<u>Tomki Road in Mendocino County – Impacts to Salmonid Habitat and Management Options to Reduce Impacts</u>

Introduction

The Tomki Road is a Mendocino County-maintained road located approximately five miles east of Willits, CA. The road runs in a north-south direction for approximately nine miles and provides an alternate route between the cities of Ukiah and Willits. Sections of the road are rocked, including the 2.9 mile length that runs parallel to Cave Creek, a tributary to Tomki Creek (an Eel River tributary). In less than 2.5 miles, there are nine wet fords where the road crosses Cave Creek. It is this series of wet crossings, the road's unpaved surfaces, and the road's location through the riparian corridor that are impacting salmonid spawning and rearing habitat in Cave Creek and Tomki Creek. The North Coast Regional Water Quality Control Board (Regional Water Board) is currently investigating water pollution caused by sediments introduced to Cave Creek along the portion of Tomki Road that runs through Sections 18, 19, and 30 T18N, R12W.

The objectives of this report are to:

- Describe the life history requirements of the two salmonid species present in Cave Creek.
- Summarize the road's impacts to spawning and rearing habitat requirements.
- List both short-term and long-term options for minimizing and/or eliminating the impacts.
- For each option or alternative, evaluate its probable effectiveness in providing benefits.

Fisheries Background

Although significant reaches of Cave Creek are seasonally dry, both Chinook salmon (*Onchorhynchus tshawytschaw*) and steelhead (*O. mykiss iredius*) are known to utilize Cave Creek for spawning and rearing (Harris, pers. comm.). Both species within the Eel River basin are currently listed as threatened under the federal Endangered Species Act. Spawning surveys conducted by the California Department of Fish and Game (CDFG) suggest that the numbers of chinook salmon using Cave Creek in any given year are highly variable and may range from less than 20 fish to several hundred (Jones and Harris, pers. comm.). In drought or low-water years, it is possible that no chinook spawning occurs in Cave Creek. The numbers of adult steelhead spawning in Cave Creek are unknown, yet juveniles are often observed in large numbers in late-spring and early-summer after emergence from the gravel.

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Chinook Salmon Life History

Chinook salmon in California return to spawn at two to seven years of age, with three and four year olds comprising the bulk of spawning populations. The timing of fall chinook runs into coastal watersheds is variable and highly influenced by rainfall and stream discharge. Sand bars at the mouths of coastal watersheds must often breach before Chinook salmon can enter. Runs of fish may enter freshwater from October through January, depending on rainfall. Although the presence of Chinook salmon is influenced greatly by the timing, frequency, and magnitude of winter storms; these fish would most likely be present in Cave Creek between November and January.

The fecundity of female Chinook salmon is variable, depending on the age and size of the fish and geographic location. Estimates range from 2,000 to 14,000 eggs (Moyle 1976). Klamath River chinook average 3,600 eggs, while Sacramento River fish average 7,300 eggs (Allen and Hassler 1986). After completing her redd, a female Chinook may defend the redd site from four to 25 days, depending on her condition (Neilson and Geen 1981, Neilson and Banford 1983). All Chinook salmon eventually die after spawning.

The incubation of Chinook salmon eggs is inversely related to water temperature and varies from 36 to 160 days. In a controlled setting, eggs incubated in 16^{o} C water hatched in about 32 days, whereas eggs in 3^{o}C water hatched in 159 days (Healey 1991). Newly-hatched fish (alevins) then spend two to four weeks within the streambed substrate prior to emergence, subsisting on their yolk sacs. Survival to emergence is highly variable and influenced by numerous environmental factors.

Redds (nests) are typically constructed in riffles and pool-tails where suitable-sized substrate is located, generally a mix of gravels to small cobbles. These areas also have adequate stream flow for providing oxygen for the developing eggs and a means of flushing metabolic waste products. Redd sites are selected by female Chinook salmon (Briggs 1953; Allen and Hassler 1986) in water depths of six to 50 inches (Chapman 1949). Fall-run Chinook salmon construct redds in gravels ranging from one-half to four inches in diameter (Allen and Hassler 1986). Eggs are usually buried seven to 24 inches below the surface of a completed redd (Briggs 1953). The requirement of sufficient sub-gravel water flow seems to be of more importance to Chinook salmon spawning success relative to other salmonid species (Healey 1991). Chinook produce the largest eggs which have the smallest surface area-to-volume ratio of all salmonid species. Healey (1991) speculated that chinook eggs would be more sensitive to reduced oxygen levels and require a higher, and more certain, rate of sub-gravel water flow. In Cave Creek, most of the wet fords are located at pool-tails with characteristics conducive to Chinook salmon spawning.

A large downstream migration of Chinook fry right after emergence is common in most populations, and may be a dispersal mechanism to distribute fry among all suitable rearing habitats (Bjornn 1971; Reimers 1971). Once started downstream, Chinook fry may continue to the estuary or take up residence in the watershed for a period ranging from several weeks to a year or more (Healey 1991). Residing fry will initially seek cover along channel margins or in low velocity areas associated with the channel bottom. As they grow larger they tend to establish territories in faster, deeper habitats (Everest and Chapman 1972).

Estuaries play a vital role in the life cycle of Chinook salmon. Fry of fall-run chinook often migrate downstream immediately after emergence and rear to smolt-size in estuaries (Healey 1991). Chinook migrating as young-of-the-year or yearling smolts also rely on estuarine habitat for additional growth and acclimation to saline water prior to oceanic migrations.

Steelhead

The anadromous (sea-run) coastal rainbow trout is called the steelhead, which accounts for most of the variable life history patterns. Steelhead populations occur throughout the range of coastal rainbow trout except in the northern and southern extremities (Behnke 1992). The present southern limit of steelhead distribution is Malibu Creek, California. The southern range of summer run steelhead is the Middle Fork of the Eel River (Barnhart 1986).

The life histories of coastal rainbow trout and steelhead have been reviewed by numerous authors (Smith 1973; Jones 1976; Moyle 1976; Barnhart 1986; Behnke 1992). Steelhead populations may be grossly categorized as summer run or fall/winter run fish, depending when spawning adults enter fresh water. This is an oversimplification and adult steelhead probably enter fresh water every month of the year somewhere in their widespread distribution (Behnke 1992). Summer run steelhead are not abundant throughout the Pacific southwest and the runs in many watersheds consist of less than 100 adults (Roelofs 1983).

Summer run fish usually enter fresh water from May through August and move upstream to hold in deep pools until the following winter or spring to spawn. Fall/winter run fish generally enter fresh water from September through November, whereas many coastal watersheds have late runs of winter steelhead that enter fresh water from January through April. The partitioning of an anadromous species into distinct races is an excellent reproductive strategy since this enlarges the use of its environment and increases productivity (Behnke 1992). Steelhead could be present in Cave Creek between January and April, and possibly even as late as May if late-spring storms occurred.

Adult steelhead spawn more than once and repeat spawners are a significant contribution to many populations. Most populations consist of 10% to 20% repeat spawners (Behnke 1992). Forsgren (1979) reported that second time spawners comprised 70% to 85% of repeat spawners and third time spawners comprised 10% to 25% of repeat spawners. Spawning survival is highly variable and influenced by genetic factors, habitat quality, fishing pressure and management plans.

The fecundity of coastal rainbow trout (either resident or anadromous) is highly variable, from 200 to 12,000 eggs depending on the size of the female (Moyle 1976). Moyle (1976) also reported that resident fish usually produce less than 1,000 eggs and that steelhead average about 2,000 eggs per kilogram (2.2 lbs) of body weight.

Incubation of steelhead eggs, as with all salmonids, is inversely related to water temperature. Eggs in 15^{o}C water hatch in approximately 19 days, whereas eggs in 5^{o}C hatch in about 80 days (Barnhart 1986). Steelhead alevins remain in the gravel for two to four weeks and are sustained by their yolk sacs. Survival of eggs and alevins to emergence is highly variable and dependent on numerous environmental factors.

Steelhead reside in fresh water from one to four years before smolting and out-migrating to the ocean. Juveniles in California watersheds typically rear one to two years in fresh water before smolting (Barnhart 1986). Steelhead then spend one to four years at sea before returning to spawn. The length of both in-stream and oceanic residency increases from south to north along the species' distribution (Barnhart 1986).

Spawning usually occurs in pool tails with cool, clear, well oxygenated water with suitable current velocity, depth and substrate particle-size (Reiser and Bjornn 1979). Depending on the watershed and size of the fish (resident or anadromous), coastal rainbow trout spawn at depths of four to 24 inches, in current velocities of 0.7- 5.0 ft/sec and in substrate of 0.25"-5.0" in diameter (Smith 1973; Barnhart 1986). Generally summer run steelhead spawn in the upper sections of watersheds, utilizing habitat inaccessible to fall/winter run fish. Steelhead often utilize intermittent stream reaches for spawning purposes (Kralik and Sowerwine 1977; Carrol 1984). In these streams, the young migrate downstream to reaches that have year-round surface flow.

After emergence, steelhead fry tend to school and seek out shallow water along stream margins. As the fry grow they start to establish and defend individual territories. Most young-of-the-year steelhead fry inhabit riffles or runs (Barnhart 1986). Mortality of juvenile steelhead is highest the first few months after emergence as fry move about and attempt to establish territories (Shapovalov and Taft 1954; Chapman 1966). Larger steelhead fry (age 1+ year and older) generally maintain territories in pool and run habitats. A productive steelhead stream should have summer temperatures of 10^{o} C to 15^{o} C and an upper limit of around 20^{o} C (Barnhart 1986).

Tomki Road – Impacts to Chinook Salmon and Steelhead Habitat Requirements

The approximately two-mile section of Tomki Road that parallels Cave Creek winds through the riparian zone and intersects Cave Creek's main-stem with eight wet fords. The ninth wet ford crosses a tributary to Cave Creek (MP 7.05). Six of these fords are grouped together in two clusters (Figure 1).

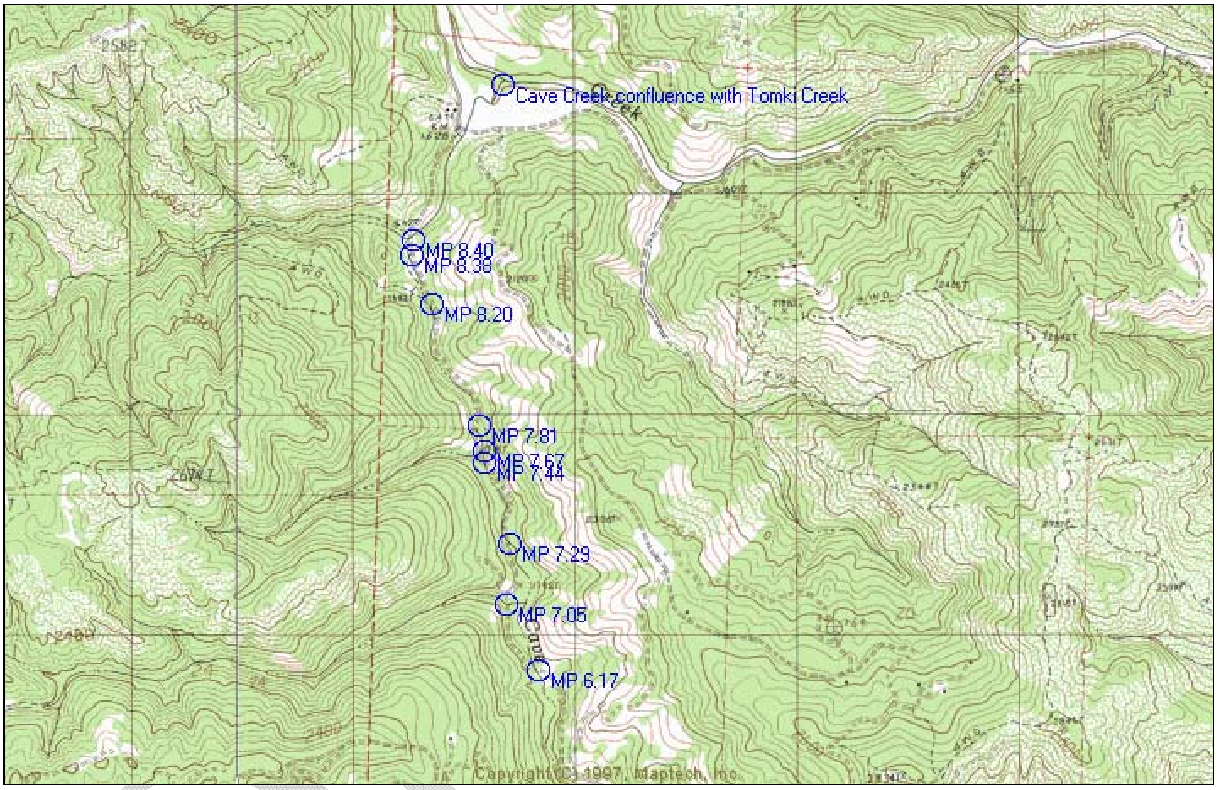

Figure 1. Tomki Road and the locations of nine wet fords along Cave Creek.

Tomki Road is functionally classified as a local road and has an average daily traffic (ADT) use of less than 50 consisting primarily of passenger vehicles. The ford crossings have existed since the late 1800's and the current right-of-way enjoyed by users of Tomki Road is by prescriptive easement. Along the reach of Tomki Road with the nine fords, there are no permanent residential dwellings and only four to five individual landowners – with most of them currently absentee landowners that live outside of Mendocino County. Up to the 1960's-70's, Tomki Road was designated by CalTrans as its official alternate route to Highway 101 in an event of a highway closure between Willits and Ukiah. Although this designation is no longer official, Tomki Road is still utilized by locals on a year-round basis as an alternate route to Highway 101. Only during high winter discharges are the wet fords, to varying degrees, impassable to most passenger vehicles.

On February 12, 2003 the nine fords and two-mile reach of Tomki Road along Cave Creek were examined by the following persons: Ross Taylor (Five-Counties fisheries biologist), Howard Dashiell (Mendocino County DOT), Allan Gialdini (Mendocino County DOT), Andy Baker (Regional Water Board), Dave Hope (Regional Water Board), Weldon Jones (CDFG), and Scott Harris (CDFG). The purpose of the field meeting was to discuss the ongoing erosion and sediment issues, discuss the short-term and long-term options to correct the problems, and examine the nine crossings. Notes and digital photos taken during the field tour provided the basis for much of my summary concerning the factors along Tomki Road impacting salmonid habitat.

Spawning Habitat

Spawning habitat is impacted in several ways by Tomki Road. Fine sediment fills the spaces between cleaned gravels within completed redds, potentially suffocating the eggs. Most of the fords cross at pool-tails with good spawning habitat, redds in these locations have a high likelihood of being crushed by vehicles. Adult Chinook salmon are quite conspicuous in Cave Creek and their presence often leads to poachers who have excellent access to spawning fish along Tomki Road.

1. The introduction of sediment into Cave Creek occurs off of the gravel/dirt surfaces of Tomki Road. This source of sediment enters Cave Creek at numerous locations. At each ford, the road approach slopes towards the creek channel with all storm run-off draining directly into the creek. In-board ditch relief culverts also introduce road run-off into the creek channel at other locations. When mobilized during storms, fine sediment generated from Tomki Road probably degrades the quality of spawning substrate in Tomki Creek too.

2. The constant re-mobilization of fine sediment occurs each time a vehicle crosses a ford, or the series of nine fords. In most cases, a vehicle traveling on Tomki Road crosses every ford. Incubating eggs and developing alevins are impacted each time a ford is crossed when fine sediment is mobilized, drifts downstream and covers redds with additional layers of silt. During our site visit, we observed thick layers of silt on the channel bed downstream of each ford.

3. Because the wet fords are located at pool tails, these areas have the substrate sizes, water depths, and water velocities consistent with Chinook salmon and steelhead spawning requirements. In past years, CDFG biologists have observed adult chinook have spawning at several of these fords (Harris, pers. comm.). Completed redds in these locations have a high likelihood of being crushed by vehicles using the fords. In one instance, the CDFG biologist observed a four-wheel drive truck crossing a Cave Creek ford while Chinook salmon were spawning (Harris, pers. comm.).

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4. Conversations with CDFG biologists and other agency personnel indicate that for decades, the reach of Cave Creek along Tomki Road has been a popular location for poachers to illegally harvest salmon. The road's location along the creek and its seclusion allows these illegal activities to occur unnoticed. Cave Creek is relatively small with few deep pools, thus adult Chinook salmon (often ranging from 15 to 40 lbs) are easy prey for a determined person(s) armed with a net, gaff, and/or pitchfork.

Rearing Habitat

Rearing habitat is impacted in several ways by Tomki Road. Excess sediment fills pools, decreasing the amount of rearing habitat. Most of the fords cross at pool-tails with good rearing habitat for newly emerged fry, fish residing in these locations have a high likelihood of being crushed by vehicles. Chronic turbidity caused by vehicles crossing the fords may affect the growth and survival of chinook and steelhead fry through irritation of the gills and reducing feeding efficiency.

1. Excess sediment that settles in pools leads to decreases in pool depth and volume – lessening the amount of suitable rearing habitat. Severely aggraded channels also tend to exacerbate conditions such as the drying-up of surface flow. Stream channels with high amounts of fine sediment also tend to have a lower diversity and biomass of aquatic invertebrates, an important food source for juvenile salmonids. Newcombe and MacDonald (1991) reviewed 21 research papers that all reported sub-lethal and lethal effects of turbidity on benthic invertebrate populations.

2. The months of March-June are when juvenile salmon and steelhead emerge from the spawning gravels en masse. The fry tend to school together along the stream channel margin and pool tails with shallow water and slower velocities. In Cave Creek, juveniles have been observed during the spring in large schools at most of the wet fords (Dashiell, Jones and Harris, pers. comm.). Fry holding in these areas are physically displaced each time a vehicle crosses a ford. While direct mortality by being crushed by a vehicle is speculative, each passing vehicle disrupts feeding, rearing, and territorial behavior as the fry are required to repeatedly avoid the traffic.

3. While in most streams suspended sediment and turbidity occur only during elevated storm flows, in Cave Creek turbidity is created each time a vehicle uses one of the wet fords. Bjornn and Reiser (1991) summarized literature which reported disruptions in territorial and feeding behavior caused by short-term exposures to turbid water (up to 60 NTU), as well as reduced growth rates of newly emerged juvenile coho salmon and steelhead that were exposed to chronic turbid conditions (25 to 50 NTU). Newcombe and MacDonald (1991) reviewed more than 70 research papers concerning the effects of inorganic suspended sediments on aquatic biota. From these papers, a database was created to allow for statistical analyses of the effects. A regression analysis indicated that sediment concentration alone was a poor indicator of effects, and that the product of sediment concentration and duration of

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exposure was a better indicator (Newcombe and MacDonald, 1991). The list of sub-lethal effects they summarized included: reduction in feeding rates, feeding ceased, reduction in feeding efficiencies, physiological stress, changes in behavior, reduced growth rates, histological damage to gills, poor overall condition factors, impaired avoidance response, and harm to quality of rearing habitat.

<u>Additional Impacts Occurring along Tomki Road</u>

The field visit conducted on 2/12/03 revealed that damage is occurring to Tomki Road and Cave Creek beyond the impacts caused by people simply using the road for transportation. We observed numerous areas adjacent to Tomki Road and within the riparian zone severely damaged by recreational 4-wheel drive vehicles. Several areas had deep, mud-filled ruts caused by trucks repeatedly driving through them. In other areas we observed damage to stream banks and steep slopes adjacent to Tomki Road where 4-wheelers were attempting "hill-climbs" with their trucks. Much of this damage is occurring on private property adjacent to Tomki Creek.

Several garbage dumps were observed, with a wide range of potentially hazardous materials or fluids entering Cave Creek. The following items were observed:

1. Appliances – refrigerators, washers, and driers near confluence of Cave Creek and Tomki Creek.
2. Automobiles - an abandoned van at MP 7.67 with CA license #494-KCS, it was leaking fluids onto road surface within five feet on wetted channel. Upstream of the ford at MP 7.29 there is a large dump on the right-bank flat adjacent to the creek. There were five to six abandoned vehicles, including one in the wetted channel. This site also had several large piles of assorted garbage that included diapers and literature printed off the Internet regarding the production of methamphetamine. At this site were several burn piles of unknown substances.
3. At several locations we observed the remains of vehicle oil changes – with old oil on the ground, filters, and empty oil containers.
4. Tires – upstream of ford at MP 7.29 there were a large number (≈50-75) of tires dumped off of Tomki Road into a severely-eroded gully at the outfall of an in-board ditch relief culvert.

Short-term Solutions to Reducing Impacts Caused by Tomki Road

Proposed Action	Intended Benefit	Potential Impacts	Final Recommendation
Take no action – leave Tomki Road in its existing condition.	None.	Same suite of impacts previously listed, with further degradation of aquatic and riparian habitat conditions.	This option is not recommended because the list of ongoing impacts will still occur.
Modify existing fords and approaches by applying coarse substrate to road surface and fords.	Reduce sediment entering Cave Creek and reduce fine sediment mobilized when a vehicle crosses a wetted ford.	May encourage salmonids to spawn in the substrate placed at the ford. Substrate will probably wash away on storm flows and would require frequent supplementation. Improving the road may lead to an increase in use, thus increasing the ongoing impacts.	This option is not recommended because of the list of potential impacts that will still probably occur.
Modify existing fords and approaches by paving them with concrete. Hardened fords would be slightly v-shaped to concentrate low-flow and provide better fish passage. Rest of road would be rocked to reduce fine sediment contribution from remaining road surfaces.	Reduce sediment entering Cave Creek and reduce fine sediment mobilized when a vehicle crosses a wetted ford.	Hardened concrete fords (even when installed at present stream-grade) often become migration barriers as the channel readjusts and the ford remains at a static elevation. Typically, high flows scour the channel-bed downstream of the hardened ford, creating drops at the downstream edge. Improving the road may lead to an increase in use, thus increasing the ongoing impacts.	After a seasonal road closure with locked gates, this is probably the second-best option from a biological point-of-view. However, Mendocino County DOT should be held responsible for monitoring the performance of these hardened fords and implementing corrective maintenance if it is determined that any of the fords are impeding fish migration.
Pave the entire 2.9 mile length of Tomki Road along Cave Creek and install bridges or culverts at the stream crossings.	Reduce sediment entering Cave Creek and eliminate the need to for vehicles to enter the stream channel.	Improving the road may lead to an increase in use and human activity, thus increasing potential impacts caused by 4-wheelers, fish poachers, and illegal garbage dumpers.	This option is not recommended because of the high cost to pave the road and construct nine bridges or fish-friendly culverts. Not recommended to spend large amounts of money to keep this road within the riparian zone of a fish-bearing stream.

Short-term Solutions to Reducing Impacts Caused by Tomki Road

Proposed Action	Intended Benefit	Potential Impacts	Final Recommendation
Seasonally close Tomki Road to vehicular traffic when fish are present in Cave Creek, from November 1st through July 15th. Locked gates should be installed at strategic locations to prevent vehicles from driving around the gates and still use Tomki Road. NOTE: dates listed above are intended as a guideline. The most appropriate method for closing and opening the road would be an annual decision based on when rainy season starts in the fall (close road) and when fry are either absent in the spring, or when the creek goes sub-surface (open road).	Reduce impacts caused by vehicles driving through creek when salmon and steelhead are most likely present. Reduce the occurrences of 4-wheeler damage, poaching, and illegal dumping.	Landowners may not have convenient access to their property. Poor access for emergency response vehicles. If not treated, road related sediment will still enter Cave Creek during rain storms.	Probably is the best short-term solution as long as locked gates are located correctly and maintained. Due to past problems with vandalism at locked gates on County roads, the success of this option requires the support of county, state, and/or federal law enforcement to fine and/or prosecute violators. If requested, provide landowners with gate combination or key. Anyone provided a key must agree to use Tomki Road only as a last resort. For safety purposes, issue gate keys or combination to CDF, Fire Department, Sheriff's Department, and CDFG warden. Treat the road-related sediment sources.

Long-term Solutions to Reducing Impacts Caused by Tomki Road

Proposed Action	Intended Benefit	Potential Impacts	Final Recommendation
Pave the entire 2.9 mile length of Tomki Road along Cave Creek and install bridges or culverts at the stream crossings.	Reduce sediment entering Cave Creek and eliminate the need to for vehicles to enter the stream channel.	Improving the road may lead to an increase in use and human activity, thus increasing potential impacts caused by 4-wheelers, fish poachers, and illegal garbage dumpers. A paved road may lead landowners towards developing sub-divisions which will cause additional impacts.	This option is not recommended because of the high cost to pave the road and construct nine bridges or fish-friendly culverts. Not recommended to spend large amounts of money to keep this road within the riparian zone of a f fish-bearing stream.
Relocate Tomki Road to one side of Cave Creek and reduce the number of crossings from nine to two. Install bridges or fish-friendly culverts at the two required crossings.	Reduce sediment entering Cave Creek and eliminate the need to for vehicles to enter the stream channel.	Relocation will impact the riparian zone and improving the road may lead to an increase in use and human activity, thus increasing potential impacts caused by 4-wheelers, fish poachers, and illegal garbage dumpers.	This option is not recommended because of the high cost to pave the road and construct two bridges or fish-friendly culverts. Not recommended to spend large amounts of money to keep this road within the riparian zone of a fish-bearing stream.
Relocate Tomki Road to one side of Cave Creek and reduce the number of crossings from nine to two. Maintain wet fords at the two required crossings.	Reduce sediment entering Cave Creek and reduce the number of locations where vehicles enter the stream channel.	Relocation will impact the riparian zone and improving the road may lead to an increase in use and human activity, thus increasing potential impacts caused by 4-wheelers, fish poachers, and illegal garbage dumpers. Impacts will increase at the two remaining wet fords.	This option is not recommended because of the high cost to relocate the road. Not recommended to spend large amounts of money to keep this road within the riparian zone of a fish-bearing stream.
Relocate Tomki Road out of Cave Creek's riparian corridor to the ridge-top road that already exists to the east of Cave Creek. Decommission Tomki Road using accepted restorative methods. Remove garbage dumps and replant damaged riparian areas.	Reduce sediment entering Cave Creek and eliminate the need to for vehicles to enter the stream channel and the riparian corridor.	The monetary cost may be prohibitive. Is based on the assumption that the property east of Cave Creek can be purchased, or a prescriptive easement can be arranged.	This option should be evaluated more closely to assess its feasibility. Overall cost may be too expensive for the County to justify pursuing.

Long-term Solutions to Reducing Impacts Caused by Tomki Road

Proposed Action	Intended Benefit	Potential Impacts	Final Recommendation
Decommission Tomki Road using accepted restorative methods. Remove garbage dumps and replant damaged riparian areas.	Reduce sediment entering Cave Creek and eliminate the need to for vehicles to enter the stream channel and the riparian corridor.	No impacts to stream habitat or fisheries resources. Impacts are more social – loss of a road that has been available for decades. This option is based on the assumption that the property east of Cave Creek can **not** be purchased, or a prescriptive easement can **not** be arranged.	This option should be evaluated more closely to assess its feasibility.

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