

Appendix D—Low-Water Crossing Effects on Water Quality

Most of the small body of scientific literature about ford effects on water quality is related to sediment, the most common pollutant from road and stream crossing sources. It is quite difficult to generalize the conclusions from those papers because researchers use different methods in different studies and because of the site-specific nature of the effects. Furthermore, research is lacking that would tie ford-related sediment changes directly to impacts on aquatic species and habitats. [Numerous references summarize the effects of sediment on aquatic species and their habitats, including Bilby 1985; Bilby et al. 1989; Vaughan 2002; and Furniss et al. 1991.]

In an excellent summary of crossing effects on water quality, Taylor (1999) concluded that unvented fords have more effects on water quality than do culverts, and that bridges have fewer detrimental effects. The research leading to that conclusion compared suspended sediment concentrations both upstream and downstream from each crossing type on flowing streams during construction, reconstruction, and traffic use. Although results varied quite a bit, they nonetheless showed that, for culverts and fords, sediment increased downstream during active construction and occasionally during a subsequent rainfall. Traffic usually produced detectable increases downstream. The longer-term effects of fords on water quality appeared to depend on factors such as type of surfacing on the ford and its approaches, vehicle type and use level, and time since disturbance for reconstruction or maintenance, among other things (Taylor 1999).

Traffic through unimproved fords has been shown to produce sediment by several processes (Brown 1994). These processes include:

- Waves from vehicles eroding banks.
- Ruts concentrating surface runoff during storms.
- Water washing off vehicles (as they emerge from the water) eroding the approach as it runs back into the stream.

Erosion on the ford approaches can, of course, be mitigated by using best management practices (BMPs) (section 4.11).

Driving across an unprotected streambed also mobilizes sediment that is already present but would not otherwise be transported during low flows. Sample et al. (1998) showed that, compared to a natural (unimproved) ford, much less sediment appeared downstream of a hardened ford (streambed excavated and replaced with compacted rock and gravel) after vehicles crossed.

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Note that these studies did not consider the potential catastrophic impacts that culvert crossings can have when culvert capacity is exceeded and the roadfill fails. Properly designed ford crossings may be a chronic impact, but do not pose the catastrophic risk of sediment inputs that culverts do.

For chemical pollutants, the situation may be different. As vehicles drive through water, oil, grease, and other chemical pollutants can wash off. Pollutants that have been identified in highway rights-of-way, which could conceivably enter the water, include lead, zinc, cadmium, and polychlorinated biphenyls (PCBs) from tire wear; asbestos, copper, chromium, and nickel from brake-lining wear; and oil and grease (Hyman and Vary 1999). The authors are not aware of any evidence that these constituents cause detectable or significant water quality problems at fords.

There is no evidence to suggest that paving a ford is likely to put water quality at risk due to petroleum hydrocarbons leaching from the asphalt. A study at the USDA Forest Service Coweeta Hydrologic Laboratory found total petroleum hydrocarbons (TPH) in very low (<0.5 parts per million) concentrations in runoff from a 2-year-old paved forest road (Clinton and Vose, 2003). Although there was some evidence for the migration of TPH absorbed to fine material (e.g., sand, silt) from fresh asphalt surfaces, TPH was not detected in solution in either runoff or stream water. There is no surface water quality standard for TPH.

Preliminary monitoring results from three streams on the Fishlake National Forest in Utah show how off-highway vehicle (OHV) traffic through fords affects turbidity, streambed fines, and concentrations of volatile organic compounds and total TPH (Deiter, 2006). Deiter measured downstream turbidity and numbers of vehicles crossing an unimproved ford over several years, and established a relationship between the two parameters (fig. D-1).

Turbidity attenuated rapidly with distance downstream from the Dry Creek study crossing (fig. D-2), and pebble counts demonstrated that the percent of fines in the streambed near the crossing increased after a 6-day OHV event (200 to 500 crossings). No information is available on whether the increase persisted after flushing flows or how it affected the aquatic community.

Although naphthalene and gas- and diesel-range organic compounds were detected during the OHV event, all were below levels of concern for ambient surface water. Deiter concluded that, for the hydrocarbon parameters measured, OHV traffic did not appear to cause significant damage to the aquatic environment.

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Deer & Dry & Chalk Creek Study Crossings -- Fording Intensity versus Peak NTUs

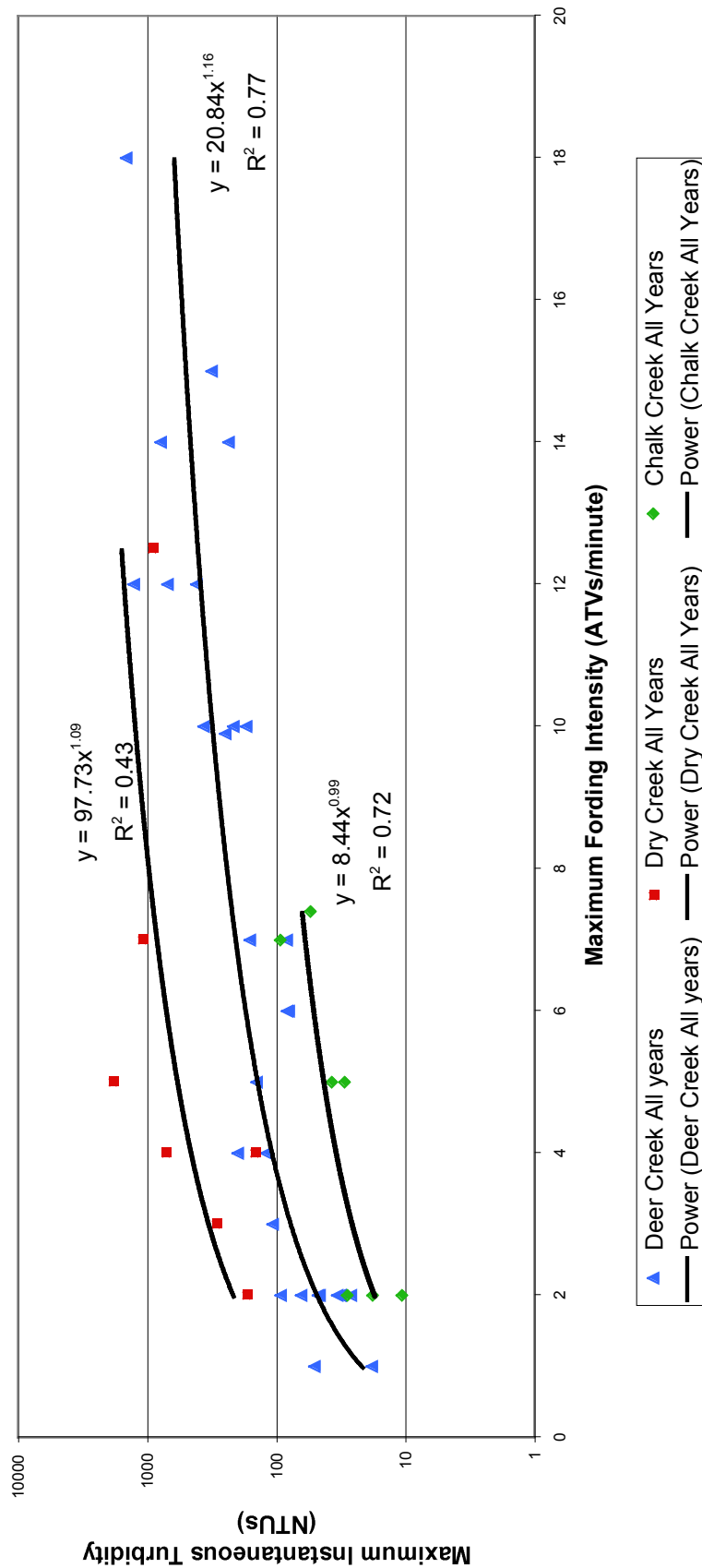


Figure D-1. Fording intensity is moderately well-related to turbidity. These data represent turbidity measurements taken as waves of riders passed the crossing at times when turbidity was at background levels (i.e., water quality was not affected by previous riders) (Deiter 2006).

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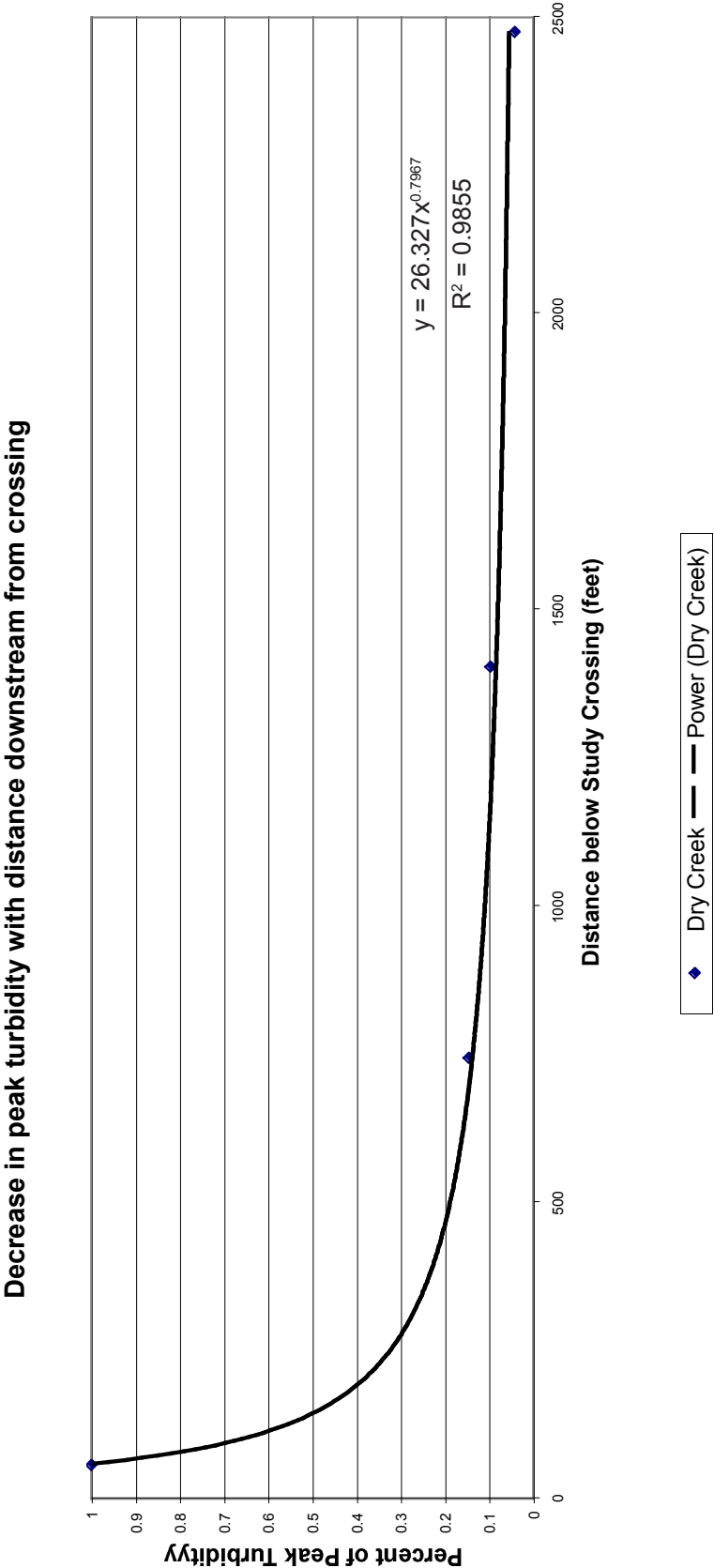


Figure D-2. Turbidity decrease with distance downstream. Dry Creek has four unimproved fords along a fairly uniform 1/2-mile length. These data represent turbidity measured at a downstream ford (the study ford) as a wave of riders crossed fords at different distances upstream. Peak turbidity data are reported as a percentage of peak observed at the study ford (study ford data shown as 100 percent). The other fords are at 750, 1,400, and 2,480 feet upstream of the study ford. (Deiter 2006)

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There are no demonstrated instances of OHVs transferring whirling disease to uninfected streams, and the likelihood of that happening is not thought to be large (Wilson 2006). However, fine sediment enrichment, such as the increase in streambed fines that Deiter did demonstrate, could improve habitat conditions for one of the hosts of whirling disease. Hypothetically, this could worsen an infection where it already exists (Wilson 2006).

Using the structure location and design recommendations in this guide will help protect water quality by properly siting a structure and then fitting it to the site. Standard BMPs also apply here (as at all road-stream crossings), and include:

- Proper crossing location.
- Timing of construction.
- Good structural design.
- Disconnecting the road from the stream by
 - Armoring approaches
 - Draining the road to the forest floor before runoff can reach the stream
 - Providing sediment traps or filter areas at ditch outlets.

In addition, water quality protection at low-water crossings includes hardening the crossing surface itself and protecting streambanks from vehicle backwash or overflow during floods. Section 4.11 goes into more detail on long- and short-term water quality protection at low-water crossings.

