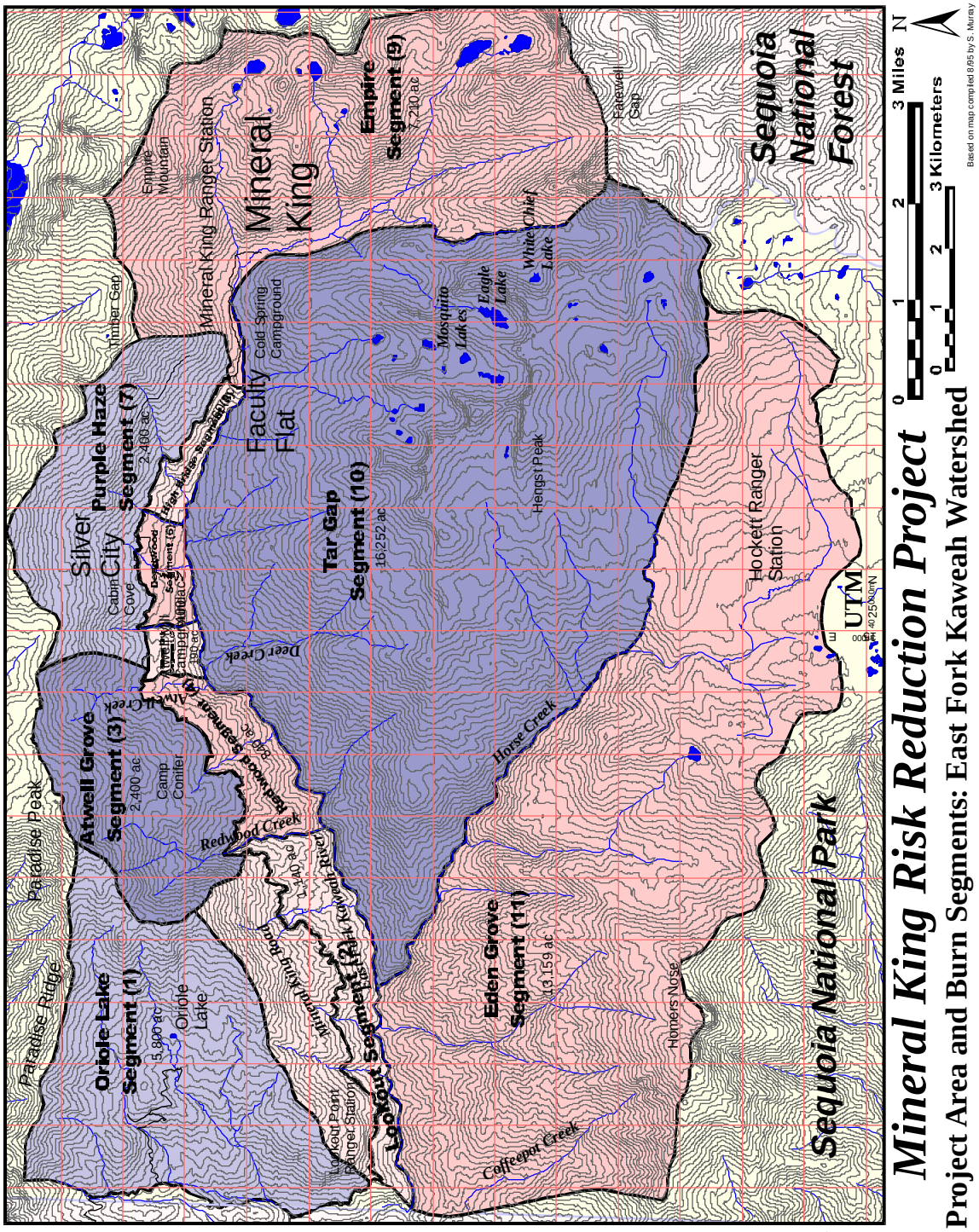


**Figure 1.**

**Figure 2.1-1.** Mineral King Risk Reduction Project project area and segment layout.

consistent with the study objectives. Descriptions of studies and the East Fork are available in the 1995 and 1996 MKRRP Annual Reports (Caprio 1995; Caprio 1996).

# 2.2 - Description - East Fork Project Area

The East Fork watershed (**Fig. 2.2-1**)which encompasses the MKRRP is one of five major drainages comprising the Kaweah River watershed which flow west (historically but is now heavily diverted for agriculture) into the Tulare Lake Basin in the southern Central Valley. Terrain in the watershed is rugged, elevations range from 874 m (2884 ft) to 3767 m (12,432 ft) within the project area. The watershed, 21202 ha (52369 ac) in size, is bounded by Paradise Ridge to the north, the Great Western Divide to the east, and Salt Creek Ridge to the south. Major topographic features of the watershed include the high elevation Mineral King Valley, Hockett Plateau, Horse Creek, the high peaks producing the Great Western Divide, and the Oriole Lake subdrainage (with an unusually low elevation lake for the Sierras at 1700 m elevation).

**Table 2.2-1.** Segment number and size.

| Segment | Hectares | (Acres) |
|---|---|---|
| Oriole Lake (#1) | 2352 | (5811) |
| Lookout Point (#2) | 439 | (1084) |
| Atwell Grove (#3) | 962 | (2377) |
| Redwood (#4) | 289 | (716) |
| Deadwood (#5) | 121 | (300) |
| Silver City (#6) | 135 | (335) |
| Purple Haze (#7) | 989 | (2445) |
| High Bridge (#8) | 121 | (299) |
| Empire (#9) | 2917 | (7210) |
| Tar Gap (#10) | 6577 | (16252) |

Eleven burn segments have been outlined within the watershed by fire management staff (**Table 2.2-1** and **Fig. 2.1-1**). Eight segments were designated on the south facing slope (north side of the East Fork) and three large segments on the more remote north slope (south side of the East Fork). Segment locations were established to facilitate prescribed burning operations and protection of primary developments within the watershed.

Vegetation of the area is diverse, varying from foothills chaparral and hardwood forest at lower elevations to alpine vegetation at elevations above 10-11,000 feet. About 80% of the watershed is vegetated with most of the remainder rock outcrops located on steep slopes and at high elevations. Lower elevation grasslands and oak woodland, while common at low elevations in the Kaweah drainage, are uncommon within the park's portion of the East Fork watershed. Sequoia groves within the project area include Atwell, East Fork, Eden, Oriole Lake, Squirrel Creek, New Oriole Lake, Redwood Creek, Coffeepot Canyon, Cahoon Creek, and Horse Creek. Vegetation is dominated by red and white fir forest with pine and foothill types of somewhat lesser

| Vegetation Class | Hectares | (Acres) |
|---|---|---|
| Foothills Chaparral | 1119 | (2764) |
| Foothills Hardwoods & | 1433 | (3538) |
| Ponderosa Pine Mixed Conifer | 1968 | (729) |
| White Fir Forest | 4034 | (9964) |
| Red Fir Forest | 4206 | (10388) |
| Xeric Conifer Forest | 1244 | (3074) |
| Montane Chaparral | 484 | (1195) |
| Mid-Elevation Hardwood Forest | 170 | (420) |
| Lodgepole Pine Forest | 967 | (2387) |
| Subalpine Forest | 99 | (266) |
| Meadow | 133 | (328) |
| Other (primarily water) | 100 | (247) |
| Barren Rock | 4198 | (10368) |
| Missing or No Data | 1050 | (2593) |

**Table 2.2-2.** Vegetation type classification for the East Fork watershed and the area occupied by each class.

**Figure 2.2-1.** Main drainage of the East Fork of the Kaweah from Case Mountain. Photo does not show the Oriole Lake subdrainge (left of view). Photo by Linda Mutch.

importance (**Table 2.2-2**). No endangered species are known from the watershed although several sensitive species have been located during surveys (Norris and Brennan 1982).

Access to the area by road is limited to the narrow winding Mineral King Road, 25 miles long. The Mineral King Valley is popular with backpackers and packers as a starting point for many high country trips. Higher elevations of the watershed receive considerable recreation use while lower elevations receive relatively little use. Developed or semi-developed areas within the watershed include Silver City/Cabin Cove, Mineral King, Lookout Point, Oriole Lake, and the Atwell Mill areas. NPS campgrounds exist at Atwell Mill and Mineral King.

In early 1998 black-and-white DOQQs (digital orthophoto quarter quads) were made available for the East Fork drainage (**Fig. 2.2-2**). These can be accessed off the park computer system at Ash Mountain (see Pat Lineback, SEKI GIS Coordinator). They have an image resolution of 1 meter.

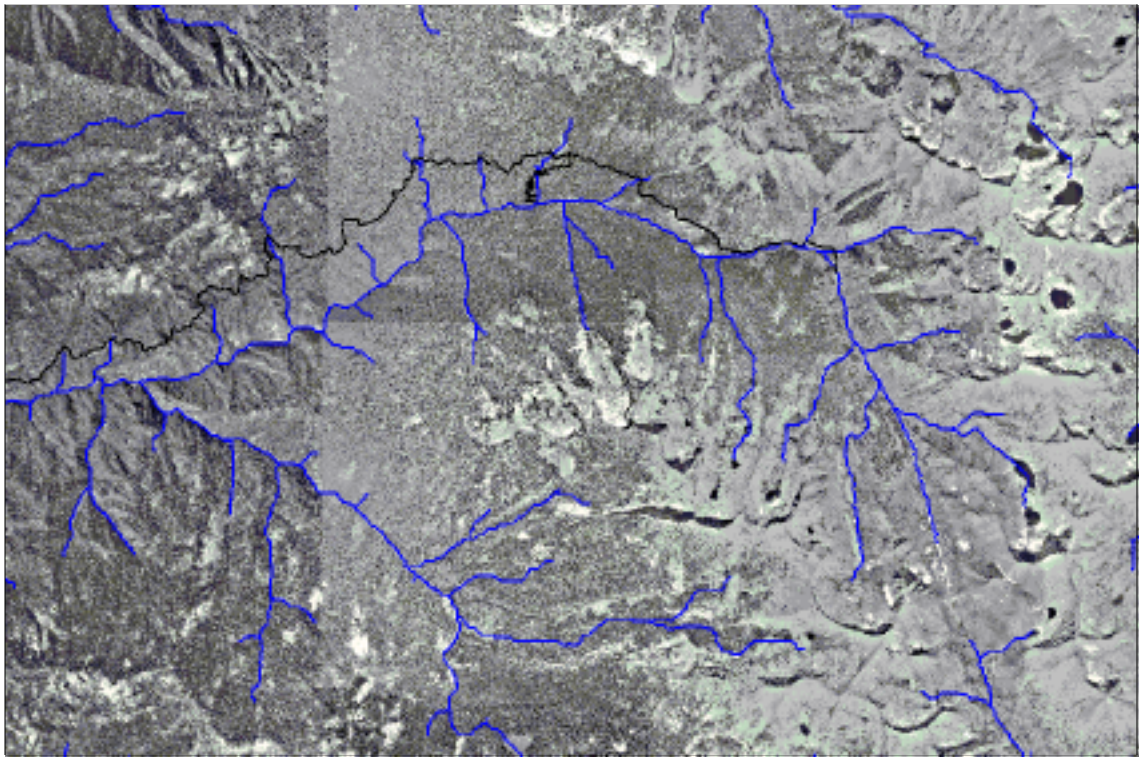

**Figure 2.2-2**. Image of the East Fork drainage derived from the eight DOQQs which cover the area. Hydrological features and roads were added in ArcView using park GIS data layers.