Montana US Highway 93 South Wildlife Crossings Research

MDT # HWY – 308445-RP

2011 Annual Report

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Prepared for the Montana Department of Transportation

January 31, 2012

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1. Study Area and Purpose

The Montana Department of Transportation (MDT) installed 16 large wildlife crossing structures along US Highway 93 South between Florence and Hamilton from 2004 to 2011. Three additional wildlife crossing structures will be completed in 2012. Details of the 16 existing wildlife crossing structures and three future wildlife crossing structure sites are presented in Table 1. A map of the study area showing the locations of existing wildlife crossing structures and future wildlife crossing structure sites is presented in Figure 1.

The purpose of this research is to determine:

1. white-tailed deer (*Odocoileus virginianus*) usage rates of existing wildlife crossing structures and future wildlife crossing structures,
2. white-tailed deer usage rates of wildlife crossing structures by type and across types (including height, width, and length),
3. relationships among wildlife crossing structures with landscape variables and crossing rates,
4. changes in animal-vehicle collisions between pre-construction and post-construction of wildlife crossing structures within a twenty-five mile stretch of US Highway 93 South, mile post (mp) 74 to mp 49, and,
5. relationships between animal-vehicle collisions and wildlife crossing structures over time and space.

This research began in 2008 and will be completed in 2015. This research is approximately 46% complete. This report presents preliminary results which preclude discussion and conclusion sections. The project is on time and on budget for all tasks.

Table 1. Existing Wildlife Crossings Structures and Future Wildlife Crossing Structure Sites, US Highway 93 South, Montana.

Existing Structures	**Year Completed**	**Approximate Mile Post**	**Structure Type**
Bass Creek North	2005	71	Bridge
Bass Creek South	2005	70	Bridge
Bass Creek Fishing Access	2005	70	Round Corrugated Steel Culvert
Dawn's Crossing	2005	70	Bridge
Kootenai Creek	2009	66	Bridge
McCalla Creek North	2009	66	Bridge
McCalla Creek South	2010	65	Bridge
Kootenai Springs Ranch	2010	65	Concrete Box Culvert
Indian Prairie Loop	2010	63	Concrete Box Culvert
Big Creek	2011	61	Bridge
Axmen Propane	2010	61	Round Corrugated Steel Culvert
Sweathouse Creek	2011	60	Bridge
Mountain Gallery	2011	56	Concrete Box Culvert
Fun Park	2011	55	Concrete Box Culvert
Mill Creek	2011	55	Bridge
Blodgett Creek	2008	50	Bridge
Future Sites	**Expected Completion**	**Approximate Mile Post**	**Structure Type**
Bear Creek North	2012	58	Bridge
Bear Creek South	2012	57	Bridge
Lupine	2012	56	Concrete Box Culvert

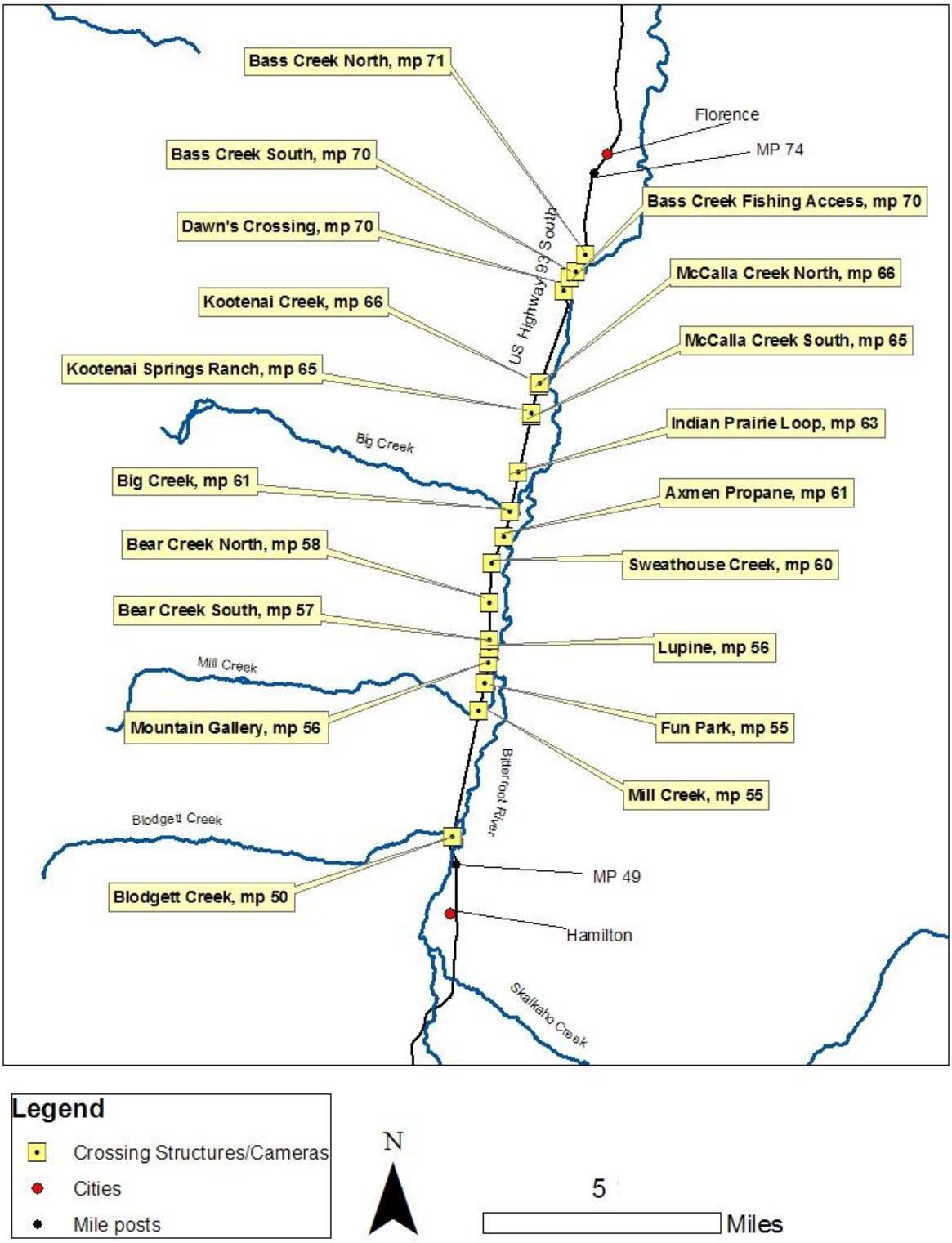

Figure 1. Map of US Highway 93 South Study Area and Locations of Existing and Future Wildlife Crossing Structures, Montana.

2. White-tailed Deer Use of Existing Wildlife Crossing Structures and Future Wildlife Crossing Structure Sites

2.1. Methods

Wildlife usage rates were determined by monitoring existing wildlife crossing structures and future wildlife crossing structure sites with Reconyx Professional Cameras, Model PC85 and Model PC800. Cameras are triggered by motion and take pictures of large and small animals, day and night. All cameras, with five exceptions, were installed inside metal telephone-utility boxes. Each box was secured by a cable, locked to the camera on one end and buried in concrete at the other. All cameras were also secured by electronic code locks. Cameras at Kootenai Creek (mp 66), Big Creek (southwest camera, mp 61), Sweathouse Creek (east and west cameras, mp 60), and Mill Creek (east camera, mp 55), were locked in metal Reconyx Bear Boxes mounted on a large fence post or a large tree, and secured with locked cables.

A single camera was installed near one entrance of the following existing wildlife crossing structures: Bass Creek North (mp 71), Bass Creek South (mp 70), Bass Creek Fishing Access (mp 70), Dawn's Crossing (mp 70), Kootenai Creek (mp 66), Axmen Propane (mp 61), Mill Creek (east camera, mp 55), and Blodgett Creek (mp 50). Two cameras were installed, one near each entrance, of the following existing wildlife crossing structures: McCalla Creek North (mp 66), McCalla Creek South (mp 65), Kootenai Springs Ranch (mp 65), Indian Prairie Loop (mp 63), and Sweathouse Creek (mp 60). One camera was installed to monitor the jump off ramp at McCalla Creek South (ramp camera, mp 65). Four cameras were installed at Big Creek (mp 61). Cameras were placed near the entrances of existing wildlife crossing structures in order to record the number of white-tailed deer successfully using, moving parallel to, and repelled from the crossing structures. As new wildlife crossing structures are constructed, additional cameras will be installed to monitor post-construction wildlife activity.

Two cameras were installed at each of the future wildlife crossing structure sites. One camera was placed as near as possible to any current structures (existing culverts or bridges) or the location of the future wildlife crossing structure. A second camera was placed approximately 25 to 75 meters away. Cameras were positioned so that the first camera could capture animal usage of any current structure or other movements nearby, and the second camera could record animal movements as they approached or departed the road way. All pre-construction monitoring was completed in April, 2011.

Two cameras at Bell Crossing (east and west cameras, control) were installed near a bridge over an unnamed spring run on County Road 370, approximately one-quarter mile east of the Bitterroot River. This site was selected as a control to help evaluate changes in the white-tailed deer population over time in a location where road construction is not scheduled to occur. Big Creek (south camera, control, mp 61) was also selected as a long-term control site after construction was completed in April, 2011.

This reporting period, four cameras were installed at the following locations: Indian Prairie Loop (east camera, mp 63), Sweathouse Creek (east and west cameras, mp 60), and Mill Creek (east camera, mp 55) to monitor post-construction activity. Locations, approximate mile posts, and installation dates of cameras currently monitoring post-construction wildlife activity at existing wildlife crossing structures, and cameras at control sites, are presented in Table 2.

Table 2. Cameras Currently Installed at Existing Wildlife Crossing Structures on US Highway 93 South, Montana, and at Control Sites.

Camera Location	Approximate Mile Post	Date Installed
Bass Creek North	71	Oct. 10, 08
Bass Creek South	70	Nov 22, 08
Bass Creek Fishing Access	70	Nov 22, 08
Dawn's Crossing	70	Nov 23, 08
Kootenai Creek	66	Apr 21, 09
McCalla Creek North (east camera)	66	Apr 22, 09
McCalla Creek North (west camera)	66	Apr 22, 09
McCalla Creek South (east camera)	65	July 30, 10
McCalla Creek South (west camera)	65	June 16, 10
McCalla Creek South (ramp camera)	65	June 16, 10
Kootenai Springs Ranch (east camera)	65	June 10, 10
Kootenai Springs Ranch (west camera)	65	July 29, 10
Indian Prairie Loop (east camera)	63	Sept 27, 10
Indian Prairie Loop (west camera)	63	Oct 25, 11
Big Creek (northeast camera)	61	July 28, 11
Big Creek (southeast camera)	61	July 29, 11
Big Creek (northwest camera)	61	July 28, 11
Big Creek (southwest camera)	61	Aug 12, 11
Big Creek (south camera, control)	61	Apr 12, 11
Axmen Propane	61	Sept 28, 10
Sweathouse Creek (east camera)	60	Dec 10, 11
Sweathouse Creek (west camera)	60	Dec 10, 11
Mill Creek (east camera)	55	Dec 10, 11
Blodgett Creek	50	Mar 15, 10
Bell Crossing (east camera, control)	CR 370	May 29, 09
Bell Crossing (west camera, control)	CR 370	May 29, 09

The following calculations were made for each camera location, where applicable:

- deer per day = the total number of deer observed at a future wildlife crossing structure site divided by the number of days the camera was in operation
- success per day = the total number of deer observed successfully using an existing wildlife crossing structure divided by the number of days the camera was in operation
- success rate = the total number of deer moving through the structure or onto the roadway at future structures, divided by the total number of deer recorded at the structure or site
- rate of repellency = the total number of deer repelled at existing crossing structures or repelled at future crossing sites divided by the total number of deer recorded at the structure or site
- parallel rate = the total number of deer moving parallel to structures or sites divided by the total number of deer recorded at the structure or site.

2.2. Results

Pre-construction monitoring was completed. Twenty-six pre-construction data sets are summarized in Table 3. The order of camera locations is based on the number of deer per day photographed at each camera site.

Table 3. Summary of Complete Pre-Construction Data Sets.

Camera Location	Mile Post	Camera Days	Deer Per Day	Successful Crossings	Success Rate (%)	Rate of Repellency (%)	Parallel Rate (%)
McCalla Creek South (south camera)	65	93	5.0	44	9	3	88
Indian Prairie Loop (north camera)	63	78	4.7	0	0	0	100
Indian Prairie Loop (south camera)	63	150	4.5	0	0	0	100
Bear Creek South (north camera)	57	629	2.6	1662	98	1	1
McCalla Creek South (north camera)	65	109	2.3	21	9	7	84
Big Creek (south camera)	61	260	2.2	0	0	0	100
Kootenai Springs Ranch (east camera)	65	107	2.1	78	32	8	60
Fun Park (east camera)	55	490	1.5	606	79	11	10
Axmen Propane (north camera)	61	212	1.5	0	0	0	100
Lupine (west camera)	56	382	1.3	0	0	0	100
Mill Creek (south camera)	55	566	1.2	525	70	15	15
Sweathouse Creek (north camera)	60	452	1.1	65	13	1	86
Kootenai Springs Ranch (west camera)	65	55	0.9	26	54	10	36
Sweathouse Creek (south camera)	60	503	0.8	219	52	4	44
Big Creek (north camera)	61	277	0.8	33	14	14	72
Bear Creek North (east camera)	58	454	0.6	29	11	2	87
Lupine (east camera)	56	385	0.6	0	0	0	100
Bear Creek South (south camera)	57	509	0.4	140	68	7	25

Camera Location	Mile Post	Camera Days	Deer Per Day	Successful Crossings	Success Rate (%)	Rate of Repellency (%)	Parallel Rate (%)
Axmen Propane (south camera)	61	176	0.4	4	6	3	91
Mountain Gallery (north camera)	56	440	0.3	64	45	4	51
Fun Park (west camera)	55	556	0.2	57	52	3	45
Lupine (south camera)	56	172	0.1	16	80	15	5
Mill Creek (north camera)	55	599	0.07	1	3	0	97
Mountain Gallery (south camera)	56	587	0.06	24	61	3	36
Bear Creek North (west camera)	58	536	0.03	2	14	14	72
Lupine (north camera)	56	204	0.005	0	0	100	0

Construction monitoring is complete. Eleven construction data sets are summarized in Table 4. The order of camera locations is based on the number of deer per day photographed at each camera site.

Table 4. Summary of Complete Construction Data Sets.

Camera Location	Mile Post	Camera Days	Deer Per Day	Successful Crossings	Success Rate (%)	Rate of Repellency (%)	Parallel Rate (%)
Big Creek (north camera, construction)	61	394	1.7	0	0	0	100
Big Creek (south camera, construction)	61	407	1.3	0	0	0	100
McCalla Creek South (ramp camera, construction)	65	93	0.5	20	44	22	34
Axmen Propane (north camera, construction)	61	52	0.4	0	0	0	100
Axmen Propane (south camera, construction)	61	49	0.4	0	0	0	100
Kootenai Springs Ranch (west camera, construction)	65	152	0.2	5	18	4	78
Kootenai Springs Ranch (west structure camera, construction)	65	46	0.2	0	0	0	100
Kootenai Springs Ranch (east camera, construction)	65	146	0.2	4	17	0	83
Sweathouse Creek (north camera, construction)	60	115	0.2	0	0	39	61
McCalla Creek South (west camera, construction)	65	199	0.1	16	67	8	25
Kootenai Springs Ranch (east structure camera, construction)	65	47	0.06	0	0	0	100

White-tailed deer use of existing wildlife crossing structures is compiled in Table 5. During this study, cameras recorded individual white-tailed deer successfully moving through existing wildlife crossing structures on approximately 9,000 occasions (this number includes data from Bear Creek South, north camera, reported in Table 3). The order of camera locations is based on success per day. Camera data reported were analyzed through December 9, 2011.

Table 5. White-tailed Deer Use of Existing Wildlife Crossing Structures.

Camera Location	Mile Post	Camera Days	Number of Deer	Success Per Day	Successful Crossings	Success Rate (%)	Rate of Repellency (%)	Parallel Rate (%)
Kootenai Creek	66	886	1881	2.0	1799	92	4	4
Dawn's Crossing	70	1112	2029	1.7	2025	96	2	2
Bass Creek Fishing Access	70	1103	1386	1.2	1368	96	3	1
Big Creek (southwest camera)	61	121	134	1.0	116	83	11	6
Blodgett Creek	50	598	512	0.8	498	96	1	3
McCalla Creek North (east camera)	66	826	737	0.8	661	86	3	11
Big Creek (northeast camera)	61	135	87	0.6	78	89	7	4
McCalla Creek North (west camera)	66	788	566	0.5	434	76	12	12
Big Creek (northwest camera)	61	135	49	0.3	47	96	0	4
Big Creek (southeast camera)	61	135	41	0.3	37	88	10	2
McCalla Creek South (east camera)	65	482	210	0.2	114	54	8	38
McCalla Creek South (west camera)	65	521	231	0.2	122	52	16	32
Bass Creek North	71	1051	334	0.1	158	46	7	47
Kootenai Springs Ranch (west camera)	65	425	687	0.09	39	6	11	83
Kootenai Springs Ranch (east camera)	65	483	535	0.08	40	7	7	86
Indian Prairie Loop (west camera)	63	442	599	0.03	14	2	7	91

Camera Location	Mile Post	Camera Days	Number of Deer	Success Per Day	Successful Crossings	Success Rate (%)	Rate of Repellency (%)	Parallel Rate (%)
Axmen Propane	61	431	360	0.01	6	2	11	87
Bass Creek South	71	1043	11	0.005	5	38	16	46
Indian Prairie Loop (east camera)	63	46	27	0	0	0	19	81

2.3. Anticipated Work

- Install post-construction cameras at Mountain Gallery, Fun Park, and Mill Creek
- Ongoing monitoring and data analysis.

3. White-Tailed Deer Usage Rates of Wildlife Crossing Structures by Type and Across Types

A detailed statistical analysis of white-tailed deer usage rates of wildlife crossing structures by type and across types will be completed when construction of future wildlife crossing structures is completed and data are compiled, and will include variables such as height, width, and length.

4. Relationships among Crossing Structures with Landscape Variables and Crossing Rates

A methodology to measure and quantify variables such as structure, road, traffic, landscape, vegetation, and deer pellet counts at existing and future wildlife crossing structures was developed. Data was collected in 2010 at existing wildlife crossing structures and future wildlife crossing structure sites, except for the following: Indian Prairie Loop, Big Creek, and Axmen Propane. Construction activities were occurring at these three locations; and landscape variables there were drastically changed by the recent construction activities. Data will be collected at these three locations in 2012. Collected data and usage rates will then be analyzed using multivariate statistics.

5. Changes in Animal-Vehicle Collisions between Pre-Construction and Post-Construction of Wildlife Crossing Structures

5.1 Methods

Generalized Linear Models (GLM) will be used to analyze changes in animal-vehicle collisions (AVC) between pre-construction and post-construction of wildlife crossing structures. A direct comparison of pre-construction and post-construction AVC would be incomplete because deer density and traffic volume change over time. GLM developed for this study will determine how deer density and traffic volume influence AVC, and may predict future AVC based on pre-construction data. The predicted AVC can be compared to actual AVC once wildlife crossing structures and fencing are completed.

Pre-construction deer density, traffic volume, and AVC data were compiled and summarized. Deer density data sets included aerial abundance surveys and hunter harvest numbers conducted by Montana Fish, Wildlife & Parks (MFWP) in hunting district 260. Aerial surveys were not conducted in 1990, 1994 through 2000, and after 2005. Hunter harvest data were conducted from 1981through 2011. A correlation analysis between aerial survey data and hunter harvest data was conducted because of the incomplete aerial survey data set. Traffic volume was collected by MDT at counters A-047 (mp 72.5) and A-056 (mp 50.8). Counter A-047 did not collect data from June 2004 to August 2005; and counter A-056 did not collect data from May 2008 to May 2010. AVC data to the nearest one-tenth mile was collected by MDT from 1998 to the present.

5.2 Results

Hunter harvest data was significantly correlated to aerial survey data (Pearson's correlation, p=0.86). A plot of annual hunter harvest, traffic volume from counter A-056, and AVC from 1999 to 2007 is presented in Figure 2. A GLM (Poisson distribution and log link function) was used to determine if annual hunter harvest and traffic volume

measured by counter A-056 influenced annual AVC from 1999 to 2005. AVC values from 2006 and 2007 were excluded from the GLM because they appear to be outliers (Figure 2). The GLM revealed a positive, significant influence of annual traffic volume from counter A-056 on annual AVC ($Z=4.22$, $p<0.0001$) from 1999 to 2005. Annual hunter harvest did not significantly influence annual AVC from 1999 to 2005.

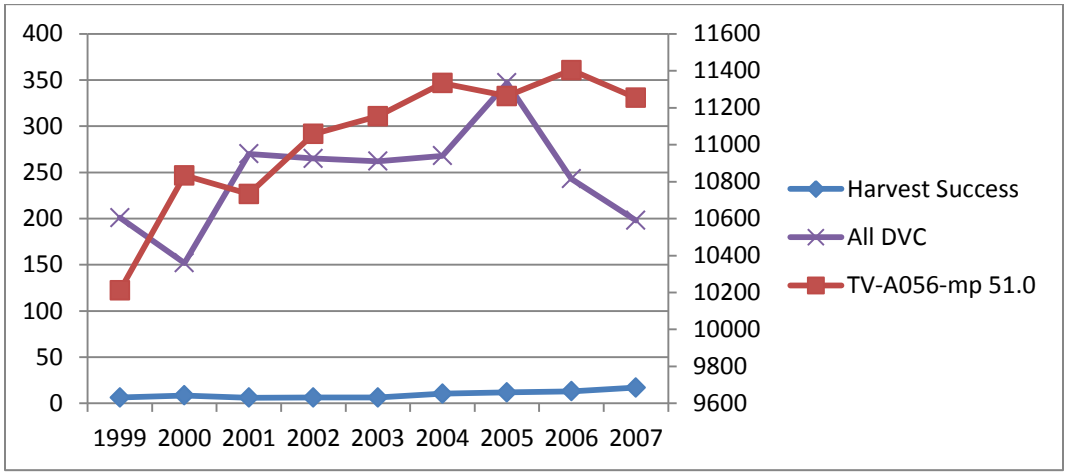

Figure 2. Annual hunter harvest (Harvest Success), animal-vehicle collisions (All DVC), and traffic volume (TV-A056-mp 51.0) on Highway 93 between mile posts 50 and 72 from 1999 to 2007.

5.3 Anticipated Work

The scale of the analysis above is coarse. Future fine scale GLM will determine if monthly deer density and monthly traffic volume influence monthly AVC within one mile of wildlife crossing structure sites that were monitored during pre-construction (mp 54 through 65). Deer density estimates will utilize pre-construction monitoring camera data summarized as deer per month recorded by cameras at each site. These detailed models will account for mixed effects and many zeros in the data. These models will then be used to predict AVC for the study post-construction.

6. Relationships between AVC Numbers and Wildlife Crossing Structures over Time and Space, Kernel Density Analysis

Additional kernel density analysis will continue as new wildlife crossing structures are completed and AVC data are collected.

Major Task Progress

Note: Only the first 15 of the 30 tasks submitted to MDT pre-study are presented at this time.

Task	Description	Estimated Span of calendar years Estimated after kickoff	Cost	Total billed to date	Percentage complete based on original budget
1	Task 1 Purchase equipment	Oct 1, 08 - Aug 31, 09	$49,650	43,052	87%
2	Task 2 Install equipment	Oct 9, 08 – Aug 31, 09	6,300	6,300	100%
3	Task 3 Monitor wildlife movement	Nov 1 08 – May 1, 09, 6 months	18,105	18,105	100%
4	Task 4 Obtain & analyze current a-v-c	Fall, 08 - Aug 31, 09	8,520	8,520	100 %
5	Task 5 Hold public meeting	Summer 09	Not applicable	Not applicable	Not applicable
6	Task 6 Create a-v-c prediction models	Spring/ Summer/ Fall 09	9,880	989	10%
7	Task 7 Monitor wildlife movement	May 1, 09- April 30 ‘10 = 12 months	41,810	41,810	100%
8	Task 8 Create Interim Report	Aug 09	3,720	3,720	100%
9	Task 9 Hold public meeting	Summer ‘10	2,760	2,760	100%
10	Task 10 Monitor wildlife movement	May 1 10 – April 30 ’11 = 12 months	40,560	40,560	100%

11	**Task 11 Create Interim Report**	**Jan 1 ’10- Dec 31 ‘10**	**3,720**	**3,720**	**100%**
12	**Task 12 Analyze pre-construction data**	**July ‘09 – June ‘10**	**13,360**	**5,382**	**40%**
13	**Task 13 Reinstall Equipment**	**June ‘10 – July ‘11**	**2,760**	**2,760**	**100%**
14	**Task 14 Monitor Wildlife Movement**	**May ‘11 – April ‘30 12**	**40,560**	**27,040**	**67%**
15	**Task 15 Create Interim Report**	**Jan 1 ’11 – Dec 31 ‘11**	**3,720**	**3,720**	**100%**