Wildlife Culvert Passage Monitoring 2022 Yearly Report: Bruce Freeman Rail Trail

JANUARY 2023

PREPARED FOR

MIG Corporation, Inc.

PREPARED BY

SWCA Environmental Consultants

WIDLIFE CULVERT PASSAGE 2022 YEARLY REPORT: BRUCE FREEMAN RAIL TRAIL

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1 INTRODUCTION

As part of the Bruce Freeman Rail Trail Phase 11B Project (Project), the Massachusetts Department of Transportation (MassDOT) constructed a wildlife tunnel crossing where the Rail Trail crosses State Route 2 in the Town of Concord, Massachusetts (Site) (see Study Area, below). The tunnel consists of a precast concrete box culvert ±7feet (ft) wide by ±5ft tall with ±1-ft of native substrate on the bottom. Construction of the tunnel was completed in the winter of 2021.

The Project received an Order of Conditions (OOC) from the Concord Conservation Commission (Commission) for impacts to resource areas regulated under the Massachusetts Wetlands Protection Act (M.G.L. c. 131 § 40) (WPA) and its implementing regulations (310 CMR 10.00 *et seq*.) as well as the Town of Concord Wetlands Protection Bylaw (Art. 43 of 2009 Town Meeting, as amended) (Bylaw) and its implementing regulations (Art. 59 of 2010 Town Meeting).

The final monitoring protocol proposed by SWCA Environmental Consultants (SWCA) (Appendix A) was approved by the Town on March 19, 2020. As part of that Plan, two camera traps and two track beds were installed at either end of the tunnel. Further details describing the implementation of the monitoring plan are included in Section 3, Methods. Monitoring of the wildlife tunnel is to occur for up to three years. This is the first year of monitoring and shall serve as the Year 1 monitoring period.

The following sections detail the study area, monitoring methods, monitoring results, and recommendations for the following monitoring seasons. Also included as appendices are the completed track bed and road mortality data sheets as well as representative photos from the monitoring events including photos of the study area, track bed/camera trap set-ups, camera captures, and wildlife sign.

2 STUDY AREA

The wildlife tunnel crossing is located ±800-linear feet (lf) east of the Massachusetts State Police Mounted Unit (located at 50 Wetherbee St, Acton, Massachusetts) and ±240-lf west of Nashoba Brook where Route 2 crosses the Bruce Freeman Rail Trial (located at approximately 42.469240, -71.407439) (see Figure 1, Appendix B). The study area includes the area within the wildlife tunnel as well as an area ±25-lf perpendicular from the edge of pavement and extends ±500-lf in each direction (i.e., east and west) on both the north and south sides of Route 2 for a total of ±1,000-lf on each side of the tunnel (see Figure 2, Appendix B). The study area also includes a similarly situated area ±1,000-lf within the east and west travel lanes of Route 2 and the median.

3 METHODS

Following approval of the Plan and subsequent construction of the wildlife crossing, post-construction monitoring of the wildlife tunnel began in March 2022. The two camera traps were installed on March 4, 2022, and the bounds of the road mortality surveys were demarcated. The two track beds were installed on April 14, 2022.

3.1 Track Beds

3.1.1 installation

Two track beds were installed at the wildlife tunnel, one at each end of the tunnel entrances (i.e., the north and south entrances). Each track bed was constructed from pressure-treated 2x4 lumber and assembled with weather resistant galvanized 90-degree angle brackets and deck screws. Originally, track beds were meant to span the ±7-ft width of the tunnel entrance and extend inward from the entrance ±6-ft, as described in the Plan. The south track bed required a field change in construction location due the dimensions of the tunnel entrance approach which prevented the track bed from being constructed flush with the entrance of the tunnel. Instead, the south track bed was installed ±6-inches (in) inside the south entrance. The beds were filled with ±3-in of very fine sand such that the top of the sand was within ±0.5-in from the top of the track bed frame. After the sand was evenly spread, a soft-bristled broom was used to smooth the surface of the sand (i.e., "set" the track beds), being careful not to accidentally transfer soil or other debris into the sand bed or otherwise disturb or leave stray imprints on the prepared sand.

3.1.2 Monitoring and Data Collection

Monitoring of the track beds occurred for approximately eight weeks between April 13 and June 15 in 2022 and will continue until 2024 (i.e., three years).

While the track beds were deployed, monitoring occurred twice per week. Monitoring events were scheduled with regular, evenly spaced intervals between efforts with approximately three to four days between each event. Scheduling considered anticipated weather events that could have damaged track retention (e.g., rain). The track beds were set prior to the beginning of each monitoring event by removing any debris (e.g., leaves, weeds, etc.) and lightly brushing the surface of the sand with a soft-bristled broom to smooth the surface of the sand and clear any existing impressions. Each individual track path or other wildlife sign (e.g., scat, feathers, etc.) captured within the track beds was photographed with a photomacrographic scale placed adjacent to the sign during each monitoring event. Care was taken not to impact tracks before they were recorded.

Track paths and sign were identified to species level when possible or characterized according to similar group (e.g., rodent, canine, salamander, etc.). A degree of certainty ranging from 1 (uncertain) to 4 (very certain) was assigned to each track path or sign. Tracks were identified utilizing methods described in Rezendez (1999) and/or Lowery (2006). The number and direction of each path and sign was also recorded for each track bed by sketching the general location and path of each track on a bed-specific datasheet (Appendix C). In addition to recording tracks and sign within the track beds, signs of wildlife immediately adjacent to the beds was recorded. An overall picture of each track bed was taken at the beginning of each monitoring event. After each track and sign was identified and photographed, the track bed was re-set for the next monitoring event.

Following completion of the track bed survey window, data collected was analyzed for crossing rates by comparing the number of individuals identified at each crossing to the number which crossed both track beds within the survey period (i.e., between each monitoring event), therefore assumed to have successfully crossed the tunnel. An "attempt" is defined as an individual that approaches the tunnel but does not enter or successfully cross. Individuals who were seen entering and exiting the same entrance were also counted as attempts.

3.2 Camera Traps

3.2.1 Installation

Camera traps were mounted at each entrance to the tunnel in concert with the track beds. Each camera trap was installed near the top of the tunnel and angled slightly down and across the associated track bed. Cameras faced down the length of the tunnel as much as practicable so that only animals within the tunnel will be captured. Each camera trap consisted of a Reconyx HP2X Hyperfire 2 Professional Covert Infrared (IR) Camera secured in a Reconyx Hyperfire 2 Heavy Duty Security Enclosure and locked with a shackle-protected padlock. The security housing was attached to a heavy-duty swivel mount and attached via a pressure-treated lumber mounting block affixed to the tunnel wall with heavy duty construction adhesive.

Cameras were programmed to capture five mages in rapid-fire succession every time the IR sensor was triggered. Each camera was powered by lithium batteries and utilized a minimum of a 32-gigabyte (GB) SanDisk (SD) card.

3.2.2 Monitoring and Data Collection

Camera traps were deployed from March 4, 2022, to November 3, 2022. Inclement weather prevented cameras from being deployed on March 1, 2022 as originally planned.

Between March 4 and April 15 as well as June 15 to November 3, the camera traps were monitored once every two weeks. While the track beds were deployed (e.g., April 13 to June 15), camera traps were monitored concurrently with the track bed monitoring twice per week. During each monitoring event, the existing SD cards in the cameras were exchanged with an empty card. The silica desiccant packet in each camera trap was replaced (as needed) and each camera setup was inspected to ensure the camera was in good working condition. Captured images were downloaded and sorted by monitoring event, capture date, species, individual, and direction of travel.

3.3 Road Mortality Surveys

The bounds of the survey area were conspicuously flagged with fluorescent polyvinyl surveyor tape aid in locating the limits of the survey area in future survey efforts. Flagging was hung at eye level and attached to sturdy branches or trunks of woody vegetation whenever possible. Flagging was hung at the beginning of the monitoring season (i.e., March 4) and refreshed as needed throughout the survey season.

The road mortality survey was completed during each monitoring event for camera traps and track beds, documenting all wildlife sign observed within the survey corridor including not only remains, but also visual observations of live individuals, tracks, scat, feathers, nests, eggs, songs/call, or other identifiable sign. All sign was identified to species whenever possible. If sign was not able to be identified to species, it was identified by similar group (e.g., rodent, canine, etc.). Each sign was assigned a level of certainty ranging from 1 (uncertain) to 4 (very certain) and its location sketched on a datasheet. The survey was divided into four quadrants with the wildlife tunnel serving as the central axis. The west bound lane of Route 2 and median was included in the northern quadrants while the east bound lane was included in the southern quadrants.

4 RESULTS

4.1 Track Beds

In total, four unique species were identified, as shown below in Table 1. The most frequently documented species was the Virginia opossum (*Didelphus virginiana*), with a total of 27 track paths. Common snapping turtle (*Chelydra serpentina*), human (*Homo sapiens*), and racoon (*Procyon lotor*) tracks were recorded as well but at a much lower frequency than the opossum.

Both track beds were crossed with similar frequency, with the north track bed recording 14 track paths and the southern track bed recording 18 track paths. Track paths north (n=19) were slightly more common than track paths south (n=13). Although there were 32 track paths, only 13 successful crossings were recorded by two of the four observed species (i.e., Virginia opossum and raccoon). Virginia opossum successfully crossed the tunnel 12 times (6 north and 6 south) while common snapping turtle successfully crossed once heading north. Table 2 summarizes successful tunnel crossings.

Table 1. Summary of Track Bed Utilization

Taxonomic Name	Common Name	North Track Bed		South Track Bed		Total	
		N	*S*	*N*	*S*	*N*	*S*
Reptiles							
Chelydra serpentina	Common snapping turtle	1	0	1	0	2	0
Mammals							
Didelphus virginiana	Virginia opossum	6	6	9	6	15	12
Homo sapiens	Human	0	0	2	0	2	0
Procyon lotor	Raccoon	0	1	0	0	0	1
Total		**7**	**7**	**12**	**6**	**19**	**13**

4.2 Camera Traps

Table 3 summarizes the successful capture of the two camera traps. In total, 16 unique species were captured by the camera traps. The most common species captured was a member of the deer-mice genus (*Peromyscus* sp.). Song sparrow (*Melospiza melodia*), Virginia opossum, eastern cottontail (*Sylvilagus floridanus*), eastern chipmunk (*Tamias striatus*), and human, were frequently observed. American robin (*Turdus* migratorius), gray catbird (*Dumatella carolinensis*), brown rat (*Rattus norvegicus*), and raccoon were less frequently observed. Rare occurrences included common snapping turtle, painted turtle (*Chrysemys picta*), European house sparrow (*Passer domesticus*), eastern coyote (*Canis latrins*), woodchuck (*Marmota monax*), American mink (*Neovision vision*), and eastern meadow vole (*Microtus pennsylvanicus*).

No significant difference in direction of travel was observed; a similar number of species were moving north (n=12), south (n=12), or attempting to cross the tunnel (n=13). Both camera traps were crossed with similar frequency like the track beds (north: n=71, south: n=76). However, the number of attempted crossings was greater than movements north or south (n=128). Species that frequently attempted to cross the wildlife tunnel included American robin and song sparrow; most of the attempted crossings were by a member of the field-mouse family (n=45) at the southern camera trap. No significant difference in direction of travel was observed for common snapping turtle, painted turtle, raccoon, opossum, brown rat,

eastern coyote, or eastern chipmunk. Eastern cottontail traveled south (n=19) more frequently than north (n=14). Woodchuck were only observed moving north (n=4).

The two camera traps were crossed with different frequencies with the north trap recording 118 captures and the southern trap recording 156. The southern trap had 32% more captures than the northern trap. The camera traps recorded a total of 27 successful crossings (north: n=12, south: n=15) by eight different species. Eastern cottontail (n=13) and Virginia opossum (n=7) crossed most frequently. The remaining species such as the brown rat (n=1) successfully crossed infrequently. Table 2 provides a summary of successful tunnel crossings.

Table 2. Summary of Successful Tunnel Crossings

Taxonomic Name	Common Name	Track Beds		Camera Traps		Total	
		N	*S*	*N*	*S*	*N*	*S*
Reptiles							
Chelydra serpentina	Common snapping turtle	1	0	1	0	2	0
Birds							
Turdus migratorius	American robin	-	-	0	1	0	1
Mammals							
Didelphus virginiana	Virginia opossum	6	6	4	3	10	9
Marmota monax	Woodchuck	-	-	1	0	1	0
Neovision vision	American mink	-	-	0	1	0	1
Procyon lotor	Raccoon	0	0	1	1	1	1
Rattus norvegicus	Brown rat	-	-	1	0	1	0
Sylvilagus floridanus	Eastern cottontail	0	0	4	9	4	9
Total		**7**	**6**	**12**	**15**	**22**	**21**

Table 3. Summary of Camera Trap Captures

Taxonomic Name	Common Name	North Track Bed			South Track Bed			Total
		N	*S*	*A*	*N*	*S*	*A*	
Reptiles								
Chelydra serpentina	Common snapping turtle	0	0	2	0	0	0	2
Chrysemys picta	Painted turtle	0	1	0	0	0	0	1
Birds								
Passer domesticus	European house sparrow	0	0	0	0	0	1	1
Mammals								
Canis latrins	Eastern coyote	0	1	0	0	0	0	1
Didelphus virginiana	Virginia opossum	8	3	1	4	10	0	26
Homo sapiens	Human	0	0	14	2	0	7	23
Marmota	Marmota monax	3	0	0	1	0	0	4
Microtus pennsylvanicus	Eastern meadow vole	1	0	0	0	0	0	1
Neovision vision	American mink	1	1	0	0	1	1	4
Peromyscus spp.	Deer mice genus	0	0	0	17	16	45	78
Procyon lotor	Raccoon	2	1	2	1	3	0	9

Taxonomic Name	Common Name	North Track Bed			South Track Bed			Total
		N	*S*	*A*	*N*	*S*	*A*	
Rattus norvegicus	Brown rat	1	0	1	3	3	3	11
Sylvilaagus floridanus	Eastern cottontail	10	10	0	4	9	4	37
Total		**28**	**21**	**37**	**33**	**44**	**74**	**237**

4.3 Road Mortality Survey

Numerous wildlife strikes including reptiles, birds, and small mammals were observed. A total of 14 species remains were observed throughout the four quadrants. A total of 22 remains and seven other wildlife signs were observed, with the majority of both occurring in the northeast quadrant. The most common species remains encountered was a member of the deer-mice genus (*Peromyscus spp.*) (n=4), followed by members of the class Mammalia (n=3). Other species were slightly less frequent such as American bullfrog (*Rana catesbeianus*), eastern painted turtle, eastern milk snake (*Lampropeltis triangulatum*), a member of the pond turtle family (Emydidae), American robin, grey catbird, Eastern coyote, Virginia opossum, raccoon, American mink, and Eastern gray squirrel (*Sciurus carolinensis*). Most of the remains were located within the road shoulder with occasional encounters within adjacent vegetated habitats. Table 4 below summarizes the results of the road mortality surveys.

Wildlife sign was also documented during the mortality surveys. Observed sign included scat (coyote and eastern cottontail), feathers, and mammal hair. The following sections detail the results of the road mortality surveys for each quadrant.

Table 4. Summary of Road Mortality Survey

Taxonomic Name	Common Name	NE Quadrant		NW Quadrant		SE Quadrant		SW Quadrant		Total	
		Remains	*Sign*	*Remains*	*Sign*	*Remains*	*Sign*	*Remains*	*Sign*	*Remains*	*Sign*
Amphibians											
Rana catesbeianus	American bullfrog	2	-	-	-	-	-	-	-	2	0
Reptiles											
Chrysemys picta	Painted turtle	1	-	1	-	-	-	-	-	2	0
Emididae	Pond turtle family	-	-	1	-	-	-	-	-	1	0
Lampropeltis triangulum	Eastern milk snake	1	-	-	-	-	-	-	-	1	0
Birds											
Turdus migratorius	American robin	-	-	-	-	-	-	1	-	1	0
Mammals											
Canis latrins	Eastern coyote	2	1	-	-	-	-	-	-	2	1
Didelphus virginiana	Virginia opossum	1	-	-	-	-	-	-	-	1	0
Mammalia	Mammal	3	1	-	1	-	-	-	-	3	2
Neovision vision	American mink	1	-	-	-	-	-	-	-	1	0
Odocoileus virginianus	White-tailed deer	-	2	-	-	-	-	-	-	0	2
Peromyscus spp.	Deer mice genus	4	-	0	-	-	-	-	-	4	0
Procyon lotor	Raccoon	-	-	1	-	-	-	-	-	1	0
Sciurus carolinensis	Eastern gray squirrel	1	-	-	-	-	-	-	-	1	0
Sylvilaagus floridanus	Eastern cottontail	-	-	-	-	1	-	-	-	1	0
Total		**17**	**6**	**3**	**1**	**1**	**0**	**1**	**0**	**22**	**7**

4.3.1 Northeast Quadrant

The northeast quadrant contained the majority of remains (n=17) and wildlife sign (n=6). The northeast quadrant contains 79% of the total remains and wildlife sign observed in all four quadrants. The deer-mice genus followed by members of Mammalia were the species most frequently observed in this quadrant. Wildlife sign included a bird nest, turkey (Meleagris *gallopovo*) feather, coyote scat, white-tailed deer (*Odocoileus virginianus*) hair and an antler, and a mammal bone. Table 5 below summarizes the wildlife remains and sign observed within the northeast quadrant.

Table 5. Summary of Road Mortality Survey in Northwest Quadrant

Taxonomic Name	Common Name	Sign
Reptiles		
Chrysemys picta	Painted turtle	Remains
Emydidae	Pond turtle family	Remains
Lampropeltis triangulum	Eastern milk snake	Remains
Lithrobates catesbeianus	American bullfrog	Remains
Birds		
Aves	Bird	Bird nest
Meleagris gallopavo	Wild turkey	Feather
Dumatella carolinensis	Gray catbird	Remains
Mammals		
Canis latrins	Eastern coyote	Scat; remains
Didelphus virginiana	Virginia opossum	Remains
Mammalia	Mammal	Remains; bone
Neovision vision	American mink	Remains
Odocoileus virginianus	White-tailed deer	Antler; hair
Peromyscus spp.	Deermice genus	Remains
Procyon lotor	Raccoon	Remains
Sciurus carolinensis	Eastern grey squirrel	Remains

4.3.2 Northwest Quadrant

Wildlife remains and sign in the northwest quadrant was scarce. The remains of three species were observed: eastern painted turtle, a member of the pond turtle family (Emydidae), and raccoon. The only sign observed in this quadrant was a tuft of mammal fur. Table 6 summarizes the wildlife remains and sign found within the northwest quadrant.

Table 6. Summary of Road Mortality Survey in Northwest Quadrant

Taxonomic Name	Common Name	Sign
Reptiles		
Chrysemys picta	Painted turtle	Remains
Emydidae	Pond turtle family	Remains
Mammals		
Mammalia	Mammal	Fur
Procyon lotor	Raccoon	Remains

4.3.3 Southeast Quadrant

Wildlife remains and sign was scarce in the southeast quadrant. Only the remains of an eastern cottontail was observed. No other remains or wildlife sign were found during road mortality surveys. Table 7 summarizes the wildlife remains and sign found within the northwest quadrant.

Table 7. Summary of Road Mortality Survey in Southeast Quadrant

Taxonomic Name	Common Name	Sign
Mammals		
Sylvilagus floridanus	Eastern cottontail	Remains

4.3.4 Southwest Quadrant

Only the remains of an American robin was observed in the southwest quadrant. No other remains or wildlife sign were found during road mortality surveys. Table 8 summarizes the wildlife remains and sign found within the northwest quadrant.

Table 8. Summary of Road Mortality Survey in Southeast Quadrant

Taxonomic Name	Common Name	Sign
Birds		
Turdus migratorius	American Robin	Remains

5 DISCUSSION

Both the track beds and camera traps showed that a variety of wildlife are actively using the tunnel. Species that are more frequently found in developed areas and more tolerant of anthropogenic impacts (e.g., opossum, mice, eastern cottontail, raccoon, chipmunk) utilized the tunnel more frequently than other species. Sporadic usage of the tunnel by other species common in developed areas (e.g., woodchuck, grey squirrels, etc.) could be for several reasons. The open habitat (i.e., mowed grass) surrounding the north and south entrances of the tunnel provides minimal cover for animals transitioning from adjacent forested habitats to the tunnel entrances and vice versa. This lack of suitable cover may deter small mammal prey species (e.g., squirrel, woodchuck, chipmunk, etc.) from utilizing the tunnel by creating a high-risk

transition from nearby cover to an area of constriction. Prey species could instead quickly cross between adjacent forested habitats via the road to minimize this risk. In addition, the lack of directional barriers creates the same issue that the open habitat does. Without directional barriers, wildlife are given the option of quickly crossing the road rather than risk exposure in open habitat. Research has shown that the lack of suitable and sufficient cover at wildlife crossing entrances decreases its utilization by wildlife (Putnam 1997, Clevenger and Waltho 2000, U.S. Department of Transportation 2011, and Myslajek et al. 2020).

Lastly, little evidence of wildlife sign (e.g., scat, tracks, fur) outside the tunnel may be indicative that few individuals are typically within the study area. Research indicates that traffic volume and noise levels influences culvert passage by wildlife (Clevenger et al. 2001). Specifically, traffic related noise can cause species to reduce their activity near the highway or avoid the area all together. Construction of the tunnel and rail trail likely created a similar disturbance and reduced usage of adjacent habitat by wildlife.

Utilization of the tunnel by predators was minimal. Observations of eastern coyote and American mink were infrequent; raccoons utilized the tunnel the most frequently but not as much as prey species such as deer-mice and chipmunks. This was expected as predator utilization of wildlife tunnels takes an average of two to three years to begin (Bernier et al. 2017). We expect this to be the case as prey species such as eastern cottontail and mice will likely continue to utilize the tunnel and attract predators.

The utilization of track beds and camera traps to document wildlife usage of the tunnel was beneficial. Both methods provide unique benefits that work well in concert with each other. The following sections provide a brief analysis of the pros and cons of each survey system, how they worked together, the challenges encountered, and recommendations on how the monitoring study could be enhanced in the following seasons.

5.1 Track Beds

Track bed utilization did not yield the expected results. Based on the thousands of photos captured by the camera traps, we expected track bed utilization to mirror these results. Only three wildlife species (i.e., raccoon, opossum, and common snapping turtle) were captured within the track beds over the 8-week survey period. In addition to low species diversity, the number of track paths observed was also low. However, camera trap data from the eight-week period indicates more frequent usage of the tunnel than the track beds show. This is likely due to frequent inundation of the tunnel from rain events, which washed away most of the track paths along with large amounts of sand from the track beds. The bottom elevation of the tunnel caused water to frequently collect for extended periods and the steep southern approach to the tunnel increased stormwater runoff velocity which often destroyed tracks.

In addition, sand does not capture tracks as well as other natural mediums such as snow or mud. Tracks that are left often appear artificially weathered and are more susceptible to weather conditions (e.g., wind, rain, etc.), which make accurate identification challenging. Sand within the track beds also settled because of rain, vibration, and other factors. Although sand was routinely added to mitigate for the loss, extensive rain events continuously washed away any additional sand added. Additionally, tunnel flooding resulted in sand frequently becoming too dense and hardened after waters had receded to effectively capture track data.

5.2 Camera Traps

The camera traps were able to capture clear and easily identifiable photos of many species that crossed over the track beds. The traps provided confirmation of which species were utilizing the tunnel, especially

when the tracks had been compromised by weather conditions, human interference, or other factors. Additionally, the traps were often able to confirm which individuals successfully crossed the tunnel and provided ID confirmation

However, there were several challenges preventing the effective capture of wildlife traversing the tunnel. The height of the cameras was ±36- in above the track beds to allow for a greater overall view of the track beds and tunnel entrance and lead to more successful captures. However, the limited maneuverability of the security housing and mounting brackets combined with the narrow dimensions of the tunnel provided limited flexibility to adjust the camera angle and height and effectively capture wildlife movements. This created blind spots along the wall they were installed. Both these factors resulted in numerous missed captures and a lower number of successful crossings. Additionally, the limitations of IR detection (i.e., how quickly images can be stored) prevented the cameras from successfully capturing individuals traveling too fast or who were too small to trigger the sensor (e.g., rodents, etc.). On several occasions, the angle of the cameras was adjusted to attempt to capture more individuals.

5.3 Road Mortality Survey

The road mortality survey was effective at determining what species were still crossing the road despite the wildlife tunnel. Identification to the individual level is not possible without clear field marks (or other markers such as GPS collars)- wildlife struck crossing the road could have successfully crossed the tunnel but been struck on the other side of the road. These individuals could have previously successfully crossed before but chose to cross the road instead (e.g., weather conditions, predator presence, etc.) when they were struck. The results of this survey indicate that wildlife are still choosing to cross the road despite access to the wildlife tunnel. Lack of directional barriers and the open habitat surrounding both entrances could be a factor.

The walking meander surveys provided an effective method of documenting wildlife; however, the danger of the Route 2 travel lanes prevented extensive investigation of wildlife remains within the median as well as within or near the travel lanes. The majority of remains encountered were in the road shoulder in the northeast quadrant and appear to be the result of vehicular collisions. Nashoba Brook runs from the northeast quadrant to the southeast quadrant and animals were likely struck attempting to move between these habitats.

Double counting of remains and wildlife sign was prevented by consistently using the same investigators as well as sketching the approximate locations of remains and signs on datasheets.

6 SUMMARY AND RECOMMENDATIONS

Documenting wildlife usage of the tunnel utilizing a combination of track beds, camera traps, and road mortality surveys has been successful. Despite the challenges noted above, a combination of the methods above provided a more thorough collection of data than any method alone. We recommend monitoring continue utilizing all three methods. However, the following recommendations will likely improve the quality and quantity of data to ensure better success in the following monitoring seasons. These recommendations may also increase wildlife utilization of the tunnel.

Track Beds

- Modification to the tunnel design was discussed early in the 2022 monitoring season to address the flooding issues. We recommend the design be amended to prevent flooding. Flooding

prevents the effective collection of wildlife crossing data (e.g., tracks are washed away) and potential loss of assets (e.g., cameras, etc.). Track beds are not feasible if frequent and persistent flooding of the tunnel continues.

Camera Traps

- Attempts to cross the tunnel were most common; adding an additional camera trap on the outside wall of each tunnel entrance would likely provide valuable data including what species are utilizing the habitats immediately adjacent to the tunnel, what species are approaching the tunnel but not entering that are too far away for the existing cameras to capture, and what species are avoiding the tunnel completely but passing by the entrance.

Road Mortality Survey

- Coordination with MassDOT so that wildlife that is removed from the road (i.e., white-tailed deer) because it is a hazard to vehicles is still counted toward the mortality surveys.

General Recommendations

- Adding directional fencing on either side of the tunnel entrances to encourage wildlife utilization of tunnel.
- Creating cover habitat to encourage wildlife utilization of the tunnel. This could be accomplished by planting cover vegetation (e.g., native bushes) at the entrance. Additionally, habitats adjacent to the entrances could be managed to allow for a natural, soft transition from the forests to the entrances by providing enhancement plantings, tall grasses, natural succession, etc. to become established. This would encourage wildlife utilization of the tunnel instead of having to traverse the mowed grass areas.

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APPENDIX A

Monitoring Plan

LETTER OF TRANSMITTAL

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181 Ballardvale St.#202
Wilmington, MA 01887

Date:	03/13/2020	Job No. :	174
Attention:	Brian Myers		
Re:	Construction of Bruce Freeman Rail		
	Trail (BFRT) (Phase 2B)		
	Acton-Concord, MA		
	Contract # 019678		
	FAP # CMQ-003S(318)X		
Submittal No.	2		

Concord Natural Resources Commission comment (3/19/20):
Good to see that the monitoring will extend later into the season if pushed back due to the construction start date. However, it doesn't appear that the camera traps will be similarly extended beyond October 31 if delayed by the start of construction. Can this form of monitoring also be extended during the first season to capture the full 8 months? For example, if monitoring isn't able to commence until June 1, but is scheduled to being March 1, then it should be extended to January 31. That may already be the intention, but it isn't clear to me from the plan. Can you clarify?

4. For review and comment 8. Disapproved 12. Other

ITEM	COPIES	DATE	DESCRIPTION	ACTION
1	1	03/13/20	Wildlife Passage Culvert Monitoring Plan	1
			Item #755.6	

☐ APPROVED ☐ NOT APPROVED
☒ APPROVED AS NOTED ☐ REVIEW NOT REQUIRED
☐ REVISE AND RESUBMIT ☐ REJECTED

REVIEWED ONLY FOR GENERAL CONCEPT AND AGREEMENT WITH THE UNDERSTANDING THAT IT IS THE CONTRACTOR'S SUBMISSION OF HIS PROPOSED DESIGN, EQUIPMENT, AND METHODS TO CONSTRUCT THE WORK INDICATED IN THE CONTRACT DOCUMENTS. THE CONTRACTOR IS NOT RELIEVED THEREBY, OF HIS ENTIRE RESPONSIBILITY, INCLUDING BUT NOT LIMITED TO, THE ADEQUACY OF THE DESIGN AND FOR FULFILLING THE TERMS OF THE CONTRACT.

REMARKS:

3/23/20
NAME DATE
Greenman - Pedersen, Inc.

DISTRIBUTION:
Jay Patel ~ MassDOT
Mark Hayden ~ MassDOT
Delia Kaye ~ Town of Concord, MA

MIG CORPORATION

Chris Keefe, Project Manager

WILDLIFE CULVERT PASSAGE MONITORING PLAN: BRUCE FREEMAN RAIL TRAIL PHASE IIB

Prepared for

MIG Corporation, Inc.
One Acton Place; Suite 200
Acton, MA 01720

☐ APPROVED ☐ NOT APPROVED
☒ APPROVED AS NOTED ☐ REVIEW NOT REQUIRED
☐ REVISE AND RESUBMIT ☐ REJECTED

REVIEWED ONLY FOR GENERAL CONCEPT AND AGREEMENT WITH THE UNDERSTANDING THAT IT IS THE CONTRACTOR'S SUBMISSION OF HIS PROPOSED DESIGN, EQUIPMENT, AND METHODS TO CONSTRUCT THE WORK INDICATED IN THE CONTRACT DOCUMENTS. THE CONTRACTOR IS NOT RELIEVED THEREBY, OF HIS ENTIRE RESPONSIBILITY, INCLUDING BUT NOT LIMITED TO, THE ADEQUACY OF THE DESIGN AND FOR FULFILLING THE TERMS OF THE CONTRACT.

3/23/20
DATE

Greenman - Pedersen, Inc.
NAME

Prepared by

P. Chase Bernier, CWB, PWS

SWCA Environmental Consultants
1900 West Park Drive, Suite 280
Westborough, MA 01581
(508) 232-6668
www.swca.com

SWCA Project No. 59524.00

March 2020

Concord Natural Resources Commission comment (3/19/20):
Good to see that the monitoring will extend later into the season if pushed back due to the construction start date. However, it doesn't appear that the camera traps will be similarly extended beyond October 31 if delayed by the start of construction. Can this form of monitoring also be extended during the first season to capture the full 8 months? For example, if monitoring isn't able to commence until June 1, but is scheduled to being March 1, then it should be extended to January 31. That may already be the intention, but it isn't clear to me from the plan. Can you clarify?

Wildlife Culvert Passage Monitoring Plan: Bruce Freeman Rail Trail Phase 2B

MARCH 2020

PREPARED FOR

MIG Corporation, Inc.

PREPARED BY

SWCA Environmental Consultants

CONTENTS

Appendices

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INTRODUCTION

As part of the Bruce Freeman Rail Trail Phase IIB Project (Project), the Massachusetts Department of Transportation (MassDOT) has proposed a wildlife tunnel crossing where the Rail Trail crosses State Route 2 in the Town of Concord, MA (Site) (see Study Area, below). The tunnel will consist of a precast concrete box culvert ±7-ft wide by ±5-ft tall with ±1-ft of native substrate placed on the bottom of the culvert.

The Project has received an Order of Conditions (OOC) from the Concord Conservation Commission (Commission) for impacts to resource areas regulated under the Massachusetts Wetlands Protection Act (M.G.L. c. 131 § 40) (WPA) and its implementing regulations (310 CMR 10.00 *et seq.*) as well as the Town of Concord Wetlands Protection Bylaw (Art. 43 of 2009 Town Meeting, as amended) (Bylaw) and its implementing regulations (Art. 59 of 2010 Town Meeting). Special Condition 23 of the OOC states:

> *"The Applicant shall submit a Wildlife Culvert Passage Monitoring Plan prior to construction for review and approval by the Natural Resources Director at least 60 days prior to construction. The Monitoring Plan shall include provisions for a baseline survey to be conducted, and post-construction monitoring to be conducted for three years using a combination of two cameras (one at each end of the culvert) and track beds. Roadkill surveys shall also be included in the Monitoring Plan."*

Additionally, MassDOT's Special Provision Item 755.6 of the Project's Contract Documents and Special Provisions package states:

> *"...A wildlife biologist shall be responsible for implementation and/or overseeing the activities...The wildlife biologist shall be a Certified Ecologist or* [Certified] *Wildlife Biologist with a minimum of five years of experience working with wildlife. Any personnel conducting field research other than the designated biologist shall receive training directly from the wildlife biologist and demonstrate the knowledge, skills, and abilities necessary to perform the procedures and collect data accurately. The contractor shall submit the wildlife biologist's qualifications for review by the MassDOT landscape section and the Commission..."*

Construction is expected to begin approximately mid-May 2020. The following sections detail the study area, monitoring methods, and reporting of the wildlife tunnel including a pre-construction baseline survey and post-construction monitoring of wildlife utilization of the tunnel. As detailed below, post-construction monitoring will include the use of track beds, camera traps, and road mortality surveys. Mr P. Chase Bernier, CWB, PWS will oversee and direct all efforts related to the wildlife tunnel baseline survey and post-construction monitoring. Mr. Bernier is a Certified Wildlife Biologist (CWB) and Professional Wetland Scientist (PWS) with SWCA Environmental Consultants (SWCA) with over 14 years of experience conducting habitat evaluations, rare species surveys, biodiversity assessments, and wildlife investigations. Additionally, he was responsible for all aspects of the efforts to monitor the Crosby's Corner wildlife tunnel, also along Route 2 in Concord, MA, for the first four years of monitoring of that wildlife crossing. A copy of Mr. Bernier's resume is provided as Appendix A for reference.

STUDY AREA

The wildlife tunnel crossing is located ±800-lf east of the Massachusetts State Police Mounted Unit (located at 50 Wetherbee St, Acton, MA) and ±240-lf west of Nashoba Brook where Route 2 crosses the

Bruce Freeman Rail Trial (located at approximately 42.469240, -71.407439). The study area includes the area within the wildlife tunnel (once constructed) as well as an area ±25-lf perpendicular from the edge of pavement and extends ±500-lf in each direction (i.e., east and west) on both the north and south sides of Route 2 for a total of ±1,000-lf on each side of the tunnel. The study area also includes a similarly situated area ±1,000-lf within the east and west travel lanes of Route and the median.

METHODS

The following sections detail the methods for the pre-construction baseline survey as well as the methods for installation, monitoring, and data collection for the post-construction monitoring including the track beds, camera traps, and road mortality survey.

Basline Survey

In-field Surveys

The baseline survey is intended to document existing habitat conditions and wildlife utilization of the survey area in proximity to the proposed wildlife tunnel prior to construction. As part of the baseline survey, all observed wildlife sign will be documented including live visual observations, tracks, scat, nests, eggs, feathers, remains, songs/calls, or other identifiable sign. Sign will be identified to species whenever possible. If sign is not able to be positively identified to species, it will be identified to the nearest phylogenetic group (e.g., genus, family, etc.) When recorded, each sign will also be assigned a level of certainty regarding positive identification ranging from 1 (uncertain) to 4 (very certain). Additionally, the location within the study area where each sign is observed will be recorded. In addition to recording wildlife sign within the study area, the baseline survey will also document existing habitat conditions including vegetative species diversity, strata, class structure, cover types, invasive species, and important wildlife habitat features and functions (e.g., food, shelter, breeding areas, etc.)

The baseline survey will commence as soon as the baseline survey protocols have been approved by MassDOT and the Concord Natural Resources Director (Director) and will continue until temporary barrier installation for the traffic crossovers have been constructed (anticipated mid-May 2020). Site visits are anticipated to occur approximately once every two weeks dependent on weather and construction schedule with at least four site visits occurring.

Post-Construction Monitoring

Following approval of the Wildlife Culvert Passage Monitoring Plan and subsequent construction of the proposed wildlife crossing, post-construction monitoring of the wildlife tunnel will commence. On the first visit, the two track beds and camera traps will be installed as described below. Additionally, the bounds of the road morality survey will be demarcated.

Track Beds

INSTALLATION

Two track beds will be installed at the wildlife tunnel, one at each end of the tunnel entrances (i.e., the north and south entrances). Each track bed will be constructed from pressure-treated 2x4 lumber and assembled with weather resistant galvanized 90-degree angle brackets and deck screws. The track beds will span the ±7-ft width of the tunnel entrance and will extend inward from the entrance ±6-ft. Each bed

will be set flush with the existing grade within the tunnel with the end of the track bed being flush with the entrance to the tunnel. The beds will be filled with ±3-in of very fine sand such that the top of the sand is within ±0.5-in from the top of the track bed frame. After the sand has been evenly spread, a soft-bristled broom will be used to smooth the surface of the sand (i.e., "set" the track beds), being careful not to accidentally transfer soil or other debris into the sand bed or otherwise disturb or leave stray imprints on the prepared sand.

MONITORING AND DATA COLLECTION

Monitoring of the track beds will occur for approximately eight weeks between April 15 and June 15 beginning in 2020 and continue to 2022 (i.e., three years). However, given the anticipated construction schedule in 2020, it may be necessary to shift the beginning of the 2020 monitoring period later into the season until construction has been completed before initiating track bed monitoring. Should the construction schedule necessitate a delay in deployment of the track beds, monitoring will commence as soon as practicable following the completion of construction and will continue for a period of eight weeks. The regular proposed schedule (i.e., April 15 – June 15) will resume in subsequent years following construction.

Monitoring and required maintenance of the track beds will consider the variability in wildlife movements and the efficiency of monitoring efforts. If significant trends in wildlife migrations are noted, the track bed monitoring schedule may be adjusted to capture those trends. However, any proposed changes in monitoring schedule will first be proposed to and approved by MassDOT and the Director prior to implementation.

While the track beds are deployed, monitoring will occur twice per week. Monitoring events will attempt to be scheduled with regular, evenly spaced intervals between efforts with approximately three to four days between each event. Scheduling will also consider anticipated weather events that may damage track retention (e.g., rain). The track beds will be set prior to the beginning of each monitoring event by removing any debris (e.g., leaves, weeds, etc.) and lightly brushing the surface of the sand with a soft-bristled broom to smooth the surface of the sand and clear any existing impressions. Each individual track path or other wildlife sign (e.g., scat, feathers, etc.) captured within the track beds will be photographed with a photomacrographic scale placed adjacent to the sign during each monitoring event. Care will be taken not to impact tracks before they are recorded.

Track paths and sign will be identified to species level when possible or characterized according to similar group (e.g., rodent, canine, salamander, etc.). A degree of certainty ranging from 1 (uncertain) to 4 (very certain) will be assigned to each track path or sign. Tracks will be identified utilizing methods described in Rezendez (1999) and/or Lowery (2006). The number and direction of each path and sign will also be recorded for each track bed by sketching the general location and path of each track on a bed-specific datasheet (Appendix B). In addition to recording tracks and sign within the track beds, signs of wildlife immediately adjacent to the beds will also be recorded. An overall picture of each track bed will also be taken at the beginning of each monitoring event. After each track and sign has been identified and photographed, the track bed will be re-set for the next monitoring event.

Camera Traps

INSTALLATION

Camera traps will be mounted at each entrance to the tunnel in concert with the track beds. Each camera trap will be installed near the top of the tunnel and angled slightly down and across the associated track bed. Cameras will face down the length of the tunnel as much as practicable so that only animals within

the tunnel will be captured. Each camera trap will consist of a Reconyx HP2X Hyperfire 2 Professional Covert Infrared (IR) Camera secured in a Reconyx Hyperfire 2 Heavy Duty Security Enclosure and locked with a shackle-protected padlock. The security housing will be attached to a heavy-duty swivel mount and attached via a pressure-treated lumber mounting block affixed to the tunnel wall with heavy duty construction adhesive.

Cameras will be programmed to capture multiple images in rapid-fire succession every time the sensor is triggered. Each camera will be powered by lithium batteries and will utilize a minimum of a 32-gigabyte (GB) SanDisk (SD) card. Additionally, silica packets will also be placed inside each camera box to reduce the potential of moisture damage.

Monitoring and Data Collection

Camera traps will be deployed from March 1 to October 31 each year for a period of three years (i.e., 2020 – 2022). Similar to the track bed deployment, dependent on the construction schedule, deployment of the camera traps may need to be delayed until construction of the wildlife tunnel has been completed. However, once the tunnel has been completed, the camera traps will be deployed and will remain active until October 31, 2020. In subsequent years, the normal monitoring schedule will resume.

Between March 1 and April 15 as well as June 15 to October 31, the camera traps will be monitored once every two weeks. While the track beds are deployed (e.g., April 15 to June 15), camera traps will be monitored concurrently with the track bed monitoring. During each monitoring event, the existing SD cards in the cameras will be exchanged with an empty card. The silica desiccant packet in each camera trap will also be replaced (as needed) and each camera setup will be inspected to ensure the camera is in good working condition. Captured images will be downloaded and sorted by monitoring event, capture date, species, individual, and direction of travel.

ROAD MORTALITY SURVEYS

The road mortality survey will include an area on each side of the tunnel extending ±25-lf perpendicular to the edge of pavement and spanning ±500-lf in each direction for a total of ±1,000-lf on each end of the tunnel as well as the median. The bounds of the survey area will be conspicuously flagged with fluorescent polyvinyl surveyor tape with the words "SURVEY BOUNDARY" written on it to aid in locating the limits of the survey area in future survey efforts. Flagging will be hung ±25-lf to ±50-lf, depending on visibility, at eye level and attached to sturdy branches or trunks of woody vegetation whenever possible. Flagging will be refreshed at the beginning of each monitoring season (i.e., March 1) and as needed throughout the survey season.

The road mortality survey will be completed during each monitoring event for camera traps and track beds, documenting all wildlife sign observed within the survey corridor including not only remains, but also visual observations of live individuals, tracks, scat, feathers, nests, eggs, songs/call, or other identifiable sign. All sign will be identified to species whenever possible. If sign is not able to be identified to species, it will be identified by similar group (e.g., rodent, canine, etc.) Each sign will be assigned a level of certainty ranging from 1 (uncertain) to 4 (very certain) and its location sketched on a datasheet (Appendix C). The survey will be divided into four quadrants with the wildlife tunnel serving as the central axis. The west bound lane of Route 2 and median will be included in the northern quadrants while the east bound lane will be included in the southern quadrants.

REPORTING

Baseline Survey Summary Report

Following the completion of the baseline survey, the results of the field efforts will be provided in a report submitted to MassDOT and the Director. The report will summarize all the species observed including details regarding how the species were identified, location sign was observed, habitat composition, important wildlife habitat features and functions, site photos, and appropriate mapping. The report will be submitted no later than 30 days following the completion of the baseline survey.

Annual Monitoring Report

Following the completion of each monitoring year, a year-end report will be prepared that summarizes the results of the year's monitoring efforts. The report will detail the data collected and provide recommendations for the upcoming monitoring season. The report will include a discussion of the study area including a description of the tunnel and the adjacent habitats, how those habitats have changed, and how they may affect wildlife population trends, utilization of the tunnel, or other related trends and information. The report will also include a detailed description on the methods used for installation and monitoring of the track beds, camera traps, and road mortality survey.

The report will include a discussion of the results of the track beds, camera traps and road mortality. That discussion will include a summary of the number of individuals and species that were observed, prevalence of species, and direction of travel. The report will also discuss successful crossings, crossing rates, diversity of species, frequency, and other pertinent information. Successful crossing rates will be calculated for each species following the methods described by Rogers *et al.* (2009). In addition, the report will detail the results of the road mortality survey including the prevalence and diversity of species observed and location by quadrant and type of signs recorded. Results of the road mortality survey will be divided into remains and other sign. The report will also include data presented with both tabular and graphic summary statistics and will depict and describe any trends observed.

The discussion section will include a summary of the efficacy of the monitoring methods and the ability of the tunnel to successfully pass wildlife. Additionally, it will include a discussion of any recommendations for improvements to the post-construction monitoring including modifications to the study area or methods, enhancements to improve wildlife utilization of the tunnel, or any corrective actions to repair/maintain the track beds and/or camera traps.

Lastly, the report will include representative photos from the monitoring events including photos of the study area, track bed/camera trap set-ups, tracks, camera captures, wildlife sign, and other representative photographs. Additionally, the report will include the completed track bed and road mortality data sheets as appendices. The report will be submitted to MassDOT and the Director no later than December 31 each monitoring year.

REFERENCES CITED/LITERATURE CITED

Lowery, J. C. 2006. The Tracker's Field Guide: A comprehensive handbook for animal tracking in the United States. Morris Book Publishing, LLC.

Rezendez. P. 1999. Tracking and the Art of Seeing: How to read animal tracks and sign. Second edition. New York: HarperCollins Publishers, Inc.

Rogers, L., D. Stinson, K. Holden, D. Kay, D. Kaye, R. McAdow, B. Metcalfe, B. Windmiller, and N. Charney. 2009. Wildlife Tunnels Under a Busy, Suburban Boston Roadway. Wildlife Passages Task Force, Division of Natural Resources, Concord, MA and University of Massachusetts, Amherst, MA.

APPENDIX A

P. Chase Bernier, CWB, PWS Resume

CHASE BERNIER, CWB, PWS, NATURAL RESOURCES PROJECT MANAGER

Mr. P. Chase Bernier is a Natural Resources Project Manager with SWCA based out of their Boston, MA office. He holds degrees in Fisheries and Wildlife Technologies and Wildlife Management and is a Certified Wildlife Biologist and Professional Wetland Scientist. Chase has over 14 years of consulting experience and has worked on projects throughout the United States and abroad including projects in Central and South America and New Zealand. His work has focused on natural resource studies, impact assessments, environmental permitting, biodiversity assessment, natural resource conservation, wildlife management, wetland science, restoration ecology, rare species, and stakeholder engagement.

TRAINING

OMP Turtle Training, NHESP

Technical Service Provider, NRCS

MEMBERSHIPS

Member, Association of Massachusetts Wetland Scientists; 2016

Member, Society for Ecological Restoration; 2019

Member, Massachusetts Association of Conservation Commissions; 2016

Member, Society of Wetland Scientists; 2010

Board Member, The Wildlife Society; 2002

Restoration ecology

Rare species

Stakeholder engagement

EDUCATION

B.T., Wildlife Management; State University of New York at Cobleskill

A.A.S., Fisheries and Wildlife Technologies; State University of New York at Cobleskill

REGISTRATIONS / CERTIFICATIONS

10-hr Construction Safety; 2016

Certified Wildlife Biologist; The Wildlife Society; 2014

40-hr HAZWOPER; 2009

8-hr HAZWOPER Refresher; 2019

Professional Wetland Scientist No. 3110; Society of Wetland Scientists; 2019

Technical Service Provider, NRCS

SELECTED PROJECT EXPERIENCE (* denotes project experience prior to SWCA)

***Route 2 Crosby's Corner Safety Improvement Project; Lincoln and Concord, Massachusetts.** *Role: Senior Ecological Scientist. Five-year monitoring plan documenting wildlife usage of a constructed wildlife underpass tunnel across a heavily-travelled highway. The study utilized track beds, camera traps, road mortality surveys, and snow tracking to determine the diversity of wildlife using the tunnel and the frequency of usage. He directed all aspects of this project including study design, installation of track beds and camera traps, monitoring, data analyzation, and reporting. Monitoring began in late spring and continued through the end of fall. An annual report was developed which analyzed the diversity of species utilizing the tunnel as well as the efficacy of the tunnel to successfully pass wildlife and recommendations to improve data collection and wildlife utilization of the tunnel. The results of this project of yielded Mr. Bernier numerous publications and presentations at state, regional, national, and international conferences.*

***Rannapo Road Re-alignment; Sheffield, Massachusetts.** *Role: Senior Ecological Scientist. Habitat assessment for the potential presence of wood turtles (Glyptemys insculpta)* and ostrich fern borer moth (*Papaipema* sp. 2 *near pterisii*) along a section of Rannapo Road in support of a proposed road realignment. Mr. Bernier successfully identified several turtle dens and excluded the presence of fern borer moth due to lack of suitable habitat. In response, Mr. Bernier implemented several project amendments that would prevent adverse impacts to turtles including the use of exclusion methods during construction and restoring adjacent habitats to prevent further degradation of slopes adjacent to suitable habitat and enhancing suitable upland habitat.

***County Road Bridge and Culvert Replacement; Sheffield, Massachusetts.** *Role: Senior Ecological Scientist. Phase 1 habitat assessment for the potential presence of bog turtles (Glyptemys muhlenbergii) as well as an assessment of existing coldwater fisheries in support of a proposed bridge and culvert replacement in Sheffield, MA as part of a Section 7 Endangered Species Act (ESA) consultation. Mr. Bernier successfully identified two areas of suitable emergent wetland habitat for bog turtles in addition to multiple migration corridors within and in proximity to the project. Mr. Bernier was also able to identify multiple existing coldwater fisheries that could potentially be*

impacted by the project. Through careful review, adverse impacts to these sensitive ecological receptors were avoided via changes in proposed road crossing design.

***Lawrence Street Improvements and South Bank Restoration; Norfolk, Massachusetts.** *Role: Senior Ecological Scientist / Project Manager. Detailed wildlife habitat evaluation (WHE) of a proposed roadway improvement project that exceeded the impact threshold for Inland Bank and impacted Bordering Vegetated Wetland (BVW) and Land Under Water (LUW). As part of the site investigation, important wildlife habitat features including overhanging branches, snags, large woody debris, rock crevices, dense herbaceous vegetation, and others were identified. Limited space and mitigation options resulted in the need for creative solutions. Through working with the Town and an adjacent landowner, an area was identified adjacent to the proposed impact that would benefit from enhancement plantings to replace lost habitat functions. As a result, a finding of no adverse effect was determined for the project by the Conservation Commission and upheld by the Massachusetts Department of Environmental Protection (DEP) through the issuance of a Superseding Order of Conditions (SOC). Mr. Bernier also designed, permitted, and directed the restoration of ±400-lf of Inland Bank and riparian habitat as part of the Project. Restoration included the use of bio-logs and natural fiber erosion control blankets, planting native shrubs and seeding native vegetation with high wildlife habitat value, and rigorous monitoring plan.*

***Cape Cod Water Resources Restoration Project; Barnstable County, Massachusetts.** *Role: Wildlife Biologist. Supported the National Environmental Policy Act (NEPA) compliance effort for a $30 million project initiated by Natural Resources Conservation Service-Massachusetts and numerous project partners throughout Cape Cod. The project involved over 75 projects which were broken down by restoration type, including salt marsh, shellfish habitat, and fish passage. Mr. Bernier was also responsible for the completion of an Environmental Assessment (EA) under NEPA for the rehabilitation of Santuit Pond Dam, a project add-on, which included the rehabilitation of a pre-20th century dam, construction of a new fish ladder, compensatory wetland mitigation of impacted bogs, and a wetland habitat assessment and functional evaluation. Additionally, Mr. Bernier designed and completed an in-field chance encounter survey and suitable breeding habitat survey for the state-protected eastern box turtle (Terrapene carolina).*

***Town of Belchertown Peer-Review; Belchertown, Massachusetts.** *Role: Project Manager and Senior Ecological Scientist. Third-party peer-review of a proposed 7.9 MW solar development that would impact over 48-ac of wildlife habitat including regulated resource areas. As part of the review, Mr. Bernier completed a site investigation which evaluated potential impacts to wildlife from the proposed development including impacts to large mammals, bats, herpetofauna, and wildlife migration. Through project review, the proposed development was amended to protect and mitigate important wildlife habitat features and functions resulting in no significant adverse effect.*

***Nexamp Solar Photovoltaic Facility, Hubbardston, MA.** *Role:* Wildlife Biologist. Survey for wood turtles (*Glyptemys insculpta*) and other turtles along an area of exclusion fence separating natural habitats from an area of habitat restoration. Surveys included traversing the area adjacent to the exclusion fencing as well as throughout the restoration work area to locate any turtles and safely relocate them outside of the potential impact area. Mr. Bernier also oversaw construction efforts to remove deposited fill material from within the wetland and the subsequent seeding and mulching of the disturbed areas. Additionally, Mr. Bernier was responsible for working with the Town Conservation Commission and the U.S. Army of Corps Engineers (USACE) to ensure thesSite was in compliance with applicable local, state, and federal regulations.

***Line 393 Electric Transmission Improvements, Berkshire County, MA.** *Role:* Senior Ecological Scientist / Task Manager. Rare species surveys along a ±21-mi section of electric transmission utility right-of-way (ROW) in support of necessary line upgrades. The survey extended from the Town of Hancock along the New York state border to the eastern limits of the Town of Windsor. As part of that survey, Mr. Bernier independently identified a previously undocumented population of wood turtles (*Glyptemys insculpta*) in the Town of Lanesborough. Mr. Bernier documented two adult wood turtles on different dates in the same active season in different locations of a large wetland complex associated with a coldwater stream. The observations were submitted to the Natural History and Endangered Species Program (NHESP) via their Vernal Pool and Rare Species (VPRS) online reporting system. NHESP accepted both observations and confirmed that this was a previously undocumented population.

***Westfield Reliability Project, Berkshire County, MA.** *Role:* Senior Ecological Scientist. Rare species habitat survey and Turtle Protection Plan (TPP) in support of an electric utility transmission upgrade project serving Pittsfield, Greenfield, and surrounding communities. Mr. Bernier evaluated the project area for the potential to support wood turtle (*Glyptemys insculpta*) including documenting

habitat communities, slopes, solar exposure, soils, forage, and overwintering areas. He also supported the development of a TPP to mitigate potential project impacts on wood turtle populations within the project ROW.

***SuAsCo Supplemental Watershed Plans, Worcester and Middlesex Counties, MA.** *Role:* Wildlife Biologist. Development of six Environmental Assessments (EAs) under the National Environmental Policy Act (NEPA) in support of six individual Supplemental Watershed Plans for floodwater retarding dams. Mr. Bernier completed environmental impact analyses, economic and cost-benefit analyses, environmental consequences, partner coordination, and public comment outreach. All six dams contained sensitive ecological habitats ranging from mature upland forests to wetlands. Two of the six dams contained documented habitat for state-listed rare species. Therefore, Mr. Bernier designed and directed a visual and auditory survey for the presence of grasshopper sparrow (*Ammodramus savannarum*) as well as a chance encounter survey for wood turtle (*Glyptemys insculpta*) in addition to suitable breeding habitat surveys for both species.

***Line 3419 Electric Transmission Improvements, Hampden County, MA.** *Role:* Senior Ecological Scientist / Task Manager. Rare species survey and Detailed Wildlife Habitat Evaluation (WHE) for a ±12-mi electrical transmission utility right-of-way (ROW) in support of proposed upgrades and improvements. The survey extended from the Town of Ludlow to the southern limits of the Town of Wilbraham. Mr. Bernier was responsible for completing habitat evaluations and surveys for numerous listed rare species including blue-spotted salamander (*Ambystoma laterale*), eastern spadefoot toad (*Scaphiopus holbrookii*), worm snake (*Carphophis amoenus amoenus*), eastern box turtle (*Terrapene carolina carolina*), and wood turtle (*Glyptemys insculpta*).

***Lines 315/303/327/3520 Electric Transmission Improvements, Norfolk & Bristol Counties, MA.** *Role:* Senior Ecological Scientist. Conservation and Management Permit (CMP) for a proposed ±68-mi electric utility transmission right-of-way (ROW) extending from Medway to Somerset in support of proposed line upgrades and improvements. The project proposed impact to ±6-ac of rare species habitat including habitat for intricate fairy shrimp (*Eubranchipus intricatus*), blue-spotted salamander (*Ambystoma laterale*), marbled salamander (*Ambystoma opacum*), eastern box turtle (*Terrapene carolina carolina*), Blanding's turtle (*Emys blandingii*), and others. Through consultation with the Natural Heritage and Endangered Species Program (NHESP), the Project was found to likely impact habitat for marbled salamander. Mr. Bernier provided oversight for the development of a CMP for impacts to marbled salamander including technical review and quality assurance/quality control which included a combination of mitigative strategies including implementing best management strategies (BMPs), habitat preservation, and other methods.

***Cromwell Landing, Cromwell, CT.** *Role:* Senior Ecological Scientist / Task Manager. Rare species survey in support of a proposed public park. Mr. Bernier developed, directed, and implemented a rare species survey for midland clubtail (*Gomphorus fraternal*), riverine clubtail (*Stylurus amnicola*), and northern leopard frog (*Lithobates pipiens*). Surveys for dragonflies consisted of meander surveys throughout the project area wherein Odonate species were observed via binoculars, sweep nets, and exuviae identification. Concurrent to dragonfly surveys, meander surveys for northern leopard frog were also conducted. Mr. Bernier also investigated and characterized on-site habitat communities, degradation and fragmentation, and other pertinent information that may have affected species' utilization of on-site habitats.

***Connecticut Transmission Right-of-Way Reliability Program, Tolland & Hartford Counties, CT.** *Role:* Senior Ecological Scientist. Rare species survey for a ±25-mi section of electric utility transmission right-of-way (ROW). Mr. Bernier completed habitat and potential presence surveys for several listed rare species including yellow-horned beaded lacewing (*Lomamyia flavicornis*), midland clubtail (*Gomphorus fraternus*), cobra clubtail (*Gomphus vastus*), spotted turtle (*Clemmys guttata*), and eastern box turtle (*Terrapene carolina carolina*). As part of in-field investigations Mr. Bernier identified numerous eastern box turtles and a spotted turtle in addition to recording a previously unrecorded observation of a riverine clubtail (*Stylurus amnicola*). Survey reports for purse web spider and yellow-horned beaded lacewing were completed and included project-specific mitigation measures to protect these species and enhance existing habitat. Mr. Bernier also directed and lead efforts to identify regulated resource areas and oversaw construction.

***Overton Subdivision, Tuxedo Park, NY.** *Role:* Wildlife Biologist. Telemetry study and habitat evaluation of timber rattlesnake (*Crotalis horridus*) which included the utilization of dermal patch and surgical implant telemetry transmitters. The study sought to determine dispersal and migration patterns as well as onsite habitat utilization of a known offsite den population. Mr. Bernier also completed a supplemental tree survey of all trees greater than 5-in diameter at breast height (dbh) as well as an ecological assessment report documenting the biodiversity and ecological resources of the site and was responsible for the completion of the aquatic resources permits.

***Moehau Environmental Group, Coromandel Peninsula, New Zealand.** *Role:* Wildlife Biologist. Implementing in-field efforts to support the study of population dynamics and trends monitoring for North Island brown kiwi (*Apteryx mantelli*). Monitoring included radio-tracking

individual birds and locating them in their burrows with the assistance of a specially-trained tracking canine. Birds were weighed, measured, sexed, and inspected for general health. Burrows were inspected for the presence of eggs or accompanying birds.

***Rimutaka Forest, Wellington, New Zealand.** *Role:* Wildlife Biologist. Point-count surveys for endemic New Zealand songbirds including fantails (*Rhipodura fulginosa*), silvereyes (*Zosterops lateralis*), and bellbirds (*Anthornis melanura*) to collect data regarding breeding bird population trends. Visual and auditory recognition was utilized to identify individuals along transects. Vegetation and habitat communities were also recorded at each survey location.

***New Zealand Fur Seal Population and Behavioral Surveys, North Island South Coast, New Zealand.** *Role:* Wildlife Biologist. Implementation of population and behavior surveys of New Zealand fur seals (*Arctocephalus forsteri*) along four areas of coastline on the southern portion of the North Island of New Zealand. Population monitoring involved traversing the seal colony and documenting species, sex, and age of each individual. Additionally, at periodic points throughout the colony, individuals were selected to test their behavior responses to human approach distances. As part of this effort, Mr. Bernier was responsible for training volunteers, directing survey group efforts, and conducting data quality management.

PRESENTATIONS AND PUBLICATIONS

Bernier, C. 2019. Reducing Wildlife Mortality on Roadways: A Case Study of a Wildlife Underpass on Massachusetts Route 2. New England Chapter of The Wildlife Society Annual Spring Workshop. Guilford, VT.

Bernier, P.C., J. Magoon, and J. Holden. 2019. Wildlife Habitat Assessments: How Commissions can Evaluate and Mitigate Potential Impacts to Wildlife. Massachusetts Association of Conservation Commissions Annual Environmental Conference 2019. Worcester, MA.

Bernier, P.C. and J. Kenny. 2018. "Reducing Vehicular and Wildlife Conflicts: A Case Study of an Urban Wildlife Tunnel in Concord, Massachusetts." Northeast Transportation and Wildlife Conference. Amherst, MA.

Bernier, P.C, W. Daniels, and B. Tillotson. 2018. Wildlife Habitat Assessments: How Commission Can Evaluate Potential Impacts to Wildlife (Inland). Massachusetts Association of Conservation Commissions Annual Environmental Conference. Worcester, MA.

Dexter, T. and C. Bernier. 2017. BMPs for Reducing Wildlife-Vehicle Collisions. Massachusetts Department of Transportation Innovation and Technology Transfer Exchange. Worcester, MA.

Bernier, P.C. and T. Martin. 2017. Wildlife Habitat Assessments: How Commissions Can Evaluate Potential Impacts to Wildlife. Massachusetts Association of Conservation Commissions Annual Environmental Conference 2017. Worcester, MA.

Dexter, T. and P.C. Bernier. 2017. Maintaining Habitat Connectivity & Linking Landscapes. - A Case Study Association of Massachusetts Wetland Scientists Annual Meeting. Boxborough, MA.

Bernier, P.C., J. Magoon, and J.B. Holden. 2018. "Best Management Practices to Protect Wildlife Populations and Improve Habitat within Active and Regularly Maintained Rights-of-Way." Environmental Concerns in Rights-of-Way Management 12th International Symposium. Denver, CO.

Bernier, P.C., J. Kenny, and T. Dexter. 2018. "Population Trends for an Urban Wildlife Tunnel in Concord, MA." Transportation Research Board Committee ADC30. August 2018.

Bernier, P.C., A. Echandi, and J. Kenny. 2017. Wildlife Usage of a Constructed Wildlife Underpass. Transportation Research Board 96th Annual Meeting. Washington, D.C.

APPENDIX B

Sample Track Bed Data Sheet

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

Observer(s):			Date:	
Track Bed:	N	S	Time:	

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Track bed Sketch:

Comments:

APPENDIX C

Sample Road Mortality Data Sheets

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):		Date:		Time:		Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:

Sketch:

APPENDIX B

Figures

ACTON AND CONCORD, MA BRUCE FREEMAN RAIL TRAIL PHASE 2B

Figure 1.
Site Location USGS Topographic Map

SWCA ENVIRONMENTAL CONSULTANTS

Project Location

Middlesex County, MA
USGS 7.5' Quadrangle:
Maynard, MA, 42071-D4

NAD 1983 UTM Zone 19N
71.4074°W 42.4692°N

Base Map: ESRI ArcGIS Online, accessed December 2022

Updated: 12/12/2022
Project No. 59524
File: 01_ProjLoc

N

1:24,000

0 1,000 2,000 Feet

0 250 500 Meters

ACTON AND CONCORD, MA BRUCE FREEMAN RAIL TRAIL PHASE 2B

Figure 2.
Aerial Map

Road
Wildlife Tunnel Entrance
Road Mortality Survey Area
Municipal Boundary

Middlesex County, MA
USGS 7.5' Quadrangle:
Maynard, MA, 42071-D4

NAD 1983 UTM Zone 19N
71.4073°W 42.4692°N

Base Map: ESRI ArcGIS Online, accessed December 2022

Updated: 12/12/2022
Project No. 59524
File: 02_AerialWildTunnel

N

1:2,500

0 100 200 Feet
0 25 50 Meters

SWCA®
ENVIRONMENTAL CONSULTANTS

APPENDIX C

Data Sheets

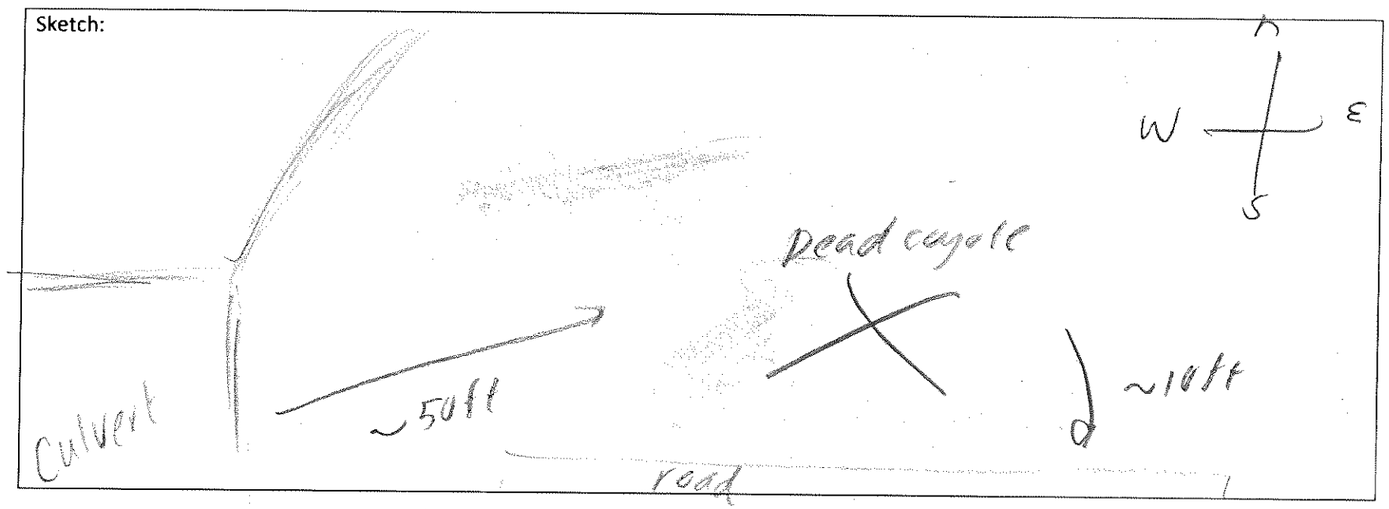
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Date:	Time:	Section:
Ashley Bernard	3/29/22	3:39 PM	(NE) NW SE SW

Species:	Location:	Description:	Photo No.:	Certainty:
Eastern coyote	East of tunnel ~ 50 ft; side of road	Dead coyote; still mostly intact + barely any decomposition so most likely hit recently		100% 4

Sketch:



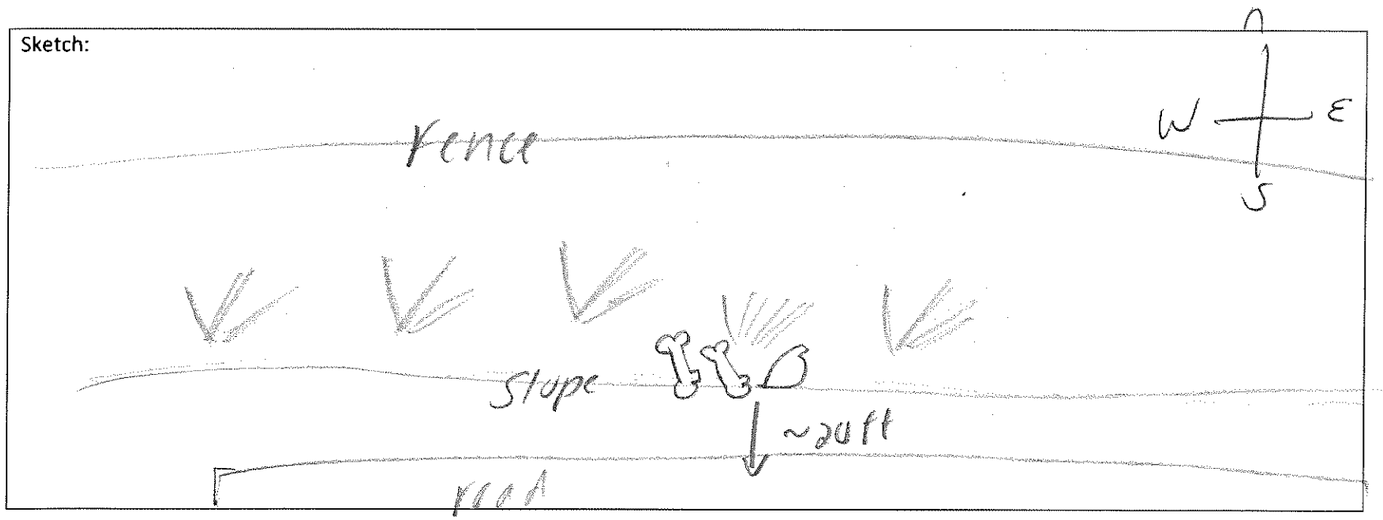
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	3/29/22	Time:	3:50PM	Section:	NE	(NW)	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
White-tailed deer	side of road ~ 20 ft away near state police fence	old bones		~~1~~ 3

Sketch:



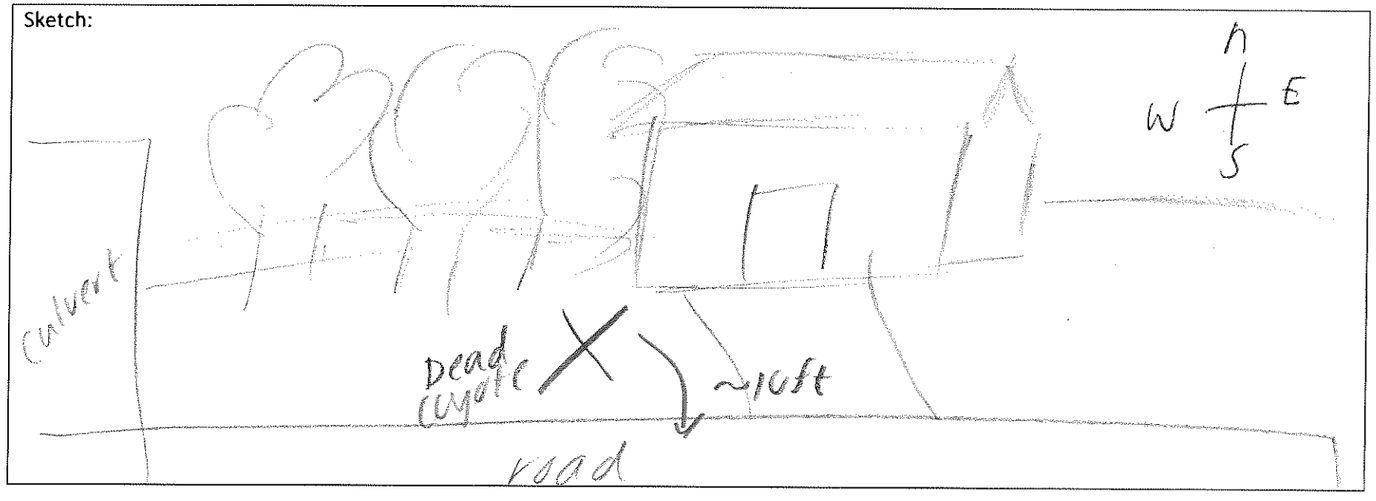
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	4/14/22	Time:	2:548M	Section:	(NE)	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Eastern coyote	on side of road ~10ft away in grass near the house	pretty decomposed, mostly fur left (almost whole pelt)		1 2 3 4

Sketch:



BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

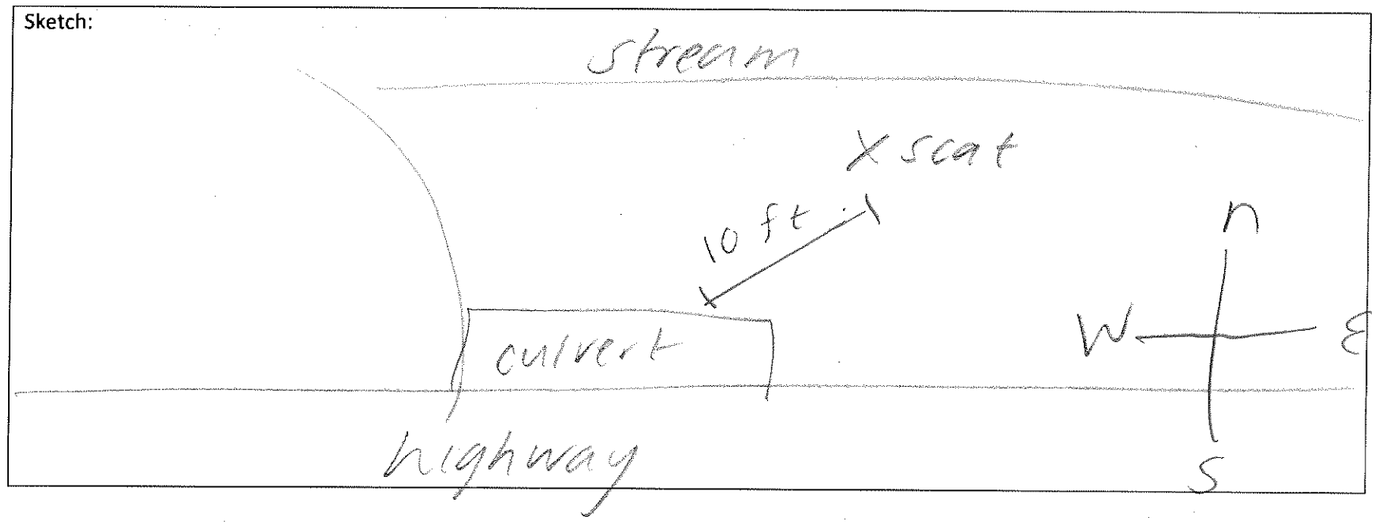
ROAD MORTALITY DATA SHEET

N

Observer(s):	Ashley Bernard	Date:	4/18	Time:	6.31PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Coyote	~10ft north of culvert (cam 2) on grass (westbound side)	Scat		mod 4

Sketch:



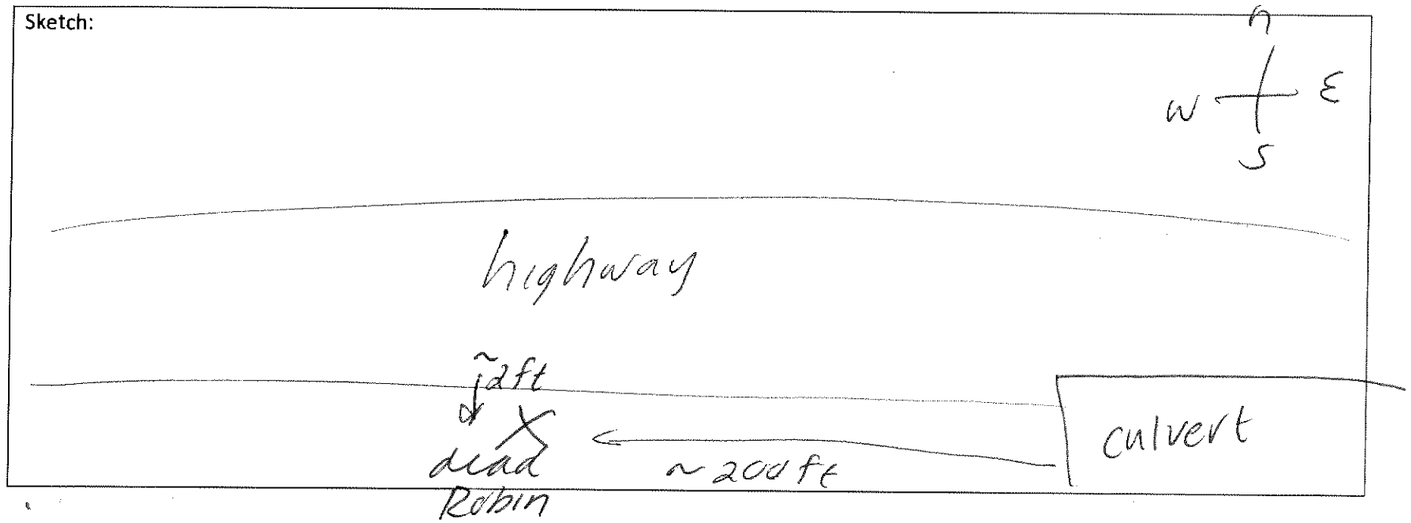
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Date:	Time:	Section:	NE	NW	SE	SW
Ashley Bernard	4/18/22	6:16 PM					(SW)

Species:	Location:	Description:	Photo No.:	Certainty:
American Robin	side of road, SW section	Bird likely struck by vehicle		Unsure 4

Sketch:



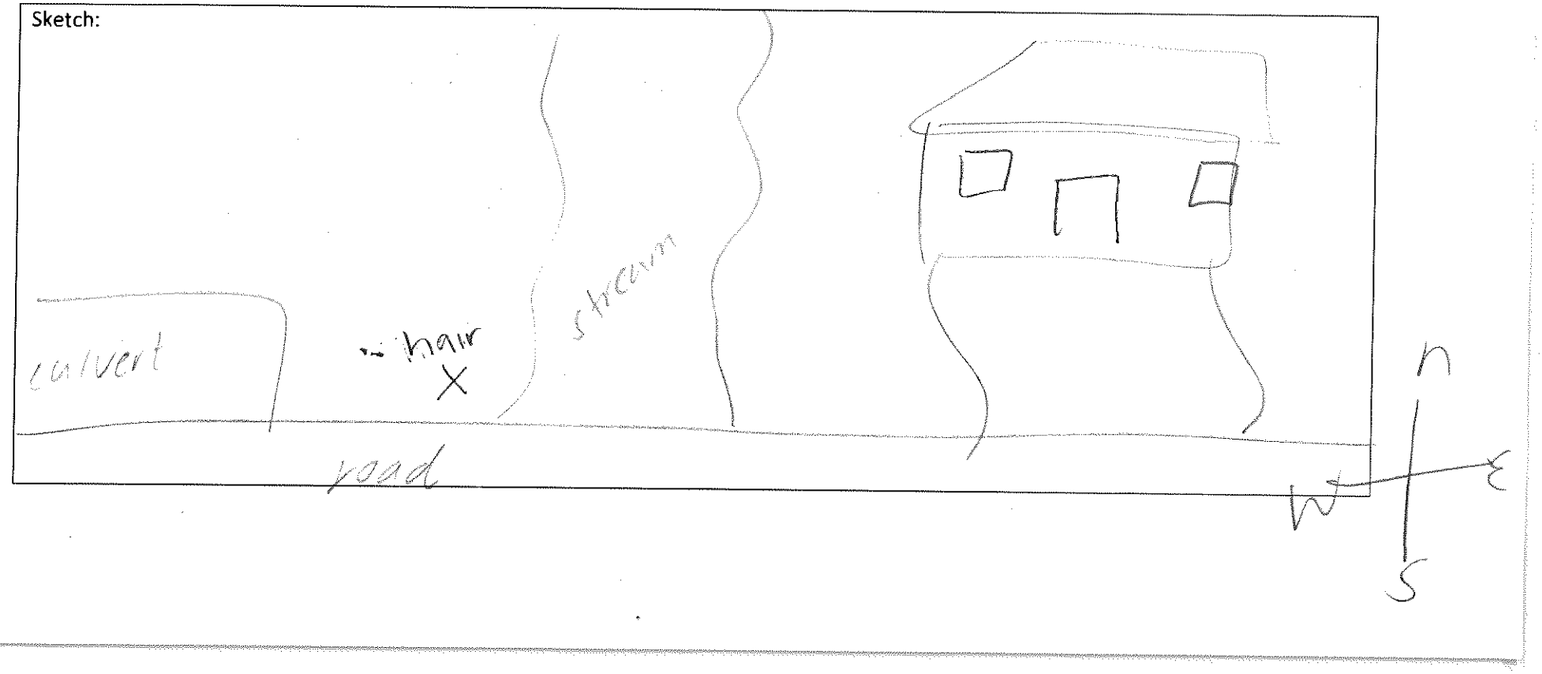
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	4/22/22	Time:	12:16 PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
White-tailed deer	~ 5ft from road near stream on westbound side of road	Large clumps of deer hair → can be tracked to river		Unsure 4

Sketch:



BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

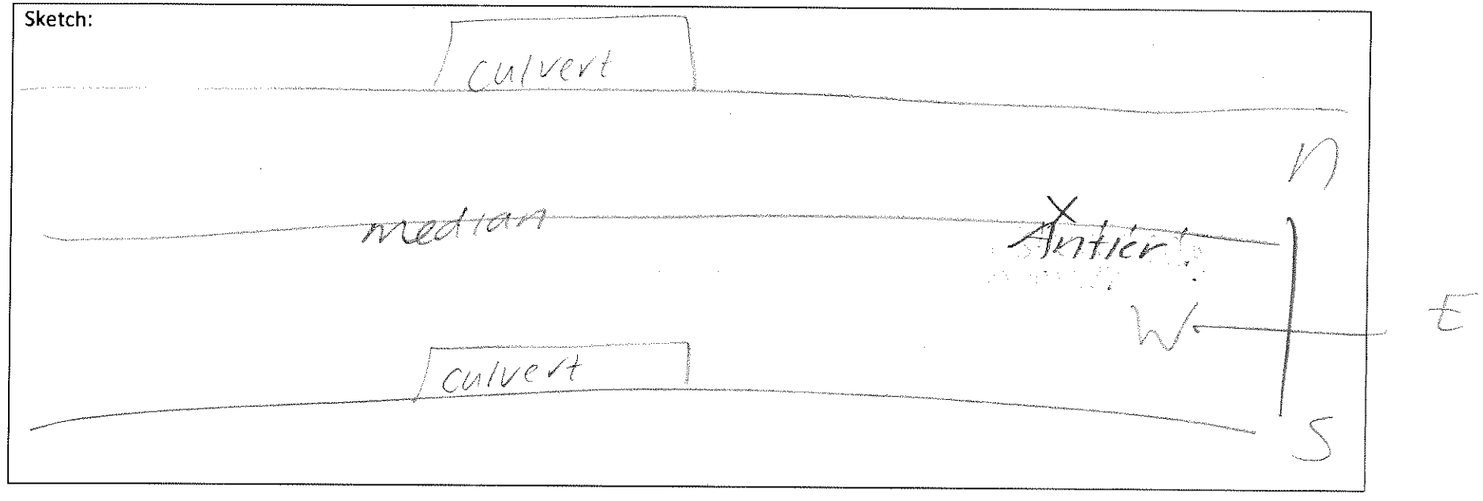
ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	4/26	Time:	12:13pm	Section:	NE	NW	SE	SW

median

Species:	Location:	Description:	Photo No.:	Certainty:
White-tailed deer	W/in the median of the highway ~15ft east of the tunnel	Antler shed		~~2001~~ 4

Sketch:



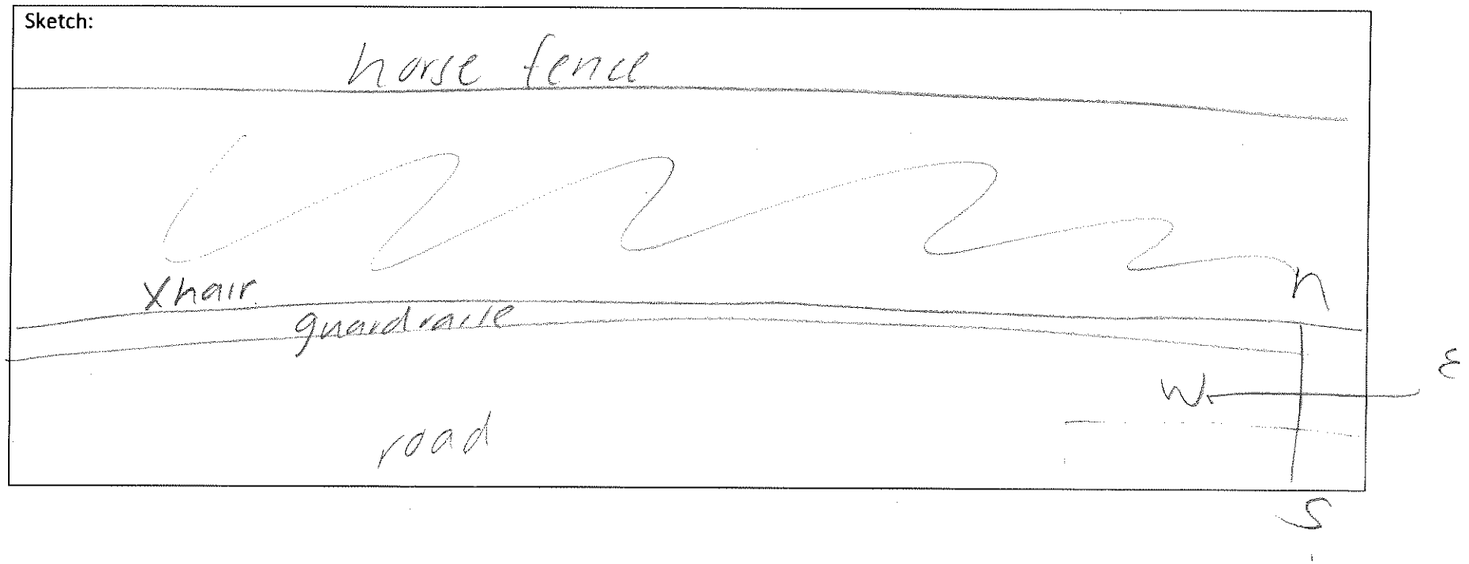
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	4/26	Time:	12:20 pm	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Mammal sp.	side of road near State Police Horses ~500ft+ from culvert	White mammal fur		- certain it's a mammal → cannot ID to species level

Sketch:



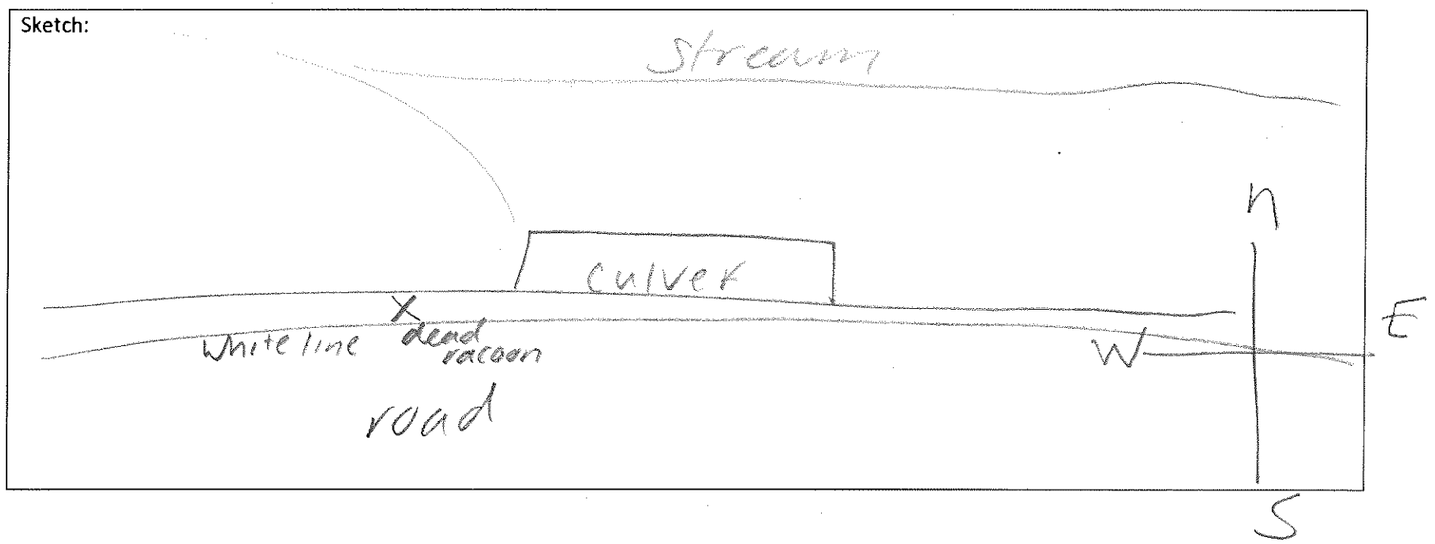
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/06	Time:	10:55	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Racoon	side of road, ~25 ft W of culvert	Dead Raccoon		Max 4

Sketch:



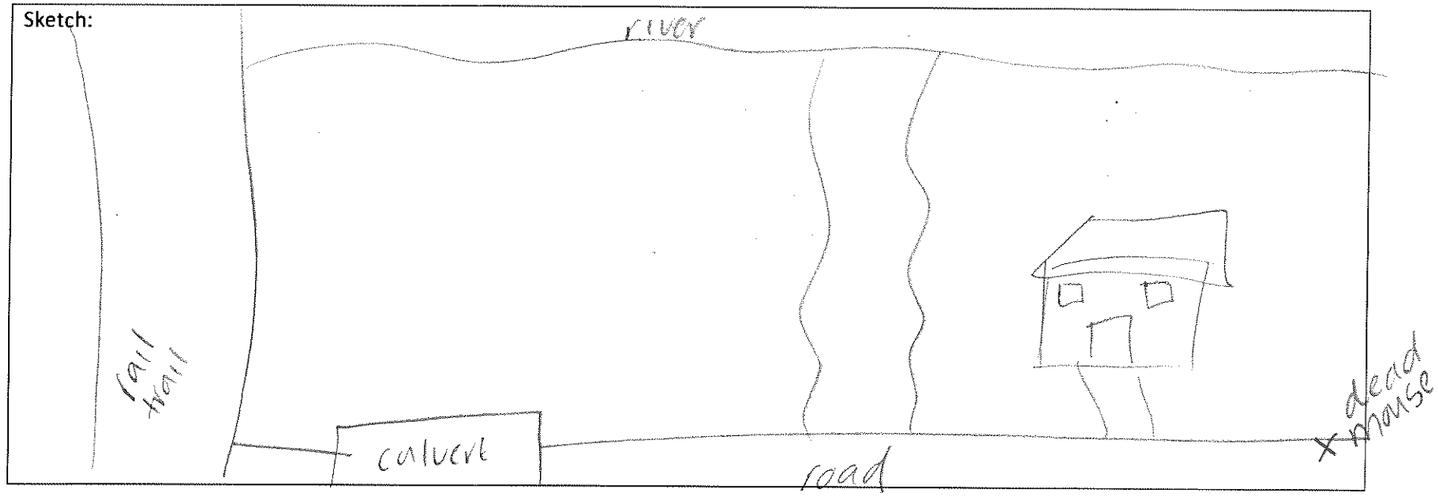
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/10/22	Time:	2:12 PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Field mouse	side of road, ~500 ft from culvert	Dead Field mouse		Real 4

Sketch:



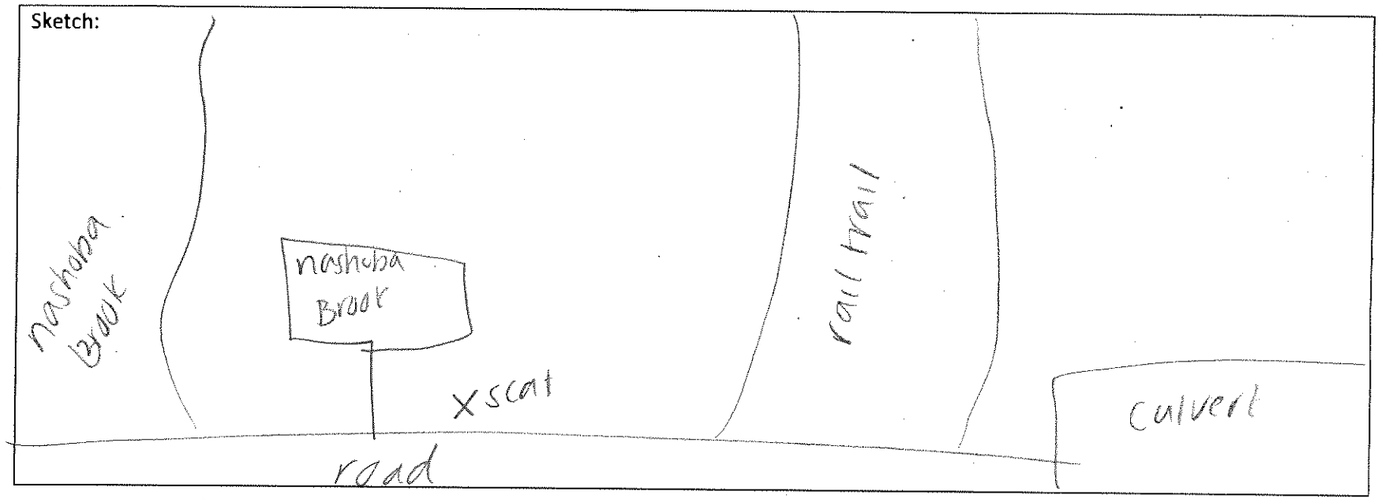
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/10/22	Time:	1:57 PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
eastern cottontail	side of highway under nashoba Brook sign	rabbit scat		Road 4

Sketch:



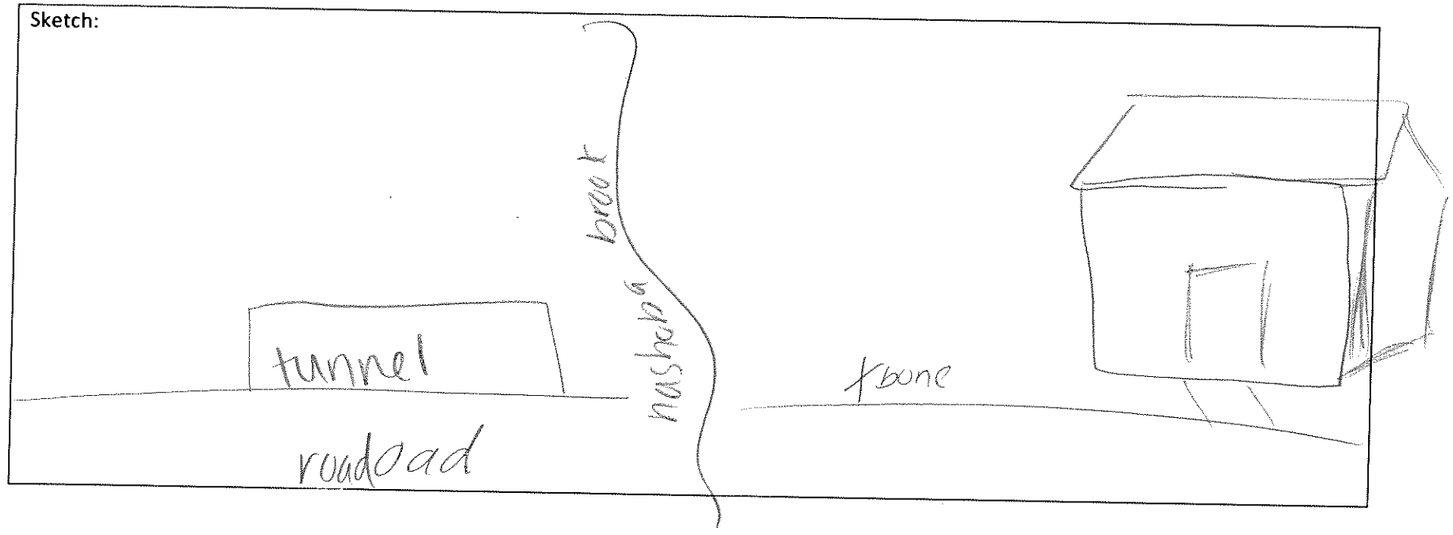
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/13	Time:	9:15AM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
mammal sp	side of road east of nashoba brook before house	old mammal bone	n/a	100% mammal 4

Sketch:



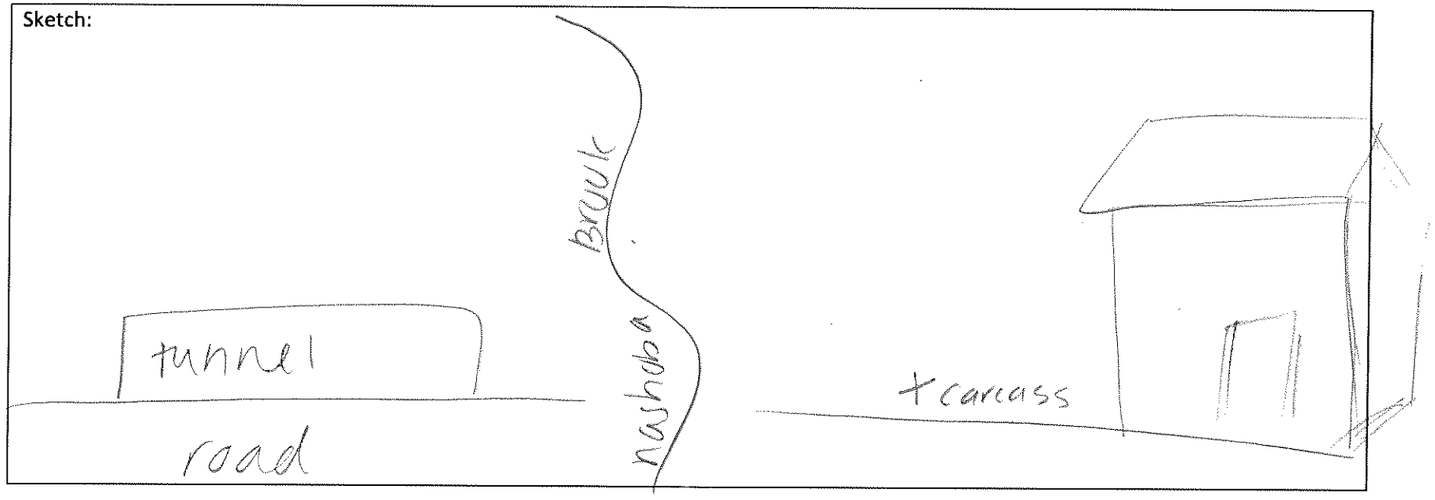
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Brinard	Date:	5/15	Time:	2:01 PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
mammal (possible rodent / weasel sp.)	side of road, east of Nashoba Brook before house	carcass	n/A	Map 4 (mammal)

Sketch:



BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

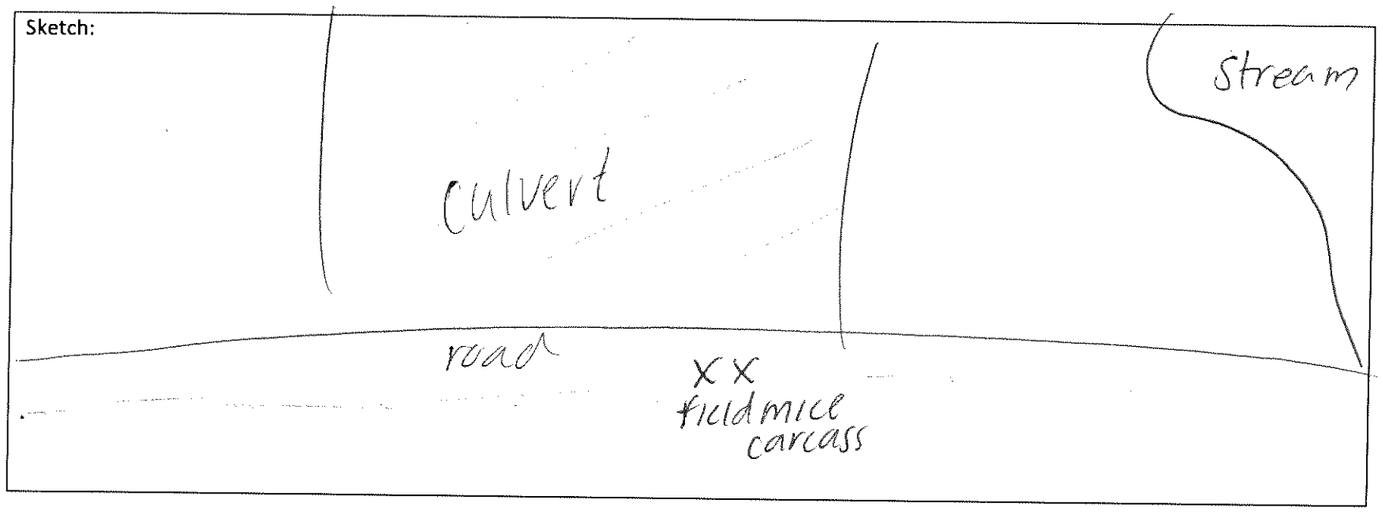
ROAD MORTALITY DATA SHEET

N

Observer(s):	Ashley Bernard	Date:	5/26	Time:	12:54 PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Field mouse (2)	Directly on side of road of the N enterance to the tunnel	Carcasses of 2 field mice	N/A	~~100%~~ 4

Sketch:



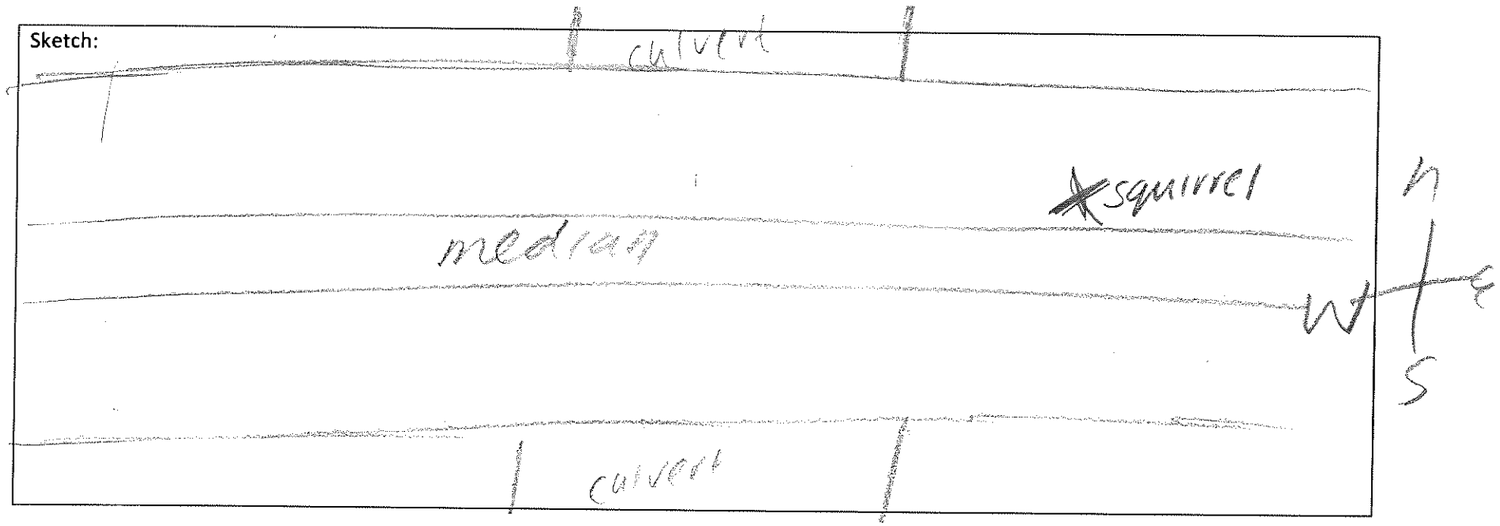
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/29	Time:	1:39	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Squirrel	median of highway	carcass & struck by vehicle	N/A 3129	~~100%~~ 9

Sketch:



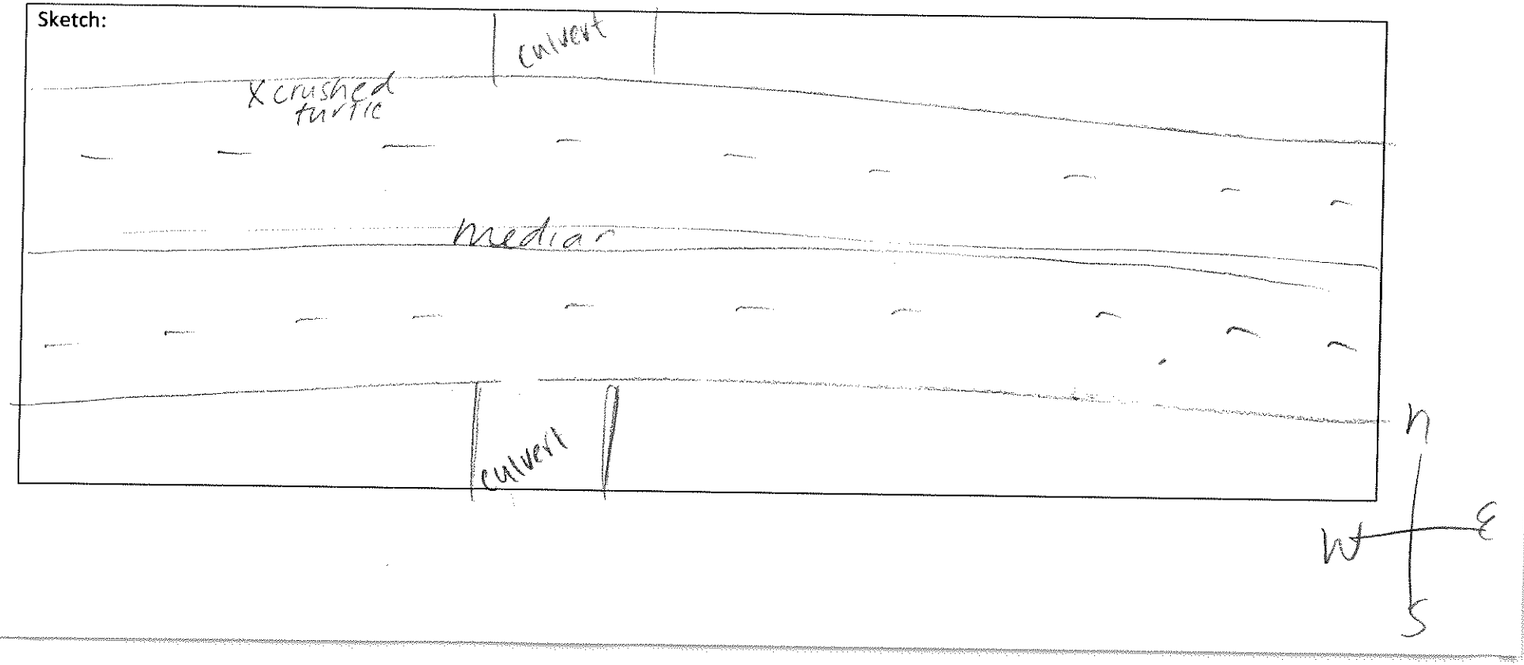
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/31	Time:	11:02 am	Section:	NE	(NW)	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Turtle SP	w/in roadway	carcass & carapace fragments	N/A 3099	Good 4

Sketch:



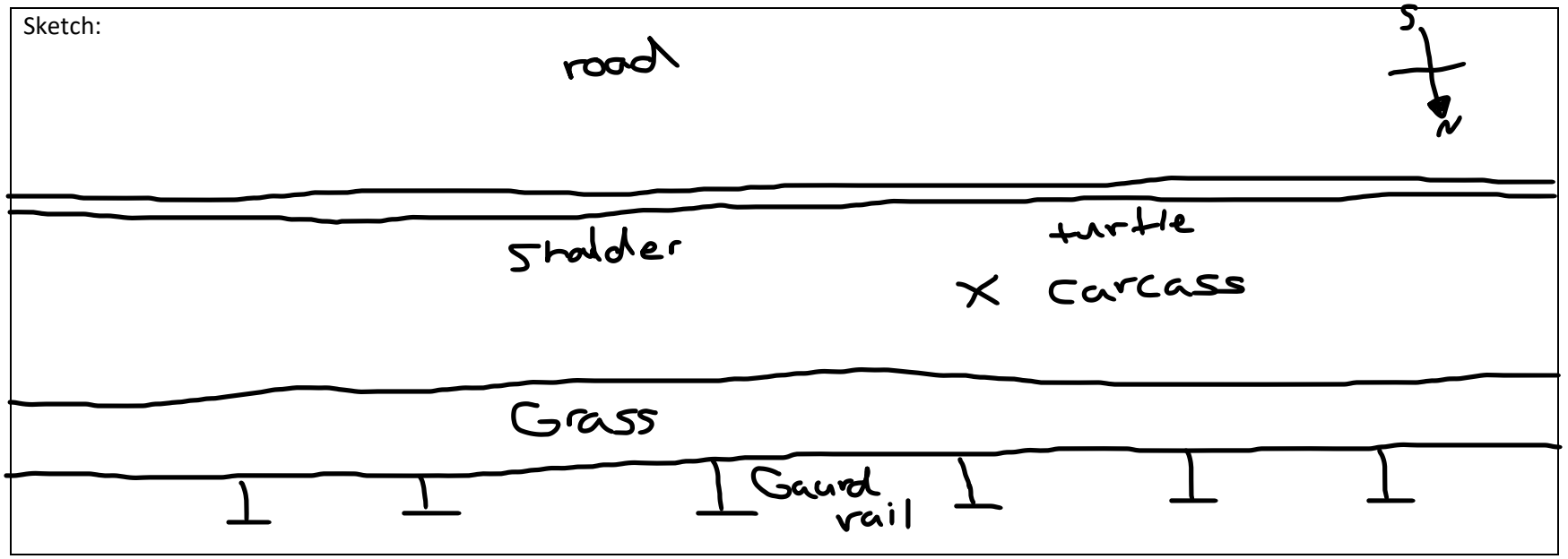
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Frank Hoey	Date:	06/02/2022	Time:	10:00am	Section:	NE	**NW**	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Painted Turtle	Roadside roughly 400ft west of the northern entrance of the tunnel	Half carcass of painted turtle	N/A	4

Sketch:



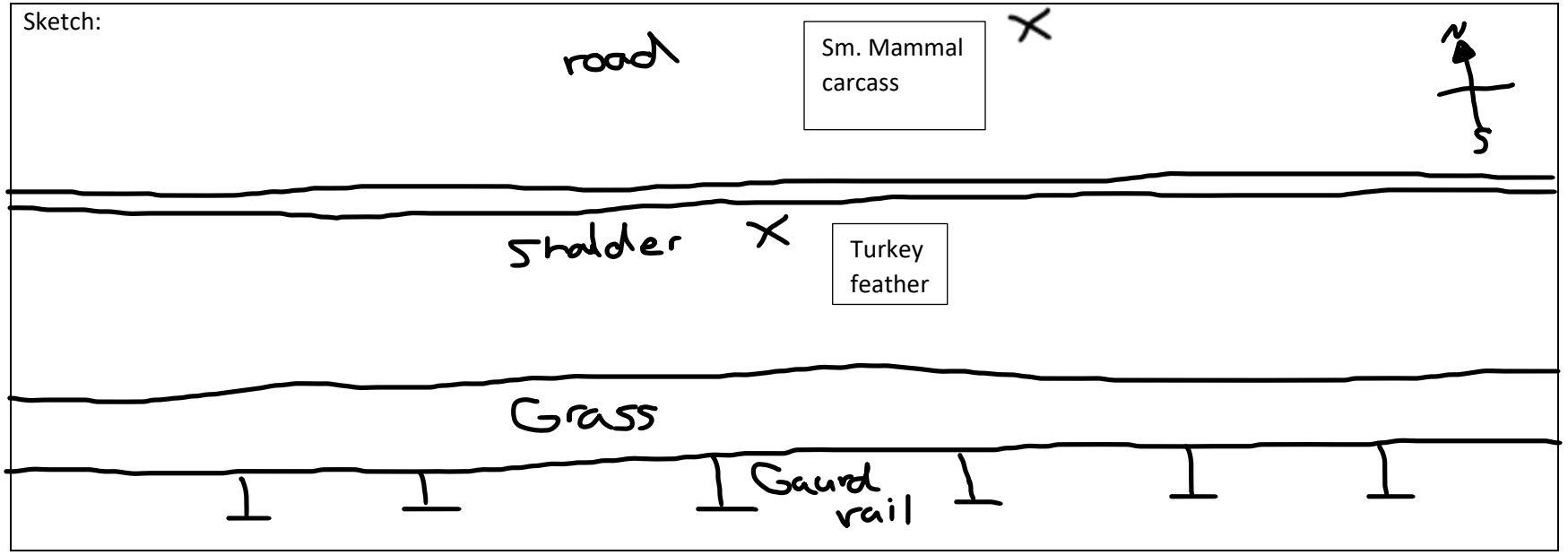
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	C. Bernier	Date:	06/07/2022	Time:	1315	Section:	**NE**	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Meleagris gallopavo	Roadside roughly 350-ft of the tunnel	Feather	01	3
Mammalia spp.	200-ft of tunnel near median	Remains	02A and 02B	4

Sketch:



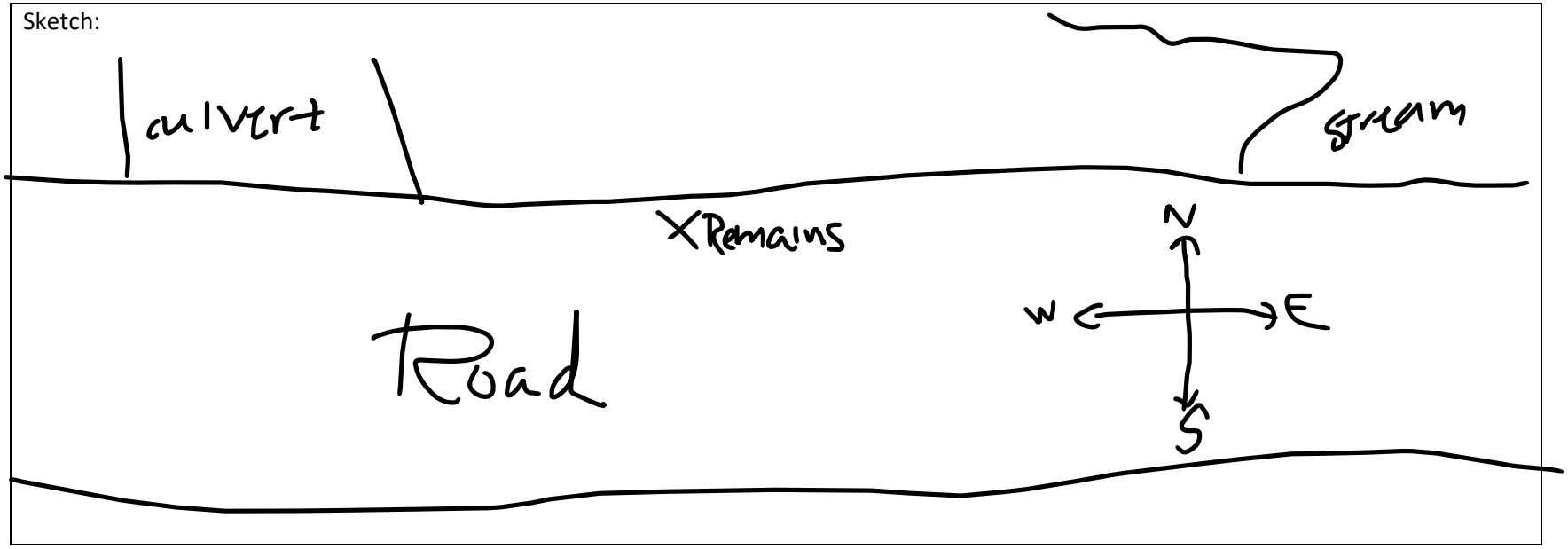
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Chase Bernier	Date:	6/14/22	Time:	8:12AM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Eastern milk snake	Just east of tunnel	Remains	See project folder	~~100%~~ 4

Sketch:



BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	6/21/22	Time:	12:20PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Field mouse	Edge of road, east of house	Remains; crushed by vehicle		4

Sketch:

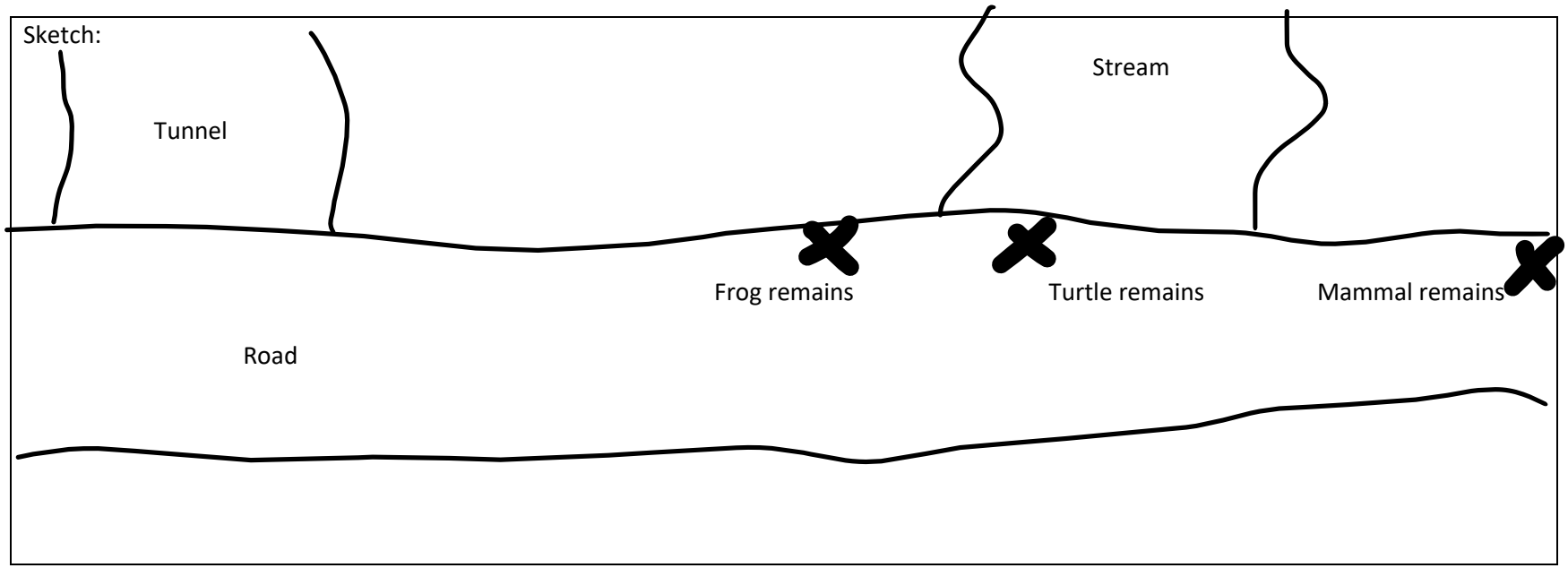
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	7/08/22	Time:	12:30PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Bull frog, Painted Turtle, and mammal sp.	All on edge of road in East of the tunnel, in close proximity to the stream	Carcasses; appear to have been crushed by a vehicle	See project folder	4

Sketch:



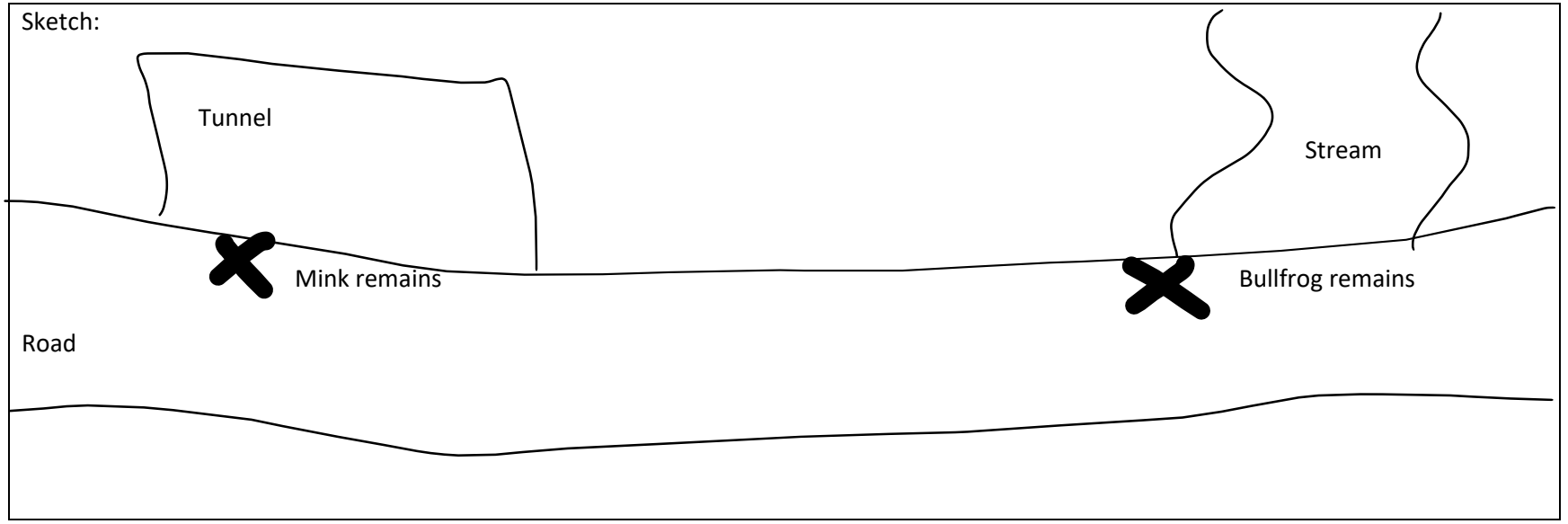
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard & Roisin Stapleton	Date:	8/4/2022	Time:	12:00 PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Bullfrog and mink	NE quadrant- mink adjacent to tunnel and frog adjacent to stream	Remains of both appear to have been struck by a vehicle		4

Sketch:



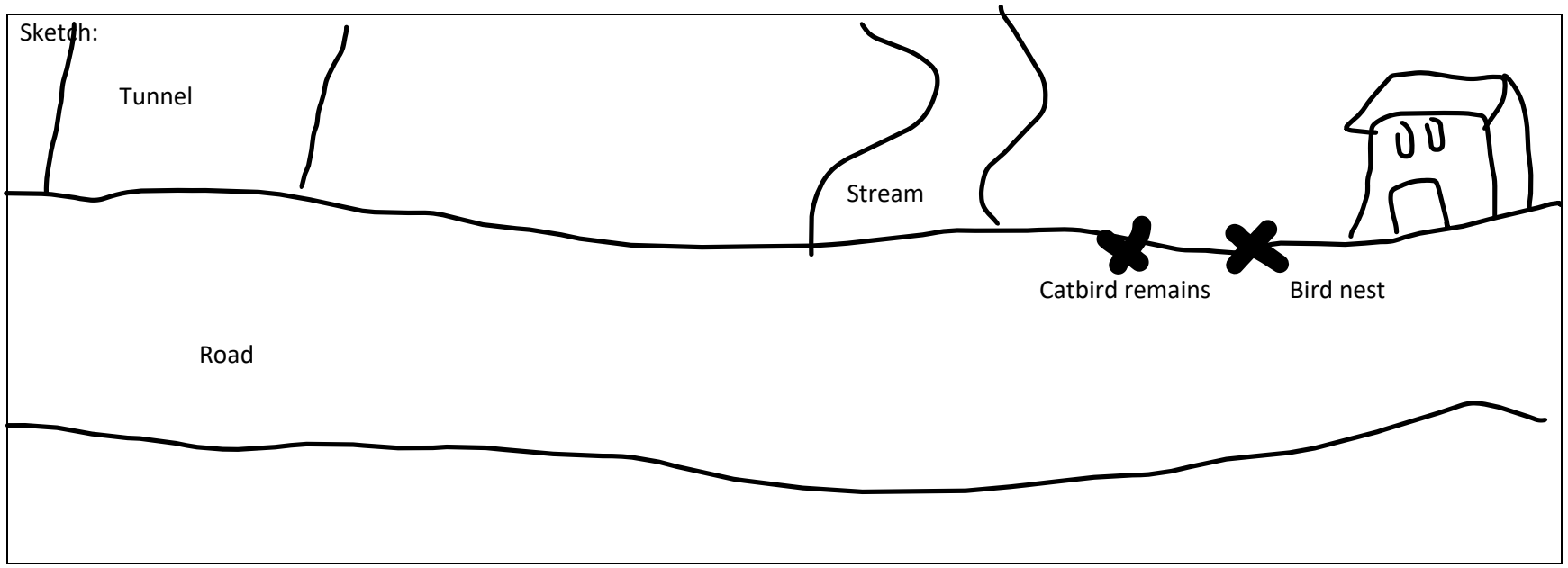
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET

Observer(s):	Ashley Bernard	Date:	8/19/2022	Time:	12:45 PM	Section:	NE	NW	SE	SW

Species:	Location:	Description:	Photo No.:	Certainty:
Grey catbird; bird nest	NE quadrant, side of road	Located within a few feet of each other between stream and house		4; species of bird nest unkown

Sketch:



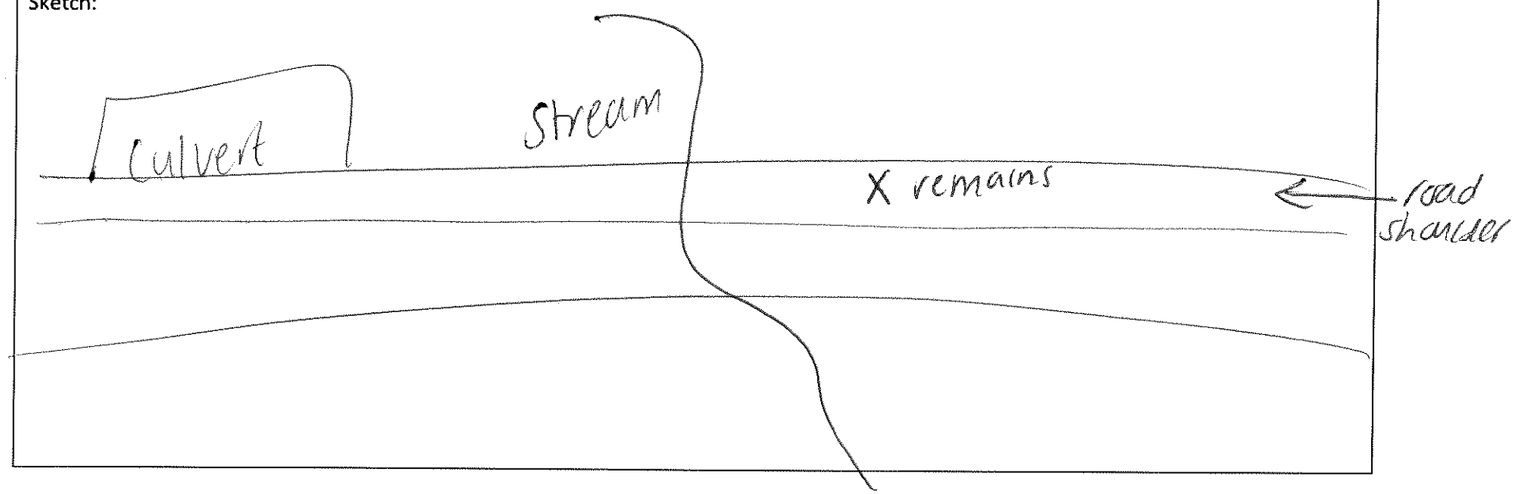
BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

ROAD MORTALITY DATA SHEET 1:27 PM

Observer(s):	Date:	Time:	Section:	NE	NW	SE	SW
Ashley Bernard	8/31	12:27 pm					

Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opposum	road shoulder	Remains	IMG 4356	4

Sketch:



BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

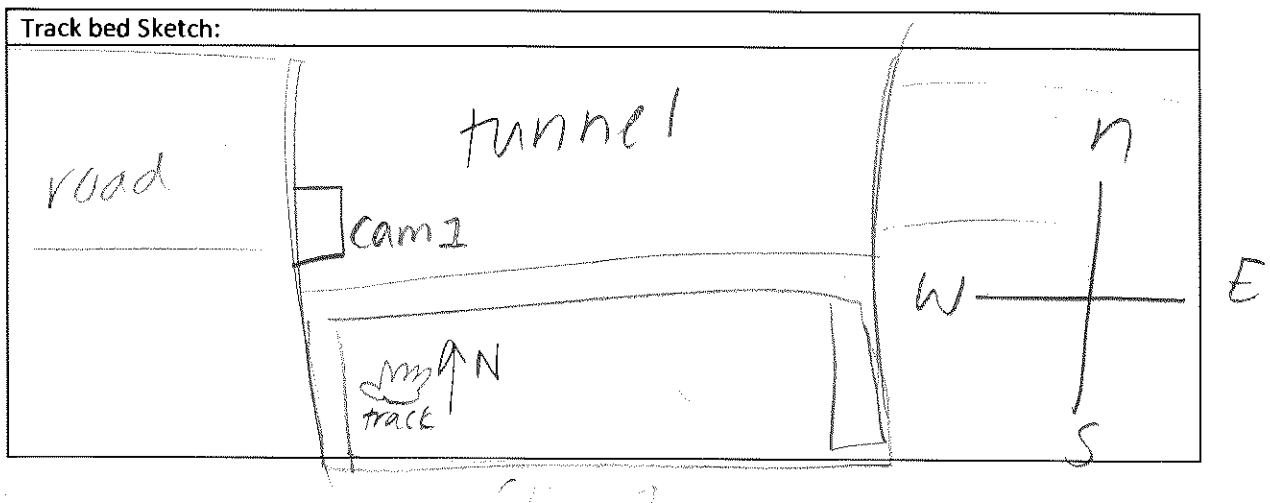
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/15/22
Track Bed:	N	(S)	Time:	2:20 PM

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opossum	w/in the track bed	tracks headed north towards cam 2	n/a	4 *verified with trail cam photos

Track bed Sketch:



Comments:

* Didn't trigger camera 7 - might have been out of range. caught individual exiting tunnel @ northern end (cam 2)

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/20/22
Track Bed:	N	S	Time:	9:20AM

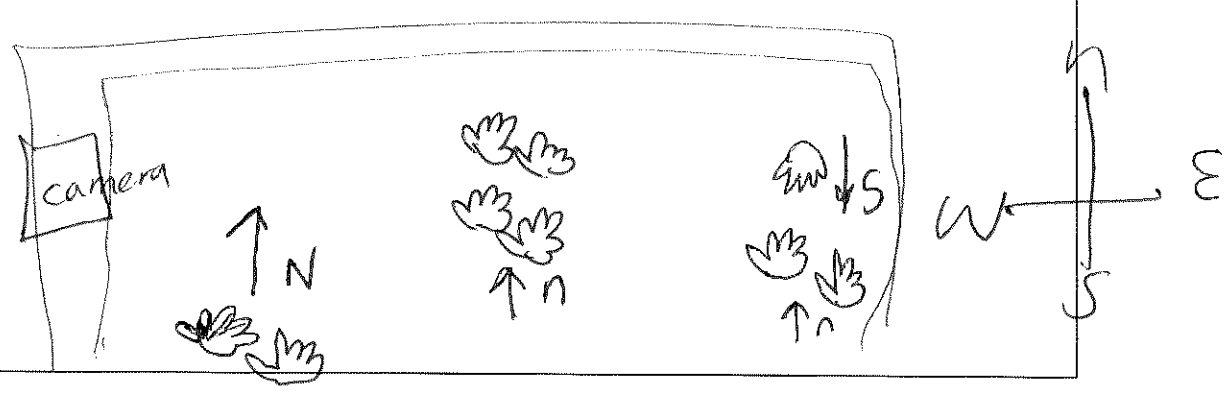
Wildlife sign observed outside of the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opossum	Dist. all through-out the TB	multiple sets of tracks going both N + S (confirmed via camera trap - mult. individuals moving over a few nights)	N/A	Prob. 4

Track bed Sketch:



Comments:

Multiple sets of tracks throughout the TB. Might be same individual moving through each night.

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

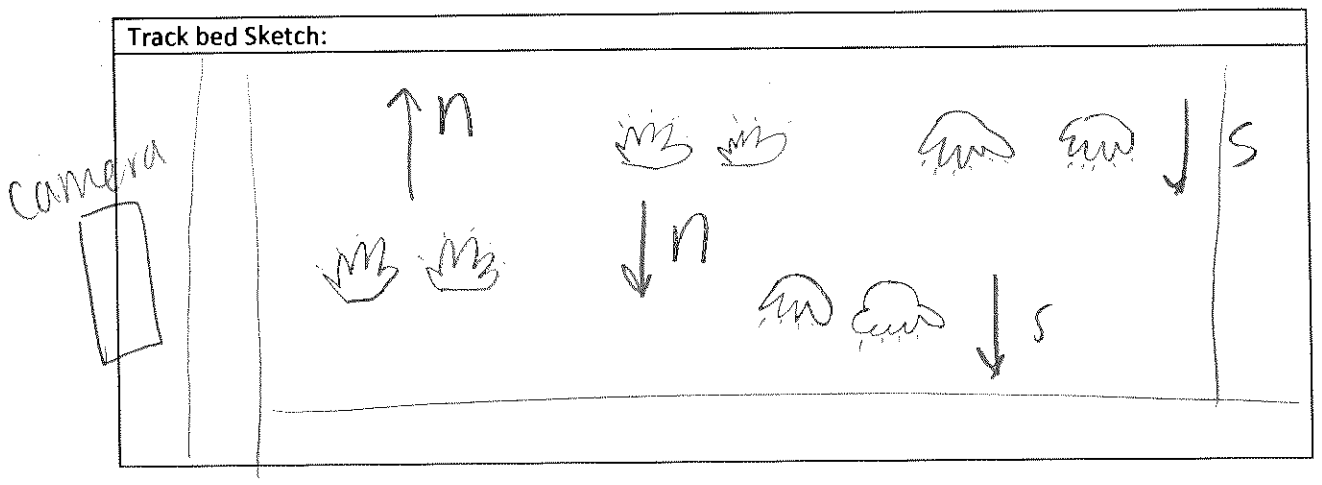
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/20
Track Bed:	N (cam 2)	S	Time: 8:50 AM

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opossum	scattered through out tracked	multiple sets of Virginia opossum tracks	n/a	4

Track bed Sketch:



Comments:

mult sets of tracks from multiple crossings (might be same ind.) on 5/16, 5/17, 5/18, 5/20 (caught on cam 2)

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

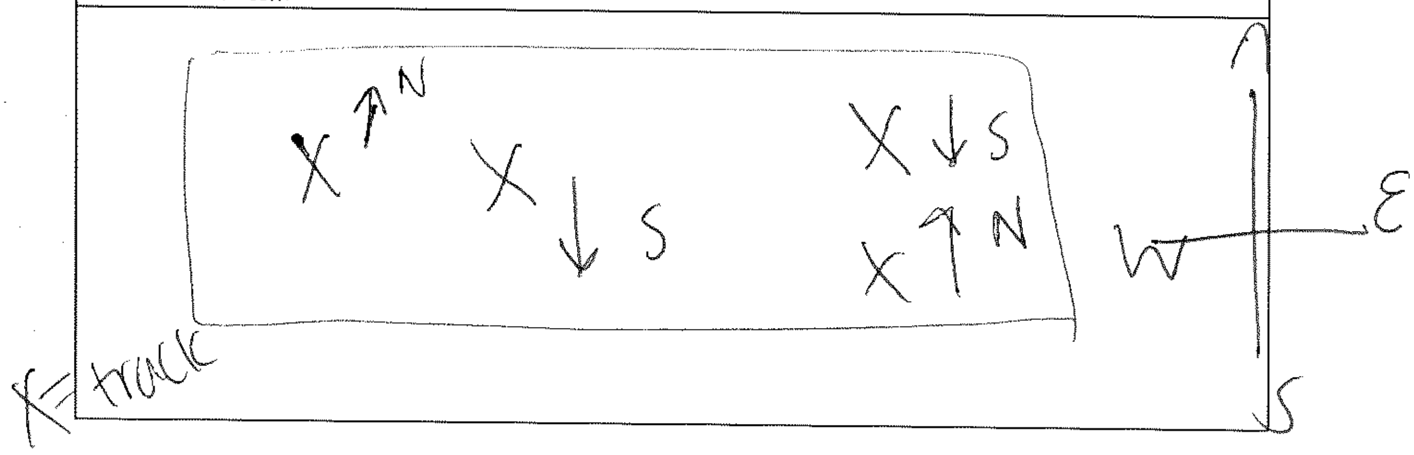
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/26
Track Bed:	N	(S) CAM 1	Time:	12:17

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opossum	w/in TB	multiple sets of tracks throughout TB	N/A	4 ~~[illegible]~~ (saw on camera)

Track bed Sketch:



Comments:

~~(*Didn't catch boss~~

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

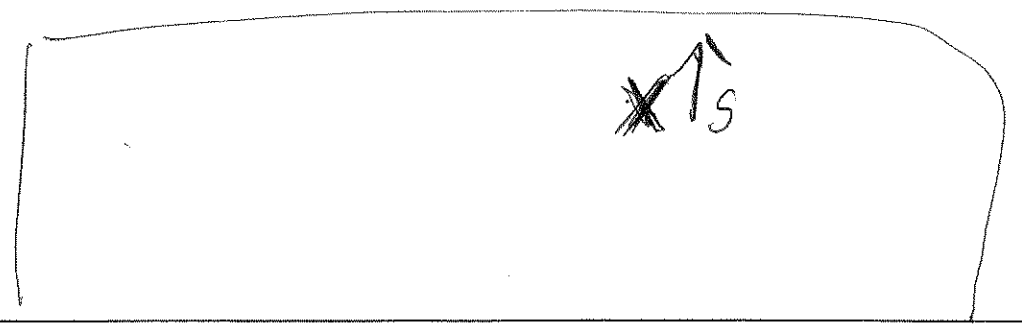
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/26
Track Bed:	~~N~~ CAM 2	S	Time:	12:47

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Bird sp.	W/in TB	Small bird tracks - likely sparrow	~ N/A	Mod 4

Track bed Sketch:



Comments:

Bird not caught on camera - very unlikely it flew through the tunnel

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

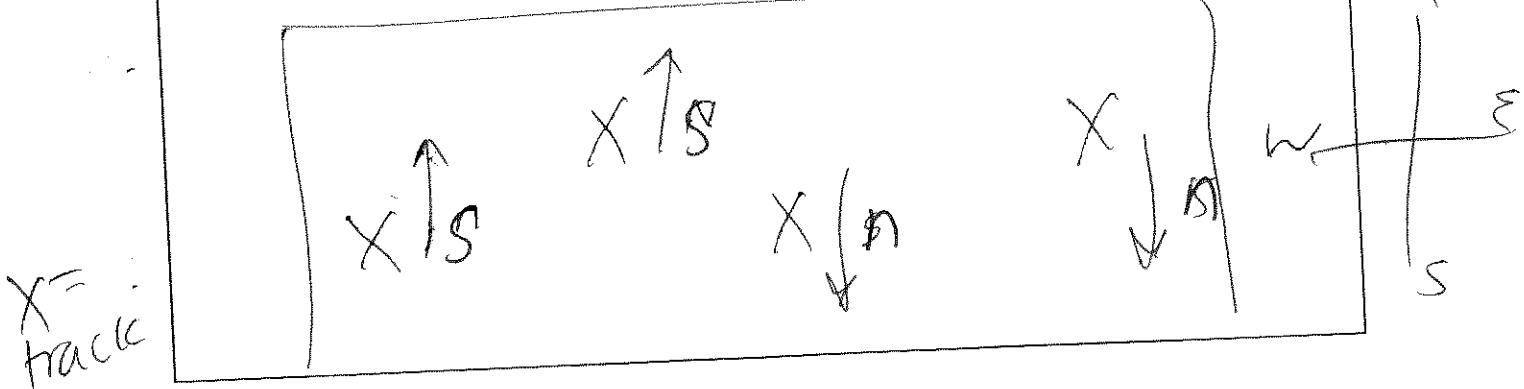
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/26
Track Bed:	N (CAM 2)	S	Time:	6:47

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opossum	w/in TB	mult. sets of tracks throughout TB	N/A	100% 9

Track bed Sketch:



X = track

Comments:

Did not catch opossum on this camera for some reason - might have been moving too fast to catch

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/29
Track Bed:	N	S	Time:	1:29 PM

CAM 1

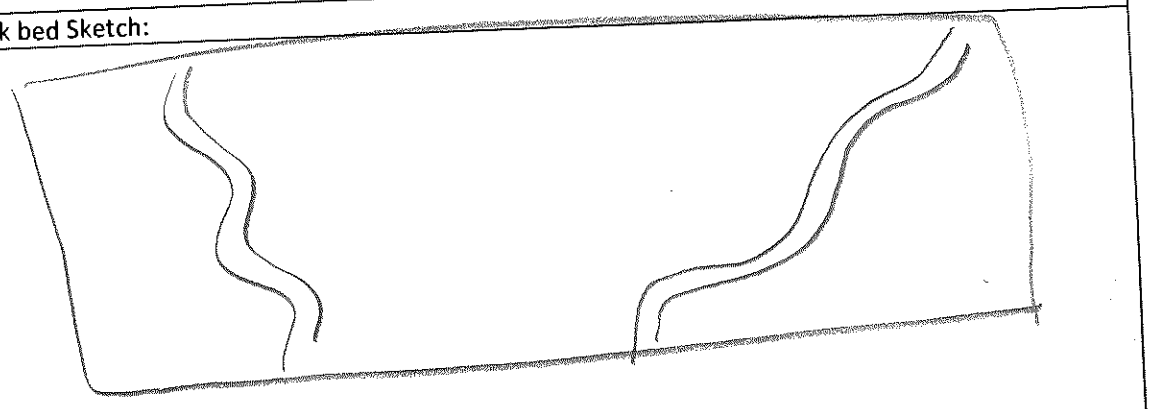
Wildlife sign observed outside of the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
[illegible]	[illegible]	[illegible]	n/a 3092	[illegible]

Wildlife sign observed within the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
snapping turtle	w/in the track bed	tail drag marks? ??	n/a	1

Track bed Sketch:



Comments:

* can tell direction from camera

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

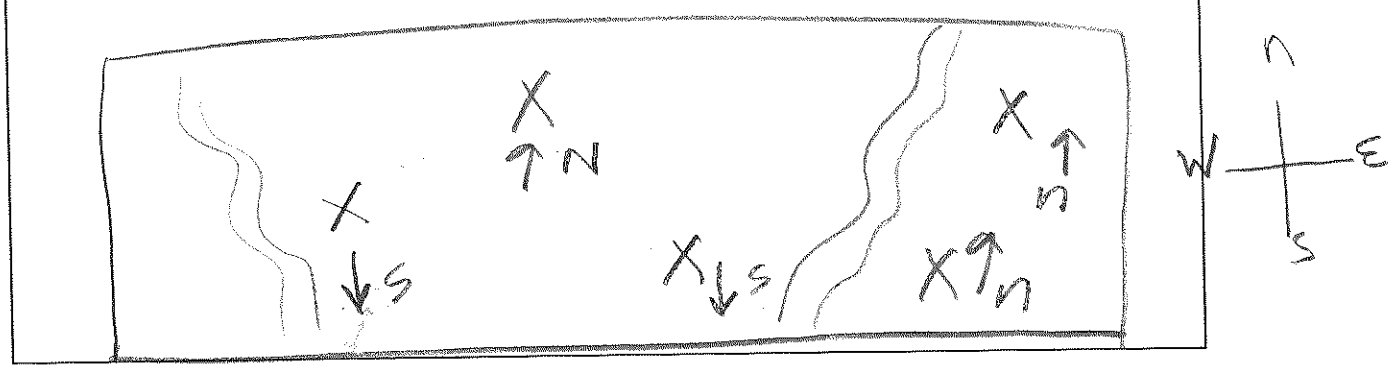
Observer(s):	Ashley Bernard	Date:	5/29
Track Bed:	N (S)	Time:	1:29 PM

cam 1

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
			3096, 3099	

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia Opposum	w/in track bed.	sporadic tracks	n/A	4

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

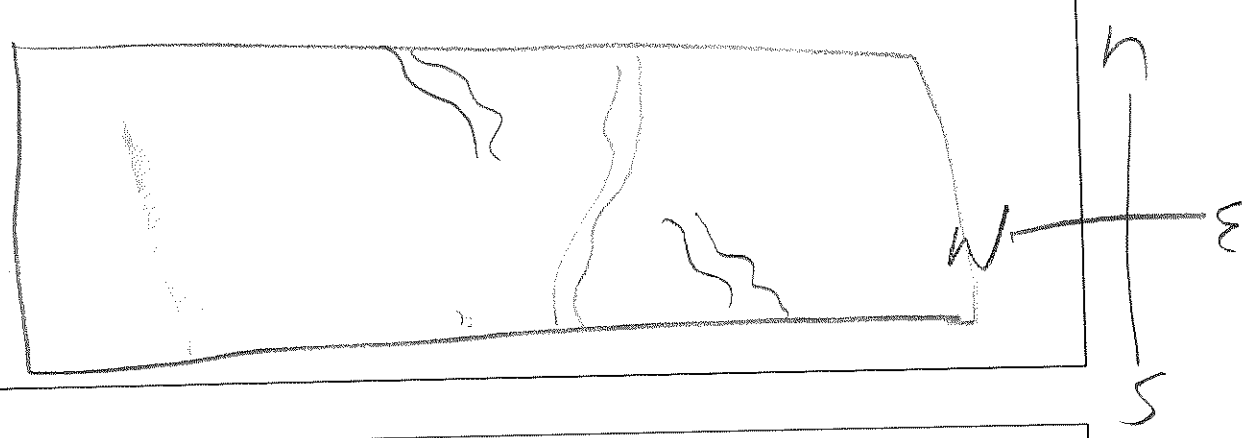
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/29
Track Bed:	N (CAM 2)	S	Time:	1:00PM

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
			3086	

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
snapping turtle?	w/in track bed	tail drag marks? may be also claw marks	n/a	1

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/29
Track Bed:	N (CAM 2) / S	Time:	1:00 PM

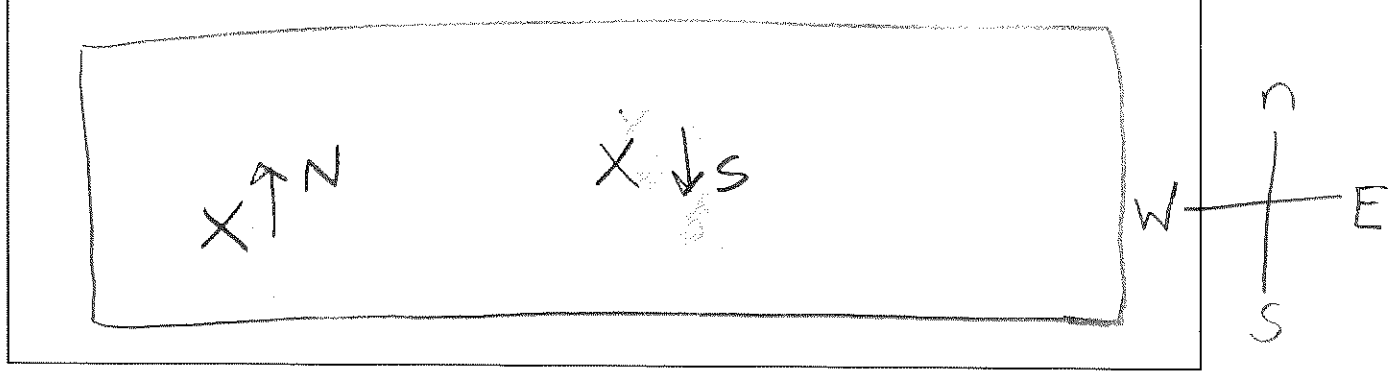
Wildlife sign observed outside of the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
			3087 3090	

Wildlife sign observed within the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opposum	w/in track bed	2 sets of tracks	n/A	4

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/29
Track Bed:	N	S	Time:	1:29 PM

CAM 1

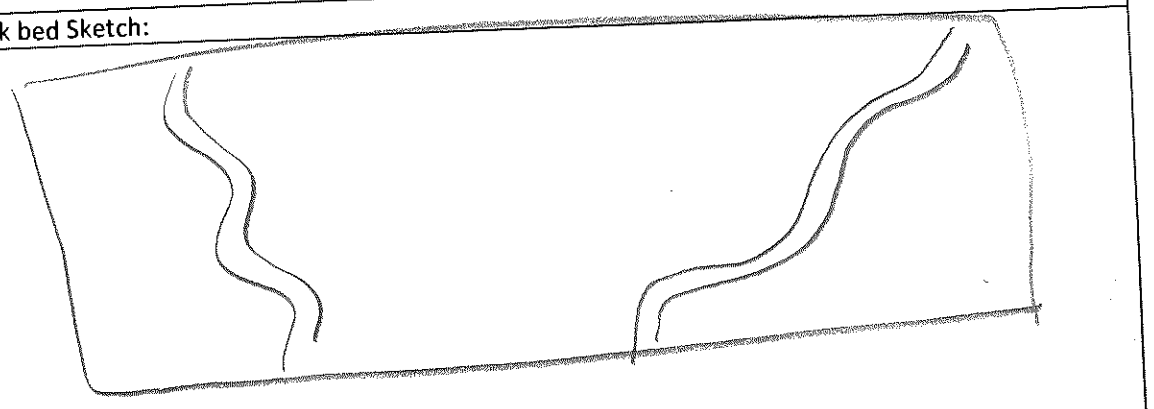
Wildlife sign observed outside of the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
[illegible]	[illegible]	[illegible]	n/a 3092	[illegible]

Wildlife sign observed within the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
snapping turtle	w/in the track bed	tail drag marks? ??	n/a	1

Track bed Sketch:



Comments:

* can tell direction from camera

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

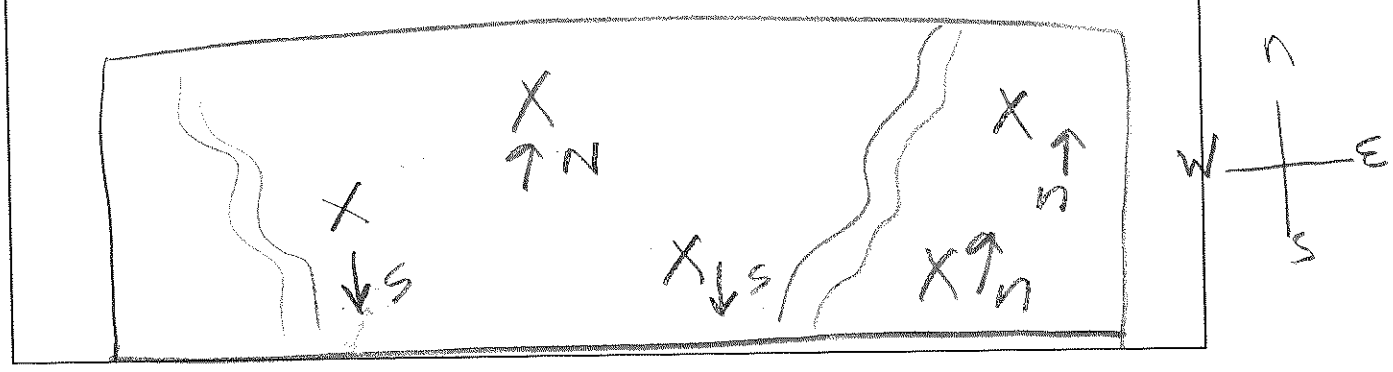
Observer(s):	Ashley Bernard	Date:	5/29
Track Bed:	N (S)	Time:	1:29 PM

cam 1

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
			3096, 3099	

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia Opposum	w/in track bed.	sporadic tracks	n/A	4

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

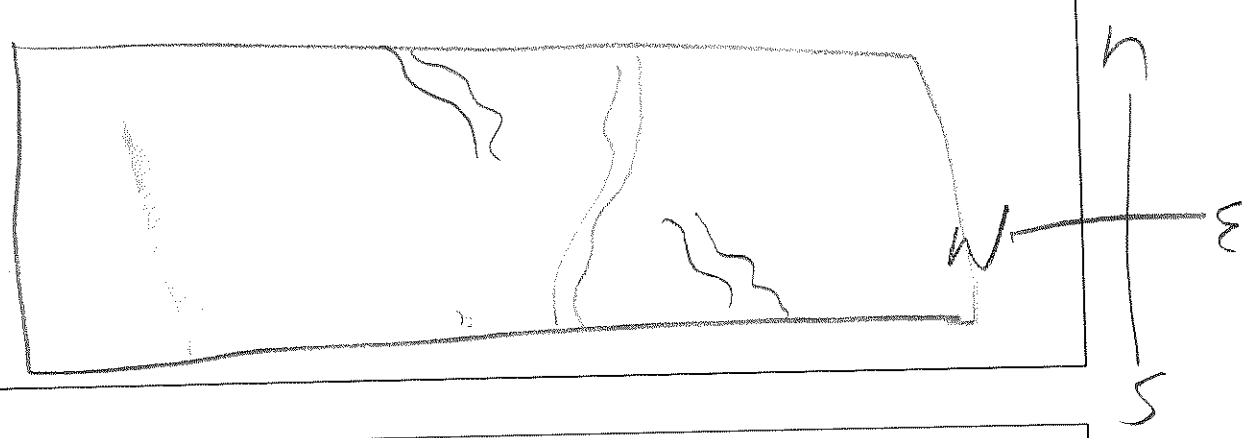
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard		Date:	5/29
Track Bed:	N (CAM 2)	S	Time:	1:00PM

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
			3086	

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
snapping turtle?	w/in track bed	tail drag marks? may be also claw marks	n/a	1

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/29
Track Bed:	N (CAM 2) / S	Time:	1:00 PM

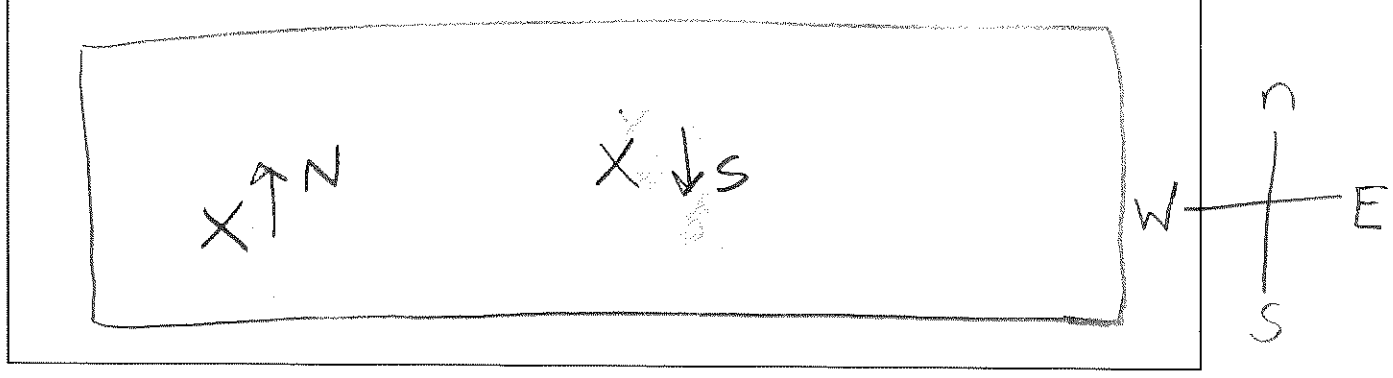
Wildlife sign observed outside of the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
			3087 3090	

Wildlife sign observed within the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opposum	w/in track bed	2 sets of tracks	n/A	4

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

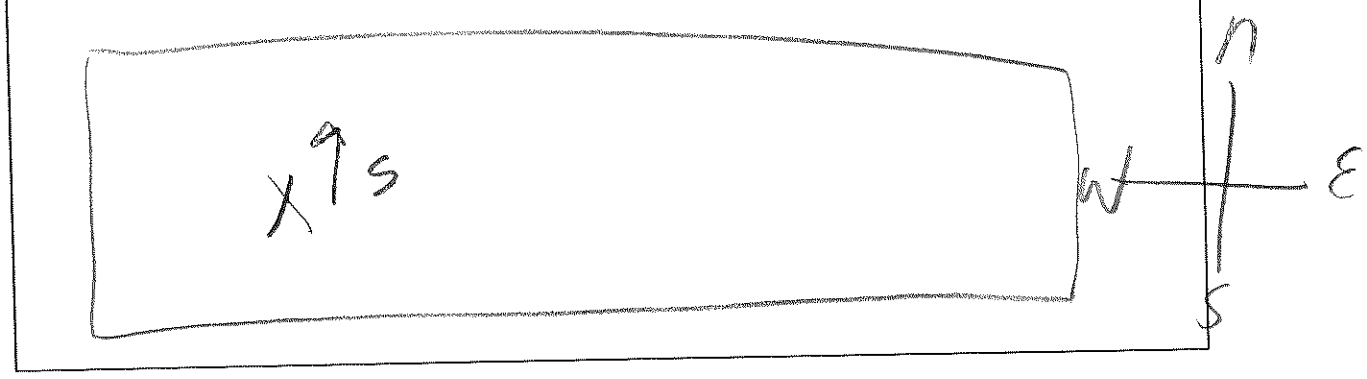
TRACK BED DATA SHEET

Observer(s):	Ashley Bernard	Date:	5/29
Track Bed:	N (CAM 2) / S	Time:	1:00

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
			3805	

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
raccoon	w/in track bed	one set of tracks	n/a	4

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

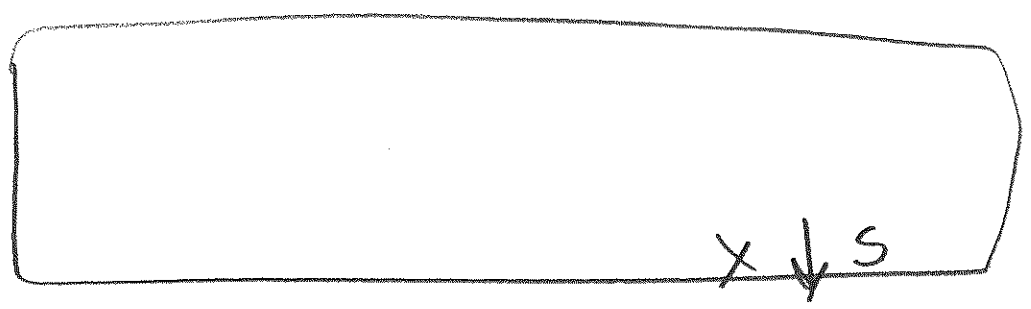
Observer(s):	Ashley Bernard		Date:	6/10
Track Bed:	N	S	Time:	12:58 PM

Cam 1

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opossum	W/in track bed	1 print registered (washout by rain?)	3302	4

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

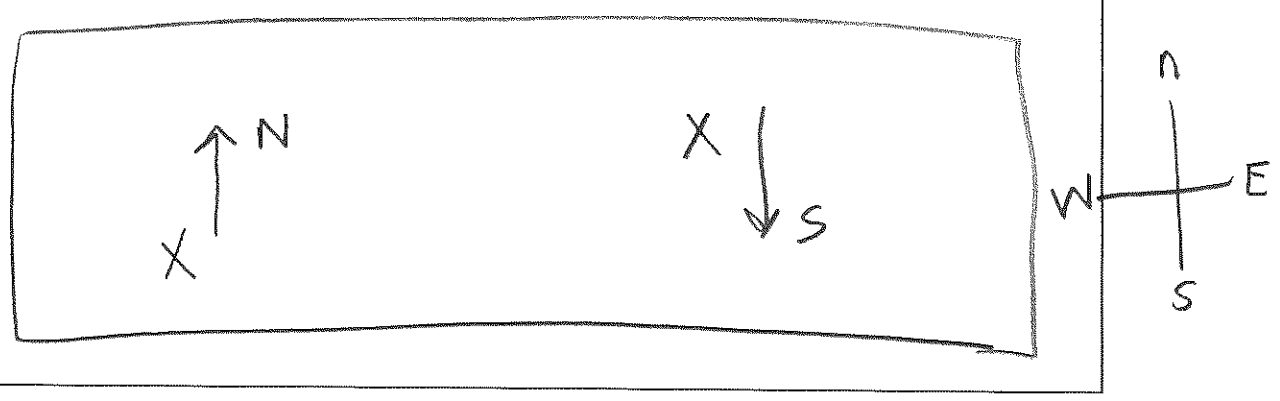
Observer(s):	Ashley Bernard		Date:	6/10
Track Bed:	N	S	Time:	12:28 PM

Enm 2

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Virginia opposum	w/in track bed	2 sets; 1 n, 1 s	3299, 3300	4

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

Observer(s):	Ashley Bernard	Date:	6/17
Track Bed:	N 9 CAM1	Time:	1:04 PM

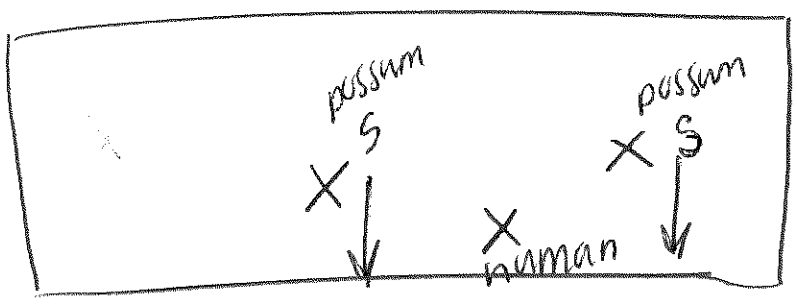
Wildlife sign observed outside of the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:

Species:	Location:	Description:	Photo No.:	Certainty:
Virginia possum	w/in TB	2 sets of tracks	3397	14
Human	w/in TB	1 single print	3398	14

Track bed Sketch:



Comments:

BRUCE FREEMAN RAIL TRAIL WILDLIFE TUNNEL

TRACK BED DATA SHEET

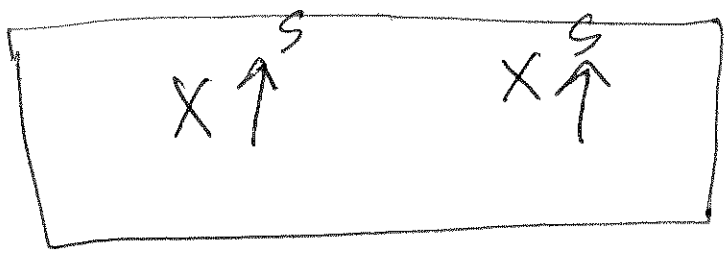
Observer(s):	Ashley Bernard			Date:	6/17
Track Bed:	N		S	Time:	1:26 PM

CAM 2

Wildlife sign observed outside of the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:

Wildlife sign observed within the track bed:				
Species:	Location:	Description:	Photo No.:	Certainty:
Raccoon	W/in track bed	2 prints	See project folder	4

Track bed Sketch:



Comments:

APPENDIX D

Photos

APPENDIX A

Photos

Photo 1. Overview of southern tunnel entrance.

Photo 2. Overview of northern tunnel entrance.

Photo 3. Overview of track bed and camera set-up.

Photo 4. Virginia opossum (*Didelphus virginiana*) traveling south captured on the north track bed.

Photo 5. Raccoon (*Procyon lotor*) traveling south captured on the north track bed.

Photo 6. Overview of opossum, raccoon, and common snapping turtle (*Chelydra serpentina*) on the north track bed.

Photo 7. Humans were common visitors at the northern camera trap.

Photo 8. Virginia opossum captured on the southern camera traveling north.

Photo 9. Common snapping turtle captured on the northern camera getting blown over by the wind.

Photo 10. A person moved a common snapping turtle into the tunnel at the northern entrance.

Photo 11. A raccoon captured on camera at the southern tunnel entrance.

Photo 12. An American robin (*Turdus migratorius*) attempting to cross the tunnel at the northern entrance.

Photo 13. A song sparrow (*Melospiza melodia*) attempting to cross the tunnel at the southern entrance.

Photo 14. An eastern cottontail (*Sylvilagus floridanus*) travelling south at the northern entrance.

Photo 15. A painted turtle (*Chrysemys picta*) attempted to cross the tunnel at the northern entrance.

Photo 16. A grey catbird (*Dumatella carolinensis*) attempted to cross the tunnel at the northern entrance.

Photo 17. An eastern chipmunk (*Tamias striatus*) travelling south captured at the northern camera trap.

Photo 18. An eastern meadow vole (*Microtus pennsylvanicus)* travelling north captured at the southern entrance.

Photo 19. An eastern coyote (*Canis latrins*) travelling south captured at the northern entrance.

Photo 20. A woodchuck (*Marmota monax*) travelling north captured at the northern entrance.

Photo 21. A member of the Cricetidae (fieldmouse) family attempted to cross the tunnel at the southern entrance.

Photo 22. A female house sparrow (*Passer domesticus*) attempted to cross the tunnel at the southern entrance.

Photo 23. An American mink (*Neovision vision*) travelling north captured at the northern entrance.

Photo 24. Frequent human visitors attempted to walk through the tunnel.

Photo 25. Frequent flooding of the tunnel as shown at the southern entrance above washed away track paths and likely prevented wildlife from successfully crossing.

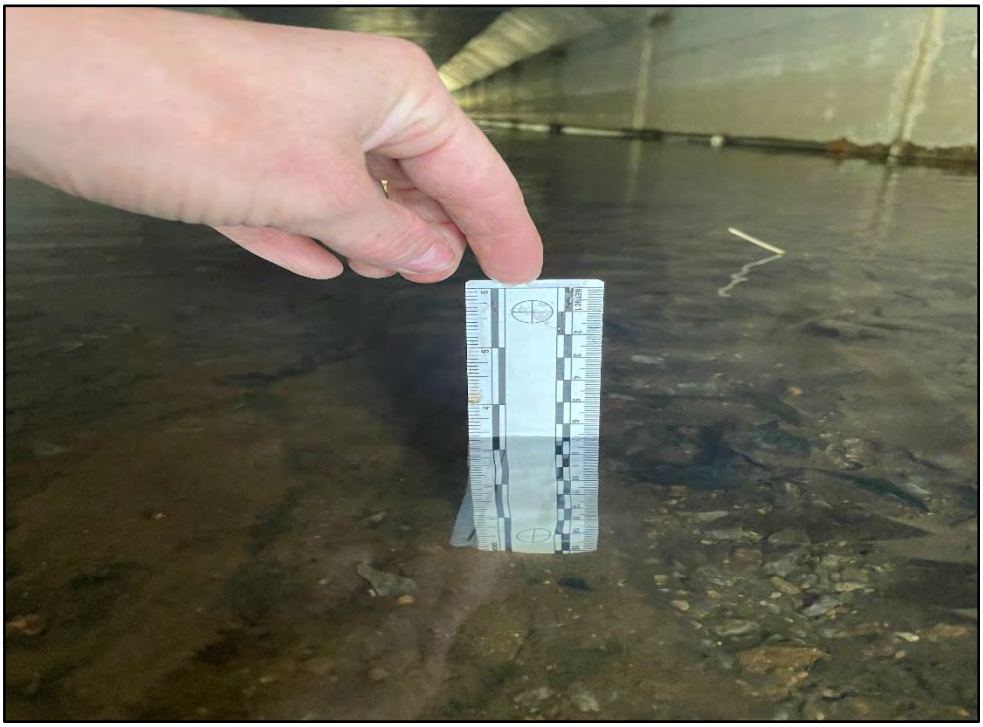


Photo 26. Over three inches of standing water in March of 2022 was observed in the tunnel. Photo taken from the northern entrance.

Photo 27. An additional view of the flooded tunnel after heavy rain, taken from the northern entrance.

Photo 28. The remains of an eastern coyote likely killed by a vehicle found in the northeast quadrant of the survey area.

Photo 29. Mammal bones found in the northwest quadrant of the survey area.

Photo 30. The remains of an American robin likely killed by a vehicle strike in the southwest quadrant of the survey area.

Photo 31. White-tailed deer (Odocoileus virginianus) hair found in the northeast quadrant.

Photo 32. The remains of a racoon struck by a vehicle in the northwest quadrant.

Photo 33. Eastern cottontail scat found in adjacent habitat in the southeast quadrant.

Photo 44. Eastern milksnake (*Lampropeltis triangulum*) remains in the road in the northeast quadrant.

Photo 45. Bird nest found in vegetated habitat adjacent to the road in the northeast quadrant.

Photo 46. The remains of a Virginia opossum likely struck by a vehicle in the northeast quadrant.

Photo 47. The remains of an American bullfrog (*Rana catesbeianus*) likely struck by a vehicle in the northeast quadrant

Photo 48. The remains of a painted turtle crushed by a vehicle in the northeast quadrant.