WRD RESOURCE ROOM JOMU

Watershed Condition Assessment

of Sub-drainage Zone No. 1167

John Muir National Historic Site
Martinez, California

Richard Inglis

Technical Report NPS/NRWRD/NRTR-2000/262

WATER RESOURCES DIVISION

National Park Service - Department of the Interior
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February 2000

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National Park Service
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Fort Collins, CO

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Acknowledgements

I gratefully acknowledge Phyllis Shaw, Superintendent of John Muir NHS, and her staff for background information and field support for this project. I want to thank Sue Worley of the NRCS for her encouragement and the Alhambra Creek Watershed Planning Group for its backing. I appreciate the cooperation of the Contra Costa County Flood Control Flood Control District and their sharing of rainfall and hydrologic information. Last, but not least, thanks to Dean Tucker for his technical wizardry and Pat Wiese for her editorial clarity.

Executive Summary

This watershed condition assessment is intended to guide John Muir National Historic Site (JOMU) to the best combination of land management practices to improve watershed condition and reduce flooding. Flooding has frequently occurred downstream in the Strentzel Lane area from the Sub-drainage Zone No. 1167 watershed, located on the south side of Mt. Wanda and Mt. Helen. The area of the Sub-drainage Zone No. 1167 watershed above the Alhambra Valley Road is 264 acres with 117 acres (or 44 percent) of this basin under National Park Service (NPS) management. This document will not discuss modifications of the drainage through the Strentzel Lane neighborhood.

This report describes how watershed processes at JOMU affect the relationship between rainfall and the potential for producing floods and reports the results of rainfall/runoff modeling to examine several land management options. The assessment examines watershed features, determines factors of concern, and analyzes those factors affecting watershed runoff and downstream flooding. Vegetation, channel condition, and the presence/absence of stock water detention structures are the primary management variables evaluated. The principle analytic tool is a computer model (TR-55) that predicts the amount of peak flows from inputs of precipitation and land use factors. The primary source of information available for the Sub-drainage Zone No. 1167 watershed and the surrounding Alhambra Creek is a Geographic Information System package prepared by the Natural Resource Conservation Service.

To compare alternative management scenarios a variety of model simulations were computed. A baseline combination of landscape factors was chosen as a starting point/ reference condition to examine the effect of each scenario separately. This modeling starting point approximates today's watershed conditions. Parameters were not changed on private lands (except for the effect of ponds). The results from the model simulations are consistent with general understanding of watershed processes. The "Baseline" discharge (182 cubic feet per second (cfs) for a 10-year storm, which is used in this report as a standard design storm) compares well to Contra Costa County Public Works results for a peak flow of 190 cfs for a 10-year storm. The 10-year storm is the rainfall event modeled in the scenarios described below.

Flooding likely will occur in the Strentzel Lane neighborhood under current conditions with any flows above an estimated 20 – 50 cfs. Reductions in peak flows can be achieved by improving watershed conditions consistent with park resource protection responsibilities. These reductions however will not significantly reduce flooding downstream. Repairing the existing stock ponds also will not reduce flooding downstream because their upper watershed locations influence only a very small percentage of the total watershed. The most significant reduction of flooding, using the model, occurred with the inclusion of a large detention basin in the lower watershed. However, such a large water control structure is not compatible with park resource protection mandates.

The alternative scenarios modeled and their reduction of peak flows include 1) improving vegetation condition – 10%, 2) changing vegetation type – 27%, 3) improving channel condition – 2%, 4) reconstruction of existing ponds – 17%, 5) fire road effects – 2%, 6) reconditioning the diversion channel – 3%, 7) addition of wetlands – 58%, and 8) effect of a stormwater pond – 88%. The results of the acceptable scenarios range from 2% to 10%, because some scenarios are incompatible with park management goals. For example, encouraging the growth of brush may not be compatible to the park's Cultural Landscape Plan because grass is thought to predominate in John Muir's era. Also, brush may not be suitable with the Contra Costa County Fire Management Plan.

The "best management practices" scenario does not result only in the improvement of water quality, but also benefits the aquatic resource and reduces flooding by 12%. To maximize the benefit for aquatic resources and ultimate hydrologic restoration of a watershed, the combined factors show a reduction of peak flow by 26%. A "worst case" scenario was created from the existing factors, which generated a peak flow of 234 cfs — an increase of 29%. If the private land is developed with ½ acre lots and the NPS property is left as is (baseline conditions) the peak flow delivered to Strentzel Lane will be 213 cfs — an increase of 17%.

Introduction

The purpose of the watershed condition assessment is to guide John Muir National Historic Site (JOMU) to the best combination of land management practices to improve watershed conditions and reduce flooding downstream. The assessment is intended to document the effects of land uses on watershed runoff and to suggest opportunities for reducing flooding by improving watershed conditions. Watershed conditions are defined as the ability of physical and biological features within a land area with a common drainage to affect surface runoff. Variables of greatest concern at JOMU include vegetation and channel conditions and the presence/absence of stock water detention ponds. The report is structured to present an overview of the Sub-drainage Zone No. 1167 (WS1167) watershed, a description of the runoff model, a brief explanation of the methods and alternative scenarios, and a discussion of the results and the conclusions.

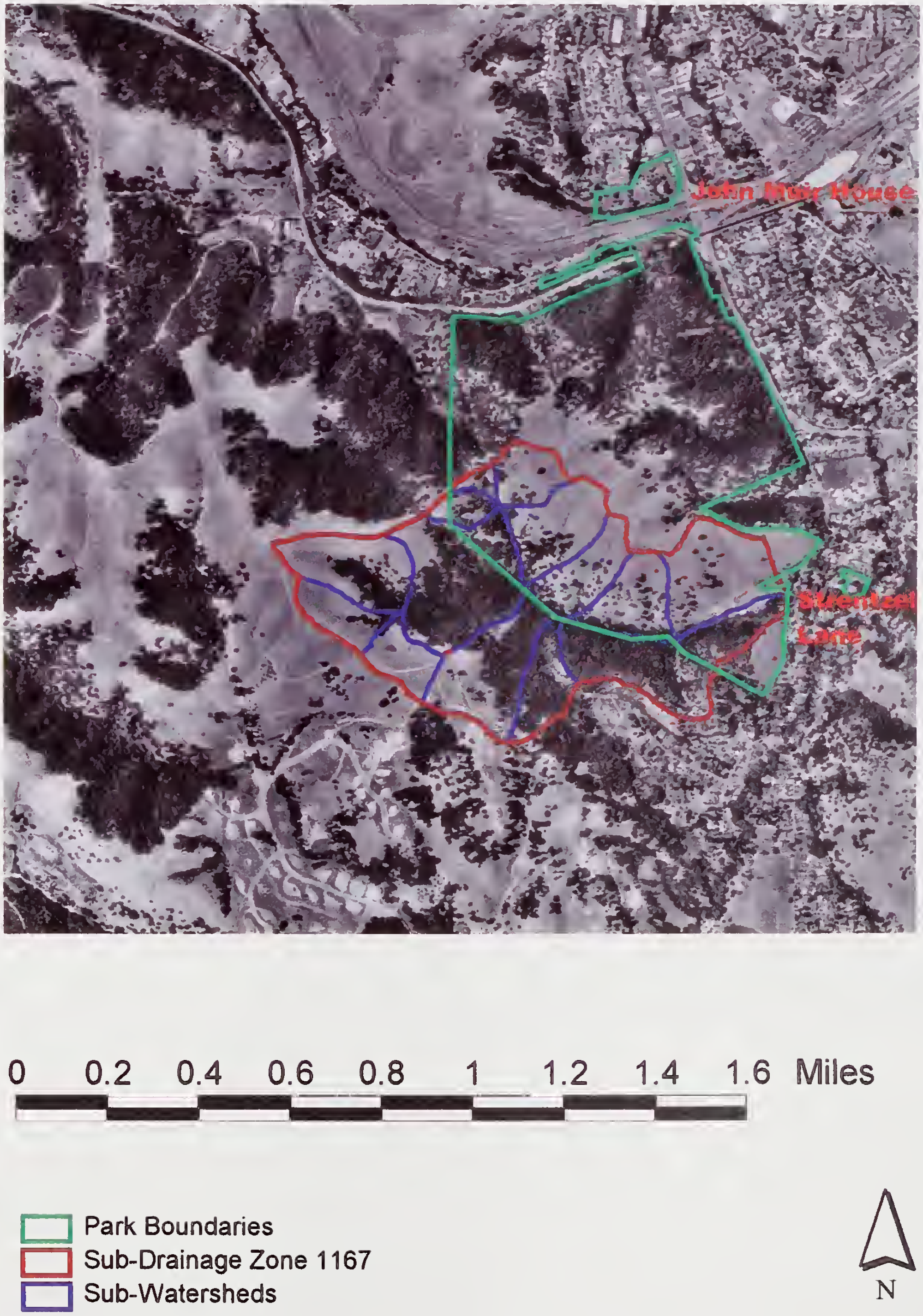
Watersheds are basic hydrologic units, which function as catchments that respond to rainfall and generate stream flow. Watersheds are often used as a practical land management unit for many purposes, such as addressing water quality degradation, managing forested ecosystems, or recovering endangered or threatened fish. The report will 1) describe how watershed processes at JOMU affect the relationship between rainfall and the potential for producing floods and 2) model rainfall/runoff to examine several land management options.

The largest watershed in JOMU is located on the south side of Mt. Wanda and Mt. Helen, named after John Muir's daughters. The Contra Costa County Flood Control District refers to it as the Sub-drainage Zone No. 1167 watershed or (using USGS nomenclature) "unnamed west tributary to Arroyo Del Hambre in the vicinity of Strentzel Lane." The watershed drains into Alhambra Creek (Arroyo del Hambre on the USGS quads) through the neighborhood surrounding Strentzel Lane. The Strentzel Lane neighborhood is outside the city of Martinez in unincorporated Contra Costa County, California. Changes to the Strentzel Lane drainage system are not discussed because it is beyond the scope of the report. The area of the WS1167 watershed above the Alhambra Valley Road is 264 acres with 117 acres (or 44 percent of this basin) under NPS management (Figure 1). There are several private pastures utilized by cattle and about a half dozen residential lots on the south side of the watershed. The watershed is generally described as open oak woodland on deeply dissected hills in the Coast Range east of San Francisco Bay (Photo 1). The only streams in the drainage are ephemeral and are not named on the USGS 7.5-minute quadrangle maps.

Many changes to the landscape have occurred to the area around JOMU, such as the construction of fire roads and the change of some of the native vegetation. These changes serve to influence watershed runoff and the magnitude of floods. It is the intent of JOMU management to restore the landscape as much as possible to the 1880's when John Muir lived in the area (see Appendix C - Archeological Assessment). The watershed management objectives for the JOMU open space areas include: 1) restoring as much as possible the historical vegetation, 2) controlling visitor access, 3) preventing wild fire, and 4) reducing unnatural causes of flooding.

The conversion of rural land to urban land usually increases storm runoff and erosion in a watershed. An urban or urbanizing watershed is one in which vegetation is removed,

Figure 1. Map of John Muir NHS and Sub-Drainage Zone No. 1167



impervious surfaces cover or will soon cover considerable areas, and drainage systems are constructed to facilitate storm runoff. Impervious surfaces include roads, sidewalks, parking lots, and buildings (Photo 2). Urbanization changes a watershed's response to precipitation. The most common effects are reduced infiltration and decreased runoff travel times, which may substantially increase peak discharges and runoff (United States Soil Conservation Service, 1986).

Photo 1 – WS1167 Watershed

Photo 2 – Impervious Surfaces

Background

During the 1998 El Niño rainstorm events, localized flooding occurred along several streets downstream from the park. The Martinez Water Department reported 3.22 inches of rain in a 24-hour period (Mark, 1998), while about ten miles away, 3.60 inches and 4.11 inches were reported at Pittsburg and Oakland, CA, respectively. Flooding in the Strentzel Lane neighborhood was near John Muir's gravesite, which has recently been acquired by the NPS.

The NPS purchased the Mt. Wanda properties upstream of the gravesite a few years previously (1991 and 1992). The Mt. Wanda property had been grazed under the management of the Strain Ranch since about 1950. The park, with the Mt. Wanda area, comprises about 4 percent of the Alhambra Creek watershed. How much flooding occurred from this tributary watershed prior to NPS ownership is not known, but homeowners are claiming increased episodes of flooding. The NPS Water Resources Division was requested to assist with the flooding issue by conducting an assessment of the condition of the watershed above the Strentzel Lane area.

The park boundary roughly leaves the edge of the Alhambra Valley Road and follows the WS1167 channel up the middle of a side valley. At the mouth of the drainage, properties (and some homes) on both sides of the road have been flooded. The downstream side is called the Strentzel Lane neighborhood (named after John Muir's father-in-law). The park side of the road (upstream) appears to be an alluvial fan where some of the homes and the Strain Ranch buildings (also acquired by the NPS) are located. The natural channel has been modified extensively in the past and it is obscure as to where it used to exist on the alluvial fan. A ditch (diversion channel) intercepts the drainage at the apex

of the fan and routes ephemeral runoff along the edge of the fan (on public lands managed by NPS) towards private property. Alteration of channels on alluvial fans can significantly affect flooding characteristics due to the tendency of sediment deposits to occur on fans. Other ditching on the fan and the driveway to Strain Ranch had considerable amount of runoff in 1998. The drainage crosses under Alhambra Valley Road through a 24-inch culvert (estimated capacity at less than 14 cfs) and continues downstream in an improvised channel (with a width of about two feet) between private backyards near Strentzel Lane. It was reported that the culvert under the road did not have the capacity to contain all the flow from the storms. On the downstream side of the road, in the valley bottom of Alhambra Creek, several streets and homes were flooded while the runoff drained toward the main channel of Alhambra Creek. The homeowners have contacted the park, requesting improvements to the drainage to reduce flooding. Flooding in Alhambra Creek is one of the primary issues of a citizens' group called the Alhambra Watershed Planning Group, which is focusing on the development of a comprehensive watershed management plan.

Many homeowners have mentioned to park staff their concern that breaching of a small stock pond by the NPS several years ago (1993) in the upper watershed of the WS1167 has contributed significantly to recent flooding. Later in this report a simulation of flood events will be conducted which includes the hydrological effect of this and other stock ponds existing in the watershed.

The citizens' planning group is developing the Alhambra Creek Watershed Plan, a part of California's Coordinated Resource Management Planning (CRMP) Program. The NPS is represented on that group. The group will develop a watershed management plan, which will address several natural resource issues including: restoration of degraded aquatic communities, prevention of soil erosion, reduction of non-point source water pollution, preservation of property rights, and prevention of catastrophic wildfires. The purpose is to facilitate, coordinate, and support the effort of landowners, municipalities, community organizations, and citizens of Alhambra Creek Watershed to develop and write a watershed management plan using the CRMP process. By addressing the watershed health as a whole, all of the watershed's components – soil, air, plants, animals, and people – will benefit. For more on CRMP, see website http://ceres.ca.gov/cacrmp/index/html.

Alhambra Creek Watershed planning concerns include: 1) chronic flooding, 2) urban developmental pressures, 3) land and water management practices, and 4) maintaining a healthy creek ecosystem. The watershed stakeholders have expressed an interest in using the consensus-based CRMP processes to develop their watershed management plan. The three fundamental tenets of the CRMP process include: 1) local controls of planning, 2) the use of consensus-based decision making, and 3) voluntary implementation of the plan. For more information, see http://www.ca.nrcs.usda.gov/wps/alhambra.htm.

Methods

This watershed condition assessment examined watershed features, determined factors of concern, and analyzed those factors affecting watershed runoff and downstream flooding. The principle analytic tool is a computer model (TR-55) that predicts the amount of peak flows from inputs of precipitation and land use factors. Factors of concern are those landscape parameters that influence runoff and respond to management actions. The factors include vegetative cover, stream channel condition, and the presence of man-made ponds. Parameters such as rainfall, watershed area, geology, and soil type are excluded from the manipulative affects of management but are necessary model inputs.

As part of the watershed assessment, considerable field data have been collected since 1998 in order to reflect current conditions (McCammon, Rector, and Gebhardt, 1998). Site visits were made during or shortly after periods of extensive rainfall. Primary access is along the fire trails maintained by the Contra Costa County Fire District. Due to the smaller size of the watershed (264 acres) the complete area was examined on foot. A field map was made to identify all tributary channels, channel measurement points, and other significant hydrological features (Figure 2). Channel reaches were mapped and assessed for proper functioning condition (PFC) (Appendix A). In general, riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to 1) dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality; 2) filter sediment, capture bedload, and aid floodplain development; 3) improve flood water retention and ground-water recharge; 4) develop root masses that stabilize streambanks against cutting action; 5) develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and 6) support greater biodiversity (Prichard, 1993). Measurement points were selected for collecting channel dimensions for typical reaches, including the diversion ditch in the lower watershed. The impoundment areas of the ponds were measured with a tape and a hand level. When a pond did not contain water, the height of the emergency spillway was located and that contour was measured and mapped uphill from the dam. Lengths and heights of the dams were documented and used for estimating the storage volume of each pond (Van Haveren, 1986). Location and number of new residences were verified as well as the extent of paved streets within the watershed.

A substantial source of information is available for the WS1167 watershed and the surrounding Alhambra Creek area from a Geographic Information System (GIS) package prepared by the Natural Resource Conservation Service (NRCS) (Cunningham and Myers, 1999). See Table 1 for the data themes included from the NRCS package. The USGS 7.5-minute quadrangles in raster format and the digital ortho photo quads were the most valuable source of topographic and surficial features of the watershed. Essential features for the watershed analysis (such as delineating the drainage divides, tributary channels, fire roads, and stock ponds) were digitized on screen using the other layers as a reference. For modeling purposes the WS1167 watershed was divided into sub-watersheds (Figure 3). Different vegetation and soil types within the sub-watersheds were delineated to determine the acreage of each component.

TR-55 Rainfall-Runoff Model

The model used in this study is called TR-55 (Technical Release 55) or *Urban Hydrology for Small Watersheds,* published by the Soil Conservation Service (United States Soil Conservation Service, 1986). It uses simplified procedures for estimating runoff and peak discharges in small watersheds. Normally, hydrologic studies determine runoff and peak

Figure 2. Significant Hydrologic Features

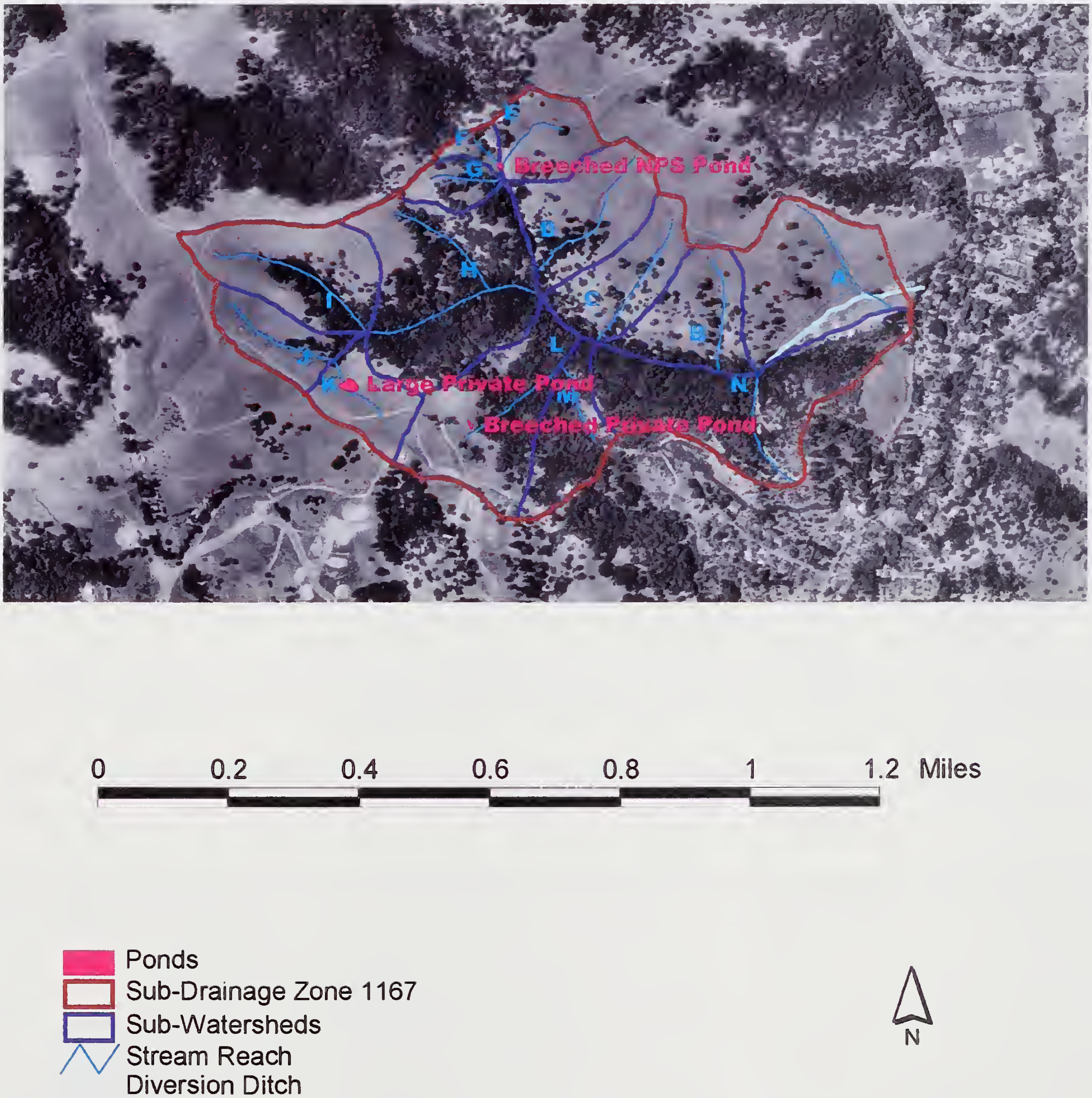
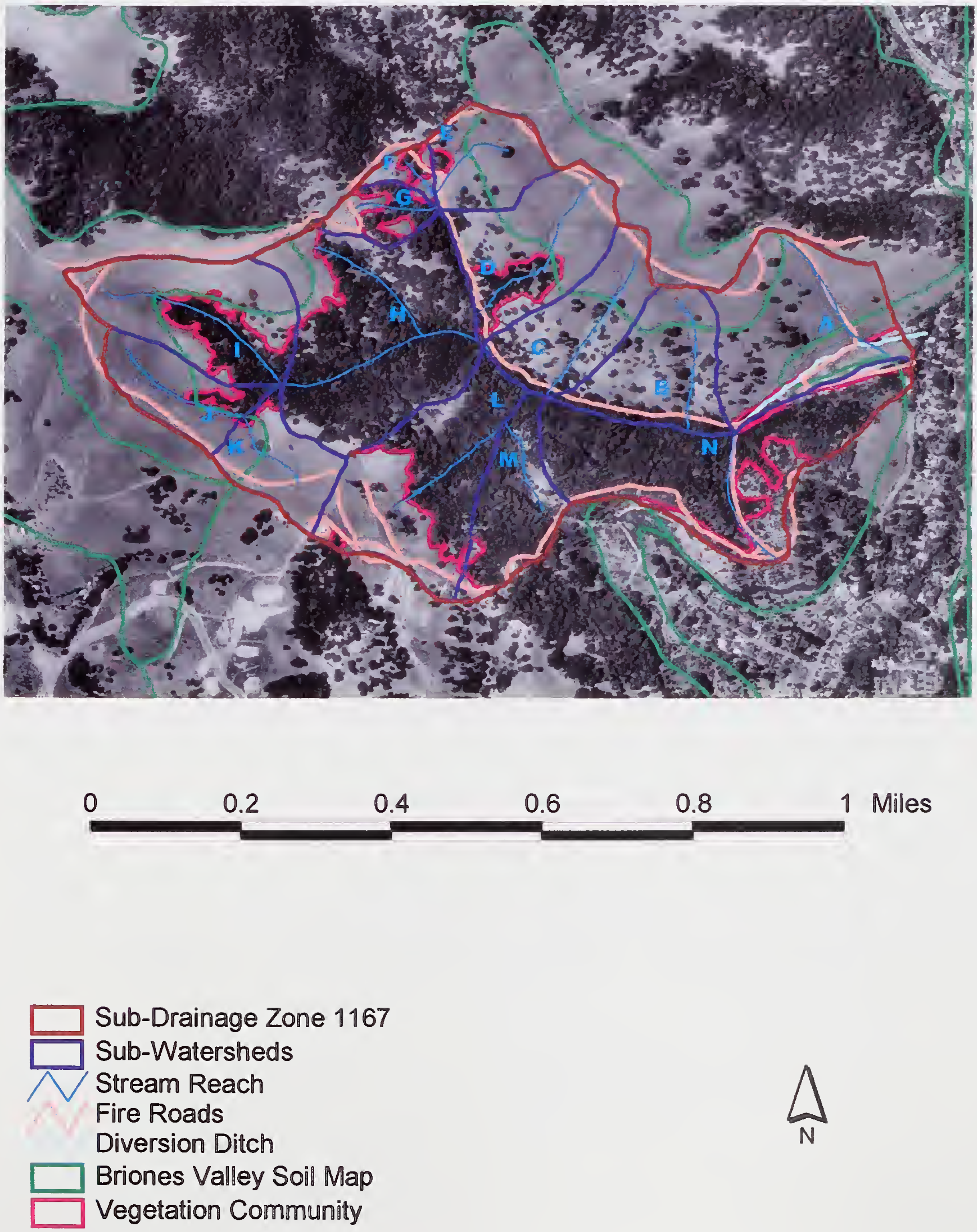


Table 1. Data Themes in the Alhambra Watershed GIS

(from Cunningham and Myers, 1999)

Coverage/ Shapefile	Description	Directory path	Scale of Data	Data Source (Original source)	Original Projection /Final	Area covered
alhambra.tif alhambra.tfw (DRG)	Alhambra DRG (digital raster graphic) file and header file	C:\geodata\alhambra\ DRGs\	1:24,000	Sure!Maps, Horizon Technologies (USGS)	UTM Zone 10 NAD 83 /same	Great Alhambra Creek Watershed Area
Benicia (dem)	Benicia DEM digital elevation model data (also includes hillshade and contours)	C:\geodata\alhambra\ GRIDDEMs\	1:24,000	NRCS (USGS)	UTM Zone 10 NAD 83 /same	Benicia 7 ½ minute quadrangle map
Benne (doq) Bennw Bensw Bense (ie:benne.bil benne.hdr)	Benicia digital orthoquad and header file-- in 4 quarter quads (NW, SW, NE, SE corners of 7 ½ minute quadrangle map)	C:\geodata\alhambra\ DOQs\	1:24,000 (in quarter quads)	NRCS (USGS)	UTM Zone 10 NAD 83 /same	Benicia 7 ½ minute quadrangle map
Bound.shp	Watershed boundary -- ACW Inventory	C:\geodata\alhambra\ shapefiles\	1:2000	NRCS Davis (Contra Costa Flood Control Map)	Unknown /UTM Zone 10 NAD 83	Alhambra Creek watershed
Brionval (dem)	Briones Valley DEM digital elevation model data	C:\geodata\alhambra\ GRIDDEMs\	1:24,000	NRCS (USGS)	UTM Zone 10 NAD 83 /same	Briones Valley 7 ½ minute quadrangle map
Bvne (doq) Bvnw Bvsw Bvse (ie:bvne.bil bvne.hdr)	Briones Valley digital orthoquad and header -- in 4 quarter quads (NW, SW, NE, SE corners of 7 ½ minute quadrangle map)	C:\geodata\alhambra\ DOQs\	1:24,000 (in quarter quads)	NRCS (USGS)	UTM Zone 10 NAD 83 /same	Briones Valley 7 ½ minute quadrangle map
Ccveg	Contra Costa vegetation	C:\geodata\alhambra\ ccutm\	1:250,000	Teale (USFS, CDF)	Albers Equal Area NAD 27 /UTM Zone 10 NAD 83	Contra Costa County
Febgpsu10.shp	February 1998 GPS data	C:\geodata\alhambra\ shapefiles\		Field collected by NRCS & CCRCD	Latitude-Longitude /UTM Zone NAD 83	Alhambra Creek Watershed area
Fireprot	Fire (CDF) areas of state responsibility	C:\geodata\alhambra\ ccutm\	1:24,000 1:62,500	Teale (CDF)	Albers Equal Area 27 /UTM Zone 10 NAD 83	Contra Costa County
Geonames	geographic names and locations	C:\geodata\alhambra\ ccutm\	Mostly 1:24,000	Teale (USGS Geographic Names Information Center	Albers Equal Area 27 /UTM /UTM Zone 10 NAD 83	Contra Costa County
Govtown	land ownership	C:\geodata\alhambra\ ccutm\	1:100,000	Teale (BLM, CDF)	Albers Equal Area /UTM Zone 10	Contra Costa County
Grdwtr	ground water basins	C:\geodata\alhambra\ ccutm\	1:250,000	Teale (Ca DWR)	Albers Equal Area /UTM Zone 10	Contra Costa County
Hardwd	hardwoods	C:\geodata\alhambra\ ccutm\	1:24,000 1:58,000	Teale (CDF-FRAP)	Albers Equal Area /UTM Zone 10	Contra Costa County
Lu.shp	Land Use for watershed (ACW Inventory)	C:\geodata\alhambra\ shapefiles\	1:2000	NRCS Davis (Contra Costa Landuse Zoning map)	Unknown/ UTM Zone 10	Alhambra Creek watershed
Majrds	major roads (highways)	C:\geodata\alhambra\ ccutm\	1:100,000	Teale (USGS DLG)	Albers Equal Area NAD 27 /UTM Zone 10 NAD 83	Contra Costa County

Figure 3. Sub-Watersheds and Vegetation Communities



discharges using long-term stream gage records for the area. Such records are seldom available for small drainage areas. The TR-55 model begins with a rainfall amount uniformly applied on the watershed over a specified time distribution. Mass rainfall is converted to mass runoff by using a runoff curve number (CN). CN is based on soils, plant cover, amount of impervious areas, interception, and surface storage. Runoff is then transformed into a hydrograph by using unit hydrograph theory and routing procedures that depend on runoff travel time through segments of the watershed.

TR-55 is based on a simplified infiltration model of runoff and a good deal of empirical approximation. For each catchment and storm a curve number is chosen for use in the model. Curve numbers are an empirical rating of the hydrologic performance of a large number of soils and vegetative covers throughout the United States. To make runoff estimates for drier or wetter conditions requires the use of antecedent moisture levels, which are classified into three groups on the basis of total precipitation occurring within the preceding 5 days. A weighted average curve number can be computed using the proportions of each land-use type (Dunne and Leopold, 1978). Runoff is determined primarily by the amount of precipitation and by infiltration characteristics related to soil type, soil moisture, antecedent rainfall, cover type, impervious surfaces, and surface retention. To estimate runoff from storm rainfall, TR-55 uses the runoff curve number method (United States Soil Conservation Service, 1985). Determinations of a CN, as stated before, depends on the watershed's soil and cover conditions, which the model represents as hydrologic soil group, cover type, treatment, and hydrologic condition. Tables are provided for choosing the cover type and land use condition to determine CN for each area within the watershed. Soil survey maps identify hydrologic soil groups ranging from permeable sands (Type A) to impermeable clay (Type D) (Welch, 1973). The model allows up to ten sub-watersheds to select CN and permits area-weighted CN for each sub-unit.

Watershed subdivision is required when significantly different conditions affecting runoff or timing are present in the watershed. Travel time is determined primarily by slope, length of flow path, depth of flow, and roughness of flow surfaces. Peak discharges are based on the relationship of these parameters and on the total drainage of the watershed, the location of the development, the effect of any flood control works or other natural or manmade storage, and the time distribution of rainfall during a given storm event (United States Soil Conservation Service, 1986). TR-55 includes four regional rainfall time distributions, which are mapped for the United States by counties. Contra Costa County is mapped as a Type I distribution. A 10-year return period for rainfall was used in this study and derived by interpolating iso-pluvial contours from national TP-40 maps showing Contra Costa County generating a 4-inch storm in a 24-hour period (Hershfield, 1961).

In order to distribute the rainfall into a hydrograph, TR-55 uses a method based on velocities of flow through segments of the watershed. Two major parameters are time of concentration and travel time of flow through the segments. These and the other parameters used are those employed in accepted hydraulic analyses of open channels. Manning's equation of open channel flow is one of the principle techniques for determining velocity of the water. Manning's "n" is a coefficient for estimating channel roughness, which could be thought as a friction parameter that is capable of reducing the

velocity of the water flow. A non-functional rating from the PFC field examination is assumed to decrease Manning's "n" by 0.01 from field estimated values, and functional at-risk and proper functioning condition ratings would not change the field estimated value of "n." The modeled result is increased streamflow velocities in channels that are rated not functional. TR-55 has a technique for routing the hydrographs from each of the sub-watersheds through the chosen segments of the channel network. TR-55 also has an approach to estimate temporary flood storage based on the hydrologic data developed from the previous methods.

Ten sub-watersheds were delineated from the WS1167 watershed (Figure 3) based largely on the existing network of tributary streams. Sub-watersheds A through G are within JOMU boundaries, and Sub-watersheds H through N are on private land. Each sub-watershed is given an area-weighted CN based on the aerial composition of vegetation type and hydrologic soil group found on the WS1167 watershed. An initial curve number was chosen to best represent each of the vegetation types seen in the GIS data and verified in the field (Photo 3). For modeling the WS1167 watershed, all of the soil types are a hydrologic soil group "C," except the area near the outlet (alluvial fan) that is soil group "B." The relatively flat area near the mouth of the watershed is considered a fan in this report and is where the Strain Ranch buildings and corrals are located. The CN for this area was determined to be a 74, based on area weighting of the land use types.

Initially, landscape units under NPS management were determined to be either clear areas, classified as "Open space (lawns, parks, golf courses, cemeteries, etc.)" with a CN of 79, or areas with open woods, categorized as "Woods-grass combination (orchard or tree farm)" with a CN of 76. Private land that is clear of trees was classified as "Pasture, grassland, or range-continuous forage for grazing" with a CN of 79 (Photo 4) and forested areas are "Woods" with a CN of 73. Time of concentration calculations used "Dense grass" on NPS lands and "Range (natural)" on private lands to calculate sheet flow. Shallow concentrated flow used lengths of "Unpaved" channel segments for all sub-watersheds measured from the GIS data. Open channel flow was calculated from field measurements for typical reaches to determine the time of concentration to the bottom of each sub-watershed. Time of travel was modeled using channel geometry

Photo 3 – Vegetation Types

Photo 4 – Grassland Used for Grazing

measured in the field for typical reaches and roughness factors (Manning's n) relative to small channels. The main channel in Sub-watershed C and the diversion channel in Sub-watershed A were rated as non-functional in the baseline conditions and, therefore, have higher velocities. Flow routing in the model allows delivering the hydrograph generated from each sub-watershed through the adjacent downstream reach ultimately to the mouth of the watershed.

Assumptions

This analysis used the TR-55 regional rainfall time distributions and not the Contra Costa County rainfall data. This would require rewriting the computer programming code for the model. The baseline peak flow results were similar to those calculated by the County (190 cfs for a 10-year storm), justifying this assumption. No adjustment was made for antecedent moisture conditions for any of the alternative scenarios, recognizing that a worst case design situation is not necessary in this watershed analysis. The relative affects of alternative watershed condition on runoff are assumed to be comparable regardless of local and seasonal perturbations. In this report a non-functional rating of the channel condition from the PFC field inspection is assumed to decrease Manning's "n" by 0.01 from field estimated values. Functional at-risk and proper functioning condition ratings would not change the field-estimated value of "n" in the model. Modeling is recognized as an approximation due to the fact that we are forcing mathematical simplicity on complex natural phenomena.

Results

To compare alternative management scenarios, a variety of model simulations were computed (Table 2). A baseline combination of landscape factors was chosen as a starting point/ reference to examine the effect of each scenario separately. This modeling starting point approximates today's watershed conditions (Appendix B). The starting point curve number as a landscape factor representing vegetation type was chosen to be in "fair" condition (defined as grass cover 50% to 75%, woods grazed but not burned, and some forest litter covers the soil). Changing parameters on private lands (except for the effect of ponds) was not done because the purpose of this exercise was to determine the direction and relative effectiveness of management on NPS lands. A pessimistic scenario, where conditions deteriorated, was computed for each factor to provide contrast and indicate model sensitivity of each numerical parameter.

Table 2 shows for each scenario 1) the amount of peak flow in cubic feet per second (cfs) at the outlet of the watershed, 2) the amount of time to the peak after the initiation of rainfall in decimal hours, and 3) the resulting runoff from a 4.0 inch rainfall (10-year storm event) displayed in inches of depth over the entire watershed. For all scenarios (including for the Wetland and the Detention), the predicted watershed outflow peak discharge is as stated in the "Peak Flow" column.

The following explains the changes applied to the model for each scenario. The positive or negative effect on peak flows for each scenario should be compared to the baseline condition presented on the top row of Table 2. The percentage differences are presented later in the Discussion section.

Table 2. Results of Model Simulation of Single Watershed Factors (10-year rainfall event)

	Condition/Scenario	Peak Flow in cfs	Time to Peak in hours	Inches of Runoff
	Baseline	182	10.3	1.81
1a	Vegetation - Good	163	10.3	1.68
1b	Vegetation - Poor	215	10.3	2.03
2a	Brush – Fair	151	10.4	1.59
2b	Brush – Good	133	10.4	1.48
3a	PFC – Increase n	173	10.3	1.81
3b	PFC – Decrease n	200	10.3	1.81
4a	Ponds – All	151	10.3	1.77
4b	Pond – NPS only	181	10.3	1.81
5a	Fire Roads	185	10.3	1.85
6a	Diversion – Increase n	177	10.4	1.81
6b	Diversion – Decrease n	193	10.2	1.81
7a	Wetland – 2.5 acres	182 to 117*	10.3	1.81
7b	Wetland – 5.0 acres	182 to 77*	10.3	1.81
8a	Detention – 10.0 ac/ft	182 to 61*	10.3	1.81
8b	Detention – 18.0 ac/ft	182 to 22*	10.3	1.81

* Outflow discharge from the detention structure.

In scenario 1a the vegetation condition was changed from "fair" to "good," and for scenario 1b the condition was changed to "poor" for the vegetation on the NPS sub-watersheds.

In scenario 2a open grassland vegetation type was changed to "fair" condition brush land, and for scenario 2b the vegetation type was changed to "good" brush land.

In scenario 3a channel characteristics on NPS managed areas that have a present rating of non-functioning condition were changed so that Manning's n was increased by 0.01, and for scenario 3b Manning's n was decreased by 0.01.

In scenario 4a the effects are added of all ponds (breached and intact) by decreasing runoff generating acreage behind ponds equal to their estimated storage volume. For scenario 4b reduced runoff was from the NPS pond alone.

In scenario 5a the effects of fire roads were added by changing area-weighted CN to include dirt roads (CN of 87) and paved road near residences (CN of 98).

In scenario 6a the effects of the channel diversion were changed by increasing Manning's n by 0.01 for that reach only, and for scenario 6b decreasing Manning's n for the diversion channel was modeled.

Scenario 7a considered the potential of a 2.5-acre wetland capable of detaining 5.5 acre-feet of stormwater, and for scenario 7b a 5-acre wetland on the alluvial fan was considered capable of detaining 8 acre-feet of water.

Scenario 8a considered the potential of a detention pond of 10 acre-feet capacity on the alluvial fan, and for scenario 8b a detention pond of 18 acre-feet was considered.

Combining the above single-factor simulations created four new scenarios, utilizing existing modeled features to construct conceptual management practices. Combinations of factors were modeled, applying what would be considered "Best Management Practices" (BMP) and assuming that JOMU's watershed condition objectives were being met. This combination accumulates the effects of alternatives 1a (change the vegetation to "good" condition on NPS lands only), 3a (enhance the PFC rating on the natural creeks), and 6a (improve the diversion channel). Another combination of factors could be considered the complete "environment enhancement" scenario with the effects of 2b (establish a cover of brush in "good" condition), 3a (enhance the creek's PFC rating), and 7b (establish a wetland on the alluvial fan). For contrast, "worst case" combination of factors is grouped using 1b (reduce the grass cover to "poor" condition only on NPS land), 3b (decrease the PFC rating for the creeks only on NPS land), 5a (decrease the condition of the diversion channel), and 6b (decrease Manning's n for the diversion channel). An "urban development" scenario was examined by modeling ½ acre lots on privately owned sub-watersheds. These results are shown in Table 3.

Table 3. Results of Model Simulation of Combined Watershed Factors

	Condition/Scenario	Peak Flow in cfs	Time to Peak in hours	Inches of Runoff
9	BMP	161	10.4	1.68
10	Max Environment	134 to 46*	10.4	1.48
11	Worst Case	234	10.2	2.04
12	Urban Development	213	10.3	1.98

* Outflow discharge from the detention structure.

Discussion

The results from the model simulation are consistent with our understanding of watershed processes. The "Baseline" (182 cfs for a 10-year storm) compares well to Contra Costa County Public Works (CCCPW) results for a peak flow of 190 cfs for a 10-year storm using local rainfall data. Small differences (<1% to 5%) in model results are not quantitatively significant but are an indication of the direction of results of a management influence on a particular parameter.

In the first scenario, changing the vegetation (however possible) on NPS lands from "fair" to "good" condition reduces peak flow by 10%. If NPS lands were to deteriorate to "poor" condition, peak flows could increase by 18%. If it were possible to change the vegetation community type to "brush" from "grass", the second scenario indicates peak flow reduction of 17% for "fair" condition and 27% for "good" condition. Encouraging the growth of brush may not be compatible to the park's Cultural Landscape Plan because

grass is thought to predominate in John Muir's era. Also, brush may not be suitable with the Contra Costa County Fire Management Plan.

The third scenario examines natural channel (not the diversion channel) condition by modifying roughness to reduce water velocity. Channel condition often improves in response to termination of livestock grazing. Increasing roughness of NPS managed channels predicts decreased peak flows by 2% and a delay of the flood peak by about 6 minutes. If NPS managed channels were to continue to gully, reduce riparian vegetation, and decrease roughness, peak flows could increase by 6% and shorten the time to peak by about 6 minutes.

The fourth scenario models the results assuming reconstruction of breached stock ponds. (Photo 5) For the purpose of modeling the maximum possible effect of the ponds on peak flows, it was assumed that two small ponds and one large pond could retain the amount of runoff volume as they did when newly built (Photo 6). Plus, it was assumed that all the ponds were empty at the beginning of the modeled rainfall (an unlikely situation, but used to maximize the effect of pond storage on flood peaks). With all ponds in the watershed included with the above assumptions, peak flows at the mouth of the watershed would be reduced by 17%. With the above assumption applied to the one abandoned pond on NPS lands, peak flows would be reduced by less than 1%.

Photo 5 – Breeched Pond on Private Land

Photo 6 – Large Pond on Private Land

A fifth scenario was created to examine the effect of fire roads on the watershed. Their width and condition varied throughout the watershed, but the average width was assumed to be 12 feet. The roads are located primarily on the ridge surrounding the basin. By traversing the ridgeline the roads cross the theoretical watershed divide frequently. Sometimes a road crosses the divide from outside the basin on a descending gradient, introducing runoff into the WS1167 watershed. The opposite condition was equally true and too frequent to measure in the field. It is assumed that the effect cancels itself and no acreage adjustment was necessary. The model treats the area of roads as a different curve number and adjusts the runoff proportionally to the length (times the average width) of road found in the sub-watershed. The quarter mile of paved road with gutters is found near the new residences. It was given a width of 24 feet for its entire length. Adding roads to the model results in a predicted increased peak runoff of 2%.

In the lower watershed a diversion channel was built around the Strain Ranch buildings. Due to evidence of topographical depression and relic riparian vegetation, it is believed that the original channel existed where the ranch driveway is now. The diversion channel is in marginal condition and did not contain all of the flows from the 1998 El Niño flood. If the channel could be reconditioned, the modeled effect would be to increase channel roughness (while maintaining capacity) with the result of a decrease in peak flow of 3%. If the channel deteriorated and gullied, the predicted model effect would increase peak flow by 6%.

The last two single-factor scenarios address the question: Can a wetland or stormwater detention basin reduce flooding downstream? Two sizes of wetlands were modeled using the values from the baseline runoff and peak flow amounts. A 2.7- acre wetland with a 2-foot freeboard (2-foot berm on downstream end with a low capacity drain) could reduce the peak flow by 36% while a 5.7- acre wetland with a 2-foot freeboard could reduce it by 58%. It has not been determined if a two-foot berm is acceptable with the cultural setting. A 10-acre-feet stormwater basin could reduce the peak flow by 66% and a basin with the size of 18 acre-feet would reduce the peak flow by 88% (discharge reduced to 22 cfs). The amount of benefits from storm water detention decreases with larger, but less frequent, rainstorms. Flood reduction benefits also decrease with longer duration storms regardless of rainfall intensity.

The scenarios with a combination of factors were created to accumulate the benefit of an integrated management approach. The "best management practices" scenario, while not strictly for improvement of water quality, will benefit the aquatic resource and reduce flooding by 12%. To maximize the benefit for aquatic resources (and ultimate hydrologic restoration of the watershed) the combined factors show a reduction of peak flow by 26%. A worst case scenario was created from the existing factors (paving the watershed on the NPS side was not considered), which generated a peak flow of 234 cfs — an increase of 29%.

Model results indicate that for larger magnitude storms (100-year peak flow is 391 cfs for baseline conditions) flood reduction benefits are less from the watershed improvements and slightly greater by improving the condition of the channels. This suggests that for larger storms improved channel conditions increase theoretical effectiveness. However, due to limitation of the model and familiarity with larger magnitude floods, it is doubtful that reduction in flooding predicted by the model for large magnitude storms will be measurable.

A point of concern is the private section of the watershed is available for housing development. If the private land is developed with ½ acre lots and the NPS property is left as is (baseline conditions) the peak flow delivered to Strentzel Lane will be 213 cfs or an increase of 17%.

Conclusions and Recommendations

It is apparent that flooding will occur in the Strentzel Lane neighborhood under current conditions with any flows above an estimated 20–50 cfs based on field reconnaissance. It is also apparent that the WS1167 watershed is currently in fairly good hydrologic shape. The positive and negative management scenarios considered in the model bracket the generated peak flows of the baseline (today's conditions) by roughly equal amounts. Reductions in peak flows can be achieved by improving watershed conditions consistent with park responsibilities. These reductions, however, will not significantly reduce flooding downstream. Repairing the existing NPS stock pond also will not meaningfully reduce flooding downstream due to its location in the upper watershed. The most significant reduction of flooding modeled resulted from the scenario that included a large detention basin. However, NPS management policies and mandates would not permit this sort of development within the boundary of John Muir NHS. Addressing necessary channel modifications or flood proofing actions for the Strentzel Lane area so that floods can be conveyed without impacting private properties should be addressed through the Alhambra Creek Watershed Planning group, the homeowners involved, and the Contra Costa County Flood Control District.

It is recommended to begin implementing the "best management practices" scenario in the Results section above. This combination of actions encompasses the effects of alternatives 1a, 3a, and 6a. Those alternatives involve changing the vegetation to "good" condition, enhancing the PFC rating on the natural creeks, and improving the diversion channel. Changing the grassland areas on NPS areas from the estimated current condition of 50% to 75% cover density to a higher cover density above 75% would necessitate botanical expertise in preparing a vegetative management plan. This plan would identify species selection, soil and vegetation treatments, and long-term landscape management procedures, involving, perhaps, prescribed fires, selective grazing, and/or seeding and fertilization applications.

The second part in implementing the BMP involves enhancing the PFC rating on the natural creek channels. Improvements are needed to the hydrologic, vegetative and geomorphic characteristics of the channels rated as "non-functional" in the watershed. For example, sinuosity, width/depth ratio, and gradient need to be in balance with the landscape setting (landform, geology, and bioclimatic region). A diverse age structure and composition of the riparian vegetation should be established and channels need to be vertically stable or agrading. Partially rebuilding the channel may be needed, involving the addition of more rock, logs, and large organic debris. Further hydrologic and geomorphic assessment is needed to prepare a plan of action in restoring the creek channels.

Actions are needed to address the diversion channel near the Strain Ranch buildings. This reach is critical because not only does all the discharge from the watershed pass through this reach, but also it is located very near residences and other buildings which are at risk from flooding. Additionally, it is the most manipulated section of landscape in the watershed. This reach will also be affected by the eventual reconstruction of the drainage crossing under Alhambra Valley Road by Contra Costa County. Any modification of the diversion channel must be compatible to the Facilities Management Plan for the Strain Ranch buildings and corrals. A BMP improvement to the channel would involve enhancing its capacity and at the same time reducing the velocity of the floodwater. By increasing the roughness coefficient of the channel, water velocity will be reduced by increasing friction of the bed to flows. Several preliminary steps would be needed before implementing a restoration design. A detailed topographic survey should be conducted to accurately map the affected area. At the same time a floodplain map should be completed. Sediment reduction would also play a part of the restoration design. The goal of the BMP is to infiltrate as much storm water as possible into watershed soils and attenuate the runoff as it leaves the watershed. Funding may be accomplished through the Park Service's Project Management Information System. It is estimated that about $20,000 is needed to conduct the studies for implementing the BMP.

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Appendix A

Proper Functioning Condition Checklists - Field Measurements

Standard Checklist

Name of Riparian-Wetland Area: above Strain Ranch -.10 mi

Date: ______ Segment/Reach ID: Reach 1 - trib E

Miles: 1030 ft Acres: ______

ID Team Observers: R. Inglis, Sue Worley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
		✓	Floodplain inundated in "relatively frequent" events (1-3 years)
		✓	Active/stable beaver dams
✓			Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
✓			Riparian zone is widening
	✓		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
	✓		Diverse age structure of vegetation
	✓		Diverse composition of vegetation
✓			Species present indicate maintenance of riparian soil moisture characteristics
	✓		Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
✓			Riparian plants exhibit high vigor
	✓		Adequate vegetative cover present to protect banks and dissipate energy during high flows
	✓		Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
	✓		Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
		✓	Point bars are revegetating
✓			Lateral stream movement is associated with natural sinuosity
	✓		System is vertically stable
✓			Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

Reach 1 is a grassy swale in a 1st Order channel
Slumps and headcuts are found in Upper Watershed
Reach may not be applicable to PFC analysis
Slumps, age and composition of Vegetation are NOT stabilizing Hydraulics
because no woody species are found in riparian zone. However, sedges
and frogs were found.
Hillslope processes are dominating channel shape + form.
Channel is not Vertically stable due to slumps and nick points,
but no fresh deposition or cutting was observed.

Dimensions: 14' across, No channel, 11° gradient

Summary Determination

Functional Rating:

Proper Functioning Condition	
Functional—At Risk	
Nonfunctional	X
Unknown	

due to low scores in Vegetation and Erosion deposition

Trend for Functional—At Risk:

Upward	
Downward	
Not Apparent	X

Are factors contributing to unacceptable conditions outside [redacted]'s control or management?

Yes	/
No	

If yes, what are those factors?

____ Flow regulations ____ Mining activities ____ Upstream channel conditions
____ Channelization ____ Road encroachment ____ Oil field water discharge
____ Augmented flows ____ Other (specify) Lack of Woody species

Standard Checklist

Name of Riparian-Wetland Area: Jonue - Above Strain Ranch

Date: ______ Segment/Reach ID: Reach 2 - below Trib F

Miles: 105' Acres: at old Damsite

ID Team Observers: Rick Inglis, Sue Worley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
	✓		Floodplain inundated in "relatively frequent" events (1-3 years)
		✓	Active/stable beaver dams
	✓		Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
	✓		Riparian zone is widening
	✓		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
	✓		Diverse age structure of vegetation
	✓		Diverse composition of vegetation
	✓		Species present indicate maintenance of riparian soil moisture characteristics
	✓		Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
	✓		Riparian plants exhibit high vigor
	✓		Adequate vegetative cover present to protect banks and dissipate energy during high flows
	✓		Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
	✓		Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
		✓	Point bars are revegetating
		✓	Lateral stream movement is associated with natural sinuosity
	✓		System is vertically stable
	✓		Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

No Flood plain due to Breached Stock Dam
Gully breeching dam affects chanel geometry
Gully is cutting through impoundment area drying out riparian zone
Past grazing practices are evident in this reach.
Appears to be most annuals plants short lived
No trees in riparian Zone. No woody debris.
Major Down cutting in steep and Narrow gully.

Summary Determination

Functional Rating:

Proper Functioning Condition ______
Functional—At Risk ______
Nonfunctional __X__ Poor scores in all three catagories.
Unknown ______

Trend for Functional—At Risk:

Upward ______
Downward ______
Not Apparent ______

Are factors contributing to unacceptable conditions outside BLM's control or management?

Yes ______
No ______

If yes, what are those factors?

____ Flow regulations ____ Mining activities ____ Upstream channel conditions
____ Channelization ____ Road encroachment ____ Oil field water discharge
____ Augmented flows ____ Other (specify) ______________________

Standard Checklist

Name of Riparian-Wetland Area: JOMU - Above Strain Ranch

Date: 456 fr Segment/Reach ID: Reach 3 - above confluence w/ "Trib D"

Miles: ______ Acres: ______

ID Team Observers: Rick Inglis, Sue Worley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
/			Floodplain inundated in "relatively frequent" events (1-3 years)
		/	Active/stable beaver dams
/			Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
	/		Riparian zone is widening
	/		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
/			Diverse age structure of vegetation
/			Diverse composition of vegetation
/			Species present indicate maintenance of riparian soil moisture characteristics
/			Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
/			Riparian plants exhibit high vigor
	/		Adequate vegetative cover present to protect banks and dissipate energy during high flows
/			Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
	/		Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
		/	Point bars are revegetating
/			Lateral stream movement is associated with natural sinuosity
	/		System is vertically stable
	/		Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

Chain of headcut and intrenchment are Narrowing Riparian Zone
Past Grazing Practices are evident in this reach, lack of grassy banks
Bare channel is exposed between trees
Very few rocks and large woody debris to protect from scour
Chain of headcuts found in this reach.
General downcutting, steep banks and No deposition
Erosion is exacerbated by the steep Gradient

Summary Determination

Functional Rating:

Proper Functioning Condition ______
Functional—At Risk __x__ due to higher scores in Hydrologic and Vegetation.
Nonfunctional ______
Unknown ______

Trend for Functional—At Risk:

Upward ______
Downward ______
Not Apparent ______

Are factors contributing to unacceptable conditions outside BLM's control or management?

Yes ______
No ______

If yes, what are those factors?

___ Flow regulations ___ Mining activities ___ Upstream channel conditions
___ Channelization ___ Road encroachment ___ Oil field water discharge
___ Augmented flows ___ Other (specify) ______

Standard Checklist

Name of Riparian-Wetland Area: Jomu - Above Strain Ranch

Date: ______ Segment/Reach ID: Reach 4 - 47 Confluence w/Trib "D"

Miles: 200' Acres: ______

ID Team Observers: Rick Inglis, Sue Worsley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
/			Floodplain inundated in "relatively frequent" events (1-3 years)
		/	Active/stable beaver dams
/			Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
/			Riparian zone is widening
	/		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
	/		Diverse age structure of vegetation
	/		Diverse composition of vegetation
/			Species present indicate maintenance of riparian soil moisture characteristics Sedge + rushes.
	/		Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
/			Riparian plants exhibit high vigor
	/		Adequate vegetative cover present to protect banks and dissipate energy during high flows
	/		Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
/			Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
/			Point bars are revegetating
/			Lateral stream movement is associated with natural sinuosity
/			System is vertically stable
/			Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

Past Grazing Practices may have changed riparian zone.

No Trees or shrubs in riparian zone.

Thick grass protects banks

Current woody debris is anthropogenic. Firewood chunks.

Dimensions Floodplain Width 10' Innerchannel width 2' gradient 4½°

Summary Determination

Functional Rating:

Proper Functioning Condition	____
Functional—At Risk	x — Due to Moderate scores in vegetation
Nonfunctional	____
Unknown	____

Trend for Functional—At Risk:

Upward	____
Downward	____
Not Apparent	____

Are factors contributing to unacceptable conditions outside BLM's control or management?

Yes	____
No	____

If yes, what are those factors?

____ Flow regulations ____ Mining activities ____ Upstream channel conditions
____ Channelization ____ Road encroachment ____ Oil field water discharge
____ Augmented flows ____ Other (specify) ____________

Standard Checklist

Name of Riparian-Wetland Area: JOMU- Above Strain Ranch

Date: ______ Segment/Reach ID: Reach 5 - above Confluence w/ Trib C

Miles: 508' Acres: ______

ID Team Observers: Rick Inglis, Sue Worley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
	✓		Floodplain inundated in "relatively frequent" events (1-3 years)
		✓	Active/stable beaver dams
	✓		Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
	✓		Riparian zone is widening
	✓		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
✓			Diverse age structure of vegetation
✓			Diverse composition of vegetation
✓			Species present indicate maintenance of riparian soil moisture characteristics Ferns
	✓		Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
	✓		Riparian plants exhibit high vigor
	✓		Adequate vegetative cover present to protect banks and dissipate energy during high flows
✓			Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
	✓		Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
	✓		Point bars are revegetating
	✓		Lateral stream movement is associated with natural sinuosity
	✓		System is vertically stable
	✓		Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

No floodplain due to entrenchment.
Active gully affecting channel geometry
Past Grazing and tree clearing may have caused gully
Exposed tree roots not holding bank soils
Thick stand of trees are being undercut by gully
Downcutting is taking out much rock and wood debris.

32° side slope angle
dimensions 10' vertical Banks width: 8' inner channel 175' lap gradient 2½°

Summary Determination

Functional Rating:

Proper Functioning Condition ______
Functional—At Risk ______
Nonfunctional __x__ due to low scores in Hydrologic and Erosion Deposition.
Unknown ______

Trend for Functional—At Risk:

Upward ______
Downward ______
Not Apparent ______

Are factors contributing to unacceptable conditions outside BLM's control or management?

Yes ______
No ______

If yes, what are those factors?

____ Flow regulations ____ Mining activities ____ Upstream channel conditions
____ Channelization ____ Road encroachment ____ Oil field water discharge
____ Augmented flows ____ Other (specify) ______________________

Standard Checklist

Name of Riparian-Wetland Area: JOMU - Above Stream Ranch

Date: ____________ Segment/Reach ID: Reach 6 - above Confluence w/ Trib "B"

Miles: 1911 ft Acres: ____________

ID Team Observers: Rick Inglis, Sue Worley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
✓			Floodplain inundated in "relatively frequent" events (1-3 years)
		✓	Active/stable beaver dams
✓			Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
	✓		Riparian zone is widening
	✓		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
✓			Diverse age structure of vegetation
✓			Diverse composition of vegetation
✓			Species present indicate maintenance of riparian soil moisture characteristics Mosses
✓			Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
✓			Riparian plants exhibit high vigor
✓			Adequate vegetative cover present to protect banks and dissipate energy during high flows
✓			Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
✓			Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
	✓		Point bars are revegetating
✓			Lateral stream movement is associated with natural sinuosity
✓			System is vertically stable
✓			Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

channel is confined in Narrow valley and
fireroads ~~Are~~ Slumping into floodplain
Heavy Shading ~~on~~ channel prevents revegetation of grass

Cobbles up to 12", gravels, + Mud
Dimensions width = 7' deep = 1' $1\frac{1}{4}°$ Gradient

Summary Determination

Functional Rating:

Proper Functioning Condition	X	Due to mostly High scores in Vegetation and Erosion Deposition
Functional—At Risk		
Nonfunctional		
Unknown		

Trend for Functional—At Risk:

Upward	
Downward	
Not Apparent	

Are factors contributing to unacceptable conditions outside BLM's control or management?

Yes	
No	

If yes, what are those factors?

____ Flow regulations ____ Mining activities ____ Upstream channel conditions
____ Channelization ____ Road encroachment ____ Oil field water discharge
____ Augmented flows ____ Other (specify) ________________

Standard Checklist

Name of Riparian-Wetland Area: JOMU - Above Strain Ranch

Date: ______________ Segment/Reach ID: Reach 8 - above Confluence w Trib "A"

Miles: 1480 ft Acres: ______________

ID Team Observers: Rick Inglis, Sue Worley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
	✓		Floodplain inundated in "relatively frequent" events (1-3 years)
		✓	Active/stable beaver dams
	✓		Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
	✓		Riparian zone is widening
	✓		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
	✓		Diverse age structure of vegetation
	✓		Diverse composition of vegetation
	✓		Species present indicate maintenance of riparian soil moisture characteristics
	✓		Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
	✓		Riparian plants exhibit high vigor
	✓		Adequate vegetative cover present to protect banks and dissipate energy during high flows
	✓		Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
	✓		Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
	✓		Point bars are revegetating
	✓		Lateral stream movement is associated with natural sinuosity
✓			System is vertically stable
✓			Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

This reach is the diversion canal around ranch Buildings
Original channel was along the Ranch driveway
No riparian vegetation

Summary Determination

Functional Rating:

Proper Functioning Condition	____
Functional—At Risk	____
Nonfunctional	x Artificial Canal
Unknown	____

Trend for Functional—At Risk:

Upward	____
Downward	____
Not Apparent	____

Are factors contributing to unacceptable conditions outside BLM's control or management?

Yes	____
No	____

If yes, what are those factors?

____ Flow regulations ____ Mining activities ____ Upstream channel conditions
____ Channelization ____ Road encroachment ____ Oil field water discharge
____ Augmented flows ____ Other (specify) ____

Standard Checklist

Name of Riparian-Wetland Area: JOMU - Above Strain Ranch

Date: ______ Segment/Reach ID: Reach 7 · below Confluence w/ Trib "B"

Miles: 100' Acres: ______

ID Team Observers: Rick Inglis, Sue Worley, Don Ulrich

Yes	No	N/A	HYDROLOGIC
✓			Floodplain inundated in "relatively frequent" events (1-3 years)
		✓	Active/stable beaver dams
✓			Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
✓			Riparian zone is widening
	✓		Upland watershed not contributing to riparian degradation

Yes	No	N/A	VEGETATIVE
✓			Diverse age structure of vegetation
✓			Diverse composition of vegetation
✓			Species present indicate maintenance of riparian soil moisture characteristics
✓			Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
✓			Riparian plants exhibit high vigor
✓			Adequate vegetative cover present to protect banks and dissipate energy during high flows
✓			Plant communities in the riparian area are an adequate source of coarse and/or large woody debris

Yes	No	N/A	EROSION DEPOSITION
✓			Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy
	✓		Point bars are revegetating
✓			Lateral stream movement is associated with natural sinuosity
	✓		System is vertically stable
	✓		Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

Fire Roads + Gullies upstream contributing sediment to this reach
New sediment and Overstory Shading is preventing revegetation
Large gravel + Sand bars in this reach

Dimensions 24' across 2' Deep Gradient: 1½ Gravel + sands.

Summary Determination

Functional Rating:

Proper Functioning Condition	______
Functional—At Risk	X — Due to low score in Erosion/Deposition
Nonfunctional	______
Unknown	______

Trend for Functional—At Risk:

Upward	______
Downward	______
Not Apparent	______

Are factors contributing to unacceptable conditions outside BLM's control or management?

Yes	______
No	______

If yes, what are those factors?

____ Flow regulations ____ Mining activities ____ Upstream channel conditions
____ Channelization ____ Road encroachment ____ Oil field water discharge
____ Augmented flows ____ Other (specify) ______________________

Appendix B

Model Printouts – Runoff Curve Computations

RUNOFF CURVE NUMBER COMPUTATION — Version 2.00

Project : STRAIN RANCH — User: RRI — Date: 08-11-99
County : CONTRA COSTA — State: CA — Checked: ____ — Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : A

COVER DESCRIPTION	A	B	C	D
	Hydrologic Soil Group — Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Open space (Lawns,parks etc.)				
Fair condition; grass cover 50% to 75%	-	-	24.2(79)	-
OTHER AGRICULTURAL LANDS				
Farmsteads ----	-	5.50(74)	-	-
Total Area (by Hydrologic Soil Group)		5.5 ====	24.2 ====	

SUBAREA: A — TOTAL DRAINAGE AREA: 29.7 Acres — WEIGHTED CURVE NUMBER: 78

RUNOFF CURVE NUMBER COMPUTATION — Version 2.00

Project : STRAIN RANCH — User: RRI — Date: 08-11-99
County : CONTRA COSTA — State: CA — Checked: ____ — Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : B

COVER DESCRIPTION	A	B	C	D
	Hydrologic Soil Group — Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Open space (Lawns,parks etc.)				
Fair condition; grass cover 50% to 75%	-	-	16.5(79)	-
Total Area (by Hydrologic Soil Group)			16.5 ====	

SUBAREA: B — TOTAL DRAINAGE AREA: 16.5 Acres — WEIGHTED CURVE NUMBER: 79

RUNOFF CURVE NUMBER COMPUTATION

Version 2.00

Project : STRAIN RANCH — User: RRI — Date: 08-11-99
County : CONTRA COSTA — State: CA — Checked: ____ — Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : C

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Open space (Lawns,parks etc.)				
Fair condition; grass cover 50% to 75%	-	-	15.8(79)	-
Total Area (by Hydrologic Soil Group)			15.8	
			====	

SUBAREA: C — TOTAL DRAINAGE AREA: 15.8 Acres — WEIGHTED CURVE NUMBER: 79

RUNOFF CURVE NUMBER COMPUTATION

Version 2.00

Project : STRAIN RANCH — User: RRI — Date: 08-11-99
County : CONTRA COSTA — State: CA — Checked: ____ — Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : D

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Open space (Lawns,parks etc.)				
Fair condition; grass cover 50% to 75%	-	-	14.7(79)	-
OTHER AGRICULTURAL LANDS				
Woods - grass combination fair	-	-	4.22(76)	-
Total Area (by Hydrologic Soil Group)			18.9	
			====	

SUBAREA: D — TOTAL DRAINAGE AREA: 18.92 Acres — WEIGHTED CURVE NUMBER: 78

RUNOFF CURVE NUMBER COMPUTATION — Version 2.00

Project : STRAIN RANCH — User: RRI — Date: 08-11-99
County : CONTRA COSTA — State: CA — Checked: ____ — Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : E

COVER DESCRIPTION		A	B	C	D
		Hydrologic Soil Group — Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Open space (Lawns,parks etc.)					
Fair condition; grass cover 50% to 75%		-	-	16.1(79)	-
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair.	-	-	4.54(76)	-
Total Area (by Hydrologic Soil Group)				20.6 ====	

SUBAREA: E — TOTAL DRAINAGE AREA: 20.64 Acres — WEIGHTED CURVE NUMBER: 78

RUNOFF CURVE NUMBER COMPUTATION — Version 2.00

Project : STRAIN RANCH — User: RRI — Date: 08-11-99
County : CONTRA COSTA — State: CA — Checked: ____ — Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : H

COVER DESCRIPTION		A	B	C	D
		Hydrologic Soil Group — Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Open space (Lawns,parks etc.)					
Fair condition; grass cover 50% to 75%		-	-	4.29(79)	-
OTHER AGRICULTURAL LANDS					
Woods	fair	-	-	8.13(73)	-
Total Area (by Hydrologic Soil Group)				12.4 ====	

SUBAREA: H — TOTAL DRAINAGE AREA: 12.42 Acres — WEIGHTED CURVE NUMBER: 75

RUNOFF CURVE NUMBER COMPUTATION   Version 2.00

Project : STRAIN RANCH   User: RRI   Date: 08-11-99
County : CONTRA COSTA   State: CA   Checked: ____   Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : I

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
			Acres (CN)		
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Open space (Lawns,parks etc.)					
Fair condition; grass cover 50% to 75%		-	-	17.8(79)	-
OTHER AGRICULTURAL LANDS					
Woods	fair	-	-	6.72(73)	-
Total Area (by Hydrologic Soil Group)				24.5 ====	

SUBAREA: I   TOTAL DRAINAGE AREA: 24.52 Acres   WEIGHTED CURVE NUMBER: 77

RUNOFF CURVE NUMBER COMPUTATION   Version 2.00

Project : STRAIN RANCH   User: RRI   Date: 08-11-99
County : CONTRA COSTA   State: CA   Checked: ____   Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Subarea : J

COVER DESCRIPTION		Hydrologic Soil Group A	B	C	D
			Acres (CN)		
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Open space (Lawns,parks etc.)					
Fair condition; grass cover 50% to 75%		-	-	33.9(79)	-
OTHER AGRICULTURAL LANDS					
Woods	fair	-	-	2.24(73)	-
Total Area (by Hydrologic Soil Group)				36.1 ====	

SUBAREA: J   TOTAL DRAINAGE AREA: 36.14 Acres   WEIGHTED CURVE NUMBER: 79

RUNOFF CURVE NUMBER COMPUTATION Version 2.00

Project : STRAIN RANCH User: RRI Date: 08-11-99

County : CONTRA COSTA State: CA Checked: ____ Date: ________

Subtitle: JOHN MUIR NHS JOMUDATA

Subarea : L

COVER DESCRIPTION		A	B	C	D
		Hydrologic Soil Group			
			Acres (CN)		
FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Open space (Lawns,parks etc.)					
Fair condition; grass cover 50% to 75%		-	-	13.3(79)	-
OTHER AGRICULTURAL LANDS					
Woods	fair	-	-	28.0(73)	-
Total Area (by Hydrologic Soil Group)				41.3 ====	

SUBAREA: L TOTAL DRAINAGE AREA: 41.3 Acres WEIGHTED CURVE NUMBER: 75

RUNOFF CURVE NUMBER COMPUTATION Version 2.00

Project : STRAIN RANCH User: RRI Date: 08-11-99

County : CONTRA COSTA State: CA Checked: ____ Date: ________

Subtitle: JOHN MUIR NHS JOMUDATA

Subarea : N

COVER DESCRIPTION		A	B	C	D
		Hydrologic Soil Group			
			Acres (CN)		
OTHER AGRICULTURAL LANDS					
Woods - grass combination	fair	-	-	6.27(76)	-
Woods	fair	-	-	29.5(73)	-
Total Area (by Hydrologic Soil Group)				35.7 ====	

SUBAREA: N TOTAL DRAINAGE AREA: 35.77 Acres WEIGHTED CURVE NUMBER: 74

TIME OF CONCENTRATION AND TRAVEL TIME   Version 2.00

Project : STRAIN RANCH   User: RRI   Date: 08-11-99
County : CONTRA COSTA   State: CA   Checked: ____   Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA

Subarea #1 - A

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	175	.23	F					0.159
Shallow Concent'd		1150	.19	U					0.045
Open Channel		85	.025		.03	08	9.25		0.003
						Time of Concentration =			0.21*
Open Channel		1254	.025		.03	8	9.25		0.049
						Travel Time =			0.05*

Subarea #2 - B

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	150	.13	F					0.176
Shallow Concent'd		1115	.30	U					0.035
						Time of Concentration =			0.21*
Open Channel		2011	.02		.02	7	9		0.063
						Travel Time =			0.06*

Subarea #3 - C

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	270	.11	F					0.301
Shallow Concent'd		1390	.23	U					0.050
						Time of Concentration =			0.35*
Open Channel		568	.045		.04	14	11.5		0.018
						Travel Time =			0.02*

* - Generated for use by TABULAR method

TIME OF CONCENTRATION AND TRAVEL TIME Version 2.00

Project : STRAIN RANCH User: RRI Date: 08-11-99
County : CONTRA COSTA State: CA Checked: ____ Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA

--- Subarea #4 - D ---

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	290	.17	F					0.268
Shallow Concent'd		1390	.22	U					0.051
								Time of Concentration =	0.32*
Open Channel		656	.07		.04	.75	2.5		0.041
								Travel Time =	0.04*

--- Subarea #5 - E ---

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	300	.13	F					0.306
Shallow Concent'd		1135	.14	U					0.052
								Time of Concentration =	0.36*

--- Subarea #6 - H ---

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	300	.17	F					0.275
Shallow Concent'd		1445	.22	U					0.053
Open Channel		400	.08		.0204		6		0.007
								Time of Concentration =	0.34*
Open Channel		2024	.08		.02	4	6		0.035
								Travel Time =	0.03*

--- Subarea #7 - I ---

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	300	.10	F					0.340
Shallow Concent'd		1810	.18	U					0.073
								Time of Concentration =	0.41*

--- Subarea #8 - J ---

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	210	.12	F					0.238
Shallow Concent'd		1270	.19	U					0.050
								Time of Concentration =	0.29*

* - Generated for use by TABULAR method

TIME OF CONCENTRATION AND TRAVEL TIME — Version 2.00

Project : STRAIN RANCH — User: RRI — Date: 08-11-99

County : CONTRA COSTA — State: CA — Checked: ____ — Date: ________

Subtitle: JOHN MUIR NHS JOMUDATA

Subarea #9 - L

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	300	.29	F					0.222
Shallow Concent'd		1630	.11	U					0.085
								Time of Concentration =	0.31*

Subarea #10 - N

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	2.5	75	.13	H					0.152
Shallow Concent'd		1010	.19	U					0.040
								Time of Concentration =	0.19*

--- Sheet Flow Surface Codes ---

- A Smooth Surface
- B Fallow (No Res.)
- C Cultivated < 20 % Res.
- D Cultivated > 20 % Res.
- E Grass-Range, Short
- F Grass, Dense
- G Grass, Burmuda
- H Woods, Light
- I Woods, Dense
- J Range, Natural

--- Shallow Concentrated Surface Codes ---

- P Paved
- U Unpaved

* - Generated for use by TABULAR method

TABULAR HYDROGRAPH METHOD Version 2.00

Project : STRAIN RANCH User: RRI Date: 08-11-99
County : CONTRA COSTA State: CA Checked: ____ Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA
Total watershed area: 0.393 sq mi Rainfall type: I Frequency: 10 years

	Subareas				
	A	B	C	D	E
Area(sq mi)	0.05*	0.03*	0.02*	0.03*	0.03*
Rainfall(in)	4.0	4.0	4.0	4.0	4.0
Curve number	78*	79*	79*	78*	78*
Runoff(in)	1.89	1.96	1.96	1.89	1.89
Tc (hrs)	0.21*	0.21*	0.35*	0.32*	0.36*
(Used)	0.20	0.20	0.30	0.30	0.30
TimeToOutlet	0.00	0.05*	0.11*	0.13*	0.17*
(Used)	0.00	0.10	0.20	0.10	0.20
Ia/P	0.14	0.13	0.13	0.14	0.14

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A	B	C	D	E
9.0	12	2	1	1	1	1
9.3	16	3	1	1	1	1
9.6	25	4	2	2	2	2
9.9	40	9	3	2	3	3
10.0	63	17	5	3	5	3
10.1	106	30	8	4	9	5
10.2	161	33P	15	7	14	9
10.3	182P	22	18P	11	16P	14
10.4	178	14	15	14P	15	17P
10.5	154	11	10	13	12	16
10.6	130	9	8	11	9	14
10.7	105	8	6	9	7	11
10.8	86	7	5	7	6	9
11.0	65	6	4	5	5	6
11.2	54	6	3	4	4	5
11.4	45	5	3	3	4	4
11.6	44	5	3	3	3	4
11.8	41	5	3	3	3	4
12.0	40	5	3	3	3	3
12.3	39	4	3	3	3	3
12.6	33	4	2	2	3	3
13.0	32	4	2	2	2	3
13.5	30	3	2	2	2	3
14.0	26	3	2	2	2	2
14.5	25	3	2	2	2	2
15.0	25	3	2	2	2	2
15.5	24	3	2	2	2	2
16.0	22	3	2	1	2	2
17.0	20	2	1	1	2	2
18.0	19	2	1	1	1	2
20.0	17	2	1	1	1	1
24.0	12	1	1	1	1	1

P - Peak Flow * - value(s) provided from TR-55 system routines

TABULAR HYDROGRAPH METHOD Version 2.00

Project : STRAIN RANCH User: RRI Date: 08-11-99

County : CONTRA COSTA State: CA Checked: ____ Date: ________

Subtitle: JOHN MUIR NHS JOMUDATA

Continuation of subarea information -------------------

------- Subareas --------------------------

	H	I	J	L	N
Area(sq mi)	0.02*	0.04*	0.06*	0.06*	0.06*
Rainfall(in)	4.0	4.0	4.0	4.0	4.0
Curve number	75*	77*	79*	75*	74*
Runoff(in)	1.67	1.81	1.96	1.67	1.60
Tc (hrs)	0.34*	0.41*	0.29*	0.31*	0.19*
(Used)	0.30	0.40	0.20	0.30	0.10
TimeToOutlet	0.13*	0.16*	0.16*	0.11*	0.05*
(Used)	0.20	0.20	0.20	0.10	0.10
Ia/P	0.17	0.15	0.13	0.17	0.18

Time (hr)	------------- Subarea Contribution to Total Flow (cfs) ------------ H	I	J	L	N
9.0	0	1	2	2	1
9.3	1	1	3	2	2
9.6	1	2	4	3	3
9.9	1	2	5	6	6
10.0	2	3	6	9	10
10.1	2	4	9	15	20
10.2	4	6	16	24	33P
10.3	7	10	27	29P	28
10.4	8P	15	35P	27	18
10.5	8	17P	32	22	13
10.6	7	17	26	18	11
10.7	6	15	20	14	9
10.8	5	12	15	12	8
11.0	3	9	11	9	7
11.2	3	6	9	8	6
11.4	2	5	7	7	5
11.6	2	5	7	7	5
11.8	2	4	6	6	5
12.0	2	4	6	6	5
12.3	2	4	6	6	5
12.6	2	3	5	5	4
13.0	2	3	5	5	4
13.5	1	3	5	5	4
14.0	1	3	4	4	3
14.5	1	2	4	4	3
15.0	1	2	4	4	3
15.5	1	2	3	4	3
16.0	1	2	3	3	3
17.0	1	2	3	3	3
18.0	1	2	3	3	3
20.0	1	2	3	3	2
24.0	1	1	2	2	1

P - Peak Flow * - value(s) provided from TR-55 system routines

STORAGE VOLUME FOR DETENTION BASINS   Version 2.00

Project : STRAIN RANCH   User: RRI   Date: 08-11-99
County : CONTRA COSTA   State: CA   Checked: ____   Date: ________
Subtitle: JOHN MUIR NHS JOMUDATA

Drainage Area: .3932969 Sq miles   Rainfall Frequency: 10 years
Rainfall-Type: I
Runoff: 1.8 inches
Peak Inflow: 182 cfs
Peak Outflow: 50 cfs
Detention Basin Storage Volume: 0.56 inches or 11.8 acre feet

Appendix C

Archeological Assessment – Memorandum dated June 30, 1989

UNITED STATES GOVERNMENT

memorandum

DATE: June 30, 1989

REPLY TO ATTN OF: Regional Archeologist, Western Region

SUBJECT: Brief Assessment of Proposed Additions to John Muir NHS

TO: Associate Regional Director, Resource Management/Planning, Western Region
Through: Chief, Park Historic Preservation, Western Region

On June 21-22, I conducted a brief assessment visit to the proposed additions to John Muir NHS as authorized recently by Congress. The purpose was to obtain an overall view of the large parcel (about 330 acres in three ownerships) in terms of cultural resourc or other aspects which our Division may become involved. I was accompanied by Linda Moor Stumpf of John Muir NHS who has been over the area several times. We visited Mr. Gordon Strain, owner of 186 acre parcel, a willing seller to US Govt. He purchased this particu land in mid-1970s but is knowledgable about land use history in Alhambra valley. Other parcels are owned by 3 members of the Lo family (140 acres) and City of Martinez (2 smal parcels). Scenic vistas, some standing structures and features, and landscapes were vide taped for office viewing. 35mm Slides were also taken.

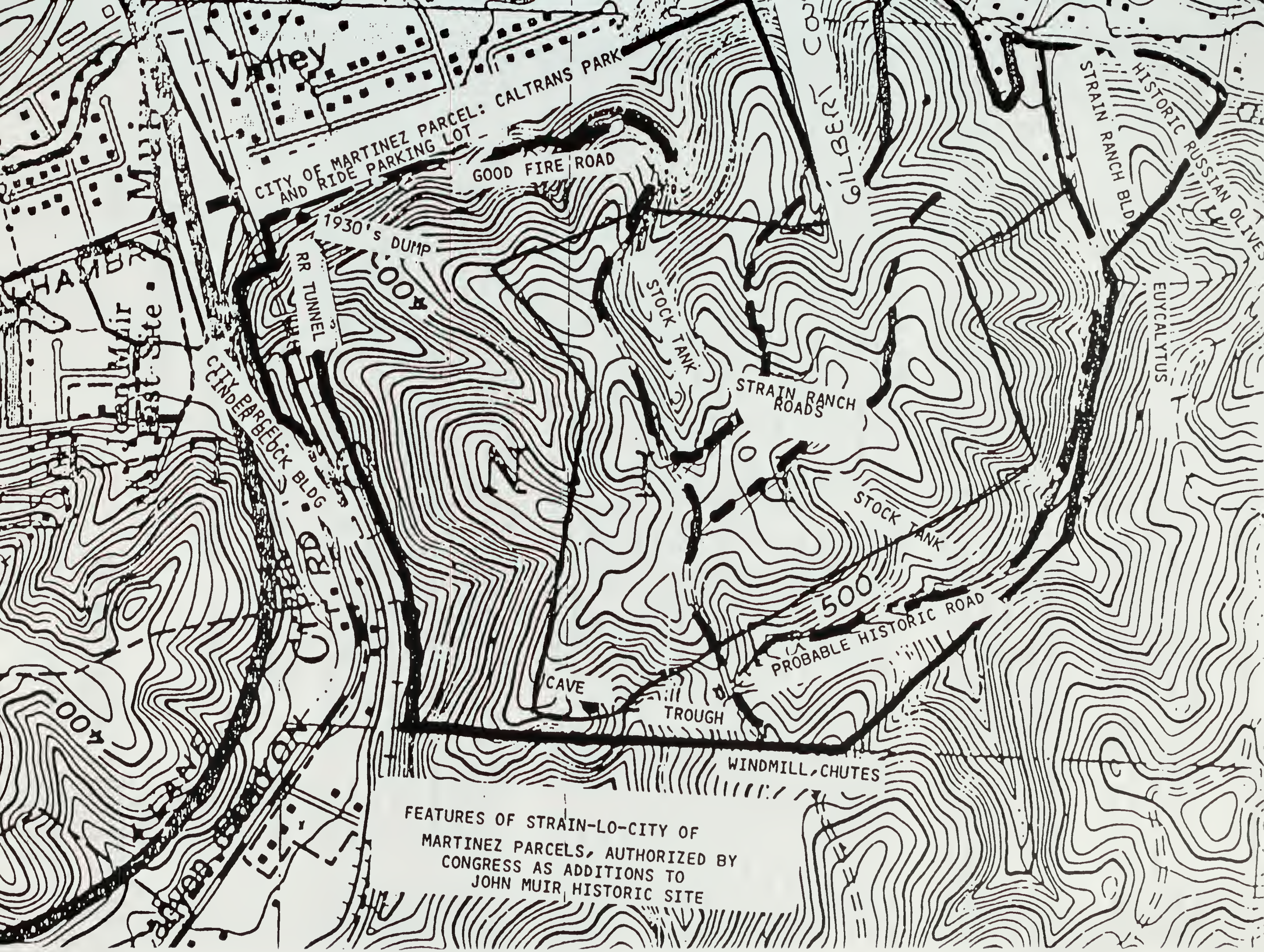
The association with John Muir's family and land use is clear - the Muirs used this area for fern gathering, picnics and outings, with Dr. Strentzel for hay production which continued after Muir's death and subdivision of holdings, and was frequently tranversed by Muir en route to Strentzel's and on Muir's long hikes. The elevated parcel may also be associated with a vista viewpoint during early Spanish exploring expeditions and was associated with the Martinez family holdings, including the local Martinez Adobe occupan of Mexican period. However, I do not believe there is any physical evidence of these lan uses - eg, archeological or historic buildings or features, but the higher elevations ha been cleared of oak and other trees for hay production. Today, the interior of these two parcels (Strain and Lo) are rolling, grass-covered hills with valley and black oak grove in drainages and hilltop margins. A post WWII fire road is the major vehicle access but Mr. Strain has constructed two secondary bladed roads, one from his residence which seem to approximate an older, historic route. He has constructed two small stock tanks, watering troughs for cattle also. A windmill, stock loading chutes, and outbuildings are on an adjoining parcel and are relatively recent. The Strain-Lo parcels include the highest viewpoints in the Martinez area - Carcinez Straits, Mt. Diablo and urbanized valleys, an overlooks to the Muir-Strentzel-Martinez structures at the NHS. The entire Muir-Strentzel agricultural operation can be seen from this point.

We observed two interesting archeological (?) features - a natural cave now used by a local homeless person which may have actual archeological evidence and a 1930s-1950s badl vandalized trash dump said to near an old house, torn down by CALTRANS for a 'park and r lot' on City lands. There are standing structures (of more than 30 years of age) on a sec City parcel - a cinder block multiroom building formerly a local cafe with frame residenc and older (1920s?) barn and residence on Mr. Strain's parcel, possibly post Muir-Strentze but unknown.

The Strain-Lo parcels possess natural resources (relic black oaks, fauna and flora native to area), historic vistas illustrating land use changes over last 100 years, and are dire ly associated with Muir-Strentzel families, indirectly associated with earlier Mexican ar Spanish periods. The cave and damaged trash dump, older (20th Cent.) standing farm buildi on Strain parcel are other potential resources. Later structures on City lands seem not to have potentialsignificance or integrity.

Addition of these lands will provide new interpretive and resource management challenges to the Superintendent!

OPTIONAL FORM NO. 10
(REV. 1-80)
GSA FPMR (41 CFR) 101-11.6



FEATURES OF STRAIN-LO-CITY OF MARTINEZ PARCELS, AUTHORIZED BY CONGRESS AS ADDITIONS TO JOHN MUIR HISTORIC SITE

As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-33 February 2000