

Project Abstract

Scope of Work

The project proposes to reduce wildlife-vehicle collisions (WVCs) and reestablish wildlife connectivity in the heart of the Green Mountains, between some of the largest and least fragmented forest blocks in the northeastern U.S. The existing culvert carrying Sharkeyville Brook under I-89 and US Route 2 is old and under-sized and does not allow passage of large animals, which instead attempt to cross the highway, resulting in WVCs. A scoping report developed by VTTrans evaluated alternatives based on wildlife connectivity, cost, and stream hydraulics. The selected alternative is a 200-foot long span arch structure. This structure would provide a relatively large opening and will incorporate an elevated path for large animal travel and a stream channel to accommodate larger stream flows and aquatic animal passage.

Project Goals and Outcomes Anticipated: WVCs and Connectivity

The highway corridor passes through Vermont's Green Mountains and is the largest fragmenting feature in this mountain range. The corridor is flanked by two of the largest and most intact forest blocks in the Green Mountains, ranked Highest Priority for both Interior Forest Blocks and Connectivity Blocks. The area is also core habitat for moose and bear, and large concentrations of deer have also been documented at the culvert inlet area. Many collisions between motor vehicles and both moose and bear have been documented along this corridor, including one human fatality. A new structure that allows large animal passage would reduce WVCs and would reconnect these forest blocks, improving regional habitat connectivity, allowing aquatic organism passage, and contributing to the health and diversity of wildlife species.

How the Project Supports Safety, Climate Change and Sustainability, Equity, and Labor

The project would enhance safety by reducing the potential for WVCs to occur, particularly collisions involving large animals such as moose, which frequently end in human injury and even fatality. A warming climate is expected to result in a northward shift in wildlife populations. Scientists expect the Appalachian range to be a critical migratory pathway for wildlife populations adapting to climate change. As the I-89 corridor cuts squarely across this migratory pathway, having north-to-south connectivity will be critical to the successful adaptation of wildlife to climate change.

Outdoor recreation is available to all Vermonters, regardless of their socioeconomic status, and many Vermonters rely on hunting as a source of food. And as outdoor recreation comprises 4.1% of the state's overall economy, many Vermonters rely on it for their jobs and businesses. By promoting healthy ecosystems and wildlife populations, the project supports the recreation economy and the equitable access to recreation activities such as hunting and wildlife watching for all Vermonters and visitors to the state.

I. Project Description

The Vermont Agency of Transportation (VTrans) is pleased to submit this application requesting \$1.62 million through the Wildlife Crossings Pilot Program (WCPP) Discretionary Grant Program.

Vermont’s natural resources – its mountains, lakes, and farmlands, its fish and wildlife – are fundamental to the state’s identity and economy. Participation rates in outdoor recreation, along with its impact on Vermont’s economy, are among the highest in the country.

This is reflected in the VTrans Mission and Vision Statements, which promote *environmentally sustainable* transportation services and systems. More importantly, VTrans has a long track record of environmental stewardship and wildlife accommodation, illustrated by the following:

- VTrans initiated the first Northeastern Transportation and Wildlife Conference, which continues biennially.
- VTrans initiated a training program about the interaction of roads and wildlife called Habitats and Highways, which includes an introductory video (Tier 1) and a 4-day training seminar (Tier 2).
- VTrans helped get the first large, successful amphibian crossing structures in the northeastern U.S. approved and constructed.
- VTrans supported the development of various mapping and modeling tools that help evaluate the potential effects of transportation facilities on habitat connectivity, amphibian habitat, and other resources.

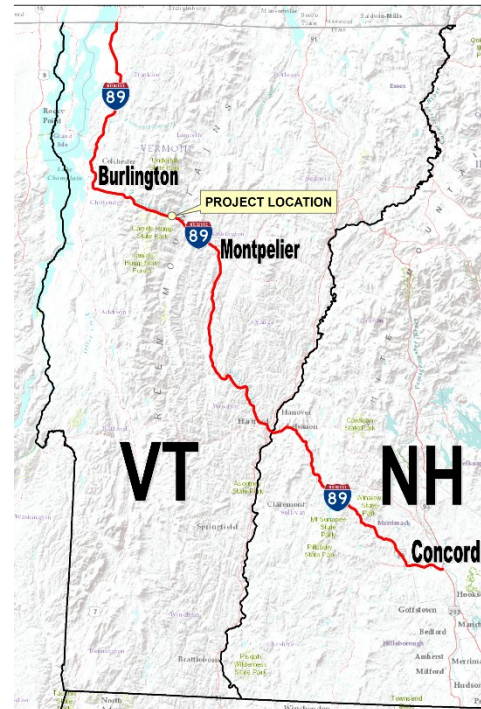


Figure 1 – Location Map

The proposed project is perhaps the single most important wildlife measure related to Vermont’s transportation system, because it would reconnect large and valuable habitat blocks in the Green Mountains that are separated by only the I-89 corridor. It would improve safety for motorists, benefit iconic wildlife species, and reconnect habitats that are critical to the habitat connectivity of not just the Green Mountains and Vermont, but the northern Appalachian Mountain range.

This grant application demonstrates the need for critical funding to address the need to reduce wildlife-vehicle collisions (WVCs) along the Interstate 89 (I-89) and US Route 2 corridor while also restoring wildlife connectivity in the Green Mountains near the Town of Waterbury, Vermont – connectivity that was cut-off when I-89 was constructed. The location chosen for this project to reduce collisions and enhance connectivity is Sharkeyville Brook, which currently flows under both I-89 and US Route 2 in a 6’ diameter corrugated metal culvert. This new structure will

provide safe wildlife passage in this rural area between two of the most important habitat blocks within the Green Mountains, the State of Vermont, and the broader region.

I-89 was constructed as part of the Dwight D. Eisenhower National System of Interstate and Defense Highways in 1961. It is Vermont's most traveled roadway and it is the only Interstate Highway to directly serve both Vermont's capital city (Montpelier) and its largest city (Burlington). Interstate 89 forms a substantial part of the main connection between the cities of Montreal and Boston. While the interstate provided much needed connectivity for passenger vehicles and freight traffic from Boston to Montreal, it divided a critical habitat in two and severely restricted wildlife connectivity and passage between the two sides of the highway.

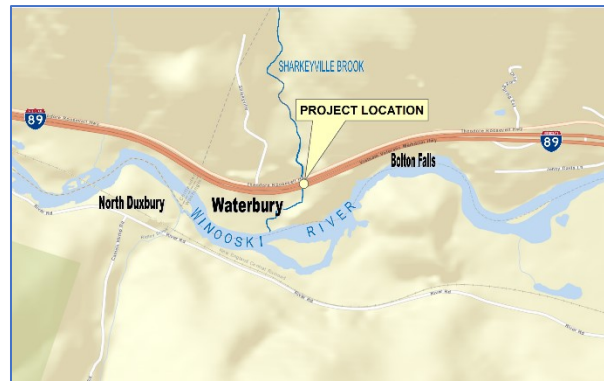


Figure 2 – Project Location

I-89 in this area consists of two 12' lanes in each direction with 10' wide shoulders on the right side and 6' shoulders on the left side. A paved median with a concrete barrier separates northbound and southbound traffic. Route 2 is located directly adjacent to the interstate, separated from it by a grass strip and double-sided guardrail. US Route 2 is a minor arterial and consists of one 11' travel lane in each direction with 4' shoulders on each side. Interstate 89 carries more than 12,000 vehicles in each direction per day while US Route 2 carries a total of 5,500 vehicles per day in both directions. This section of the interstate and the relocation of US Route 2 directly adjacent to it were originally constructed as one project, including the culvert pipe carrying the Sharkeyville Brook.

This portion of I-89 is located within a rural area that is a heavily wooded section of the Winooski River Valley and has been identified as a location that is home to many of the species common to Vermont. There is prime habitat located within the valley on both sides of the highway; however, the existing populations are not able to maintain healthy species diversity because the interstate and US Route 2 prevent migration between the two sides. Mammals up to and including deer, moose, and bear are all located here and have been fragmented into separate populations by the interstate highway reducing the opportunities for



Wide Expanses of High-Speed Roadway and Concrete Median Barrier Increases the Risk of Wildlife Collisions

genetic transfer. The median barrier creates an additional impediment to mammals crossing the highway and contributes to increased rates of wildlife mortality and vehicular crashes.

The importance of the area near Sharkeyville Brook for wildlife crossing and connectivity has been identified and discussed in numerous studies, reports, meetings and correspondence over the years. VTrans has undertaken efforts to study and better understand and implement both improved wildlife connectivity and safety for motorists. Roadkill data collected between 1986 and 2006 show many WVCs involving moose and bear and though very little information is available regarding collisions with deer, it is common knowledge that this area sees many collisions. In addition, in 2006 (and later updates), the State of Vermont published mapping of statewide road segments with Wildlife Crossing Value, which identified the Project location, as High Wildlife Habitat Suitability.

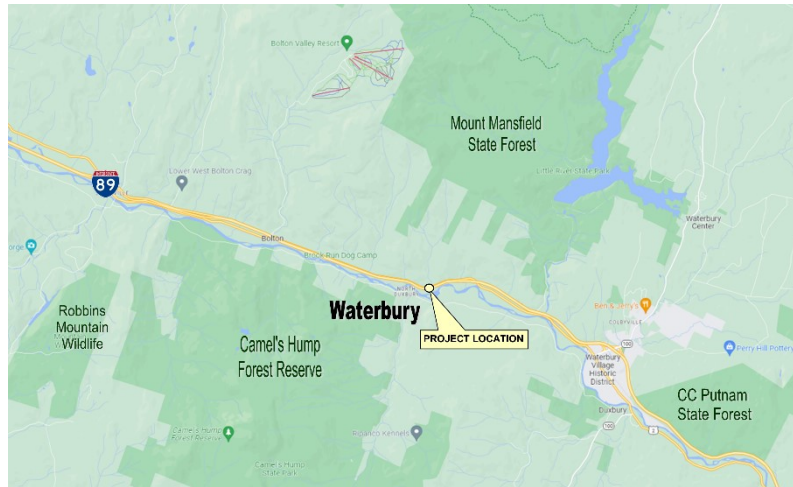


Figure 3 - Important Forested Habitat (including State Forest Land) is Separated by the I-89/US 2 Corridor

A Wildlife Connectivity Study (WCS) published in 2016 examined wildlife occurrence and habitat connectivity along an approximately 7.5-mile corridor along I-89. Please refer to *Bolton Waterbury STP 2709(1) Wildlife Connectivity Study Final Report* located at <https://www.mjinc.com/mjweb/projects/public/waterbury>. That study identified this area of the

Green Mountains in Vermont as one that would realize significant benefits to both reducing vehicle impacts and increasing wildlife connectivity given the particularly large numbers of wildlife in the area and high connectivity value. The study looked at several areas along the corridor, including the area near Sharkeyville Brook and the brook and the surrounding terrain were identified as a high priority area for improving wildlife connectivity as it has “a particularly high level of wildlife activity.”

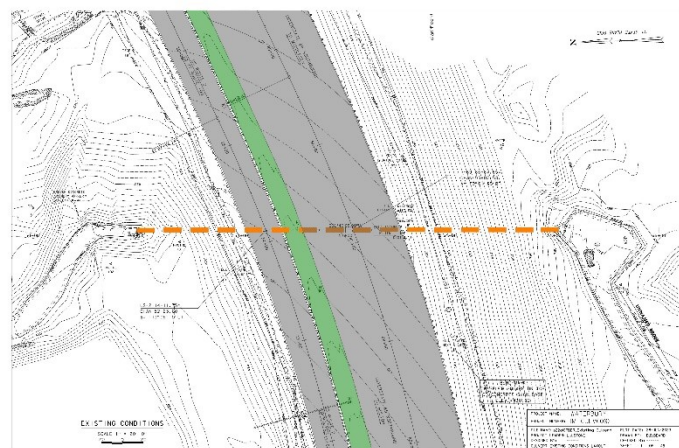


Figure 4 – Plan View of Existing Culvert

Existing Pipe Culvert

The existing structure carrying Sharkeyville Brook under I-89 and US Route 2 is a 6' diameter corrugated metal culvert located at Milepost 67.49. The latitude/longitude of the culvert site is approximately 44°21'35"N 72°49'12"W. This culvert was installed during the original construction of the roadway in the early 1960's and is located approximately 0.18 miles east of the intersection of Sharkeyville Road with US Route 2. Thus it is over 60 years old and fast approaching the end of its usable life. The culvert has held up relatively well, but the culvert invert appears to be deteriorated near the inlet and outlet. A complete inspection has not occurred in some time; however it is assumed that the pipe invert is showing deterioration along its entire 395' length.

The brook itself is somewhat larger than the culvert pipe currently in place with the bank full width of approximately 20 feet. The pipe outlet is perched with a large scour hole at the end approximately 12' below the elevation of the culvert outlet. The culvert size and topography are detrimental to both fish and animal passage of all kinds. Since the culvert is located approximately 60' below the level of the roadways above, flooding or damage of the roadways above is not an issue unless the culvert invert were to fail.



The perched outlet of the existing culvert precludes aquatic organism passage in addition to being detrimental to the passage of mammals

Proposed Solution

Based on the need to replace the culvert carrying Sharkeyville Brook, VTrans began evaluating possible options. Please refer to the Scoping Report for the Waterbury IM CULV(109) project prepared by VTrans at <https://www.mjinc.com/mjweb/projects/public/waterbury>. Since the culvert was identified as a high priority location for enhanced wildlife connectivity VTrans is only considering options that provide good aquatic and terrestrial wildlife passage. Options considered included a four sided Precast Box Culvert, a Long Span Precast Concrete Arch Structure, and a three span Conventional Steel Girder Bridge.

The box culvert option considered a box 18' wide to accommodate the natural bankfull width of the stream with a height of at least 6'. This is the least costly solution but the box culvert span and height would need to be increased substantially to accommodate large ungulates like deer and moose in order to serve as a suitable conduit for wildlife. The length of the structure is also a consideration as many animals will refuse to utilize a crossing structure if it appears to be too confined and limits the natural lighting. This "Openness Ratio" is calculated as the area of the opening divided by the length. In this case, using a length of approximately 350 feet yields an openness ratio of 0.3.

Limited data exists correlating openness ratios to the likelihood and frequency of large mammals using a given structure; however, from the available research, it appears that a minimum ratio between 10 and 15 is needed to provide a crossing that large mammals will use. Even if the box culvert height is increased to a level that would allow moose to enter the culvert (say 15') the openness ratio would still be less than 1.0. From this, it is clear that a larger opening and shorter length are needed to not only accommodate, but encourage, wildlife usage. A precast box culvert of the size needed to accommodate wildlife passage cannot be feasibly manufactured and transported to the site. For this reason, VTrans rejected a box culvert as a viable solution.

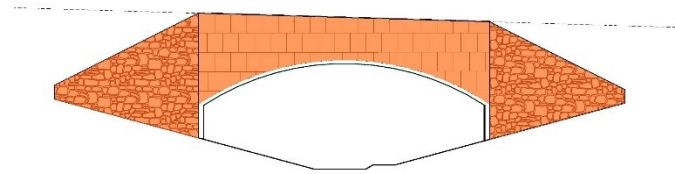


Figure 5 – Elevation View of Proposed Long Span Arch Structure

The second option (shown above in Figure 5) is a long span arch structure of approximately 100' in length. As can be seen, this structure would provide a much more open and inviting conduit for wildlife, provide more natural lighting and will incorporate a path elevated from the channel to accommodate large mammals and low flow channels and other features to accommodate aquatic habitat. Because the roof of the structure is much higher than the first option, it reduces the length substantially to approximately 200' (see Figure 6 shown below). With the increased opening and decreased length an openness ratio of approximately 13 is obtained, which is within the minimum range mentioned above. Consequently, this structure has a much higher probability of success in achieving the goals of the project to decrease WVCs and increase connectivity.

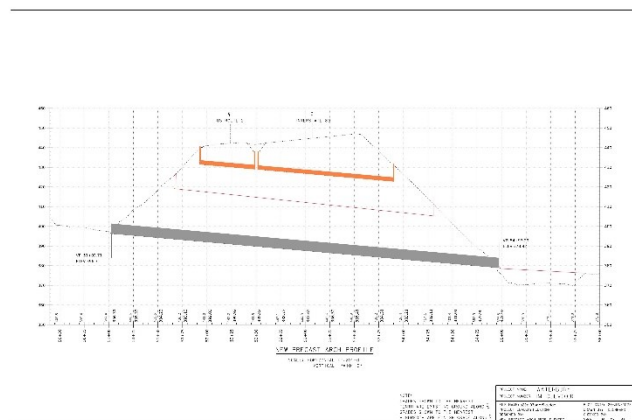


Figure 6 – Profile of Proposed Long Span Arch Structure

The final option considered is the installation of new three span steel girder bridges for both barrels of I-89 as well as US Route 2. The span of the structures is approximately 215 feet long and would provide a very large openness ratio of approximately 38. This type provides the optimum chance for success in meeting the project goals, but the design, construction and future maintenance costs for this option are substantially greater than the previous options considered.

A scoping report developed by VTrans identified the options shown above and compared the alternatives based on several factors, including cost. Other factors that were considered include the stream hydraulics and construction considerations, including traffic control. Trenchless installation of the culvert option is a possibility, but as the culvert becomes larger, trenchless options would be removed from serious consideration. Closing the interstate highway would have unacceptable impacts to commuter and commercial traffic so phased construction using crossovers is the preferred option during construction.

While a formal Benefit Cost Analysis was not performed, when all items are considered in the context of the project goals, the long span arch was determined to provide the greatest benefit to cost ratio. This option is estimated to cost approximately \$13.6 million. For comparison, the box culvert option is estimated to be approximately \$13.3 million and the bridge is estimated to cost approximately \$28.1 million. This grant would be applied to the preliminary engineering work still to be done to refine the design and make sure that the most cost-effective option that meets the project goals is carried through to construction.

Benefits to Reduction in Vehicle Collisions and Improved Wildlife Connectivity

The purpose of this project is twofold. First, is the need to improve safety along this stretch of I-89 by reducing WVCs. The second goal of the project is to increase wildlife connectivity in this area. I-89 and US Route 2 act as a barrier to wildlife interaction, impeding species diversity and migration, as well as reducing access to the Winooski River. By providing a crossing structure that wildlife will use as an alternative to crossing the highway, VTrans is increasing public safety while reducing wildlife mortality and increasing species connectivity.

The WCS indicated that I-89 has caused significant fragmentation of both habitats and wildlife populations. This contributes to a reduction in diversity of the gene pool with some species, making the population less resilient. The initial impetus of the WCS was anecdotal evidence of wildlife mortality as well as a number of reported crashes. Unfortunately, specific crash data has not been easy to obtain as reporting of crashes is haphazard at best. However, when animal tracking cameras were checked over two winters eight animal deaths were observed on the roadway.



Reducing Wildlife Collisions and Increasing Wildlife Connectivity Provides Many Benefits to Vermont's Residents

Species that would benefit from the installation of a crossing structure carrying Sharkeyville Brook range from very small mammals to medium size mammals such as raccoon, fox, coyote, and mink to large mammals such as deer,

bear, and moose. Large mammals in particular would benefit greatly if a crossing of this type is installed, but small and medium size mammals would also benefit as the concrete median barrier on I-89 is particularly troublesome, trapping some of these smaller mammals on the roadway. Deer wintering areas are located on both sides of the highway so it is clear that these animals would benefit from a crossing structure. A review of the WCS provides an indication of the fragmentation that has occurred as there were significant differences for some species from one side of the highway to the other.

The new structure will also provide additional connectivity for aquatic organism passage in two ways. First, a low flow channel will be provided within the widened channel bottom to facilitate passage even during times when water flow is at a minimum. In addition, a large scour hole has formed at the culvert outlet. This hole will be filled in, making the channel a consistent slope for its continuation to the Winooski River below.

There are a range of aquatic organisms that would benefit from these improvements. The current culvert is a barrier to most stream-dwelling invertebrates and restoring the connection with stream habitat would allow these animals to move freely upstream and downstream. Salamanders that are found in and along stream corridors would also benefit, including dusky, two-lined, and spring salamanders. Wood turtles, a Species of Greatest Conservation Need (VT Wildlife Action Plan) are found in the Winooski River and other streams in the area and could follow the restored stream channel to riparian habitat north of the highway. Even semi-aquatic animals like mink, which are usually found along streams and shorelines, would find new foraging habitat and travel corridors.



The new arch bridge will allow the stream to flow freely providing new access to aquatic organisms

While much of the land within the Winooski River Valley floodplain is privately owned, Vermont Public Lands is the caretaker of much of the surrounding slopes which are much steeper than the valley areas. As is normal, the flatter areas have been developed, however the area near Sharkeyville Brook is still largely undeveloped consisting of forested areas near the river, providing prime habitat for many species endemic to Vermont.

Much of the interstate system in Vermont was constructed in the late 1950's and early 1960's and, as with many transportation corridors, the roadways were built within river corridors to take advantage of the open areas and flatter grades available. At that time very little thought was given to wildlife fragmentation and mortality. As these facilities are now reaching the end of their design life and repair or replacement are considered, VTrans is viewing this work as a time to consider how the roadway may better fit into the natural environment.

As part of that process VTrans has made a commitment to the consideration of increased wildlife movements and decreased wildlife mortality. As the applicant, VTrans is committed to enhancing opportunities to preserve wildlife as well as reducing crashes along state roadways. VTrans has demonstrated experience in the receipt and expenditure of Federal Highway Program funds under Title 23, U.S.C. and other federal programs.

Letters of Support for this project, received from several different agencies, are included in Appendix A. These supporters realize the many benefits that improved wildlife connectivity and reductions in wildlife-vehicle collisions provide to the State of Vermont, its citizens, and the traveling public at large.

Below is a rendering that provides a sense of how the new long span arch structure that is proposed at this location will fit into the surrounding terrain. The new opening will allow Sharkeyville Brook to flow freely while also providing an inviting opening that should encourage a wide range of species to utilize the new crossing, avoiding the dangerous highway above.



A Rendering of the Proposed Crossing Looking North Toward Interstate 89

II. Budget Narrative - Grant Funds, Sources, and Uses of All Project Funding

Project Costs

VTrans is requesting \$1.62 million under the WCPP program, which is 80% of the estimated cost to fund the design and studies required to advance this wildlife crossing to the construction phase. The total cost for the study, design, and permitting phase of the project is estimated to be \$2.025 million. This includes engineering design, NEPA environmental documentation, environmental permitting, and a wildlife-vehicle crash study and documentation. The WVC study and documentation is proposed to be completed concurrently with the design and permitting so as to provide a baseline that can then be compared to the crashes later after the wildlife structure is completed.

The total project cost for design and construction is estimated to be \$13.6 million for the preferred alternative established in the project scoping study. This estimate is based on current unit costs based on other representative projects and will be refined as the design progresses. VTrans may request additional funding for construction through the WCPP program at a later date.

The project will be funded using funds from the WCPP Program for Design and Construction and using an 80%-20% funding split between the WCPP Grant and State funds. VTrans will pursue additional funding as detailed later in this application under Criterion 2.1. See the table below illustrating the project costs broken down by activity and funding source.

Sharkeyville Brook Wildlife Crossing Project Costs				
Project Activity	Activity Cost	Funding Source		
		WPCG Grant	Vtrans (State)	
Preliminary Engineering	\$ 1,500,000	\$ 1,200,000	\$ 300,000	
Environmental Documentation	\$ 225,000	\$ 180,000	\$ 45,000	
Environmental Permitting	\$ 150,000	\$ 120,000	\$ 30,000	
WVC Study and Documentation	\$ 150,000	\$ 120,000	\$ 30,000	
Total Initial Project Cost	\$ 2,025,000	\$ 1,620,000	\$ 405,000	

Funding for the Sharkeyville Brook is not currently included within the Statewide Transportation Improvement Program (STIP). Since this plan is fiscally constrained, a project of this size can only be included when a funding source is identified. In Vermont the STIP covers a four year period and can be amended at any time as the need arises.

If this project is selected to receive funding under the WCPP VTrans will include it in the next version of the STIP in order to fund the project. If it is necessary to amend the STIP, VTrans will develop an amendment. Amendments to the STIP are generally easily obtained if funding can be made available.

III. Project Merit Criteria

Criterion # 1.1 – Reduction of Wildlife Vehicle Collisions

Large animal (primarily moose and bear) WVCs were recorded and published for a 20-year period from 1986 to 2006 and compiled again starting in 2012. The data show a high number of WVCs along this stretch of road, roughly from Exit 10 in Waterbury (one mile east of the Project) to Exit 11 in Richmond (13 miles west) (as seen in the [VT Interactive Map Viewer](#)). Notable were:

- Over a three-year period (1997-1999), there were 6 moose and 1 bear collision on the one-mile stretch of I-89 and Route 2 centered on the existing culvert.
- Since 2012 there have been 14 recorded moose-vehicle collisions between Exits 10 and 11, including one human fatality.
- Since 2016 there have been 17 recorded bear-vehicle collisions along the same stretch of road. All resulted in bear mortality except one, in which the animal’s fate was unknown.

The high concentrations of wildlife in the vicinity of the structure, particularly deer, suggests that the actual numbers of WVCs are much greater than the above numbers suggest, and WVCs will continue.

Moose are among the largest and most dangerous animals that motorists may encounter crossing roads and are common in the project vicinity. The costs of the WVCs in the I-89 corridor were not recorded, but data on wildlife-vehicle collisions elsewhere showed that



Figure 7 - Wildlife-Vehicle Crashes are Common on I-89

moose-vehicle collisions lost an average of \$82,646, taking into account vehicle damage and personal injury. This data came from *Update and Expansion of the WVC Mitigation Measures and Their Cost-Benefit Model* located at <https://www.mjinc.com/mjweb/projects/public/waterbury>.

U.S. Route 2, I-89, the Winooski River, a railroad line, and local roads and driveways occur along this highway corridor, but the area around the project culvert is sparsely settled with mostly intact habitat along both sides of the highway. US 2 passes under I-89 approximately one-half mile east of the project and closely parallels the north side of I-89 for 3.7 miles to Bolton Village to the west, where it passes under I-89 again. Several residential driveways and local roads have frontage on US 2, but in the one mile stretch of highway centered on Sharkeyville Brook, only one small loop road has frontage (Sharkeyville Road).

South of I-89 is the Winooski River, which is relatively shallow and for much of the year freely crossed by most wildlife species. Approximately one mile west of the structure there are fragmenting features on both sides of the highway, including fields and residences to the north and a railroad line to the south. In short, within this corridor that is so critical to landscape connectivity, the Sharkeyville Brook area of I-89 is the one road segment with minimal fragmenting features and outstanding connectivity features making it the best choice for a structure of this type.

Near Sharkeyville Brook, US 2 and I-89 form a sweeping curve around the stream valley and adjacent ridge lines. The curve reduces sight distance and compounds the danger of wildlife-vehicle collisions. VTrans currently has three wildlife crossing warning signs in the vicinity of Sharkeyville Brook. They include:

- a Wildlife Crossing sign on US2 North less than one mile east of the Project;
- a Wildlife Crossing sign on I-89 North just east of Exit 10; and
- a Moose Crossing sign on I-89 North three miles east of the Project.

No other wildlife-specific mitigation measures have been taken in this area, and no other transportation improvements, other than normal highway resurfacing, are planned for the immediate project area.

The species recorded in WVCs along this stretch of highway are primarily moose and bear, which are the largest animals in the project area, and therefore the most dangerous to motorists. The WCS showed that deer are abundant in the project area, and many deer are believed to be killed on the highway but are not typically reported to VTrans. As shown on Figure 8 extensive deer wintering areas are located along the north side of the highway.

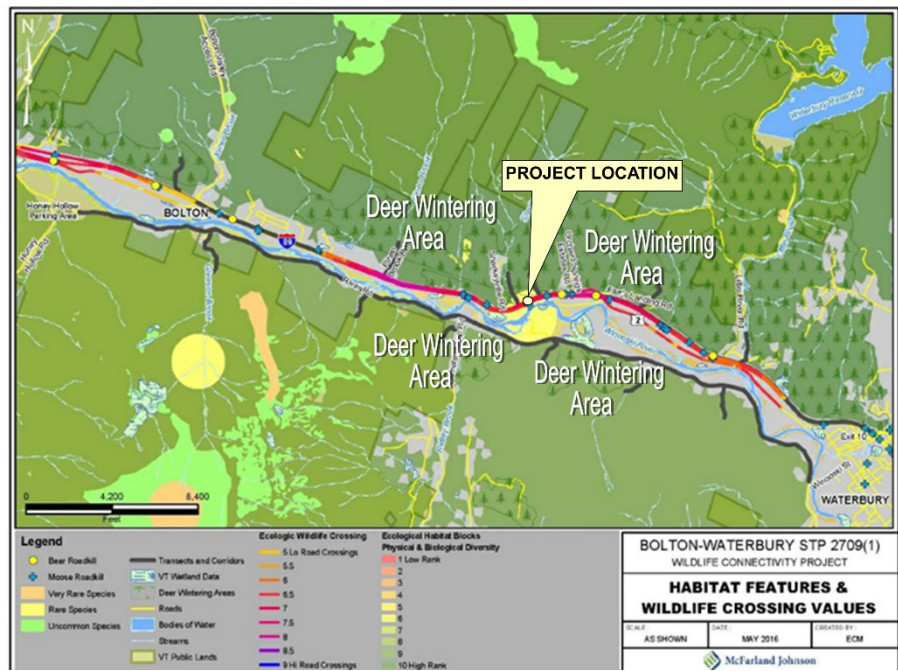


Figure 8 – Deer Wintering Areas are Extensive near Sharkeyville Brook

Trail camera data from the WCS showed this location to have the highest deer numbers of any of the 40 camera locations within the 8-mile I-89 corridor. Deer were also frequently photographed accessing the Winooski River, on the opposite side of the highway. Based on these findings as well as the topography and other factors, the WCS identified this area as a high priority crossing.

Many factors contribute to the importance of this crossing area for wildlife connectivity and for reducing WVCs. The topography within the Green Mountains; the historical record of WVCs along this roadway corridor; the large aggregations of wildlife documented in the immediate vicinity; and the roadway geometry indicate that both wildlife and motorist safety would be greatly improved with construction of a wildlife crossing structure. As VTrans implements updated wildlife monitoring through a proposed trail camera, tracking and roadkill reporting program, data will be gathered that will allow a better estimate of the numbers, kinds, and costs of wildlife movements and WVCs.

Criterion #1.2 - Improvement of Terrestrial and Aquatic Habitat Connectivity.

The Northern Appalachians are one of the largest intact temperate deciduous forests in the world. Vermont’s Green Mountains lie within the heart of the Appalachians and contain some of the most intact, least fragmented habitat in that region.

Cutting across the Greens and separating large forest blocks to the north and south is the Interstate 89 corridor, a four-lane interstate closely paralleled by U.S. Route 2, a railroad line, and the Winooski River. The project lies strategically between two large, relatively unfragmented habitat blocks with high physical and biological diversity, rare species, and extensive protected land.

Shown at right is a map excerpted from a report titled Vermont Conservation Design, located at <https://www.mjinc.com/mjweb/projects/public/waterbury>. This report identifies and describes forest blocks within Vermont. Blocks located north and south of the project area are large and intact and have high habitat and connectivity value. They have two designations as determined by the Vermont Agency of Natural Resources BioFinder, an online repository for VT Conservation Design mapping, located at <https://anrmaps.vermont.gov/websites/BioFinder/> :

- Interior Forest Blocks are considered especially important for the interior forest functions they provide and are areas of natural forest cover surrounded by roads and development.
- Connectivity Blocks are considered critically important for habitat connectivity across the Northern Appalachians. They connect core habitat, allowing for genetic exchange across populations of far-ranging animal species, with places of diversity in the physical landscape as well as the riparian network.

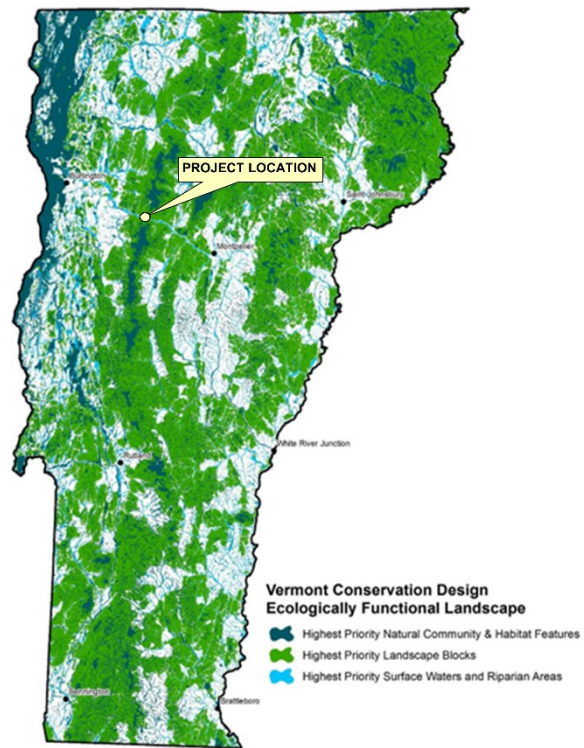


Figure 9 –Forest Blocks within Vermont

The habitat block on the north side of the project is ranked 10 of 10 for both Interior Forest and Connectivity and is over 72,000 acres. The habitat block to the south is nearly 55,000 acres and is ranked 9 out of 10 for both designations. Both forest blocks are also ranked Highest Priority.

The 5-mile stretch of I-89 passing through the main spine of the Green Mountains – between Little River to the east and Bolton Village to the west – is lacking in suitable terrestrial wildlife passage opportunities. The proposed project lies nearly in the middle of this highway segment and as noted above was identified in the WCS as the highest priority potential wildlife crossing along this roadway corridor.

The WCS included extensive trail camera deployment and winter tracking. Cameras were positioned at culverts, bridges, roadside habitat, and habitat further from the road. Winter tracking was conducted along both sides of the entire 8-mile road corridor. The study found that many species of wide-ranging, medium- and large-size mammals occur in abundance and move freely within habitat both north and south of the highway corridor. The larger mammals – deer, moose, bear, and coyote – occur in forested habitat all along the I-89 corridor. Deer were by far the most abundant: over the two-year study the 40 trail cameras recorded photos of over 5,000 deer. At this specific location, deer, moose, bear, coyotes, and other mammals were photographed and their tracks recorded, and deer were particularly abundant. However, during the study there was evidence of only one animal (a mink) passing through the existing culvert.



Black bears are located on both sides of I-89 and frequently cross the roadway

Winter tracking showed that 71% of animals that crossed I-89 crossed on the road surface, 19% passed through culverts and 10% under bridges. When animals do attempt to cross the highway, mortality is often the result, as demonstrated by the WVC data described above.

With regard to the Sharkeyville Brook area the WCS stated: “Trail cameras revealed a very high concentration of deer, along with photos of moose, coyote, and bear in the vicinity of Sharkeyville Road and Stream. Winter tracking revealed that coyote, fox, fisher, mink, and weasel cross over or under the highway in this area. There was little use of the Sharkeyville Stream culvert, but a 36-inch dry storm drainage culvert was used by three species. This appears to be an area of potentially high importance for wildlife connectivity.”

The north side of the highway has extensively mapped deer wintering areas which continue several miles to the east to Waterbury village. Smaller pockets of deer wintering areas are also mapped to the south of I-89.

The forests on the north and south sides of the corridor are intact with over 10 miles of unbroken forest in each direction. As described above, Vermont has mapped the blocks on the north and south sides of the I-89 corridor as Highest Priority for both Interior Forest Blocks and Connectivity Blocks. Wildlife habitat features include ridge lines and stream valleys, which serve as travel corridors; rare species and their habitats; mapped deer wintering areas; and protected lands. Vermont's moose and bear biologists consider these habitats to be core habitat for those species.

There are also extensive conserved lands both north and south of the project corridor. To the north is Mt. Mansfield State Forest, which is 69 square miles plus adjacent conserved and private forest lands. To the south is Camel's Hump State Park, which is 33 square miles and is part of the 128-square-mile Camel's Hump Forest Reserve.

The current I-89 corridor includes a number of impediments to wildlife movement, including a concrete median barrier separating the two travel lanes in each direction. It is closely paralleled by U.S. Route 2, so it is effectively a three-barrel roadway. In addition, there is double sided guard rail and chain link fence between I-89 and US Route 2.

The Winooski River runs along the south side of the highway. While a barrier to some species, it is known to be crossed by deer, bear, moose, and other species, and is not considered a barrier to the larger, wider-ranging species that are of greater concern in wildlife-vehicle collisions.

A local road runs along the south side of the Winooski River and the southern edge of the corridor. Traffic volume on this road is relatively light and winter tracking studies showed that it is crossed much more frequently than the highway and is not believed to be a substantial barrier to habitat connectivity.

There are a wide range of aquatic organisms that would benefit from the proposed improvements to the crossing structure. The current small diameter culvert and perched outlet structure is a barrier to most stream-dwelling invertebrates and restoring the connection with stream habitat would allow these animals to move freely upstream and downstream. Salamanders that are found in and along stream corridors would also benefit, including dusky, two-lined, and spring salamanders. Wood turtles, a Species of Greatest Conservation Need (VT Wildlife Action Plan) are found in the Winooski River and other streams in the area and could follow the restored stream channel to riparian habitat north of the highway. Even semi-aquatic animals like mink, which are usually found along streams and shorelines, would find new foraging habitat and travel corridors.



Smaller creatures like this Dusky Salamander would also use an improved crossing structure

Improved wildlife connectivity would create a connection between important habitat blocks which themselves are part of a globally significant temperate deciduous forest bioregion. The I-89 corridor has been shown to be a substantial impediment to movement in an otherwise resource-rich area. As the northeastern U.S. and southeastern Canada continue to develop and lose habitat, connectivity increases in importance. Making this particularly critical is the prospect of climate change and the population movements that are expected to follow.

A warming climate is expected to result in a northward shift in wildlife populations. The Appalachian range, with extensive forested habitat and cooler, higher elevation habitat, will be a critical migratory pathway for populations adapting to climate change. Recent studies have indicated that as the climate warms wildlife populations will be funneled northward along the Appalachians, and the Vermont I-89 corridor cuts squarely across this migratory pathway (as stated on The Nature Conservancy's website, a global environmental nonprofit working to create a world where people and nature can thrive [Appalachians | The Nature Conservancy](#)). Having north-to-south connectivity will be critical to the successful adaptation of wildlife to climate change.

The Vermont Fish and Wildlife Department and the Vermont Agency of Transportation are founding partners of the Staying Connected Initiative (SCI) which is focused on habitat connectivity across the Northern Appalachian/Acadian ecoregion. This initiative is a public/private partnership between more than 70 Federal, state, provincial, and non-governmental organizations in the northeastern United States and southeastern Canada. Five of SCI's critically important wildlife linkages occur within Vermont making improved connectivity in Vermont of utmost importance to the entire eco-region. The Waterbury site is part of the Northern Green Mountains to Suttons linkage and further connects the northern Green Mountains to the central Green Mountains.

Secondary Merit Criteria

Criterion #2.1: Leveraging Investments

The State of Vermont is prepared to provide the required 20% local share of project funding. The state has a long history of successfully funding major transportation projects. In addition, VTrans is investigating alternative sources of funding for construction. This approach was taken by a recent and highly successful amphibian road crossing structure in Monkton, VT. That project was funded by a combination of private and public sources, including local, state and national conservation organizations; a "crowdfunding" initiative; and multiple state and federal grants. As part of the design process VTrans is committed to investigating and reaching out to other



A variety of fox species would be expected to utilize the new crossing, including the Gray Fox

organizations that have an interest in reducing WVCs and improving wildlife connectivity along the I-89 corridor. This effort is ongoing.

Criterion #2.2: Economic Development and Visitation Opportunities

Vermont’s natural resources are central to its economy and its identity. According to the Vermont Chamber of Commerce, on average 13 million people visit Vermont providing an annual economic impact of over \$3.2 billion, making tourism the state’s second largest economic driver and accounting for 10 percent of Vermont’s workforce employment. Many Vermonters rely on hunting as a source of food, with over 3,000,000 meals of venison obtained in 2019 alone based on the Vermont Fish & Wildlife Department Performance-Based Budget 2020 Report. Outdoor recreation is available to all Vermonters, regardless of their socioeconomic status.

The proposed project supports these critical outdoor recreation activities by promoting healthy wildlife populations and ecosystems. Nowhere is this more important than in the heart of the Green Mountains, where some of the most valuable habitat blocks in the state – and the region – are separated by the I-89/US 2 corridor. The project will reduce WVCs and improve habitat connectivity, thereby strengthening the populations of large, iconic wildlife species such as moose and bear, economically important species such as deer; and a range of other species that are critical to healthy ecosystems. The project will allow these ecosystems and wildlife populations to continue to support equitable access to recreation activities such as hunting and wildlife watching for all Vermonters and visitors to their state.



Moose are common in this part of the Green Mountains

Criterion #2.3: Innovation

The selection of a long span precast concrete arch is an innovative structure for this type of application. It will provide an openness ratio that should be suitable for attracting its use by the large mammals in the area. In addition, it will be quicker and easier to construct than a large bridge structure. Precast elements are also long-lasting and generally require less maintenance over the life of a structure than a steel beam bridge structure as they are shielded from salt spray and other environmental factors that can work to increase deterioration of exposed structural elements. On this structure, both the arch and the entrance and exit wingwalls can be precast off site, providing a greater degree of quality control while minimizing defects, providing a longer service life for the final product.

The project will incorporate relevant technologies to ensure maximum effectiveness of the crossing structure. As part of the design process the design team will investigate different kinds

of fencing (materials, gauge, heights), jumpouts, “cattle guards”, fencing end treatments, and other features to ensure as many animals as possible, small and large, are directed toward the structure and away from the road surface. The design team will also consider animal-activated signage to alert motorists of large animals that may be entering the road surface outside of the structure, particularly at fence termini.

By implementing the use of relevant technologies to redirect wildlife to the structure where feasible, VTrans may be able to maximize the effectiveness of the structure in reducing WVCs. The more effective the structure is, the better habitat connectivity it will provide and the more WVCs it will prevent from occurring.

Criterion #2.4: Education and Outreach

The VT Fish & Wildlife Department has been actively striving to educate and engage the public regarding the important role they have to play in reducing WVCs. In their website encouraging people to participate in the “ROaDS” roadkill reporting system ([VT ROaDS and Wildlife | Agency of Natural Resources \(vermont.gov\)](http://VT ROaDS and Wildlife | Agency of Natural Resources (vermont.gov))), they describe how some animals cross the roadways seeking food, water, shelter and access to mates. Some wildlife movements are simply normal migration and some movements may be in response to climate change. They encourage people to participate in a citizen science initiative to help identify animal crossing locations:

“Roadkill tells us where our road system is still acting as a barrier and can be helpful information to fish & wildlife and transportation managers about spots where improvement is necessary. In some cases that could mean enlarging nearby bridges or culverts to allow for under the road movement. Please help us learn more about where wildlife are crossing roads by using this Roadkill Observation and Data System (ROaDS) system to report roadkill and animals close to the road.”

The results will shed light on the success of future wildlife crossing initiatives such as the proposed Sharkeyville project.

The VT Fish & Wildlife Department will continue its outreach efforts, such as the ROaDS roadkill reporting initiative, to educate the public about wildlife crossings in an effort to engage them in documenting crossing location success or failure. Most importantly, it encourages the public to care about the wildlife resources that are impacted by the road system they enjoy and use every day.



Deer Wintering Areas near I-89

Criterion #2.5: Monitoring and Research

The proposed project will utilize the existing research and baseline information available for the project area. This includes:

- Large animal roadkill records collected between 1986 and 2006 and since 2012.
- Any additional roadkill records that may be available.
- The WCS, which drew upon two years of wildlife camera images and winter tracking at the project location and extending along an 8-mile stretch of the I-89/US 2 corridor.

As part of the grant for this project, over a two-year period in 2024 and 2025, VTrans plans to install additional wildlife trail cameras at the inlets and outlets of Sharkeyville Brook and the surrounding habitat to obtain systematic records of the numbers of large animals in the area and to conduct winter tracking along an approximately one mile stretch of road to establish baseline road crossing numbers. This data will provide baseline conditions for future post-construction monitoring, which will employ the same methods to determine post-construction wildlife numbers and movements around and across the roadway corridor.

Simultaneously, VTrans district staff will be tasked with regular recording of roadkill locations along the 8-mile road corridor. This will be paired with the ROaDS citizen science reporting data to get an estimate of pre-construction and post-construction WVCs.

All of this data will be combined to determine the approximate number of animals crossing safely under the roads, the numbers continuing to pass over the road surface, and the numbers of WVCs still occurring or avoided. The results will be used adaptively to adjust the infrastructure and practices as needed. For example, additional animal-activated signage; longer fence barriers; better jumpouts or cattle guards; or other measures could be considered.

The results will be shared with other departments of transportation across the northeast and elsewhere to improve crossing structure design, effectiveness and implementation. VTrans has been a leader in organizing conferences, workshops and symposia to share knowledge on wildlife-transportation and other environmental issues facing transportation and wildlife agencies nationwide, including the recently hosted International Conference on Ecology & Transportation in Burlington.



***The Federally
Threatened Canada
Lynx***

Criterion #2.6: Survival of Species

I-89 and US Route 2 form a formidable barrier for many species. Lack of interaction between adjacent populations can lead to genetic isolation. This can adversely affect populations in a number of ways; for example, it may reduce genetic diversity, which in turn can reduce a population's resistance to, and ability to recover from, diseases. Reconnecting these habitats and populations will improve the genetic health of populations on both sides of the corridor.

The project is located within the historical range of the Federally threatened Canada lynx, a wide-ranging species which inhabits northeastern Vermont. The Vermont Natural Resources Atlas shows one rare plant and three rare animals in the immediate vicinity of the project.

IV. Project Readiness

VTrans has completed a scoping study for the replacement of the existing structure with a structure suitable for wildlife crossing. The scoping report process has been key to evaluating technical feasibility, determining project schedule, and identifying the required environmental approvals. Please refer to the Scoping Report for the Waterbury IM CULV(109) project prepared by VTrans at <https://www.mjinc.com/mjweb/projects/public/waterbury>.

Technical Feasibility

The proposed design does not pose particular risks related to its technical feasibility. While some details remain to be worked out, the basic structure – a long-span precast arch bridge with concrete abutments and wingwalls – has been installed successfully in many places. Ancillary structures such as fencing and fence jumpouts have likewise been used on many projects and do not pose technical challenges.

The most challenging aspect of the project may be the temporary placement of excavated material and storage of construction materials. It will be necessary to remove a large amount of embankment material in order to construct the long span arch and foundation. However, there are several areas close by which may be used as temporary storage sites.

Project Schedule

VTrans has been completing preliminary studies and analysis (e.g., the Scoping Report) so design work may proceed as soon as funding is secured. Because the project does not pose special technical feasibility challenges, the project schedule should be able to move forward without delay. If, in future design phases, there is a risk of fund expiration, VTrans has the option of utilizing the Design-Build project delivery method. VTrans has a well-defined process and history of success for delivering Design-Build projects.

FIGURE 10: PROJECT SCHEDULE

PROJECT ACTIVITY	2023		2024				2025				2026				2027				2028				
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Funding Procurement, Funds Allocated		■	■																				
WVC Study and Documentation			■	■	■	■	■	■	■	■													
Public Outreach				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Preliminary Design				■	■	■	■	■	■														
NEPA Environmental Documentation				■	■	■	■	■	■	■	■	■	■	■									
Environmental Permitting								■	■	■	■												
Final Design									■	■													
Contract Plan Development										■	■												
Bid-Phase & Procurement												■	■										
Construction																					■	■	■

Grant Funds Obligation Deadline September 30 2026



Required Approvals

Environmental Permits and Reviews including State and Local Approvals

The Scoping Report identified the key resources of concern within the project area. It is anticipated that the project will result in impacts to Waters of the United States and waterways under the jurisdiction of the State of Vermont. Based on the results of the scoping report, the project is expected to require the Federal, State, and Local approvals and permits listed below:

- NEPA Categorical Exclusion
- Clean Water Act Section 404 Permit
- Vermont Title 19 (Stream Alteration)
- Vermont Operational Stormwater Permit
- Vermont Construction Stormwater Discharge Permit
- Vermont Flood Hazard and River Corridor Permit

Because the project will be improving both the hydraulic capacity, aquatic organism passage and the wildlife passage capabilities of the structure, the project will be “self-mitigating” and no substantial obstacles are foreseen for obtaining permits and approvals.

Federal Transportation Requirements Affecting State and Local Planning

The project is not currently included in the Statewide Transportation Improvement Program (STIP). Upon notification of a Wildlife Crossings Pilot Program grant award, the project will be added to the STIP in accordance with the STIP Amendment Policy.

The scoping study included outreach in the form of a questionnaire sent to the Town of Waterbury. VTrans will continue working with the Town and the project’s neighbors, particularly residents of the private Sharkeyville Road development.

ROW Acquisition

The preferred alternative would not involve temporary construction easements or permanent right-of-way acquisition. Therefore, ROW acquisition does not pose schedule or other risks for the Project. If right-of-way acquisition becomes necessary, acquisition activities would begin early in the project development process to mitigate risk and reduce potential schedule impacts. The sole responsibility of the VTrans Right-of-Way Section is to facilitate the acquisition of real property needed for transportation projects and has a proven record of success.



Assessment of Project Risks and Mitigation Strategies

The Scoping Report has identified potential risks. The proposed project alternative and project delivery method will be further refined as design progresses. Potential risks and mitigation are shown in the table below.

Project Risk	Risk Mitigation
Project Funding and Scheduling	VTrans has committed to providing the State share of the project design cost. For construction, the Design-Build project delivery method will be used if necessary to streamline the project schedule and fund obligation process.
ROW Acquisition	No ROW acquisition is anticipated.
Utility Coordination	Utilities include an overhead transmission line and an underground line. The project does not propose any change to utilities, but temporary accommodations may be needed during construction. Utilities do not pose a risk to the project design, funding or schedule.
Construction Impacts to Local Traffic	There will be an extensive public outreach program to alert, inform, and mitigate impacts from construction. The proposed construction method and sequence (constructing one barrel of I89 at a time) allows vehicle traffic to continue in both directions throughout construction. More localized traffic on US Route 2 may need to be diverted from time to time.
Project Cost Overruns	VTrans understands the significance of this structure and will have additional funding on hand for use on an emergency basis.

V. Administration Priorities

This project aligns closely with the DOT Administration’s priorities and goals of enhancing safety and sustainability and mitigating the effects of climate change. The new structure will provide safer passage for both wildlife and motorists by minimizing conflicts between the two. The larger waterway opening replaces an aging culvert with a new, much larger opening that will survive any extreme flood event enhancing the sustainability and mitigating the potential effects of climate change on the existing roadway system.

The project also provides new jobs in the form of good paying skilled engineering and construction employment on an interesting and exciting project. Lastly, the project provides an upgrade to an important transportation corridor that supports commerce and jobs throughout the region.