

US 93 PRECONSTRUCTION WILDLIFE MONITORING FIELD METHODS HANDBOOK

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prepared by
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RESEARCH PROGRAMS

Montana Department of Transportation



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US 93 Preconstruction Wildlife Monitoring Field Methods Handbook

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16. Abstract The US 93 reconstruction project on the Flathead Indian Reservation in northwest Montana represents one of the most extensive wildlife-sensitive highway design efforts to occur in the continental United States. The reconstruction will include installations of 42 fish and wildlife crossing structures and approximately 15 miles (24 km) of wildlife exclusion fencing for a total investment of over \$9 million. The Western Transportation Institute at Montana State University (WTI), the Montana Department of Transportation and FHWA are working collaboratively with Tribal organizations and other stakeholders to redesign a rural highway within a multiple use landscape that accommodates the needs and concerns of different institutions, cultures and priorities. WTI is leading the evaluation of how the wildlife crossing structures and wildlife fencing affect deer- and bear-vehicle collisions and movements in a multiple-use rural landscape. The evaluation will include the collection and analysis of both pre- and post construction data. To investigate the effectiveness of the mitigation measures based on comparing before and after data, consistency within and between field observers during pre- and post-construction data collection is essential. This handbook was developed to maintain standardized field data collection methods throughout Phase I (pre-construction data collection), to ensure the safety of personnel working on US 93, to provide practical information for day-to-day tasks, to document important details regarding the methods used, and to provide background information on successful methods that can be incorporated into Best Management Practices (BMPs). This manual will be an important tool for preserving data collection protocols and standards over the duration of this project and between different personnel. All US 93 field personnel involved in WTI's evaluation project will be required to read, understand, and follow the procedures in this Handbook. Beyond this project, the methods detailed in this Handbook can be adapted for other wildlife mitigation monitoring programs and successful applications of these methods will be outlined for the forthcoming BMPs.			
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1. INTRODUCTION

US Highway 93 crosses the Flathead Indian Reservation, north of Missoula, Montana, with the Mission Mountains to the east and the Flathead Valley to the north. This land is the home of the Confederated Salish and Kootenai Tribes (CSKT) of the Flathead Nation. The Flathead Reservation is also home to various wildlife species such as grizzly bear, black bear, white-tailed deer, mule deer, elk, coyote, painted turtle, bighorn sheep, numerous fish and bird species, amphibians, and reptiles.

A 56 mile (90 km) long section of US highway 93 on the Flathead Indian Reservation will be reconstructed. The Tribes, Montana Department of Transportation (MDT) and the Federal Highway Administration (FHWA) conducted reconstruction discussions that focused on the importance of protecting cultural and natural resources and processes, including hydrologic function, seed/plant dispersal, and fish and wildlife movements across the road. Fish and wildlife crossings became a focal point as a mitigation measure. The cooperating agencies, consultant engineers from Skillings-Connolly, Inc., and consultant landscape architects from Jones and Jones Architects and Landscape Architects met with wildlife biologists to develop the Wildlife Crossings Workbook and Design Guidelines and Recommendations (Skillings and Connolly 2000). The concepts outlined in these documents were committed to by CSKT, MDT and FHWA in a Memorandum of Agreement (MOA) in 2000; this MOA served as a resolution that led to the issuance of the Record of Decision for the project's 1996 Final Environmental Impact Statement that had stalled due to an impasse between the three governments.

Specifically, the MOA commits to installing several segments of wildlife-proof fencing along a total of 15 miles (24 km) of US 93, with 42 wildlife crossing structures perforating the fenced areas to allow animals to safely pass under or over the highway. The recommendations were modeled after the wildlife crossings and fencing installations on the Trans-Canada Highway in Banff National Park, Alberta, Canada. The location of the US 93 wildlife crossing structures was based on local knowledge of wildlife movements on the Flathead Indian Reservation, road kill locations, habitat, land use and ownership, and engineering practicality. The mitigation measures are aimed at increasing driver safety through a reduction in AVCs while maintaining wildlife movements across the landscape and highway.

The MOA Design Guidelines and Recommendations state the importance of developing, “a monitoring system for all major wildlife crossings in order to document usage and to collect data that can be used for other similar projects.” The three governments agreed that, (1) pre- and post- construction monitoring and evaluation of the crossing structures and fencing must be done on the US 93 Evaro to Polson Project, and (2) the evaluation of the mitigation must produce best management practices.

Funding from FHWA and MDT was secured for Phase I, the preconstruction phase, and the Western Transportation Institute at Montana State University (WTI) was contracted in March 2002 to establish the long-term study approach and protocols, document the issues and decision-making processes involved in the planning and designing of the crossings and fencing, and collect pre-construction baseline data. In addition, WTI is to identify and report on “Best Management Practices” (BMPs) to guide applications of wildlife fencing and crossing structures as well as recommending monitoring methods and studies for future highway projects incorporating such measures. The overall goal of this long-term project (Phase I & II) is to evaluate the effectiveness of the wildlife crossings and fencing as it relates to the goals of the

mitigation measures: to reduce Animal Vehicle Collisions (AVCs) and maintain wildlife movements across US 93.

The evaluation will be based on a comparison of the number of AVCs and deer and black bear movements across US 93 before and after construction. To investigate the effectiveness of the mitigation measures based on comparing before and after data, consistency within and between field observers during pre- and post-construction data collection is essential. Due to the long-term nature of this project (Phase I pre-construction data collection will occur 2002 to 2006, Phase II post-construction monitoring could begin in late 2006 or 2007 and end around 2011, depending on construction schedules and available budgets for the post-construction monitoring). This document was developed and funded to help maintaining consistency through Phase I and to provide a “stepping stone” to finalizing comparable post-construction methods and developing BMPs, two forthcoming products that will be delivered in Phase I. The goals of the Handbook are outlined as follows:

- to ensure the safety of personnel working on US 93;
- to maintain standardized field data collection methods throughout Phase I;
- to provide practical information for day-to-day tasks such as maintaining equipment, entering and managing data, and accessing references and local contacts that may be of assistance, if needed;
- to document details that will be important to finalizing the post-construction methods and to ensure both pre-and post-construction methods are rigorously comparable to each other; and
- to provide background information on successful methods that will be incorporated into BMPs related to the monitoring of wildlife crossing structures and fencing.

The Handbook contains more detailed information than one might find in a typical “methods” section to ensure that “institutional memory” is well-documented and serves as a practical resource for this long-term project. This manual will be an important tool for preserving data collection protocols and standards over the duration of this project and between different personnel. All US 93 field personnel involved in WTI’s evaluation project will be required to read, understand, and follow the procedures in this Handbook. Beyond this project, the methods detailed in this Handbook can be adapted for other wildlife mitigation monitoring programs and successful applications of these methods will be outlined for the forthcoming BMPs.

Finally, WTI encourages suggestions to improve this Handbook so that it is understandable and ensures repeatability of the techniques. Established methods can not change significantly, but suggestions to adapt the basic methods to increase safety, efficiency, and scientific rigor of this project will always be considered.

2. SAFETY

2.1. Introduction

The US 93 project requires extensive fieldwork, much of which has been and will be conducted alongside this busy and potentially dangerous highway. For this reason, the most important procedures and protocols in this document relate to safety. This section outlines procedures and protocols that will help ensure the safety of personnel working on US 93. Most of these procedures are based on various MDT safety procedures (see Section 2.5 for more specific documents) and to the Manual of Uniform Traffic Control Devices (MUTCD) (USDOT/FHWA 2003).

These procedures and protocols are mandatory and WTI employees working on the US 93 project (including graduate fellows) will be required to follow the safety “code of conduct” as listed in the sections below. Disregard for these procedures could result in termination of employment. Annual performance review will include an assessment of the employee’s adherence to these protocols.

The protocols outlined below are intended to “cover all the bases” of maintaining safe operations in a hazardous environment, but ultimately each employee must use common sense above and beyond these precautions. Working on and along US 93 (or any highway) can place you only a few steps from danger, and even if you are very careful of your own actions, you can not control the actions of the thousands of travelers passing through our study area. Complacency can settle in after a few days of “habituating” to the passing traffic and noise, so it is critical to consciously maintain awareness of your surroundings and traffic and be able to respond to potentially dangerous situations. The following “common sense” points need to be followed at all times:

- read, understand, and follow the safety protocols outlined below, do not take shortcuts, be proactively responsible for your own safety and watch for the safety of others as well;
- always wear a safety vest and personal protective equipment when on US 93 (see below for details);
- work during daylight hours;
- drive defensively: watch for other drivers assuming they are not watching for you;
- turn on your headlights to increase your visibility;
- use your turn signals well in advance of turning;
- avoid turning left onto US 93 if possible; turning right, then left onto an access road or drive and turning around to make another right turn back onto the highway may be a better choice depending on the time of day, traffic levels, line-of-sight, etc;
- use turnouts when parking the vehicle even if it means walking further to get to your field site; in some cases, access roads provide enough room to park a vehicle on the right-of-way (not on private property) without blocking others from passing though;
- avoid parking on the shoulder of the road, but if absolutely necessary, use your hazard lights and a flashing amber warning light on the roof of the vehicle when parked on the shoulder of the road;

- use a roof-mounted amber safety light on the field vehicle;
- walk against the travel direction of traffic to better watch for and be seen by oncoming vehicles;
- look both ways, THREE TIMES, before crossing the road;
- do not wear earplugs or headphones that completely eliminate ambient noise;
- if you need to sit down or rest, either do so in your safely-parked vehicle or find a location a safe distance away from traffic flow, preferably behind a guard rail or some other feature that would intercept out-of-control vehicles;
- preferably work in groups of two or more; if working alone, make sure another WTI employee knows your plans and estimated return time;
- if confronted by the public, be polite, answer questions as well as possible, and if unable to answer a question or the person becomes hostile, take the person's name and phone or email and give to your supervisor; WTI will contact the person and try to assuage their concerns;
- if any person threatens you in any way, do not try to reason with the person, but try to remove yourself from the situation as quickly and safely as possible; if possible, record a license plate number if they are in a vehicle or take a picture of the vehicle and/or person (only if you can do so without escalating the other person's anger or anxiety) and report the incident to your supervisor; if need be, WTI can contact local law enforcement to report the incident; and
- do not trespass on to private property. Ninety percent of this work occurs in the right-of-way so you should not need to cross the right-of-way fence. When needing to access property (e.g., when doing pellet transects; see Chapter 5), make sure you have contacted the property owners and gained permission in advance of stepping onto the property. This includes tribal lands (though WTI usually keeps in touch with the tribal biologist and staff members are granted permission to access tribal lands with our research permit).

Safety is of utmost importance on this project. Please do everything in your power to stay alive and injury-free and avoid or reduce risks for others. If you are unable to abide by these common sense rules or the safety protocol below, you will be deferred to office tasks or you may be terminated.

2.2. General Safety Protocols

Employee Responsibilities

1. All personnel must have a practical working knowledge of this protocol;
2. Each employee is charged to do everything reasonably necessary to protect life, safety, and health of everyone;
3. Promptly report injuries, accidents and unsafe conditions of tools and equipment;
4. Each employee must strive to report to work each day in condition that will afford maximum agility, alertness and capability. You should be:
 - a. Healthy. If you are ill, do not continue to work;
 - b. Free from the influence of Drugs or Alcohol;

- i. **Drugs:** Whenever a physician gives you a prescription, inquire if the drug might impair your safe functioning. If any impairment might result, ask the doctor what you can and cannot do while taking the medication, and notify your supervisor; and
 - ii. **Alcohol.** Do not report to work if you are under the influence of intoxicants.
5. Each employee must provide and wear clothing and footwear appropriate to the situation and that will provide protection. (also see Clothing/Attire in Personnel Safety); and
6. Each employee must wear personal protective equipment as required by Montana Department of Transportation (see below).

Supervisor Responsibilities

1. Each supervisor is responsible for work methods and safety practices;
2. Safety must be given top priority in the planning of all work. Insofar as possible, plan around hazards, especially traffic. Planning must include:
 - a. The safest time of day that work can be accomplished;
 - b. The optimum number of personnel to do the job; and
 - c. The assignment of trained and qualified personnel for the more hazardous jobs.
3. Employee Orientation must include:
 - a. Make certain the employee has been instructed on all hazards associated with his or her work;
 - b. Show the employee where the first-aid kit and fire supplies are stored;
 - c. Show the employee where and how all equipment and supplies are safely stored; and
 - d. Brief the employee on the safe operation of tools.

Work Attire

1. **SHIRT** A minimum suitable T-shirt with sleeves that cover the shoulders and upper arms and that shall be pulled down to cover the waist. Long sleeved shirts are recommended for additional protection from the sun;
2. **PANTS** Shall be full length to the ankle. Pants with significant holes in them are not acceptable. Shorts are acceptable during summer months, though shorts are not recommended as they do not provide the same degree of protection from sun, wind, sand, vegetation, or debris; and
3. **FOOTWEAR** Every employee must wear footwear that is substantial and appropriate (e.g. sturdy boots) for the job and weather conditions.

Personal Protective Equipment

1. All employees on the job will be supplied with the necessary safety items for their personal protection. **NO EMPLOYEE SHALL BE DENIED APPROPRIATE SAFETY EQUIPMENT.** If an employee has not been properly equipped, it is the responsibility of that employee to notify his/her supervisor so that he/she can be accommodated;
2. Any employee who refuses to use such personal protective equipment as required by department policy or as directed by the supervisor will not be allowed to continue

- work and will be subject to appropriate disciplinary action as specified in the department policy;
3. If any personal protective equipment issued to an employee is found to be in unusable condition, the employee must report this to his/her immediate supervisor as soon as possible;
 4. Employees must wear and/or use personal protective equipment as required to perform their job safely and in accordance with safety rules and procedures;
 5. **When working in and around a traffic area, blaze orange vests provided to employee must be worn at all times; and**
 6. **In accordance with OSHA Std. 1910.135 and 1926.100, hard hats are to be worn while working in and around traffic zones and highways.**

Vehicle Safety

1. Every person who operates a state motor vehicle or any other vehicle (private, rental) must have a valid state driver's license or CDL with appropriate endorsements as required by the department;
2. Seat belts are furnished and must be worn;
3. Never drive a vehicle unless it is in good mechanical condition;
4. Always drive defensively;
5. Each vehicle must be checked daily to assure that all parts, equipment and accessories are in safe operating condition and free of apparent damage that could cause failures while in use. Repairs needed are to be reported to your supervisor, motor pool or equipment foreman;
6. All local, state and federal traffic regulations shall be strictly adhered to;
7. All tools and equipment should be guarded, stored and secured when transported with personnel. Sharp tools can be lethal in collisions or sudden stops;
8. All required advance warning signs and devices must be in place before the vehicle is parked in/on the roadway or shoulder. The vehicle must have a rotating and/or flashing beacon;
9. No person will ride at any time on the bumper of a vehicle or other location except in the seats of the vehicle;
10. All motor vehicles carrying or hauling hazard materials must carry approved fire extinguishers and first aid kits that must be so placed in the vehicle as to be readily accessible;
11. Gasoline carried in vehicles for chain saws, outboard motors, and the like must be transported and stored in safety cans;
12. Care must be used when crossing fields of grass or leaves in woods with a vehicle that has a hot exhaust system;
13. When not in use, all vehicles must be legally parked, as far from traffic lanes as possible and practical; and
14. The transmission and emergency brake must be used to retard vehicle movement when unattended.

2.3. Hazardous Situations

Field work on roads exposes personnel to a variety of environmental conditions that can be challenging to endure, if not dangerous. It is important for staff to be aware of and proactively avoid these hazards, and know how to respond if the situation calls for it.

Hot Weather

1. **The following precautions should be observed in hot weather:**
 - a. to avoid sunburn, wear a shirt and long pants. Light colored clothing is preferred;
 - b. wear a hat when working in the sun;
 - c. drink plenty of water, but avoid excess quantities of ice water;
 - d. avoid overexertion; and
 - e. persons with high blood pressure or a past history of sunstroke should not do strenuous field work in hot weather.
2. **Sunstroke or heatstroke** is an extreme medical emergency, and medical aid must be obtained as soon as possible. A delay of one or two hours may mean the difference between life and death. Symptoms of sunstroke are:
 - a. hot, dry skin and high body temperature;
 - b. face red and flushed;
 - c. dizziness, intense headache, hard breathing; and
 - d. may have convulsions and lose consciousness.

To treat sunstroke:

- a. move to a cool, shady spot;
 - b. remove excessive clothing and loosen tight fitting garments. Do not disrobe person;
 - c. lay on back, head and shoulders raised;
 - d. cool body with water or wet clothes;
 - e. when conscious and able to drink, give cool drink, but not ice cold, do not give stimulants; and
 - f. get the person to a doctor or hospital as soon as possible.
3. **Heat exhaustion or heat prostration** is not as serious as sunstroke, but should be treated promptly. Symptoms are:
 - a. skin cold with clammy perspiration;
 - b. face pale;
 - c. may have chills, cramps, or dizziness;
 - d. may feel sick and vomit; and
 - e. pulse weak and rapid.

To treat heat exhaustion:

- a. move to fresh, moving air;
- b. keep lying down and head low; loosen clothing;
- c. keep warm with blankets or clothing, both over and under;
- d. rub arms and legs gently toward heart; and
- e. if able to drink, give sips of tepid water. If victim is unconscious or vomiting, do not give fluids by mouth.

Cold Weather

1. Sufficient clothing should be worn to protect against the cold, but tight clothing which restricts the circulation system should be avoided;
2. **Frostbite** on the nose, cheeks, ears, fingers, or toes is the most likely danger in cold weather. Frostbite develops most frequently when high wind is blowing. Symptoms of frostbite are:
 - a. pain sometimes felt early but subsides later;
 - b. skin becomes grayish white;
 - c. affected parts feel intensely cold and numb; and
 - d. blisters may appear later.

To treat frostbite:

- a. the objective of first aid for frostbite is to protect the frozen area from further injury by warming the affected area gradually;
- b. cover the frozen part;
- c. provide extra clothing and blankets;
- d. bring victim indoors as soon as possible;
- e. do not put any suspected frozen body parts in any water; a type of burning occurs which can cause tissue to come off the injured part. Wrap the part in dry stable dressing and seek immediate medical attention; placing dry pads between fingers and toes will help control pain, NEVER RUB A FROSTBITTEN OR FROZEN PART;
- f. do not apply direct heat such as a heat lamp or hot water bottle. Keep affected part away from heat of portable heater or stoves;
- g. do not break blisters;
- h. do not allow victim to walk after affected part is thawed, if the feet are involved;
- i. discontinue warming the victim as soon as the affected part becomes flushed; this measure reduces likelihood of severe swelling after thawing;
- j. once the affected part is warmed, have the person exercise it to increase circulation;
- k. do not apply other dressing unless the person is to be transported for medical aid;
- l. if travel is necessary, cover the affected parts with sterile or clean cloths and keep the injured parts elevated; avoid contact of frozen parts with heavy blankets; and
- m. give fluids by mouth, provided the victim is conscious and not vomiting.

Electrical Storms

1. If a storm approaches while you are engaged in field work, discontinue working in the open to minimize chances of being struck by lightning;
2. Do not handle chain or metallic objects;
3. Keep away from wire fences, telephone lines, metal tools, rivers and lakes;
4. Avoid tops of ridges, hilltops, wide open spaces, ledges and outcrops of rocks;
5. If in open country, sit or lie down. Avoid grouping together and avoid large or isolated trees;
6. Get away from horses and livestock;
7. Get in the cab of a rubber-tired vehicle if possible. Choose building shelters if available, but avoid small sheds in exposed locations;
8. In the absence of buildings, seek shelter in dense woods, a grove of trees (if possible, a stand of young growth), a cave, a depression in the ground, a deep valley, or the base of a steep cliff; and
9. If you are outdoors on a humid day when a thunderstorm threatens and you notice a sensation that your hair is beginning to stand on end, lie down immediately in a ditch or depression.

2.4. First Aid

Supplies

First aid supplies must be easily accessible. If employees use first aid materials, they are to notify their supervisor so that the kit can be restocked. Minimum recommended contents for first aid kit:

- 2 1" x 2 ½ yards adhesive tape rolls;
- 24 – 3"x3" sterilized gauze pads;
- 100 – ¾"x 3" adhesive bandages;
- 8 – 2" bandage compresses;
- 10 – 3" bandage compresses;
- 2 – 2"x 6" sterile gauze roller bandages;
- 3 – 36" x 36" sterile gauze pads;
- 3 sterile eye pads;
- 2 non-sterile triangular bandages 40" x 36"x 54";
- 2 safety pins;
- 1 pair latex gloves; and
- 1 mouth to mouth airway.

Treatment

1. Emergency Medical Services should always be notified in the event of a serious medical emergency. This can be accomplished by dialing the '911' emergency phone system, or by dialing the appropriate emergency services agency listed in the area phone book;
2. Transportation:
 - a. victims should only be moved if they are in immediate life threatening danger; and
 - b. personnel should only transport victims if ambulance service is not available.
3. Minor wounds and injuries should be looked after immediately. Cuts and abrasions should be treated and dressed as soon as possible with equipment from the first aid kit. Employees should not continue working and aggravate the wound or injury requiring medical attention. First aid supplies must be replenished after using; and
4. Serious injuries. Provide first aid care only to the degree of formal training received, and summon emergency medical services for advanced life support care.

2.5. Signing and Traffic Control Procedures

Traffic control and work zone design, set-up, break down, and flagging to control traffic all demand a great deal of logistical planning, team work, trouble-shooting, and vigilance for a safe and efficient operation. If traffic control is needed for an activity, do not underestimate the need for advanced planning. Logistical details can make or break such an operation; radios, extra batteries, specific map layouts of sign placements, sign and candle rental and hauling, and bringing on additional qualified staff can make a significant difference in the amount of time spent on the road influencing traffic. Every effort must be made to minimize the time that traffic flow is subjected to disruptions and that staff are exposed to the increased risks associated with controlling traffic in work zones.

Before any operations involving traffic control can be executed, consult with the MDT Missoula District Maintenance Head (406/523-5803). Justification for traffic control needs to address why researchers are proposing to control traffic, when and where they would like to do the work, and specifically how they intend to safely control traffic. Additionally, WTI must contact the local MDT Maintenance field managers in the district(s) where the traffic control is proposed. Finally, the local schools and fire departments have asked for advance notice of significant delays (>10 minutes) that the traffic control operations may impose on their buses or emergency services (although if any emergency vehicles were to need to pass through the work zone, flaggers would stop traffic in both directions to allow the emergency vehicles to pass).

Efforts will be made to certify all field staff as flaggers. The Local Technical Assistance Program (LTAP) at MSU holds flagger classes on a regular basis or can schedule a class if there is enough demand. Flagger certification lasts for 3 years and must be renewed after certification has expired. The LTAP is also a good resource for assisting with the logistical details involved in setting up a traffic control plan (LTAP: 800/541-6671 or www.coe.montana.edu/ltap).

If employees have not been certified as flaggers, they can not perform in that specific role. At least two certified flaggers are needed when an operation involves stopping traffic. The following points are intended as a supplemental reminder of flagging protocols:

Flagging

1. **Personal Protective Equipment** (see also Clothing/Attire and MDT Flagging Handbook):
 - a. hard Hats;
 - b. reflective Vests;
 - c. safety Glasses, when appropriate;
 - d. clothing appropriate to weather;
 - e. flag paddle; and
 - f. protective/appropriate footwear.
2. Flag person. Reference the MDT Flagger's Handbook (Montana Department of Transportation, 1998). All flag persons shall receive certification training in accordance with the Department instruction to flag person manual; and
3. Supervisor. It is the responsibility of the supervisor to ensure traffic control devices are placed in accordance with the Manual on Uniform Traffic Control Devices (USDOT/FHWA, 2003), the MDT Maintenance Manual (Montana Department of Transportation, 2002), and other current construction and maintenance manuals.

Signing

1. Reference MUTCD (USDOT/FHWA, 2003); and
2. Reference MDT Work Zone Traffic Control (Montana Department of Transportation, internal document).

Proper Procedures

All work zones and traffic control devices must be set up in compliance with the following:

- MUTCD (USDOT/FHWA, 2003);
- MDT Guidelines for Temporary Traffic Control for Municipalities, Utilities and Maintenance (Montana Department of Transportation, 2005); and
- MDT Flagger's Handbook (Montana Department of Transportation, 1998).

Traffic Control and Work Zone Signing Resources

WTI recommends outsourcing tasks that require extensive traffic control. Poteet Construction, Inc. in Missoula rents signs, sign stands, paddles, candles, and qualified labor with trucks and trailers appropriate for traffic control and work zone set-up. They are located at 9435 Summit Avenue (off Airport Road, between the airport and the I-90 interchange to US 93 North) and can be contacted at 406-728-9370. Obtain estimates and consult with supervisor before contracting or invoicing any equipment rental or services.

3. ANIMAL VEHICLE COLLISION DATA

3.1. Introduction

One of the objectives of this project is to quantify pre- to post-construction changes in animal-vehicle collision (AVC) rates to determine if wildlife fencing and crossing structures have affected the occurrence of these events. To survey the 56-miles of US 93 between Evaro and Polson, a significant amount of labor, vehicle costs, and employee exposure to US 93 traffic would be required. Given limited resources and budgets, WTI has instead opted to work with existing and future databases from MDT. This chapter documents the data sources, limitations of the data, and quality control rules for database management.

3.2. Data Sources

The AVC database is a combination of the following sources:

- MDT Traffic Safety Bureau’s Montana Highway Patrol (MHP) accident database; and
- MDT Maintenance records of carcass removals.

Use of these data requires WTI to commit to a confidentiality agreement; these data are not to be released to entities outside of this project without MDT’s approval.

To obtain the above datasets, please work with WTI’s MDT liaison to request the information from MDT’s Traffic Safety Bureau. WTI typically asks for the data once a year, in the spring, in Excel format. Specifically, researchers need to request the MHP AVC records and MDT Maintenance carcass records for US 93 North, from Evaro to Polson (mile markers 6 to 58). While there may be additional attributes included in the datasets, *at a minimum, each AVC record needs to account for the following attributes:*

- date of occurrence;
- mile marker (to the 0.1 mile);
- species; and
- data source (MHP report, MDT carcass removal data, or other sources).

3.3. Limitations of Data

The AVC and carcass data are the “best available information” that will be used to track general trends in AVC occurrences over time, but there are limitations to how these data can be used. First, these data are recorded opportunistically rather than systematically and therefore the conclusions that can be drawn from these data are limited. Second, by combining two data sources that document AVC occurrences in the same area, there is a risk of double counting occurrences. For example, if MHP documents an AVC incident on a Monday at mile marker 10.1, and MDT maintenance picks up the carcass involved in this incident on Tuesday at mile marker 10.2, these two records could double count the same incident. To minimize double-counts, WTI has established “quality control” rules for combining, cleaning and sorting the AVC data; see “Quality Control,” below.

Further examination of the MHP AVC and carcass removal records from 1992-2005 (Figure 1) reveal apparent increases in AVCs and carcass removals over the years. This could be due to

actual increases in AVCs, or it may be a result of indistinguishable double counts and/or increased reporting effort. Concerning the latter point, the relatively consistent number of AVCs and carcass reports from 1998-2001 may be a result of MDT's formalizing of the carcass removal data collection protocols in 1998, whereas prior to 1998 there were no mandates to collect these data. Then, in 2002 there is a jump in occurrences. This may be explained by the fact that WTI met with MDT maintenance staff to make them aware of the importance of the carcass removal data and consistent reporting over time. It is possible that maintenance staff increased their effort, due to their awareness of the significance and purpose of these data.

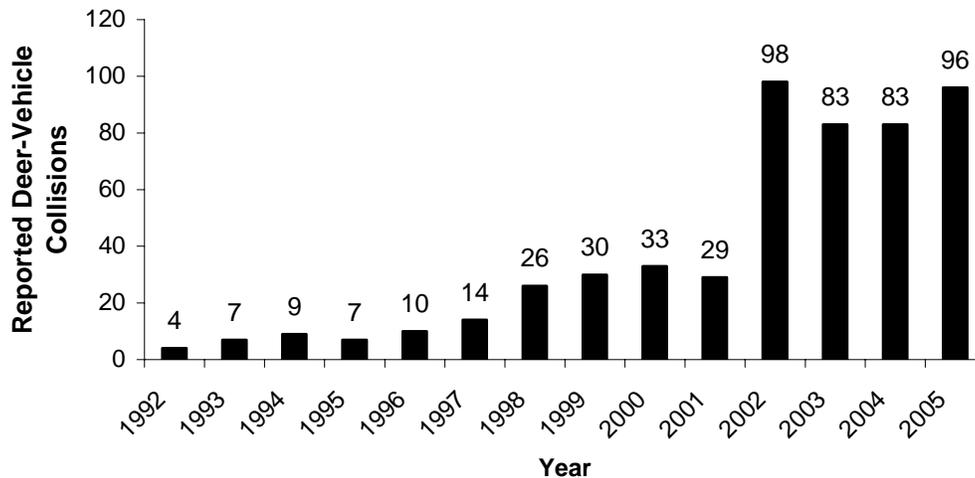


Figure 1: Annual reported animal-vehicle collisions and animal carcasses removed from US 93, Evaro to Polson, from 1992 to 2005. Data source: Montana Department of Transportation Maintenance carcass removal records; and Montana Highway Patrol animal-vehicle collision records, provided by the Montana Department of Transportation Safety Bureau

Despite potential double counts or increased reporting, it is likely these data underestimate the numbers of animals hit by vehicles (any dataset on AVCs and carcass removals, no matter how the data was sampled, must consider this issue). This is probably due to the following compounding reasons: 1) not all animal-vehicle collisions are reported by the drivers; 2) animals hit by vehicles don't always die on or near the road but could die away from the road, undetected; 3) not all animals killed by vehicles on or near the road are seen or reported and in some cases, people remove carcasses, legally or illegally, without reporting the occurrence.

As the AVC and carcass removal database grows over the years of the study, WTI will continue to note limitations and explanations for inconsistencies and search for ways to control for observer effects and double counts. Despite all these considerations, the long-term dataset can indicate overall trends in AVC incidents as long as the search and reporting effort remains similar. Nevertheless, researchers need to be cautious when drawing definitive conclusions because of the limitations mentioned earlier.

3.4. Data Management and Quality Control

General data management and quality control/quality assurance methods are described in Chapter 7. The protocols described in Chapter 7 will be applied to all aspects of data entry and management throughout the project. The text here addresses specific methods for AVC data.

All AVC data need to be in MS Excel spreadsheet format. Occasionally MDT sends files in formats other than Excel such as “notepad” format. Sometimes these data can be imported into Excel if the information has been comma, space, tab or otherwise delimited. Other times the information has come as a hard copy, requiring manual data entry. Always save the original data, even if not “cleaned”, as a “master” file. Save the file in the appropriate “original data” folder with a name that includes the year(s) the data cover, the source (“MHP” or “MDT carcass data”), and “MASTER”. The US 93 Evaluation data files are on the WTI server at

G:\PROJECT DATA\426402 US93 Evaluation\data. A single folder for AVC data can be found here and includes the following sub-folders:

AVC data

Original AVC data

- **MHP original:** Contains Excel files of MHP AVC records AS THE FILE WAS RECEIVED. These files will be (re) named with the year from which the data originated, the source (“MHP”), and “MASTER” to indicate that this is the original data (e.g., 2003 MHP MASTER.xls”); and
- **MDT carcass removal original:** Contains Excel files of MDT Maintenance carcass removal records AS THE FILE WAS RECEIVED. These files will be (re) named with the year from which the data originated, the source (“MDT carcass removals”) and “MASTER” to indicate that this is the original data (e.g., 2003 MDT carcass removals MASTER.xls”).

Working files AVC data

- **AVC working files:** Contains all Excel files that have been altered and resaved from the MASTER files. Use sub-folders to organize different working files. Name file and sub-folders to indicate how the data may have been altered; and
- **AVC analyses:** Contains files used in analyses. Use sub-folders to organize different analyses. Name file and sub-folders to indicate how the data may have been analyzed.

As previously mentioned, at a minimum, each AVC record needs the date, mile marker, species, and identification of the source (MHP report, MDT carcass removal data, etc.). If any of these parameters are missing, please make the effort to track this information down. It will necessary to add a column for “Data Source” to distinguish if the information was based on an AVC report or carcass removal. Original data from MDT may include additional parameters that should be preserved in the “master” files. The basic AVC database includes, at a minimum, parameters of date, mile marker, species, and data source.

3.4.1. Screening AVC Data for Redundant Information

Once each source of data has been standardized to include the minimum parameters outlined above, the data can be combined within years or across all years. After datasets are joined together, the data need to be systematically screened to eliminate redundant information; i.e. duplicate records. Examples of how duplicate records may be generated are:

- if highway patrol reported an AVC over the weekend, but MDT maintenance staff removed and reported the same carcass on Monday, the records would show different dates, and they appear to be separate events when, in fact, they are duplicate information; and
- if MHP reports a doe deer hit at mile marker 10.2 on Monday, and MDT maintenance removes the deer on the same day, but reports that it was located at mile marker 10.1.

WTI has established “rules” to address such potential duplicate records. If two or more sources report an AVC record involving the same animal species and sex (if known/reported) and if these locations are within 0.2 miles and within two days of each other, researchers assumed that these records were duplicates and deleted the redundant information from the dataset. It is important to pay attention to details such as whether two animals were hit at the same time/place (e.g., when an adult and young of the year cross and are hit together, or if an adult is hit and their young lingers nearby and is hit shortly thereafter); be careful that both reports are accounted for only once, and that the second animal isn’t deleted.

4. TRACKING WILDLIFE CROSSINGS

4.1. Introduction

To evaluate potential changes in animal movements across US 93, WTI researchers estimated animal crossings in three road sections that are scheduled to have extensive wildlife fencing and a concentration of wildlife crossing structures (these road sections are referred to as the Evaro, Ravalli Curves, and Ravalli Hill focal study areas). The researchers installed randomly placed sand tracking beds (each approximately 100 m long; see Appendix A) in the right-of-way and recorded all tracks of large mammal species (see Appendix B) of individuals that had crossed the track beds. The tracking beds covered approximately 30% of the total road length that will be fenced within each of the three selected areas. The pre-construction crossing estimates will be compared to post-construction crossing observations at the wildlife crossing structures and at fence ends. This chapter summarizes the procedures for track bed installation, placement and maintenance; track identification; and track data collection protocols.

The Tribes and project sponsors (MDT and FHWA) have indicated that they are mostly interested in evaluating potential changes in deer (white-tailed and mule deer combined) and black bear movements across US 93. These methods are designed to detect these and other large species, but are not ideal for tracking most medium and small mammals (smaller than coyote size).

4.2. Track Bed Materials and Installation

Although track bed installation has been completed and will not be repeated during the course of pre-construction phase of this project, information about materials and installation is summarized here for others that may consider using these methods (post-construction track beds will be constructed similarly and the placement and design of the postconstruction beds has been incorporated into construction plans). The components of a tracking bed include 100m x 2m of filter fabric covered evenly by about 10 cm of weed-free, scent-free (if possible) loose material that will accept and hold tracks of “large animals” that cross the bed. If budgets allow, use higher quality filter fabric, such as landscaping fabric, to further retard weed growth. Materials that have been used to track animals in a variety of studies include marble dust, gypsum, sandy-loamy material, ink on paper and soot on metal (e.g. Zielinski & Kucera 1995, Brandjes & Smit 1996, Huijser & Bergers 2000, Clevenger et al. 2002). For this project, researchers sampled and informally tested a variety of materials from different sources and chose to use seven parts of locally-available (to minimize transportation costs) sandy material mixed with one part small (<1cm) course aggregate material with irregular, jagged edges to help stabilize the sand once a track has been set and to slow the rate of erosion overall.

Installation of the tracking beds required significant planning and effort. Because the tracking beds were to be placed relatively close to the highway, safety was a primary concern for staff and the traveling public. WTI certified staff as flaggers and worked with the Local Transportation Assistance Program to create a traffic control plan to route vehicles around the moving work zones. The certified flaggers set up the work zones and signs and controlled traffic during the first week of installing beds, but WTI hired union flaggers and Poteet Construction (406-728-9370) to control traffic during the second installation session. Hiring traffic control professionals

was easier logistically and ultimately reduced the amount of time spent on the highway setting up work zones and signs and influencing traffic.

The research team bulk purchased filter fabric (Amoco non-woven style 4545; in hindsight, higher quality fabric is recommended to help reduce weed growth in the beds) in 4.57 m (15 feet) wide by 109.7 m (360 feet) long rolls from Roscoe Steel (Missoula, MT) and used a chainsaw to cut each roll in half. A contractor (Montana Conveyed Aggregate Delivery (Big Fork, MT) to mixed, hauled, distributed and spread the sand material. At each tracking bed site, researchers rolled the fabric out about 2 meters from the edge of the pavement and parallel to the road for ~100 meters (detailed measurements of each bed were taken after installation; see Appendix A). The fabric was rolled out a short distance ahead of where the sand was being directly deposited onto the fabric via a conveyor belt truck that allowed the operator to control the rate and direction of deposition of the sand (Figure 2). The material was then spread out across the fabric with a grader (Figure 3). The installation team used rakes to even out the material where the grader was not able to do so (Figure 4), making sure to completely cover the fabric to prevent the fabric from blowing in the wind (a potential deterrent to crossing animals or distraction to drivers).



Figure 2: Rolling filter fabric out while sand material is distributed along the top edge of the fabric by a conveyor belt.



Figure 3: Spreading of the sand material across the filter fabric using a grader.



Figure 4: Finishing the beds by raking the material out to evenly cover the fabric

4.3. Pre-Construction Track Bed Locations

Researchers determined the total length of planned wildlife exclusion fencing in the Evaro, Ravalli Curves, and Ravalli Hill areas based on the information in the US 93 Reconstruction Memorandum of Agreement (Skillings Connolly 2000). In 2003, we installed 25, 20, and 17 (62 total) tracking beds in these areas (Figure 5, Figure 6, Figure 7). The number of beds in each of the three areas covered ~30% of the length of US 93 in each area that was originally planned to have continuous wildlife fencing and a concentration of wildlife crossing structures. Within each area the beds were randomly located along the road in the right-of-way and parallel to the road. The side of the road (east-west) was also randomly determined for placing each bed. In a few cases where the road shoulder was too steep to prevent extreme erosion of the sand, the installation team opted to locate the bed on the other side of the road, and if that location was not suitable, they randomly selected an alternative site within the same focal study area.

After the 2003 tracking season, sections of the Evaro and Ravalli Hill areas that were scheduled to have extensive wildlife fencing were reduced in length (Hardy & Huijser 2004). This reduced the number of beds in the fenced areas to 38, but researchers continued to monitor an additional three beds in the Evaro area (EV2, EV7 and EV8) to investigate potential tracking bed avoidance by animals. Appendix A lists the beds that were monitored in 2003 and 2004

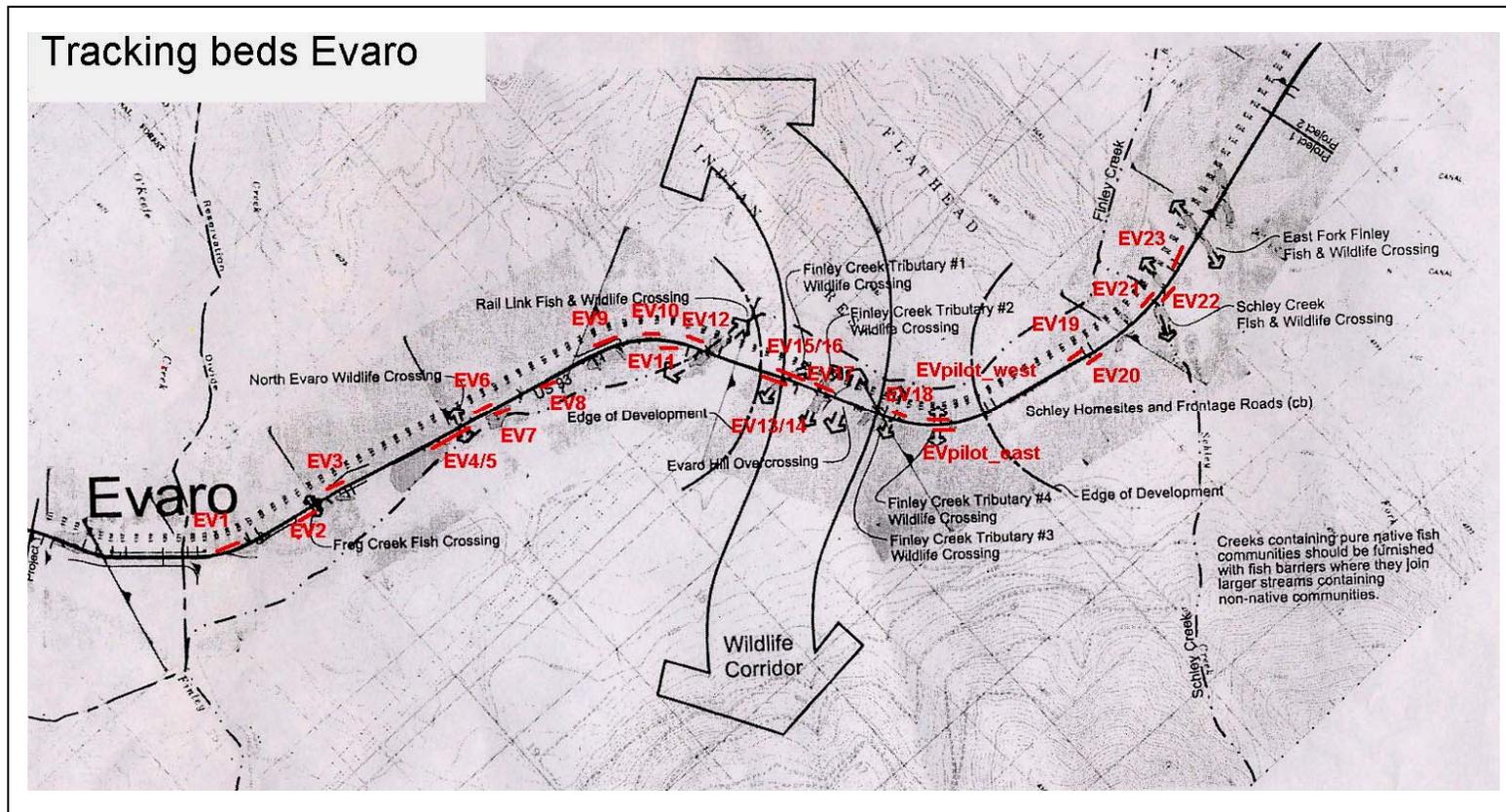


Figure 5: General locations of the 25 tracking beds in the Evaro area of the US 93 Reconstruction project on the Flathead Indian Reservation, Montana. All 25 beds were monitored in 2003; a subset of beds in this area were monitored in 2004 due to changes in the fencing design plans (see Appendix A).

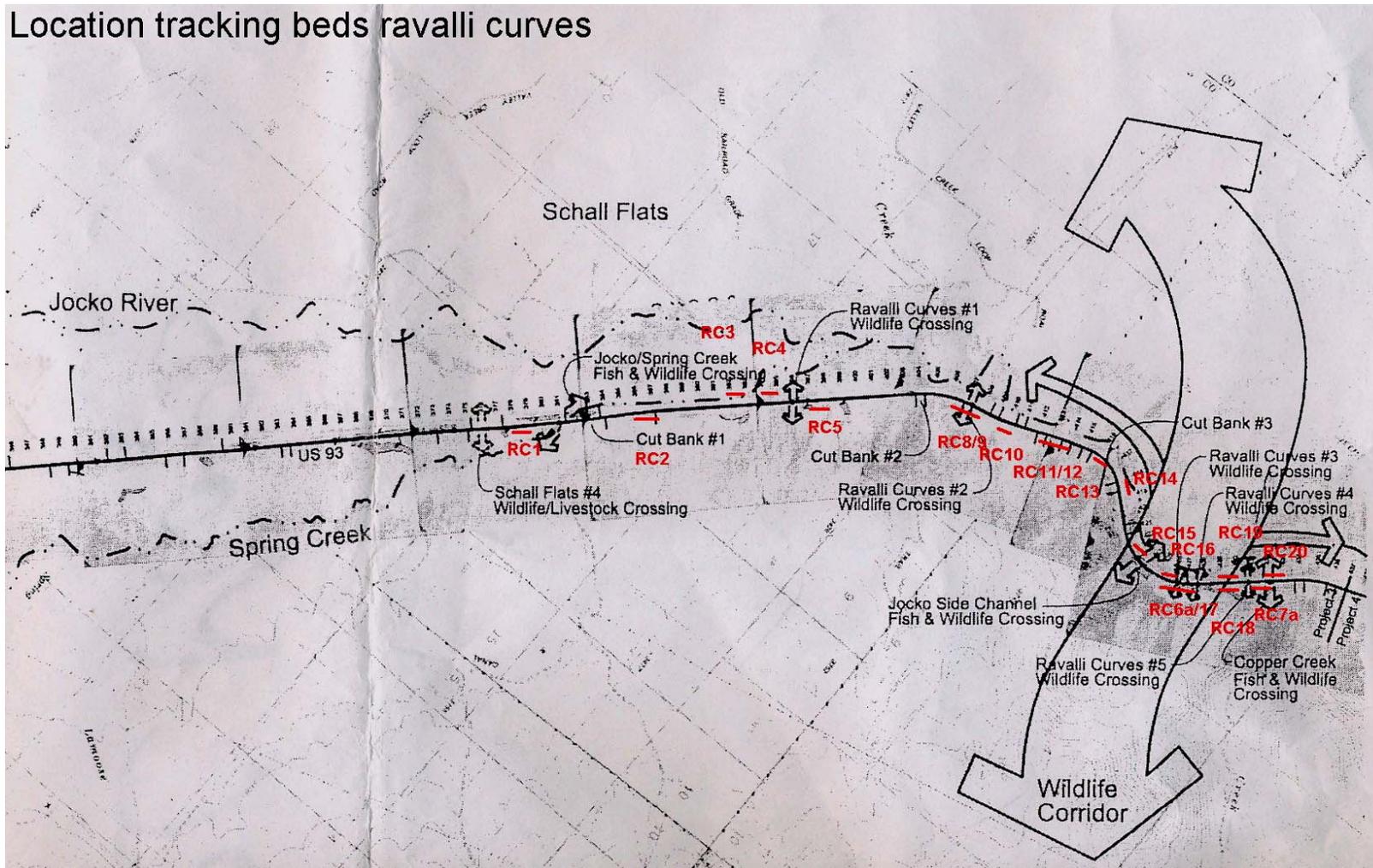


Figure 6: General locations of the 20 tracking beds in the Ravalli Curves area of the US 93 Reconstruction project on the Flathead Indian Reservation, Montana.

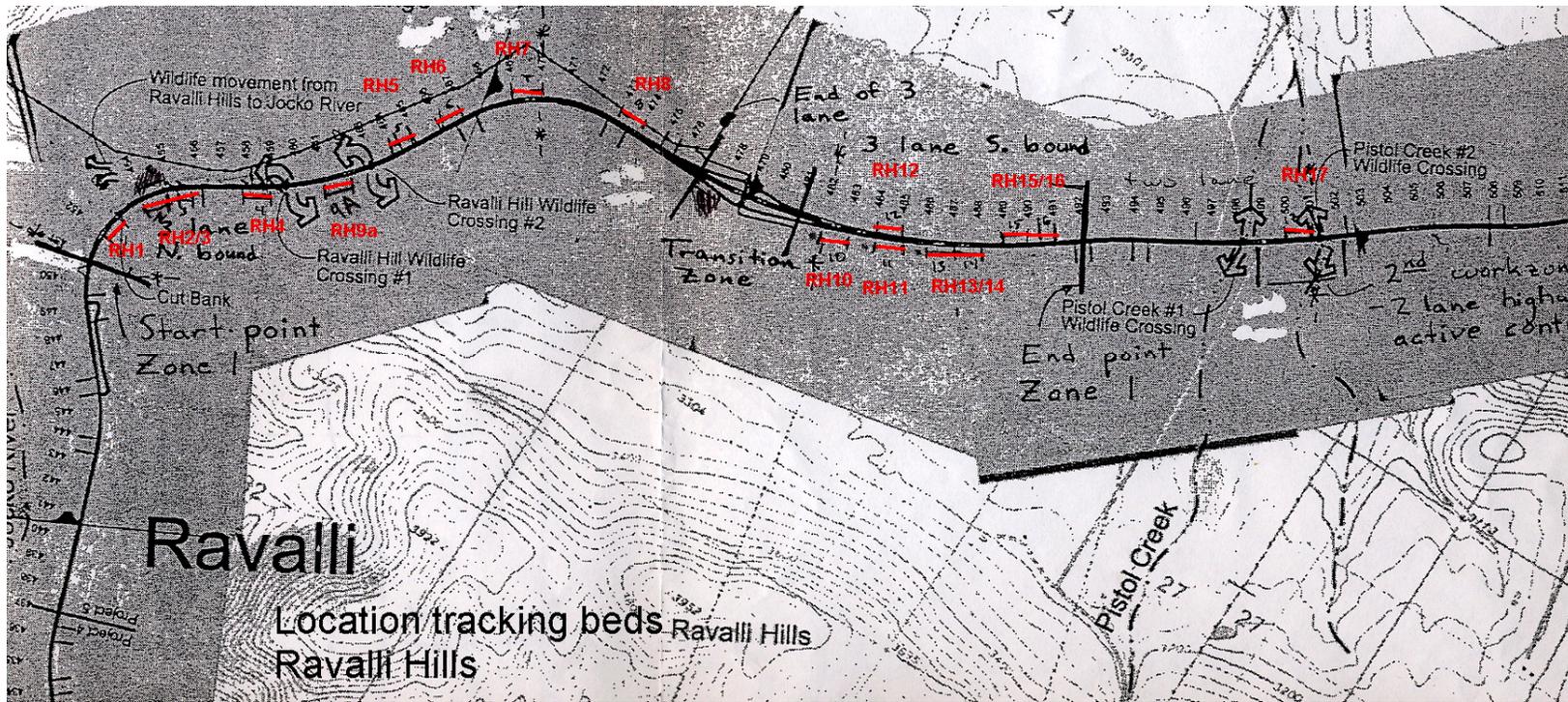


Figure 7: General locations of the 17 tracking beds in the Ravalli Hill area of the US 93 Reconstruction project on the Flathead Indian Reservation, Montana. All 17 beds were monitored in 2003; a subset of beds in this area were monitored in 2004 due to changes in the fencing design plans (see Appendix A).

4.4. Track Bed Maintenance

Track bed maintenance is essential first to ensure the safety of passing motorists, and second, to provide a sand medium that can receive and hold tracks of crossing animals. While sand track beds along the highway do not impose obstacles that could endanger passing drivers, the research team must be careful that the filter fabric does not get uncovered and does not flap in the wind as this could distract drivers or influence the behavior of animals approaching the road. This requires regular checks of each bed and either redistributing sand over the loose fabric or removing sections of fabric that may be impossible to bury with sand.

Since the tracking beds are situated close (~2-3 meters) to the edge of the pavement, the beds must be regularly checked to make sure they are not impeding run-off or depositing sand on the road. On one occasion, MDT Maintenance staff had to grade the substrate immediately adjacent to the pavement edge to improve run-off drainage in an area where the beds were located (though it did not seem that the track beds caused the problem); fortunately they contacted WTI about the situation and team members promptly visited the site and discussed the matter with the Maintenance staff. It is important to respond to such issues as soon as possible so that the operations do not create a safety hazard and/or create additional work for the Maintenance staff. Bottom line: if MDT sees a problem with the bed, work to find a reasonable solution to the problem or “retire” the track bed by pulling the sand and fabric away from the road to alleviate the problem, and properly dispose of excess sand or fabric.

Weeds that grow through the filter fabric interfere with the ability of the tracking bed material to receive and hold tracks, as well as the search effort to find and identify animal tracks. In addition, the sand substrate provides open ground for weeds, increasing an already serious threat to native habitats. After initial installation, each spring during the data collection phase, team members need to apply herbicide, grub, and rake out the beds. In the spring of 2004, Lake County Weed Control applied herbicide (Roundup) and a pre-emergent treatment (Payload) to slow the growth of new vegetation in the track beds through the summer season. Herbicide was applied in the spring shortly after weeds sprouted and required 2-3 weeks to be absorbed and processed via photosynthesis, effectively killing the weeds. Dead vegetation was removed from the beds by grubbing and raking the beds. Simultaneously, the team scraped the previous winter’s accumulation of road sanding/gravel material off the surface of the sand and “fluffed” the compacted sand so that tracks could be set in the looser material. The labor involved in this process is significant, but is essential to collecting meaningful data.

4.5. Track Identification

There is an extensive list of tracks that may be found on the tracking beds along US 93 on the Flathead Indian Reservation in NW Montana. Appendix B lists all mammal species known to occur in North America (Whitaker 1997). Their occurrence in NW Montana and recorded presence on the Flathead Indian Reservation are indicated in the first two columns of this Appendix table (Whitaker 1997; CSKT unpublished data). The third column of the table indicates species likely to leave recognizable tracks in the tracking beds. This rules out small species such as shrews, mice and voles. The species indicated by a “?” may or may not leave recognizable tracks. Experience with recording tracks on the tracking beds eventually provided information on whether these species do leave tracks or not. The likelihood of actually recording tracks of a certain species along US 93 is indicated in the fourth column of the table (CSKT).

Some of the species that leave their tracks on the tracking beds may be hard to tell apart. Dimensions of tracks of mammal species vary according to different sources. Please consult the following publications for track identification (complete citations are listed in the References chapter; these resources are available for check out from Marcel Huijser):

- Forrest 1988;
- Halfpenny & Biesiot 1986;
- Murie, O.J. 1974;
- Rezendez 1999;
- Stall 1989; and
- Zielinski & Kucera 1995.

The field guides can help distinguish between species. White-tailed deer and mule deer cannot be told apart with sufficient confidence (Halfpenny & Biesiot 1986; Forrest 1988). Therefore these two deer species will be grouped.

4.6. Data Collection

The tracking data collection season is limited by the freezing of the sand material during the winter months. While researchers had hoped to opportunistically collect winter snow tracking data at the beds, lack of enough regular snowfall to reliably track animals prevented effective snow tracking. Researchers collect data when the sand material is thawed and after spring track bed maintenance has been completed, typically between May and October. This section details the protocols used for collecting tracking data.

4.6.1. Sampling Schedule

Before collecting tracking observations, the beds must first be raked clean of previous tracks. Tracks observed when initially raking the beds can serve as anecdotal, opportunistic information; however, if such data is recorded, it is important to note the context of these data and that the information can not be used in the crossing rate calculations. Once raked out, tracking beds will preferably be checked twice a week on fixed days of the week, three or four days apart. In 2003 the tracking beds were checked once a week, but in 2004 this was increased to twice a week.

4.6.2. Data Sheet

Appendix C shows the datasheet used for collecting tracking data. Each parameter is explained in detail below.

4.6.3. Parameters

Parameters on the tracking datasheet are explained below. Please complete all the fields for every tracking bed visit.

- date: Enter sampling date;
- observer: Enter your name;

- precipitation: Each of the three areas has a precipitation meter installed. With each tracking session, record the precipitation in each study area since last visit (in millimeters). Empty the precipitation meter after reading the level. The location of each precipitation meter in the three study areas is described below:
 - the Evaro precipitation meter is mounted on the southern most post of the guard rail between EV Pilot West and EV-18, at the north end of EV-18;
 - Ravalli Curves has a precipitation meter mounted on the most northerly guardrail post at the north end of RC-14; and
 - the Ravalli Hill precipitation meter is mounted on a guardrail post on the east side of US 93, near the south end of the guard rail that lies north of RH-4 and south of RH-9A.
- temperature downloaded: The team collects temperature data to control for periods when the substrate may be frozen and unyielding to passing animals. There is a temperature data logger buried under the far right hand corner (when facing the bed from the road) of the filter fabric and sand of track bed RH-17(2003). RH-17 is no longer within the road sections that will have long sections of wildlife fences and was not restored in spring 2004. The temperature data logger was not used in 2004. However, researchers plan to reinstall the data logger in a tracking bed in 2005. For each tracking session, download the data from the temperature data logger into the data shuttle, clear the memory, and leave the data logger turned on (see the manual and software instructions). Return the data logger to its weather proof container but make sure the temperature probe extends under the filter fabric and sand;
- tracking bed area and number: Enter the area and bed number of the tracking bed that is being observed:
 - *area*: Evaro = EV, Ravalli Curves = RC or Ravalli Hill = RH; and
 - *bed number*: EV-1 to 25; RC-1 to 20; RH-1 to 17 (Note: Some beds in the Evaro and Ravalli Hill areas were removed from the study after the 2003 data collection season when design changes reduced the amount of fencing in these areas; see Appendix A for names and status of the tracking beds.).

Beds directly adjacent to each other can be identified with both bed numbers (e.g., EV 4/5) and data from these beds can be lumped together on one datasheet. The Evaro area includes pilot track beds used to test the methods and are named as such with “EV pilot east” and “EV pilot west” to indicate the side of the road the bed in question is located. Some bed numbers include an “A” indicating that bed was located in an “alternative” random location from its original random placement (a few beds were randomly relocated if the original random location placed the bed on a slope too steep to hold the tracking material).

- bed Condition: Circle one or more keywords (snow, frozen, wet, dusty, normal) that describe the tracking bed media at the time of the visit. If the tracking beds are covered in snow, snow tracks will be read;

- species: Enter the species that left the tracks. List each set of tracks separately (i.e., each set of tracks made by a single animal is a separate entry with a different track number). If in doubt, record the track sets separately with a note in the comments section;
- certainty of spp: Using a scale from 1 to 3, rate your certainty of correctly interpreting the species that left the track, with 1 being the highest certainty and 3 being the lowest. This refers to the observer's assertion that they have correctly identified the species that left the tracks. Enter the following:
 - "1" if you are *definitely certain* of the species;
 - "2" if it *probably* the species recorded; or
 - "3" if it is *possibly* the species recorded.
- photo: Indicate Y or N as to whether a photo was taken of the tracks. A picture should be taken for all feline (except domestic cats), bear, and weasel group species, "mystery tracks", and suspected wolf tracks. All track pictures should have a ruler next to the tracks, and a note with the date, tracking bed area and number, and track number (a laminated index card and a "write-on/wipe-off" marker are useful);
- behavior: Researchers categorize individual animal behaviors based on the trajectory of the animal's path relative to the track bed. Record your interpretation of the animal's behavior based on a set of tracks using one of the categories described and depicted in **Error! Reference source not found.** below:
 - 1 = "crossing": Indicates that the animal crossed the road. If the tracks cover less than 5 meters of the length of the track bed, researchers designate the observation as a "crossing only" (record "1" here). If the tracks not only indicate that the animal crossed the road, but also traveled ≥ 5 meters of the length of the track bed, researchers designate the observation as a "crossing" ("1") AND "parallel" ("2");
 - 2 = "parallel >5m": Tracks that enter and exit the track bed after covering more than 5 meters of the length of the bed are designated as "parallel" activity. If the tracks indicate that the animal crossed the road the observation is designated as a "parallel" ("2") AND "crossing" ("1"); and
 - 3 = "presence": If the tracks do not indicate that the animal crossed the road and if the tracks cover less than 5 meters of the length of the track bed, the team designates the observation as "presence only" ("3").

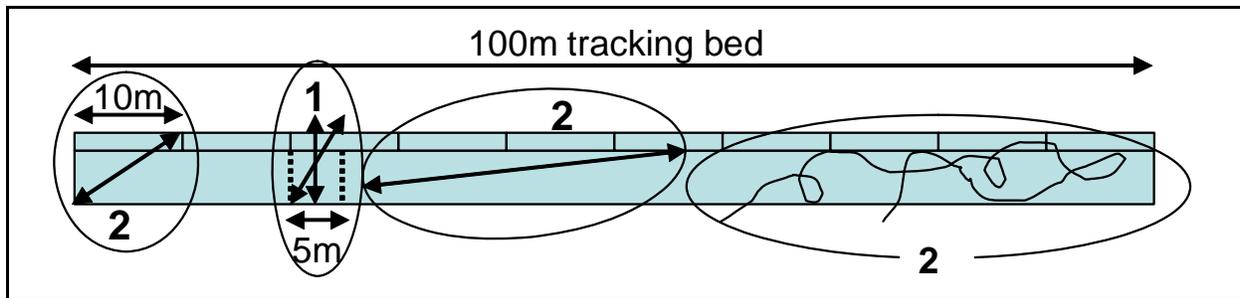


Figure 8: Diagram illustrating categories of animal behavior as interpreted by tracks. A “crossing” observation is depicted in scenario 1 while “parallel” movements are depicted in scenario 2. “Presence” was reported when only 1-2 prints were observed.

- **direction:** For all “crossings,” indicate whether the animal tracks *approached* the road (A) or *left* the road (L);
- **location:** For all “crossings,” measure in meters from either end of the bed where the animal entered and exited the tracking bed, and identify from which end of the bed the measurement was taken (measurements can be paced if the observer has practiced and knows their pacing distances). If a crossing was perpendicular to the length of the bed, there will be no difference between the entrance and exit distances; and
- **same occurrence as bed/track #:** Indicate whether or not you think different sets of tracks originate from the same animal on another tracking bed. For example, in cases where there is a tracking bed on both sides of the road, one would expect the animal to leave tracks in the track beds on both sides of the road if a successful crossing was made and if the animal crossed the road perpendicular or almost perpendicular and not at the edge of the tracking bed. If it appears that the animal did cross and leave prints in the bed on the opposite side of the road, indicate the bed and track observation number from that bed’s corresponding datasheet. Another potential scenario that observers may encounter is of a single animal repeatedly entering and leaving the same bed. This could be recorded as separate observations, or, if the tracks suggest that it is the same animal (e.g., the observer followed the tracks in substrate beyond the track bed), indicate which track observation numbers for that track bed are related.

4.7. Data Management and Quality Control

The text here addresses specific methods for managing and ensuring the quality of tracking data. Every observer is responsible for recording complete and legible data. Do not assume that stapling data sheets together makes it obvious the data was collected on the date or by the observer listed on the front of the packet—the data will be useless if the incomplete data sheets are separated from the completed top sheet. At the end of each field day, review every data sheet to make sure each sheet is properly completed and legible. Please do not take shortcuts.

All tracking data needs to be entered into an Excel spreadsheet. Always save the original data, even if not “cleaned”, as a “master” file. Save the file in the appropriate “original data” folder with a name that includes the year the data covers and “Track data MASTER”.

In addition, tracking photos of all feline (except domestic cats), bear, suspected wolf, and unknown large mammal tracks need to be downloaded into a folder named with the date that the pictures were taken. See Chapter 7, Field Equipment, for instructions on downloading pictures.

The US 93 Evaluation data files are on the WTI server at

G:\PROJECT DATA\426402 US93 Evaluation\data. A single folder for tracking data can be found here and includes the following sub-folders:

Tracking data\2003 tracking data (separate folders for 2004, 2005...)

- **Tracking MASTER:** Contains Excel files the original data files. These files will be named with the year the data originated from and “MASTER” to indicate that this is the original data (e.g., “2003 tracking MASTER.xls”);
- **Tracking WORKING FILES:** Contains files that have been changed from the master files for any reason; and
- **Tracking PHOTOS:** Contains folders named with the date on which pictures were taken; these folders contain downloaded pictures of canine, feline, bear and unknown tracks.

5. PELLET COUNTS

5.1. Introduction

The randomly placed tracking beds along US 93 allow estimates of the crossing rate for deer (white-tailed and mule deer combined) for three focal areas (Evaro, Ravalli Curves, Ravalli Hill). Once the wildlife crossing structures and exclusion fencing have been built, researchers will compare the pre-construction crossing rate estimate with the post-construction crossing observations obtained from tracking beds in the crossing structures and at the ends of the fencing. However, a potential increase or decrease in deer crossings may be related to changes in the deer population rather than a response to the mitigation measures. Therefore the team must account for such changes in the deer population. Unfortunately there are no estimates available of (relative) changes in the deer population size on the Flathead Reservation (Dale Becker, pers. comm.). To address this important variable, researchers established pellet count transects for annual surveys to provide a relative index to track fluctuations in the deer populations in the in the three study areas, both before and after construction of the wildlife crossing structures and wildlife fencing. The remainder of this chapter details the pellet count protocols.

Please note that while the research focal animals include both deer and black bears, the techniques to quantify relative bear population trends are not included here. Rather, that topic will be covered outside of the Handbook in another chapter that summarizes pre-construction thesis research on black bear movements and genetics.

5.2. Pellet Group Transect Locations and Sample Size

The research team surveys for deer pellet groups each year that tracking bed data is collected in the three focal study areas to ensure the closest possible relationship between deer crossing rate estimates and potential changes in deer population size. Transect starting points are linked to a subset of the randomly placed tracking beds. Researchers established a sample size of 25 transects based on a power analysis using data from the first 15 transects in the three study areas. With 25 transects the research team should be able to detect changes in the deer population greater than 17%. While a larger sample size would have been preferred, this survey size was deemed most feasible within the budget provided.

Appendix A identifies track beds used as starting points for pellet transects. A transect begins in the middle of the beds, at the edge of the pavement. Some transects cross private land requiring advanced notification and permission in order to complete these transects.

5.3. Pellet Group Count Methods

Pellet transects require two people, a 50-meter measuring tape (or 50 meters of string or rope), a compass, a Global Positioning System (GPS; see Chapter 8 for operating instructions), a one-meter stick with the 0.5 meter point clearly marked, and pencil and datasheet (Appendix D). Each transect starting point is anchored to the center of a tracking bed and runs perpendicular to the road, extending 500 meters from the edge of the pavement into the surrounding landscape. The first person's job is to set the course of the transect while the second person follows and records data. Starting at the middle of the tracking bed, the first person establishes a compass bearing perpendicular to the road. The second person records that bearing and a GPS UTM

location on the datasheet, while the first person follows the compass bearing from the road 50 meters, laying the meter tape or rope out along the path. If there are obstacles in the path, maintain the original trajectory with as little deviation from the initial bearing direction as possible.

When the first person reaches the end of the 50-meter tape/rope, the second person follows with the meter stick's 0.5 meter mark directly over the tape or rope, creating a 1-meter wide zone; every pellet group that falls entirely or partly within this zone is counted. A deer pellet group must have at least 10 individual pellets clustered relatively close to each other. Classify each pellet group as either "fresh black (shiny)", "old black (not shiny)" or "old brown" (for analyses, researchers combine "fresh black" and "old black" pellet groups for each transect and exclude "old brown" pellet groups from the analyses as these may be from the previous season and may not relate to the deer population of the year the survey took place in. After recording each pellet group observation, disperse the pellets to ensure these are not re-counted in later years (even though this is unlikely as the pellets will desiccate and turn brown, this measure is a safeguard).

When the second person completes the 50 meters, record primary and secondary habitats observed in that section using the habitat codes at the upper right of the data sheet (see Appendix D) and estimate the percent of that section that was impassible (i.e., where it was impossible to census for pellet groups due to thick brush or deadfall) on the datasheet. The ending point for that section is the beginning point for the next 50 meter section. Repeat the process for the remaining 9 50-meter sections to complete the 500 meter transect.

5.4. Data Management and Quality Control

The text here addresses specific methods for managing and ensuring the quality of pellet transect data. Every observer is responsible for recording complete and legible data. Do not assume that stapling data sheets together makes it obvious the data was collected on the date or by the observer listed on the front of the packet—the data will be useless if the incomplete data sheets are separated from the completed top sheet. At the end of each field day, review every data sheet to make sure each sheet is properly completed and legible. Please do not take shortcuts.

All pellet transect data needs to be entered into an Excel spreadsheet. Always save the original data, even if not "cleaned", as a "master" file. Save the file under in the appropriate "original data" folder with a name that includes the year the data cover and "Pellet MASTER".

The US 93 Evaluation data files are on the WTI server at

G:\PROJECT DATA\426402_US93_Evaluation\data. A single folder for pellet transect data can be found here and includes the following sub-folders:

\pellet transects\2004 (separate folders for 2004, 2005...)

- **Pellet MASTER:** Contains Excel files the original data files. These files will be named with the year the data originated from and "MASTER" to indicate that this is the original data (e.g., "2003 pellet MASTER.xls"); and
- **Pellet WORKING FILES:** Contains files that have been changed from the master files for any reason.

6. TRAFFIC COUNTS

6.1. Introduction

Traffic levels can affect animal-vehicle collisions and animal-highway crossings. The research team collects traffic counts to assess how changes in traffic volumes, speed, and gaps between platoons of vehicles may correspond to changes in crossings and mortalities. While MDT collects traffic volume data from an inductive loop counter north of Arlee (between the Evaro and Ravalli Curves study site), pneumatic tube road counters (Trax I Traffic Counter/Classifier, Jamar Technologies Inc., Horsham, PA; 1998) are used to collect data within the Evaro and Ravalli Curves areas. The remainder of this chapter details the field setup and installation, and downloading and archiving protocols.

6.2. Road Tube Installation

The first step to setting up road counters is to install hollow rubber tubing across the roadway. Before heading out to the field, read the Trax I User's Manual (1998; located in the WTI equipment cupboard in the main office); chapter 3 of the Trax I User's Manual details the process of installing the road tubes properly.

Because installation of road tubes involves working in the roadway itself, please refer to the US 93 Safety Protocol (Chapter 2) to ensure all personnel involved are properly prepared (safety vests, helmets, etc.). Install the tubing during the early morning hours after sunrise but before traffic levels increase, when the road surface is dry and ambient temperatures are above 4°C (40°F) (asphalt nails are easier to pound into warmer pavement). Installing tubes in the roadway does not require traffic control, but it is necessary to set up temporary "Road Work Ahead" signs 152.4 meters (500 feet) upstream of the work site to warn both north- and southbound drivers of your presence. Park the work vehicle in a location well off the road, but near the work site and use an amber safety light on top of the vehicle to provide another visual signal to drivers of your presence. Work in groups of two or more so that at least one person can watch for traffic and errant driving behaviors while the other(s) focuses on the installation. Do not underestimate the importance of having at least one person watching for the group's safety.

Beyond safety equipment, "road work ahead" signs and stands, installation of road tubes requires 2 18.3 meter (60 foot) lengths of road tubes (per counter installation), a measuring tape, 6.35 cm (2.5 inch) asphalt nails, at least one hammer, asphalt ("mastic") tape, webbing, and a galvanized c-clamp or figure-8 grip to anchor the tubing to the road surface. Tubes, nails, mastic tape, webbing, c-clamps and figure-8 grips can be purchased through Jamar Technologies. Because researchers collect traffic data for several months, the "mini tube" is not durable enough to withstand the long-term wear. Please use the standard "round tube" with an outer diameter of 1.27 cm (0.5 inch) and an inner diameter of 0.64 centimeter (0.25 inch).

Chapter 4 of the Trax I User's Manual describes the layout of the tubes. The team uses the "L6" layout to quantify class, speed, and gap for both directions of traffic (Figure 9). Place two tubes perpendicular to the flow of traffic precisely 2.44 m (8 feet) apart. Stretch the round tubes 30.5 cm (1 foot) per 3.05 m (10 feet) of roadway. Anchor the ends the tubes to the pavement using a C-clamp or a figure-8 grip. Secure the remainder of the tube in the traffic lanes using at least 3 pieces of mastic tape per tube. Throughout the process of installing the tubes, at least one person needs to watch for traffic while the other(s) are working on the roadway; the person watching

needs to tell the other(s) when to step back while there is plenty of time for a safe retreat. Once the tubes are installed, connect the tubes to the counter. Notice which tube (northern or southern) is connected to which port (A or B) and write this down. This information is necessary to correctly interpret direction of travel.

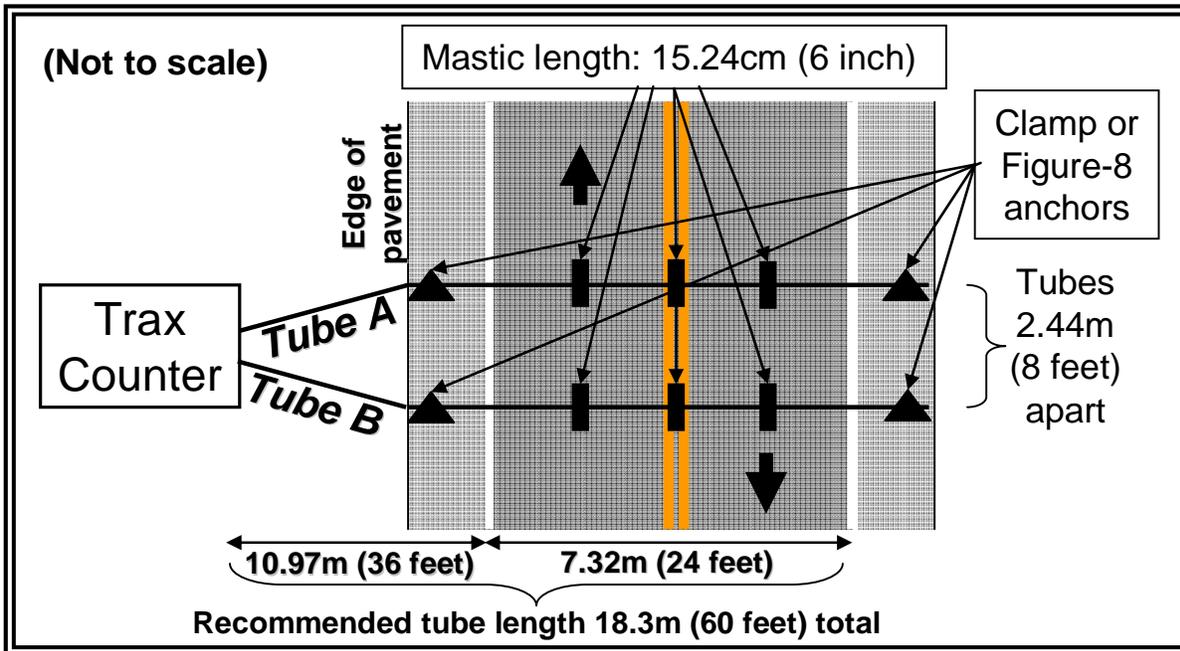


Figure 9: Road tube layout for quantifying speed, class, and gap of traffic on a 2-lane, bi-directional roadway using the Trax I Traffic Counter/Classifier (Jamar 1998).

6.3. Traffic Counter Setup

Before deploying any traffic counters in the field, they must be fully charged. Chapter 6 of the Trax I User's Manual provides information about battery maintenance. The Trax I counter uses a rechargeable lead gel battery that can be recharged using a Trax I charger (or a similar 6VDC charger with the correct plug and polarity) plugged into the charge port. The units need to be charged to at least 6.4 volts to be deployed in the field.

Chapter 2 of the Trax I User's Manual provides a guide to operating the counter. Open the lid of the Trax I counter and turn on counter using the toggle switch in the upper right corner of the front panel. You should first see an opening screen identifying the Trax I counter version, followed by a second screen that shows what the tube spacing should be, the amount of memory available, number of counts stored, battery status (should read at least 6.4v if properly charged; if less than 6.4v, recharge the unit) and the time and date that the unit is currently set for. After a few seconds, the main menu screen will appear.

To move from menu to menu and select options, use the "TAB" and "DO" keys at the lower right and left buttons of the number pad, respectively. Press the TAB key to move to the option

you want and continue using that key until the desired selection is flashing, and then press the DO key to select. If you overshoot your target, keep pressing the TAB until the choices cycle through to the selection you wanted again.

The “UTILITIES” menu allows you to download data (see “Downloading Data”, below, for details), set the time/date (note: Trax I uses a 24-hour military time format; i.e., 5:00pm is 17:00), determine the interval that to store data in (5, 10, 15, 30, or 60 minute intervals), change the tube spacing (default should be set for 2.44m or 8 feet), and clear the memory. “EXIT” allows you to return to the main menu.

The “COUNT” menu allows you to set up parameters to collect data. Select the “Binned” option to gather all three types of data offered (class, speed, and gap), then select the “L6” tube layout. Next enter a site code; record which counter is designated with which site code number.

After the site code is entered, the count start-up menu will appear. To start a count, first make sure the road tubes are attached to the traffic counter ports (note which tube is connected to which port to determine direction of travel). Select “START” and the Trax I will begin recording data. There should be a screen that allows you to view the collection of data. Watch this screen to see whether the following categories of data change according to what traffic you observe passing over the tubes at that time:

- “CHNL” tells which channel of data you are seeing; we should only be using one channel so this shouldn’t change;
- “AX:2” indicates the number of axles recorded for the most recent vehicle that passed over the tubes (in this case, 2 axles);
- “#V:0010” shows how many vehicles have been recorded (in this case 10 vehicles);
- “CLS:02” tells the class of the last vehicle that passed (in this case, class 2);
- “xx MPH” shows the speed of the vehicle;
- “A>B” indicates how the vehicle hit the tubes (in this case, the A tube was hit first);
- “GAP” tells the gap (in feet) between vehicles; and
- The last number in the third line indicates the length between axles.

You can also determine if the tubes and counter are reading the traffic properly in “TEST” mode, but be aware that no data is being collected in this mode. When done with the “TEST” mode, you must turn the unit off and proceed through the set-up again, select “START” and then “RUN” to begin collecting and storing the data.

6.4. Downloading Data

Chapter 5 of the Trax I User’s Manual covers the steps for downloading data. To download data from the counter, you need Jamar’s data analysis software (disks are stored with the User’s Manual in the equipment cupboard in the main office), a serial port on the computer to which you are downloading, and a Jamar universal cable.

First you must turn the unit off to download (you can not download while the unit is collecting data). Then plug the universal cable into the computer and the black plug on the other end into the Trax I unit. Turn the unit on. After automatically running through self-diagnostics, the main

menu screen will appear. Refer to the software manual for information on setting up the software for downloading. When the data has been downloaded, turn off the unit. Check to see that the data has, indeed, been transferred from the unit to your computer. Once you are certain (check twice!) the data has been successfully downloaded, you can turn on the unit and clear the memory. To do this, select the “UTILITIES” menu and tab over to “CLEAR”; you are given two chances to change your mind before data is removed from the nonvolatile memory. Once the clearing memory process has started, you must allow the counter to finish before turning it off. Turning the counter off before the clearing process is finished will result in a file error in the counter.

6.5. Data Management and Quality Control

The text here addresses specific methods for managing and ensuring the quality of traffic count data. Always save the original data, even if not “cleaned”, in a “master” folder. Save the file in the appropriate “original data” folder with a name that includes the year the data cover and “Traffic data MASTER”.

The US 93 Evaluation data files are on the WTI server at

G:\PROJECT DATA\426402 US93 Evaluation\data. A single folder for traffic count data can be found here and includes the following sub-folders:

\2002 traffic data (separate folders for 2004, 2005...)

- **2002 traffic data MASTER:** Contains files the original data files; and
- **2002 traffic data WORKING FILES:** Contains files that have been changed from the master files for any reason. Any analyses should be stored here.

7. FIELD EQUIPMENT

7.1. Introduction

Proper use and maintenance of field equipment will maximize the life-span of these tools, ensure quality data collection, and help keep replacement costs down. Fortunately, the pre-construction field methods are relatively straightforward and require using mainly simple equipment such as rakes. For the more technical resources, this section provides additional information to guide staff in the operation of these tools. If the text below does not provide sufficient information to confidently use these tools, please work directly with your supervisor to ensure you are properly using the equipment.

7.2. Soil Thermometer

The research team uses a Hobo soil thermometer and data logger to track temperatures as they may affect track observations in the track beds (temperatures at or below freezing may solidify the sand material, causing researchers to underestimate the activity from that period). Refer to the user's manual for detailed instructions on using this tool and downloading data. For each tracking session, download the data from the temperature data logger, clear the memory, and leave the data logger turned on. Return the data logger to its weather proof container but make sure the temperature probe extends under the filter fabric and sand.

7.3. Digital Camera

Please refer to the Nikon manual for operating and downloading instructions. Software to download digital photos is available with the manual.

7.4. Global Positioning System (GPS)

7.4.1. Description of GPS Model

This section is a guide to the use of a GPS unit, the Garmin eTrex Venture. The section discusses the basics of obtaining coordinates. Please consult the reference guide for details (<http://www.garmin.com/manuals/133.pdf>). The Garmin eTrex Venture uses up to 12 different satellites to determine a position. The model is designed to provide precise GPS positioning using correction data obtained from the Wide Area Augmentation System (WAAS). Depending on the region and the topography of the terrain a WAAS-capable receiver can give you a position accuracy of within three meters 95 percent of the time. However, WAAS may not be available in all of our study areas and the terrain in our study areas is often mountainous. Therefore the position should not be assumed to be that accurate. An accuracy of within 15 meters can be expected though. In open terrain this may be 5 meters. The Garmin eTrex Venture can record up to 500 positions (waypoints).

Units:

- position format: use UTM UPS format (advised by Peter Singleton and Jack Wierzchowski). The coordinate system is explained at http://www.gordon-info.org.uk/gps/utm_ups.htm;

- map datum: use North American Datum (NAD) 83 (advised by Peter Singleton and Jack Wierzchowski);
- distance/speed: metric;
- elevation/vertical speed: meters; and
- the GPS unit is set for the above parameters already.

System:

- GPS: Normal;
- WAAS: enabled (to allow for more precise locations);
- language: English; and
- the GPS unit is set for the above parameters already.

Waypoints:

- record waypoint number (on paper) and indicate what the waypoint represents (on paper);
- record the accuracy of the waypoint (on paper) (the accuracy is not saved by the GPS unit). Note: allow for some time for the accuracy estimate until it becomes stable;
- save the waypoint (the coordinates) on the GPS unit; and
- record waypoint coordinates (on paper) as a backup.

Software installation:

- download software from: <http://www.tapr.org/~kh2z/Waypoint/>;
- unzip and start program;
- under File, Datum, select North America 1983; and
- under file, Configuration, select UTM and meters.

Download waypoints:

- connect GPS unit to PC with cable;
- under GPS, Port, select port;
- under GPS, download from GPS, select waypoint;
- save downloaded waypoints in an ASCII file (comma delimited text file, *.txt);
- check contents of the file; and
- delete waypoints from GPS unit (clear memory).

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APPENDIX A: TRACKING BED MEASUREMENTS AND PELLET TRANSECT LOCATIONS

Table A-1. Individual track bed measurements; grey shaded beds indicate starting points for pellet transects (at the center of the bed).

Evoro		Ravalli Curves		Ravalli Hill	
BED	LENGTH (m)	BED	LENGTH (m)	BED	LENGTH (m)
EV10	87	RC1	87	RH1	100
EV11	98	RC10	99	RH2/3	200
EV12	97	RC11/12	194	RH4	100
EV13/14	218	RC13	99	RH5	100
EV15/16	216	RC14	100	RH6	100
EV17	99	RC15	100	RH9A	100
EV18	99	RC16	96		
EV2	101	RC17/6A	207		
EV7	87	RC18	99.2		
EV8	91	RC19	103		
EVPE	91	RC2	101		
EVPW	91	RC20	97.8		
		RC3	89		
		RC4	93		
		RC5	101		
		RC7A	87		
		RC8/9	199		
TOTAL	1375	TOTAL	1952	TOTAL	700

APPENDIX B: NORTH AMERICAN MAMMALS

Table B-1. All mammal species or species groups known to occur in North America (Whitaker 1997), their occurrence in NW Montana (Whitaker 1997), recorded presence on the Flathead Indian Reservation (CSKT unpublished data), whether or not the species will leave recognizable tracks on the tracking beds along Hwy 93 (“?” = recognizable tracks uncertain), and the likelihood of actually recording tracks of that species along Hwy 93 (1= unlikely; 2 = possible; 3 = expected).

Species or species groups		Present in NW Montana	Recorded on Flathead Reservation	To be recorded on tracking bed	Likelihood of presence along Hwy 93
Virginia possum	<i>Didelphis virginiana</i>	-	-	-	
Shrews and moles	<i>Soricidae and Talpidae</i>	X	X	-	
Bats	<i>Chiroptera</i>	X	X	-	
Nine-banded armadillo	<i>Dasypus novemcinctus</i>	-	-	-	
Pikas, rabbits and hares	<i>Lagomorpha</i>	X	X	-	
Rodents*1	<i>Rodentia</i>	X	X	-	
American beaver	<i>Castor canadensis</i>	X	X	?	2
Common porcupine	<i>Erethizon dorsatum</i>	X	X	?	3
Domesticated cat	<i>Felis catus</i>	X	X	?	3
Mountain lion	<i>Felis concolor</i>	X	X	X	2
Ocelot	<i>Felis pardalis</i>	-	-	-	
Margay	<i>Felis wiedii</i>	-	-	-	
Jaguarundi	<i>Felis yagouarundi</i>	-	-	-	
Jaguar	<i>Panthera onca</i>	-	-	-	
Lynx	<i>Lynx canadensis</i>	X	X	X	1
Bobcat	<i>Lynx rufus</i>	X	X	?	2
Black bear	<i>Ursus americanus</i>	X	X	X	3
Grizzly bear	<i>Ursus arctos</i>	X	X	X	1
Polar bear	<i>Ursus maritimus</i>	-	-	-	
Domesticated dog	<i>Canis familiaris</i>	X	X	X	3

TABLE 2 CONTINUED... Species or species groups		Present in NW Montana	Recorded on Flathead Reservation	To be recorded on tracking bed	Likelihood of presence along Hwy 93
Coyote	<i>Canis latrans</i>	X	X	X	3
Wolf	<i>Canis lupus</i>	X	X	X	1
Red wolf	<i>Canis rufus</i>	-	-	-	
Arctic fox	<i>Alopex lagopus</i>	-	-	-	
Kit fox	<i>Vulpes velox</i>	X	-	-	
Red fox	<i>Vulpes vulpes</i>	X	X	?	2
Common gray fox	<i>Urocyon cinereoargenteus</i>	-	-	-	
Ringtail	<i>Bassariscus astutus</i>	-	-	-	
Common Raccoon	<i>Procyon lotor</i>	X	X	?	3
White-nosed coati	<i>Nasua narica</i>	-	-	-	
Fisher	<i>Martes pennanti</i>	X	X	?	1
Short-tailed weasel	<i>Mustela erminea</i>	X	X	-	
Long-tailed weasel	<i>Mustela frenata</i>	X	X	-	
Black-footed ferret	<i>Mustela nigripis</i>	-	-	-	
Least weasel	<i>Mustela nivalis</i>	-	-	-	
Mink	<i>Mustela vison</i>	X	X	?	3
Wolverine	<i>Gulo gulo</i>	X	X	X	1
American badger	<i>Taxidea taxus</i>	X	X	?	1
Western spotted skunk	<i>Spilogale gracialis</i>	X	?	?	1
Eastern spotted skunk	<i>Spilogale putorius</i>	-	-	-	
Hooded skunk	<i>Mephitis macroura</i>	-	-	-	
Striped skunk	<i>Mephitis mephitis</i>	X	X	?	3
Common hog-nosed skunk	<i>Conepatus mesoleucus</i>	-	-	-	
River otter	<i>Lutra canadensis</i>	X	X	?	1
Sea otter	<i>Enhydra lutris</i>	-	-	-	

TABLE 2 CONTINUED... Species or species groups		Present in NW Montana	Recorded on Flathead Reservation	To be recorded on tracking bed	Likelihood of presence along Hwy 93
Eared seals	<i>Otariidae</i>	-	-	-	
Walrus	<i>Odobenidae</i>	-			
Hair seals	<i>Phocidae</i>	-	-	-	
Manatees and sea cows	<i>Sirenia</i>	-	-	-	
Domesticated horse	<i>Equus caballus</i>	X	X	X	3
Wild boar	<i>Sus scrofa</i>	-	-	-	
Collared peccary	<i>Tayassu tajacu</i>	-	-	-	
Fallow deer	<i>Cervus dama</i>	-	-	-	
Elk	<i>Cervus elaphus</i>	X	X	X	2
Sika deer	<i>Cervus nippon</i>	-	-	-	
Sambar deer	<i>Cervus unicolor</i>	-	-	-	
Mule deer	<i>Odocoileus hemionius</i>	X	X	X	3
White-tailed deer	<i>Odocoileus virginianus</i>	X	X	X	3
Moose	<i>Alces alces</i>	X	X	X	2
Caribou	<i>Rangifer tarandus</i>	-	-	-	
Pronghorn*2	<i>Antilocapra americana</i>	X	x (*2)	x (*2)	1
Domesticated cattle		X	X	X	3
Bison*2	<i>Bos bison</i>	X	x (*2)	x (*2)	1
Mountain goat	<i>Oreamnos americanus</i>	X	X	X	1
Muskox	<i>Ovibos moschatus</i>	-	-	-	
Bighorn sheep	<i>Ovis canadensis</i>	X	X	X	1
Dall's sheep	<i>Ovis dalli</i>	-	-	-	
Barbary sheep	<i>Ammotragus lervia</i>	-	-	-	
Primates*3	<i>Primates</i>	-	-	-	
Humans		X	X	X	3

TABLE 2 CONTINUED... Species or species groups		Present in NW Montana	Recorded on Flathead Reservation	To be recorded on tracking bed	Likelihood of presence along Hwy 93
Other tracks					
Vehicles					
Car					

*1 except for American beaver and common porcupine

*2 occurs only within National Bison Range

*3 except for humans

APPENDIX C: TRACKING DATASHEET

US 93 Tracking Bed Data Sheet		<i>*Photos should have ruler next to tracks</i>								
Date:		<i>All photos need date, tracking bed, and track number</i>								
Observer:		<i>Photo required for big cat, wolf, bear and weasel group species</i>								
Precipitation: EV RC RH		Temperature downloaded? Y / N								
Area and bed # EV RC RH		Bed condition: Snow / Frozen / Wet / Dusty / Normal								
Track #	Species	Certainty of spp 1=definitely 2=probably 3=possibly	Photo?*(Y/N)	Behavior 1=xing 2=parallel >5m 3=presence	approach or leaving rd? (A/L)	Xings				same occurrence as bed/track #
						entered bed:		exited bed:		
						meters	from south or north end of bed (S/N)	meters	from south or north end of bed (S/N)	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
Roadkill:										
Comments:										
										Data entered by _____

APPENDIX D: PELLETT TRANSECT DATASHEET

<u>US 93 Pellet Transect Datasheet</u>										
<p style="text-align: center;">1-m x 500 m transect perpendicular to road, start at edge of pavement Use 50 meter measuring tape, compass, 1-m stick with 0.5m mark, two observers 10+ pellets = group, every other "edge" group counted</p>						<p style="text-align: center;"><u>Habitat Codes</u> 1 = open grass 2 = open scrub 3 = coniferous forest 4 = deciduous forest 5 = wetland/riparian 6 = residential 7 = ag crop 8 = pasture</p>				
<p>Date: _____ Observers: _____ Pellet Transect / Track Bed #: _____ East or West of 93? <i>E</i> or <i>W</i></p>				<p style="text-align: center;"><u>Land Ownership</u> CSKT or Private Owner: _____ _____ owner contacted? Y / N</p>						
	0-50m	51-100m	101-150m	151-200m	201-250m	251-300m	301-350 m	351-400m	401-450m	451-500m
compass bearing										
GPS start										
GPS end										
# new (shiny) black pellet groups										
# old (not shiny) black pellet groups										
# old brown pellet groups										
Primary Habitat										
Secondary Habitat										
~% impassable										
<p>Notes (more room on back): _____</p> <p style="text-align: right;">Data entered by: _____</p>										

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