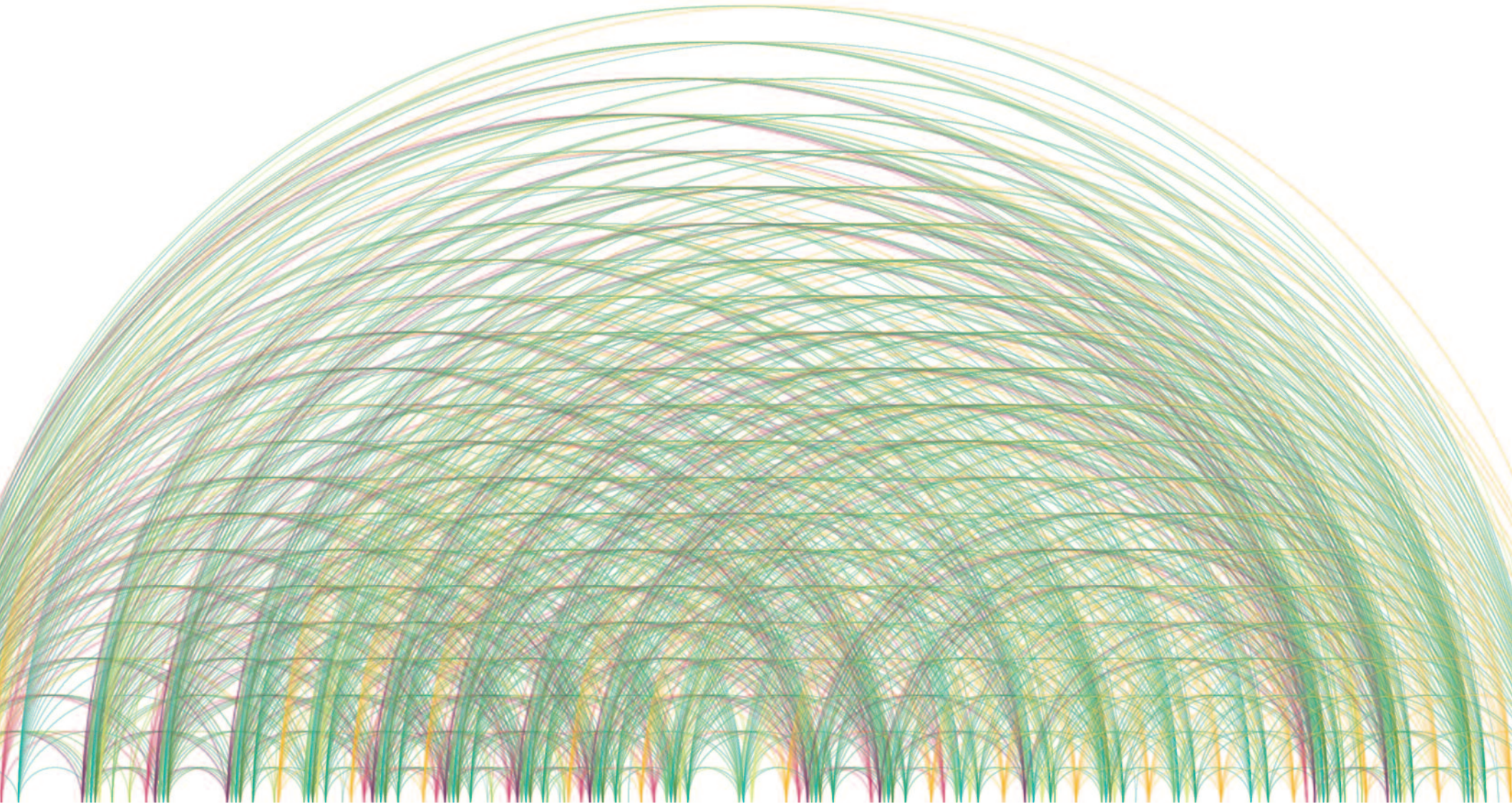
COMPETITION BRIEF

COMPETITION TO DEVELOP INNOVATIVE DESIGN SOLUTIONS FOR WILDLIFE CROSSING INFRASTRUCTURE

SUBMISSIONS DUE NOVEMBER 2, 2010.

ARC



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ARC IS MORE THAN A COMPETITION; IT IS AN IDEOLOGY that spans disciplines, species, geography and aspirations. Our name and visual identity have emerged directly from the science of road ecology. We worked with Studio:Blackwell, Chris Harrison, a PhD candidate at the Human-Computer Interaction Institute at Carnegie Mellon University, and Dr. Tony Clevenger of the Western Transportation Institute to produce the graphic arc diagram (on the cover of this document), which is a visualization of actual wildlife crossing data. These data–and the information on which the arc diagram is based—were collected over the last decade at the 24 wildlife crossing structures in Banff National Park in Alberta, Canada. They track the daily use of the crossing structures by large mammals whose adaptation to this infrastructure successfully reconnects the surrounding landscape and creates safer highways every day.

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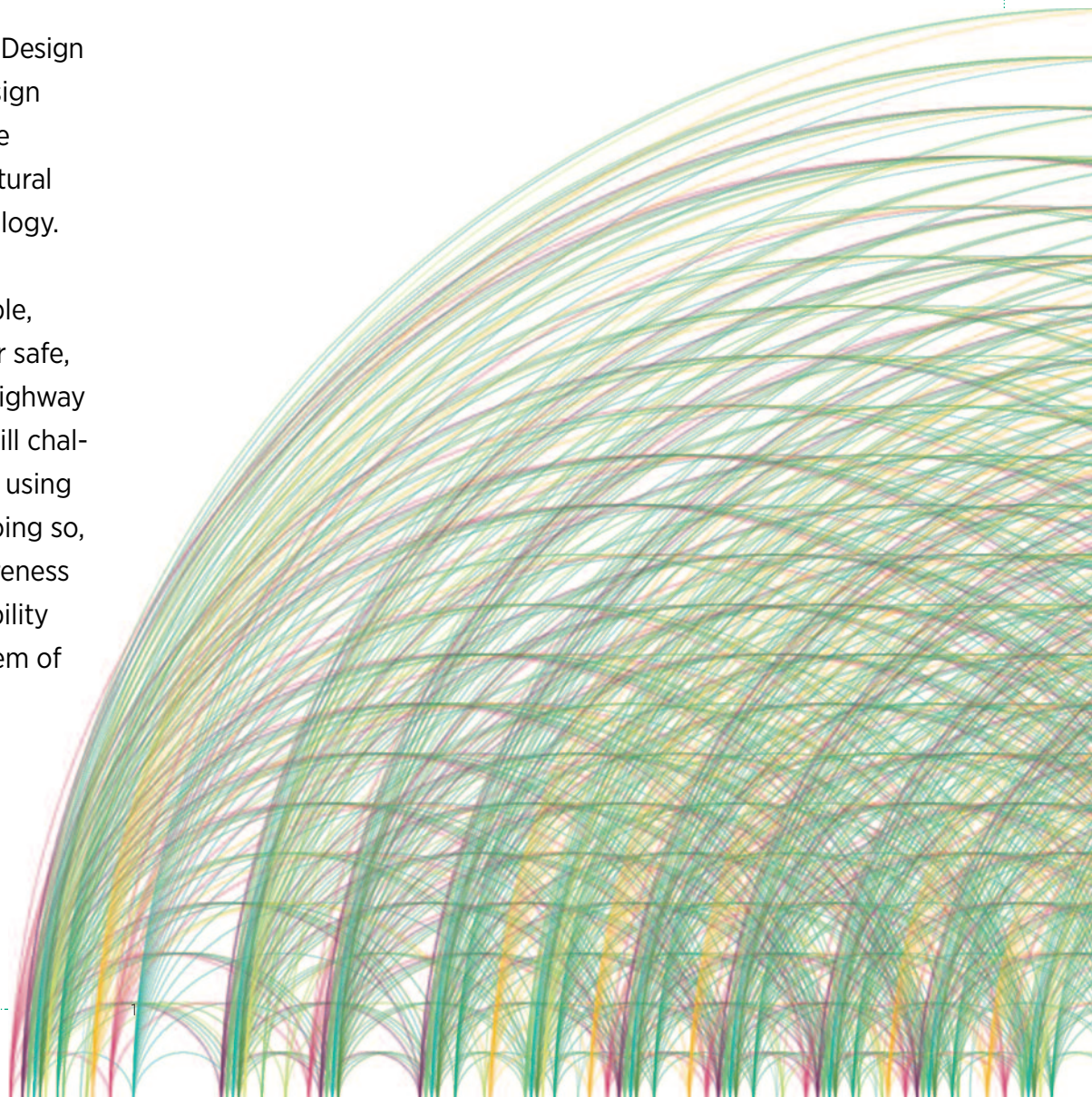
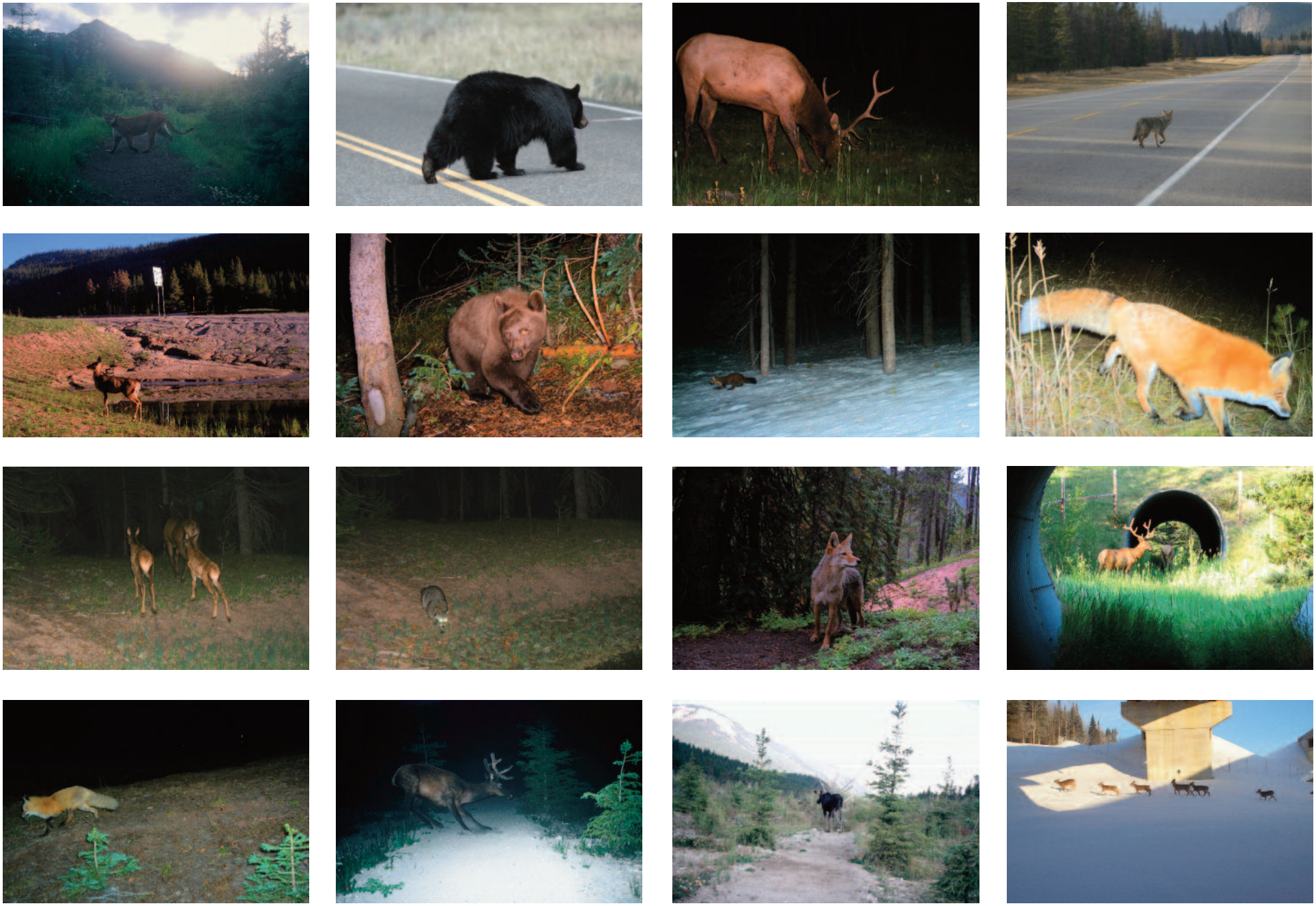
VISION

The ARC International Wildlife Crossing Infrastructure Design Competition (ARC) invites international teams of design professionals to address new design challenges in the coalescent issues of road transportation safety, structural engineering, wildlife conservation and landscape ecology.

Specifically, ARC seeks innovation in feasible, buildable, context-sensitive and compelling design solutions for safe, efficient, cost-effective, and ecologically responsive highway crossings for wildlife. In the broadest context, ARC will challenge competitors to reweave landscapes for wildlife using new methods, new materials, and new thinking. In doing so, the ARC competition aims to raise international awareness of a need to better reconcile human and wildlife mobility through a more creative, flexible and innovative system of road and habitat networks in our landscapes.





Highways are a significant barrier to wildlife movement. These images were captured by wildlife monitoring cameras and show a diversity of species attempting to cross roadways. These and other data suggest that wildlife will adapt and use crossing structures when provided at habitat linkage locations.

(Photos: Center for Native Ecosytems, except Row 1-1, Row 3-4, and Row 4-2, 3: WTI & T. Clevenger; Row 1-2: Black Bear: Jim Robertson; Row 1-4: Coyote: Roy Rea; and Row 4-4: Jacques Bélanger.)

INTRODUCTION

ARC has engaged the best and most innovative international, interdisciplinary design teams—comprised of landscape architects, architects, engineers, ecologists, and other experts—to create the next generation of wildlife crossing infrastructure for North America's roadways.

Today's transportation challenges are exacerbated by three critical factors: 1) an increasing population and expanding suburban and exurban development, 2) an aging, deficient, and outmoded infrastructure and 3) a changing climate. Experts acknowledge that these issues must be addressed comprehensively such that transportation systems are (re)designed to safely meet the transportation needs of contemporary society in a manner that maintains ecosystem integrity and connectivity, reduces the carbon footprint, minimizes consumption of non-renewable materials, recycles resources, extends the life cycle of transportation infrastructure and operates efficiently. The ARC international design competition is a first step in addressing these complex design challenges in the context of road infrastructure for human and wildlife safety and mobility.

North America's landscapes are changing at an accelerating rate. Since World War II, roads and highways have spread across the continent as a growing population made a rush for car ownership and intercity trucking expanded rapidly. Connecting nations and linking urban and rural communities, roads have cut through valleys and mountains and across prairies and farmlands to serve human convenience and drive economic growth. In locating and building North America's transportation infrastructure, little attention was given to wildlife and habitat needs or to the ways in which roads may alter ecosystem function.

After some 60 years of continuous road building, two phenomena have been recognized. First, growing numbers of wildlife-vehicle collisions are leading to higher levels of personal injury and property damage and to increasing insurance premiums. While human mortality numbers are not large, wildlife-vehicle collisions have increased by 50% in the past fifteen years. A US Federal Highway Administration study reports that there are an estimated one to two million collisions between cars and large mammals every year in the US, representing a significant danger to human safety and wildlife

The I-70 Wildlife Watch website (www.i-70wildlifewatch.org) is an interface for the public to report wildlife sightings along the I-70 Mountain Corridor where the competition site is located.

Red fox at roadside. Photo courtesy of WTI.

Dead black bear killed on I-70 near Eagle, CO
(Photo: Shane Macomber, Vail Daily)















Vehicle-wildlife collisions occur at all scales, in many places. Collisions with large animals from black bears to bighorn rams to coyotes are damaging to the vehicle and lethal to the animal. Carcass removal costs are substantial, and animals left dead or dying on the road can cause secondary accidents. Smaller animals may seem insignificant or are simply overlooked as roadkill. Yet they too are affected, sometimes in large numbers, which may affect the viability of their populations over time.

Left to right: Row 1, Badger: Sascha Rösner; Panther: Krista Sherwood; Black Bear: Shane Macomber; Coyote: Paula Mackay, WTI. Row 2: Lynx on I-70: Vernon Phinney, USFS; Bighorn ram in Montana: Sandra Jacobson; Lynx on I-70: Vernon Phinney, USFS; Panther: Krista Sherwood. Row 3:Bobcat: Transwild Alliance, Photographer Unknown; White-tailed Deer: Will Beard; Lynx on I-70: Vernon Phinney, USFS; Vehicle damage: WTI. Row 4: Black bear: WTI; Wildlife Watch Public Service Campaign, WTI; Bison in Yellowstone: Tricia White; Long-tailed tit: M. Becker

populations (Huijser et al, 2008). Wildlife-vehicle collisions are also increasing as a proportion of the total accidents on the continent's roads. In addition to obvious concerns for motorist safety, there are serious implications for wildlife in terms of both population viability and habitat connectivity. The same 2008 study identified 21 federally listed threatened or endangered species for which road mortality is documented as one of the major threats to these species' survival.

Second, at a much larger scale, the last several decades of road building have resulted in significant habitat losses through the linked processes of habitat fragmentation and (by consequence) habitat restriction as species are limited to increasingly isolated patches in which they can live and move. Subsequent loss of gene pool diversity is a related factor that further exacerbates the problem of habitat fragmentation. More recently, climate disruption portends a new need for wildlife to migrate unimpeded across landscapes in search of new habitats as resources become scarce in their current home ranges and ecosystems (see e.g. Heller and Zavaleta, 2009). New, lighter, flexible and adaptive infrastructures may offer effective means to facilitate wildlife mobility and population survival under uncertain climate conditions.

An emerging priority for both transportation and natural resource agencies is to make highways safer for both drivers and wildlife. One of the proven solutions known to improve safety, reconnect habitats, and restore wildlife movement is the provision of wildlife crossing infrastructure at key points along transportation corridors. Throughout Europe, in Asia, Australia and in various North American locations, wildlife crossing structures have been deployed with demonstrated success. These structures include both underpasses and overpasses, both of which have been constructed in a variety of sizes and designs. Although wildlife underpasses are less costly structures to build and more commonly used by a diversity of species, wildlife overpasses are preferred by certain wide roaming and charismatic species at risk, such as grizzly bears for example. Overpass structures are also more widely recognized as they are visible and noteworthy to passing motorists. As such, wildlife overpasses present a timely opportunity for the general public to experience—and identify with—engineered landscape designs that create safer roads while protecting wildlife populations and restoring ecosystem function through improved landscape connectivity.

Notably, the protection of wildlife corridors and ecological connectivity has become an increasingly high-profile issue on public policy agendas across North America. For example, conservation organizations and state wildlife agencies across the western US have worked together to establish priorities and make recommendations for new policies. In 2007, the Western Governors' Association (WGA) passed a resolution to identify and protect wildlife corridors and crucial habitats. In 2008, the Western Governors adopted a series of recommendations as part of the Wildlife Corridors Initiative report, including a chapter on transportation that highlights the importance of wildlife crossings (WGA 2008). In Colorado, wildlife crossings and environmental sustainability were identified as part of Governor Ritter's Transportation and Finance Implementation Panel. In this context, the ARC International Design Competition capitalizes on a timely window of opportunity to offer new methods, new materials and new thinking for transportation infrastructure that protects wildlife and reconnects ecosystems.

Wildlife crossing structures in Banff and the Bow River Valley, Alberta, Canada (photo: WTI and T. Clevenger).

OBJECTIVES

THE ARC INTERNATIONAL DESIGN COMPETITION WILL:

- Provide an avenue for international teams of design professionals to address new design challenges in the coalescent issues of road transportation safety, structural engineering, wildlife conservation and landscape ecology;
- Explore creative new approaches, materials, and designs that address the fundamental and emerging issues of transportation engineering and ecology;
- Increase the number and variety of potential solutions for cost efficient, ecologically responsive, safe, flexible, innovative crossing designs that can be adapted for widespread use in other locations;
- Consider adaptive infrastructures that offer flexibility for wildlife mobility under dynamic ecosystem conditions, including climate change;
- Engage design professionals and students in the interdisciplinary nature of road ecology with a real-time, in-situ application;
- Create a design that is harmonious with existing policies and programs for the West Vail Pass area; and
- Address creatively and resolve intelligently the competing site challenges at West Vail Pass.

The wildlife crossing structures in Banff, Alberta, Canada, serve as a model from which to apply lessons learned in designing innovative crossing infrastructure (photo: N.M. Lister, 2009).

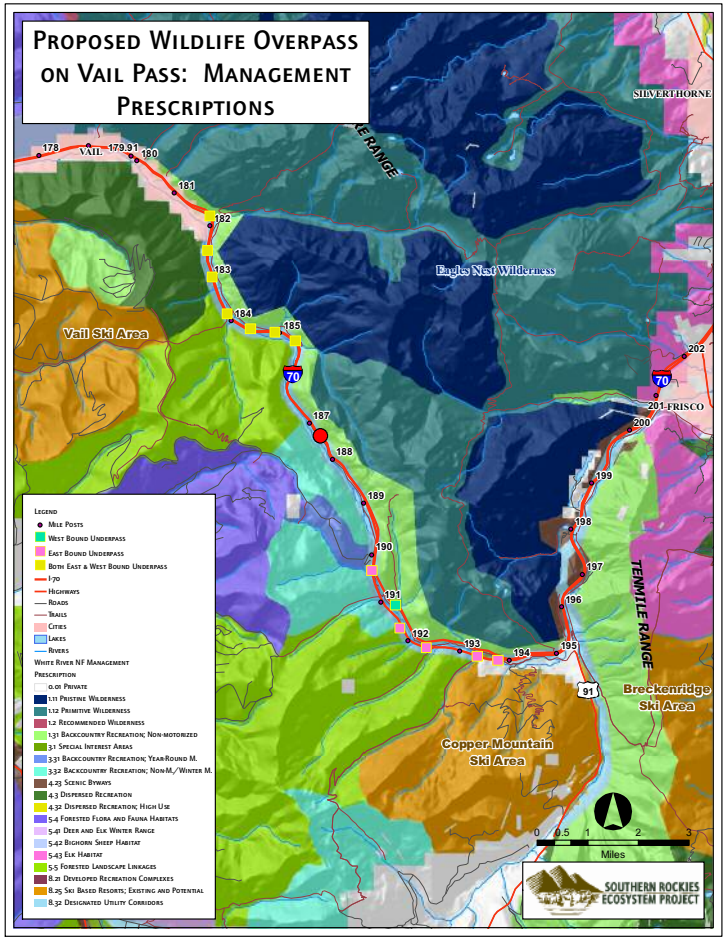
West Vail Pass Site, looking north-west on I-70 (photo: N.M. Lister, 2008).

SITE

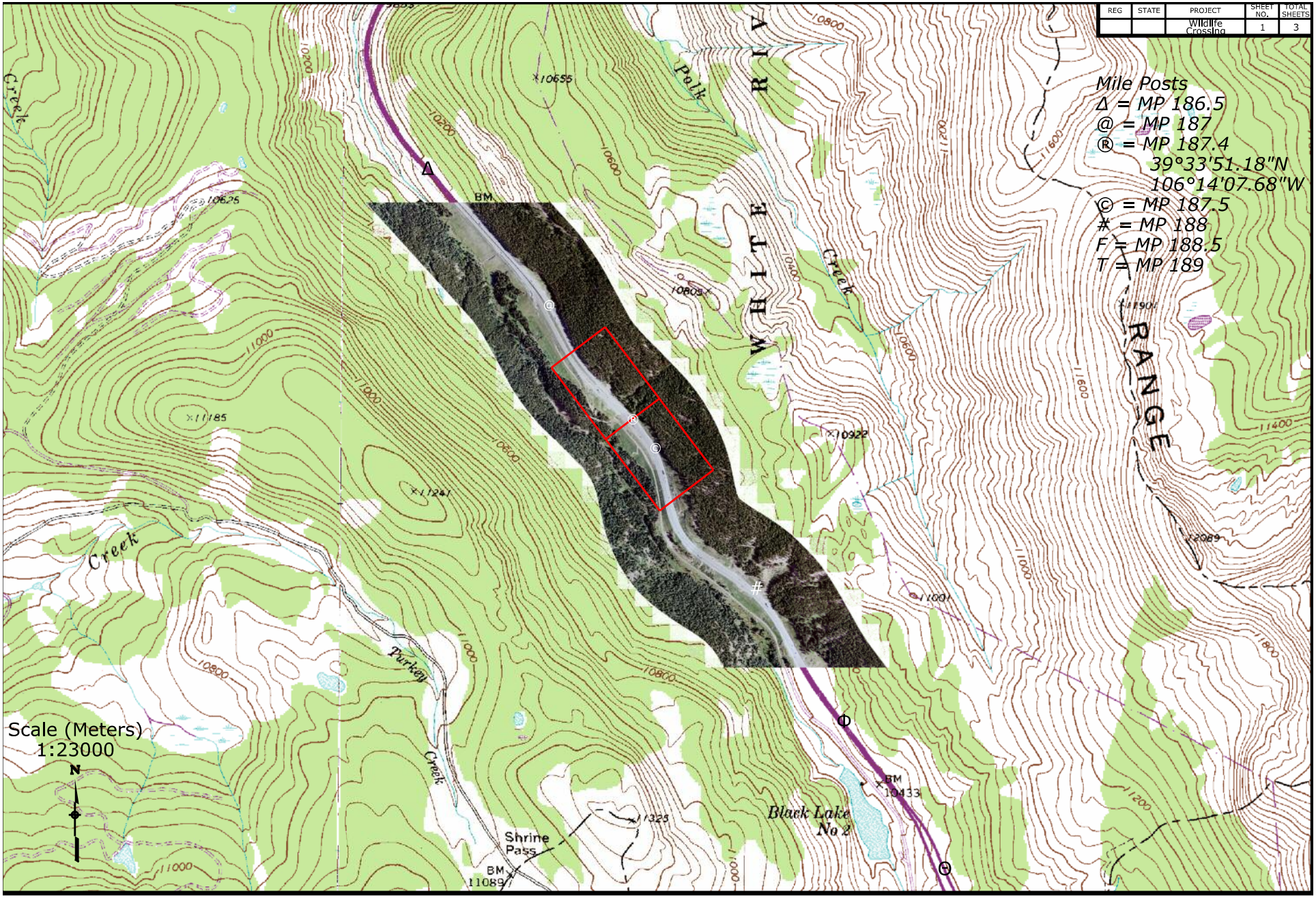
The site of the ARC design competition is located where natural and human-dominated worlds collide. Between the rapidly urbanizing metropolitan area of Denver and the resort communities of Aspen, Vail, and Breckenridge, Colorado, the site sits at approximately 10,000 feet or 3,000 meters above sea level and 90 miles or 145 kilometers west of Denver along the Interstate Highway 70 (I-70) Mountain Corridor just west of Vail Pass. Identified as a critical habitat linkage in this region of the Rocky Mountains, and home to a variety of iconic species such as black bear, cougar, bobcat, Canada lynx, coyote, elk, deer and American marten, the West Vail Pass site serves as an ideal setting for design teams to explore innovative means to safely reconnect a landscape with the charismatic wildlife that depend on and define this place.

SITE SELECTION PROCESS

During 2008-2009, the ARC team studied a variety of eligible sites for the design competition. A site competition was held in which 25 eligible sites in 16 US states and Canadian provinces were submitted for review by ARC technical advisors, including representatives from state agencies and conservation organizations. A combination of criteria were used to rank the proposed sites. These included ecological importance of the adjacent habitats; number and frequency of wildlife-vehicle collisions; traffic volume; public recognition/visibility of the location; charismatic nature of the site and its wildlife; priority of the site for the local Department of Transportation (DOT); willingness of the DOT to work with ARC; land tenure arrangements; current and long-range plans for the area; and existing plans for a wildlife structure under new infrastructure funding. Using these criteria, the site at West Vail Pass on I-70, managed by the Colorado Department of Transportation (CDOT) was selected as the competition site. In December 2009, a Memorandum of Understanding was signed between ARC and CDOT with respect to the use of the West Vail Pass site for the design competition and the role and use of the winning concept design (see: Process/Winning Design in this document).



ARC competition site location on I-70. Source: Felsburg, Holt & Ullevig, 2009.



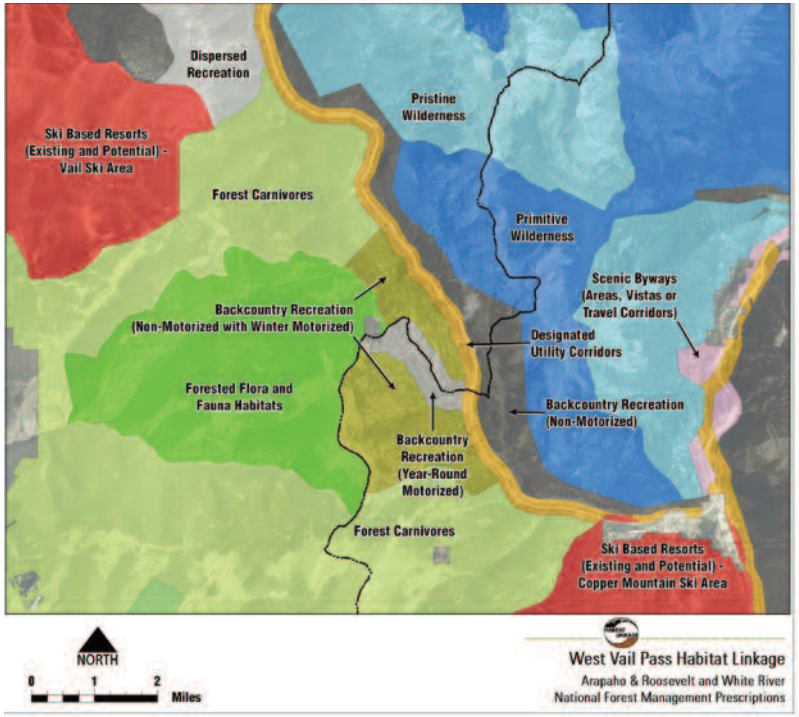
West Vail Pass Regional Context Map. Source: Federal Highway Administration, 2010.

THE SITE: WEST VAIL PASS

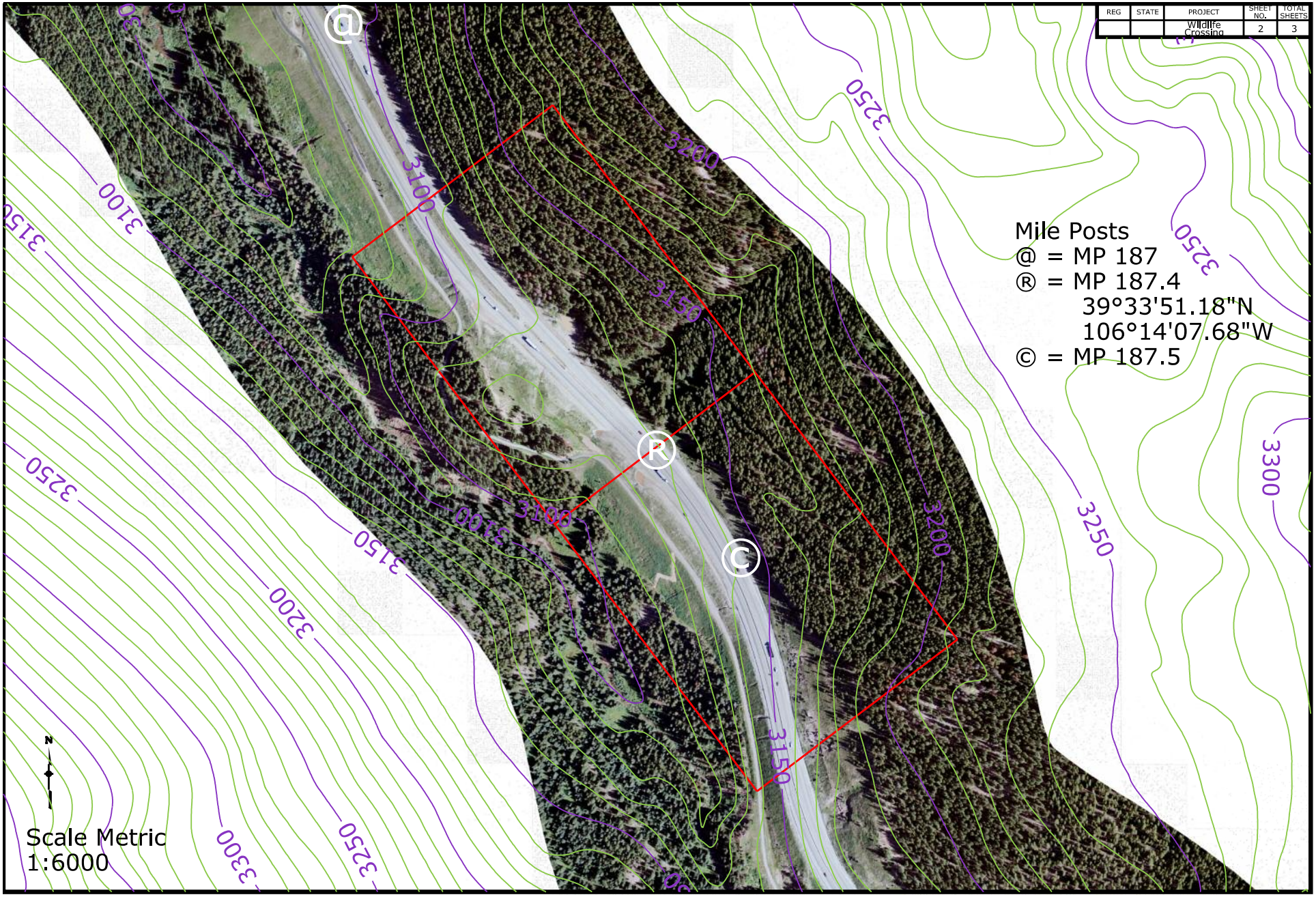
The I-70 Mountain Corridor has been extensively studied over the past decade by USDOT, CDOT and a variety of local environmental organizations, such as the Center for Native Ecosystems, and the Southern Rockies Ecosystem Project among others. Located at the core of the 232 kilometer or 144 mile Mountain Corridor that stretches across the central Rocky Mountains of Colorado along I-70 from Glenwood Springs to highway C470 in Denver, the area is considered to be of statewide and national importance. I-70 is the only east-west interstate crossing Colorado and is the only continuous east-west highway in the study area; it serves as the main transportation artery in Colorado, providing for the movement of people, goods, and services across the state. I-70 is also the primary route for access to many of Colorado's recreation and tourism destinations (I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS), 2004: Pg. Es-1).

The portion of the I-70 Mountain Corridor that runs from Glenwood Springs to C470 in Denver is particularly congested as daily commuters, weekend travelers and recreational enthusiasts in the rapidly growing area all demand access to the corridor. The site area at West Vail Pass is also widely recognized as a habitat linkage for wildlife populations seeking breeding and feeding grounds that are bisected by the existing divided four-lane highway. This situation has the potential to deteriorate if and when the corridor is widened to six lanes, as evaluated by the I-70 Mountain Corridor PEIS (2004). As is the case for many of the continent's large mammal species, the ranges and territories of Rocky Mountain wildlife in this region run north-south, and these are typically and effectively severed by the US interstate system.

The West Vail Pass Site, looking south-east from the north-east side of I-70. (Photo: NM. Lister, 2009)



USDA Forest Management Units in the Vail Pass area. Source: Felsburg, Holt & Ullevig, 2009.



West Vail Pass Site Map. Source: Federal Highway Administration, 2010.

PROPOSED CROSSING STRUCTURE LOCATION: MILEPOST 187.4

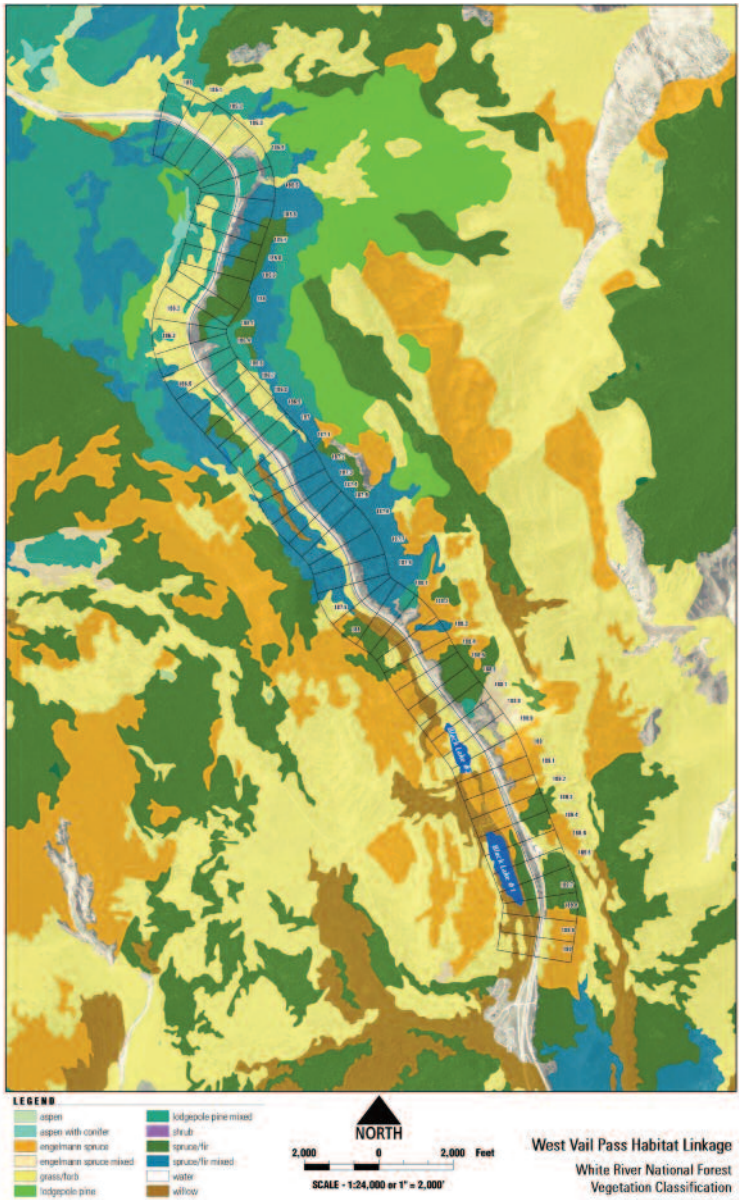
Milepost reference coordinates: 39º 33'51.18" N 106º 14'07.68" W

The proposed location for the wildlife overpass structure is at milepost 187.4 on I-70. The site is located in Eagle County and is surrounded by the White River National Forest, which is managed by the US Forest Service. Relatively dense vegetation borders both sides of the site and Black Gore Creek runs parallel to the south side of the highway. In general, the site slopes north-east to south-west.

The site lies within the Subalpine Life Zone and is characterized by vegetation adapted to elevations ranging from 9,000 feet (2,700 meters) to approximately 11,400 feet (3,500 meters). The landscape in this area is dominated by coniferous forest, alpine meadows, riparian forests and shrub species. A variety of wildlife species are associated with and rely on these vegetation communities, including black bear, cougar, bobcat, Canada lynx, coyote, elk, deer, American marten, porcupine, yellow-bellied marmot, snowshoe hare and red squirrel, among others.

A recent study conducted by the Center for Native Ecosystems, the *I-70 Ecological Monitoring 2009 Progress Report* (July 2010), provides the most comprehensive data for this area via a motion-triggered camera study along the I-70 Corridor including West Vail Pass. The data provide relative abundance information for wildlife along I-70 and use of the existing span bridges that serve as wildlife underpasses. The location of the wildlife overpass at milepost 187.4 is the one location where there is no existing structure for wildlife passage. However, on either side of this location on the I-70 there are numerous span bridges that serve as mitigation measures for wildlife.

CDOT found that I-70 on the west side of Vail Pass has two distinct areas that affect the ability of wildlife to move across the roadway. The lower portion of the pass—which lies approximately between mileposts 181.7 and 186—has a series of bridge structures over drainage areas. This area of the pass allows for wildlife movement under the highway without the need for animals to traverse the roadway. By contrast, the upper portion of the pass—which lies approximately between mileposts 186 and 190, and in which the proposed overpass site lies—does not have any structures that allow for wildlife movement, and animals have no choice other than to traverse the traffic lanes. There are also multiple barriers along the roadway that wildlife must negotiate, including guardrails, median barriers and grade separation of the southeast and north-westbound lanes of the highway (Felsburg, Holt & Ullevig, 2009).



Vegetation Classification in the Vail Pass area. Source: Felsburg, Holt & Ullevig, 2009.

Milepost 187.4 on the north-east side of I-70 (photo: NM. Lister, 2009).

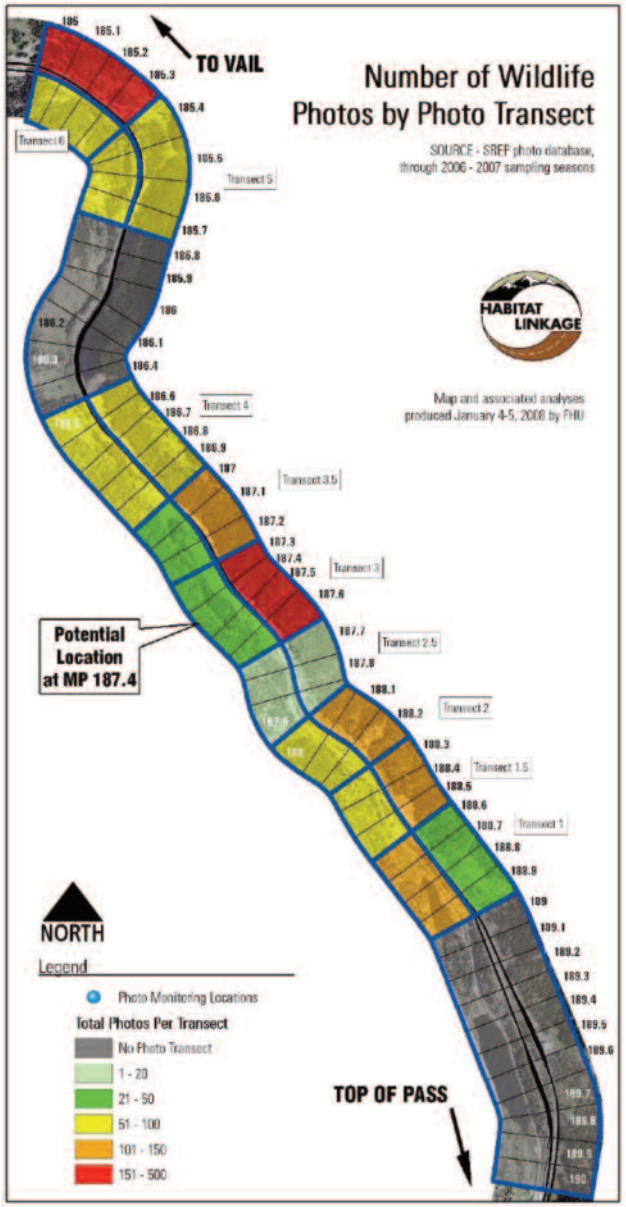
The West Vail Pass Site as seen from the center median barrier, looking south-east along the divided highway (photo: NM. Lister, 2009).

One of 3 rare Canada lynx killed during crossing attempts of the I-70 at the West Vail Pass site (photo: Vernon Phinney, USFS).

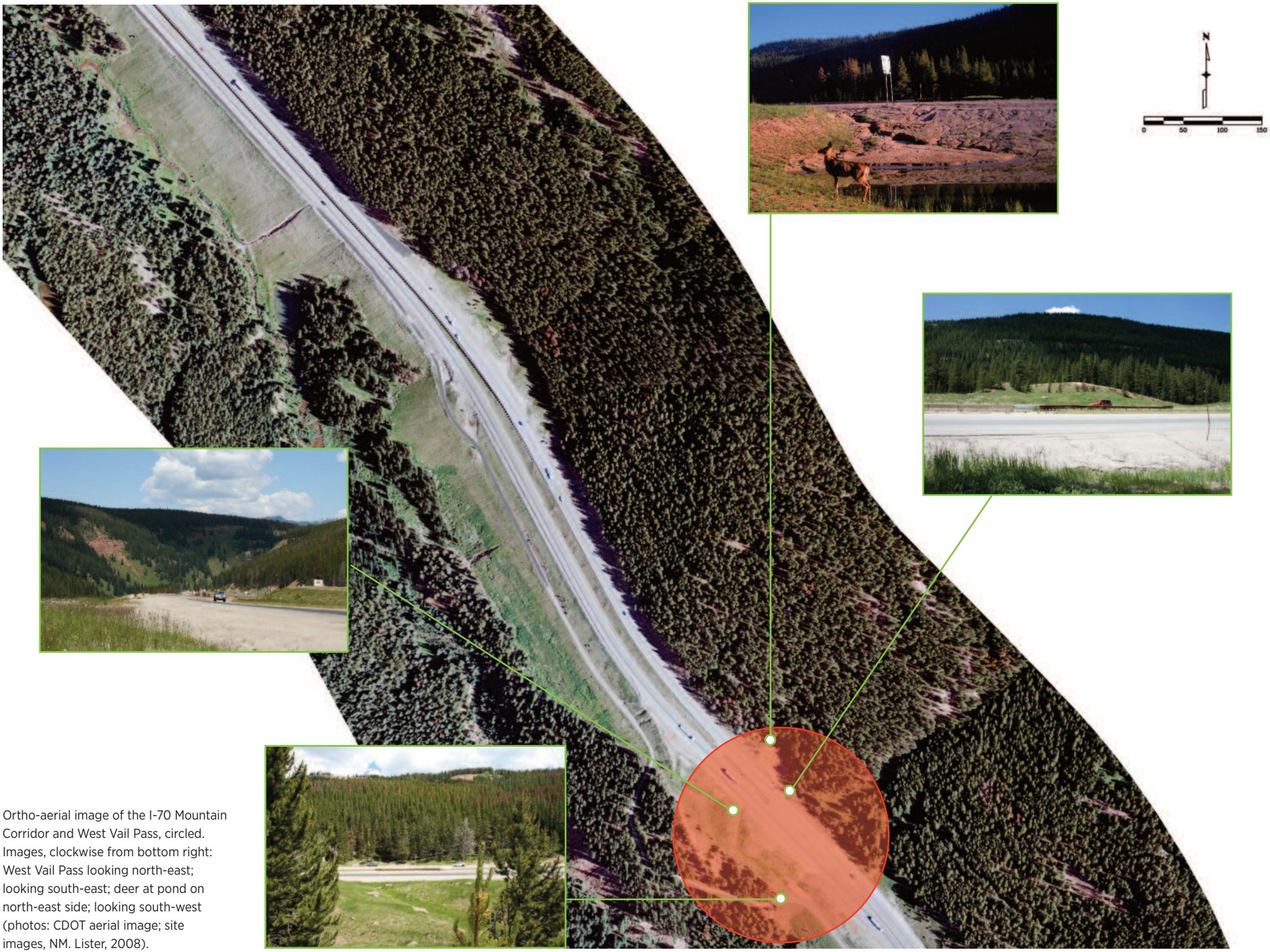
Overall, this section of the highway is recognized as a significant barrier to wildlife movement. Wildlife monitoring data gathered by state agencies and conservation organizations, as well as volunteer reports of roadkill and wildlife sightings by citizens, have provided cumulative evidence of the importance of this site as a critical habitat linkage. In particular, the White River National Forest (which is bisected by I-70) is home to a wide variety of species, including the recently reintroduced Canada lynx, a federally threatened and regionally rare species thought to be recolonizing the area. Roadkills at the site are common, recently including three (3) Canada lynx as well as the first recorded gray wolf since 1936, a female that dispersed from Yellowstone National Park, where it had been reintroduced. The Colorado Department of Wildlife (CDOW) has determined that an overpass structure at West Vail Pass will aid in the recolonization efforts of lynx and other significant species (CDOW unpublished data, 2010).

Following a preliminary site analysis, CDOT determined that the upper pass location at milepost 187.4 offers several benefits for construction of an elevated wildlife crossing structure over I-70. The north-east side of the highway lies at a favorable grade and elevation for construction of a bridge landing, and other off-bridge landscaping. The elevation difference from the highway to the terrain along either side is considered to be within a workable range for an overpass approach structure. The slope along the highway at this location is less steep than along a majority of the I-70 Mountain Corridor, which will allow for construction of a fairly simple bridge approach. Given the favorable grading at this location, disruption of the existing vegetation can be minimized as compared to other potential crossing locations along I-70 (Felsburg, Holt & Ullevig, 2009). Preliminary indications suggest that all features of a vegetated wildlife overpass could be built within the existing easement that CDOT has for this highway from the US Forest Service.

Although all background documentation locates the proposed structure at milepost 187.4, teams are advised to note that the preliminary site study and concept report by Felsburg, Holt & Ullevig (2009) determined that the geotechnical site considerations warranted exact placement of the overpass structure slightly to the south-east of the milepost marker where topographic features were more favourable for cost-effective, minimal footprint construction. The proposed location will be delineated with survey markers for the mandatory site visit for finalist teams on September 25, 2010. In addition, more detailed topographic and related spatial data are provided in the supporting technical document available to finalist teams.



Wildlife photos by photo transect on I-70. Source: Felsburg, Holt & Ullevig, 2009.



Ortho-aerial image of the I-70 Mountain Corridor and West Vail Pass, circled. Images, clockwise from bottom right: West Vail Pass looking north-east; looking south-east; deer at pond on north-east side; looking south-west (photos: CDOT aerial image; site images, NM. Lister, 2008).

SITE BOUNDARY

Milepost 187.4 is the nearest fixed point to the centre of the recommended site boundary. The site boundary recommended for the purposes of the competition is deemed to be 400 m or 1,312.3 feet along the roadway on either side of the milepost, and 150 meters or 492 feet to the approximate east and west into the forested lands on either side of the highway. The total site area recommended for the purposes of delivering the program and design elements required for the competition is therefore 24 hectares or 59.3 acres. Teams are permitted to exceed this recommended boundary if a rationale is provided with specific reference to the design concept or program elements being proposed.

KEY DOCUMENTS

The following documents, additional site data and maps are available to finalist teams in the Technical Appendices on the ARC website at http://www.arc-competition.com.

Bonaker, P., A. Huyett, and J. Kintsch (2010). I-70 Ecological Monitoring 2009 Progress Report. Unpublished report prepared by Center for Native Ecosystems and ECO-resolutions, LLC for the Colorado Department of Transportation as part of the Federal Highway Administration's Eco-Logical grant program.

Felsburg, Holt & Ullevig. (2009). I-70 West Vail Pass Habitat Linkage Structure Location, Design Criteria, and Conceptual Design Report.

Kintsch, J. (2008. Vail Pass Wildlife Linkage White Paper – DRAFT. Unpublished report, Southern Rockies Ecosystem Project, Denver CO.

Southern Rockies Ecosystem Project. (2008) Wildlife Bridge at West Vail Pass. See: http://www.restoretherockies.org/wildlife_bridge.html

US Department of Transportation, Federal Highway Administration, and Colorado Department of Transportation (2004). I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS). See:

Executive Summary:
http://i70mtncorridorcss.com/docs/peis

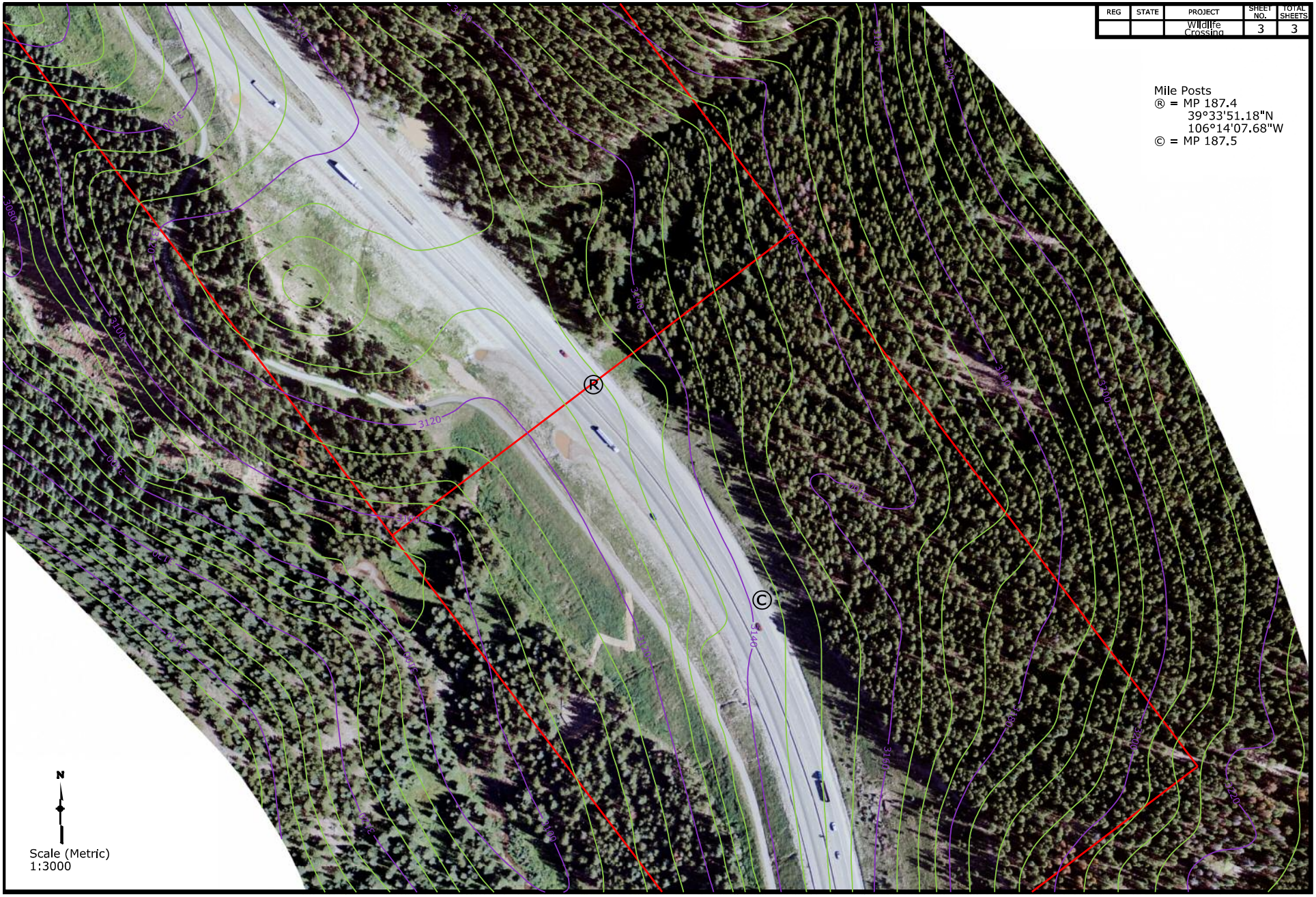
Overview:
http://www.coloradodot.info/projects/i-70mountaincorridor/

Draft PEIS 2004:
http://www.coloradodot.info/projects/i-70mountaincorridor/programmaticEIS/

Revised Draft:
http://www.coloradodot.info/projects/i-70mountaincorridor/revised-draft-peis.html

Preferred Alternative:
http://www.coloradodot.info/projects/i70mountaincorridor/programmaticEIS/2.0_Chapter_2.pdf

US Forest Service (2002). White River National Forest Management Plan. See: http://www.fs.fed.us/r2/whiteriver/ (click "Land & Resources Management")



West Vail Pass Site Detail. Source: Federal Highway Administration, 2010.

PROGRAM

ARC seeks detailed concept designs for the wildlife overpass structure and the recommended site area at West Vail Pass. Finalist teams are challenged to fulfill and exceed the competition objectives in delivering an innovative concept design for the overpass structure that uses new materials, new methods, and new thinking.

Specifically, this means that the design for the structure and related elements must be:

- Cost effective in terms of materials, construction, and maintenance;
- Ecologically responsive to current and future anticipated conditions;
- Safe for humans and wildlife alike;
- Flexible or modular for possible use in other locations;
- Adaptive to facilitate mobility of wildlife under dynamic ecosystem conditions;
- Sustainable in terms of materials and energy use, responsive to climate change;
- Compatible with the Preferred Alternative in the I-70 Mountain Corridor Draft PEIS; and
- Educational, revelatory, and communicative to the public.

The overpass structure must be situated within a site plan that must include:

- Exclusionary fencing to ensure wildlife are directed over the structure;
- Ecologically appropriate habitat for the overpass surface and ramps on both sides of the structure;
- Traffic pullouts and viewing platforms at a safe distance (according to the scientific literature);
- Continued and enhanced use of the existing bike trail;
- Accommodation of an Advanced Guideway System for a proposed commuter rail line;
- Accommodation of an additional 2 traffic lanes proposed for the I-70; and
- Educational, context-sensitive and artistic approaches to site design elements as warranted.

DESIGN

Finalist teams are asked to develop concepts that include the following design elements and criteria specific to the structure and the surrounding site:

CONTEXT SENSITIVE SOLUTIONS (CSS)

Design schemes proposed by the finalist teams should reflect an understanding and advancement of context sensitive solutions (CSS) for the overpass and the site area. The Federal Highway Administration along with their key AASHTO partners, which includes CDOT is also committed to the advancement of CSS nationwide (see http://www.contextsensitivesolutions.org/). Additionally in support of CSS and Livability, on June 16, 2009, the U.S. Department of Transportation (USDOT), U.S. Department of Housing & Urban Development (HUD), and the U.S. Environmental Protection Agency (EPA) announced a new partnership to help American families in all communities—rural, suburban and urban—gain better access to affordable housing, more transportation options, and lower transportation costs. The partnership between the three agencies, titled the *Partnership for Sustainable Communities*, will work together to ensure that these housing and transportation goals are met while simultaneously protecting the environment, promoting equitable development, and helping to address the challenges of climate change.

STRUCTURE

Teams are encouraged to pursue innovations in the form of, and materials for, the structure, taking into account safety of humans and wildlife, adaptability, constructability and potential modularity. For example, new and emerging uses of lightweight plastics, resins, acrylics or tensile and sculptural materials might be explored along with contemporary wood, concrete and steel construction.

Structural design must consider the following elements:

SAFETY

Safety of the structure for motorists and wildlife is paramount. Given the current volume of traffic on I-70 and the future volume anticipated under a 6-lane scenario, the structure must be designed with motorist safety first. As such, the upper or superstructure may have more flexibility for innovation in materials, whereas more conventional materials that meet safety requirements are envisioned on the lower portion of the structure. Teams should consider that innovative, experimental or otherwise new materials in any configuration must meet safety standards. Teams must consider that the site is located on a 6% downgrade with approaching sharp curves in the eastbound lanes, therefore maintaining a line of sight is critical for motorists. Other related design considerations include the need for braking on wet pavement and in changing road conditions related to snow, rain, fog and sleet.

LOAD

Live and dead loads must be calculated and rationalized as appropriate to the materials selected. Teams are reminded that the structure is not a conventional overpass and there is no requirement for heavy vehicles and equipment to be accommodated. To encourage lightweight cost-effective structures, concept designs should facilitate innovations in construction equipment and machinery (e.g. employing fewer, smaller, lighter equipment types). Rain, snow, runoff and microclimate effects on the load must be considered, along with soil load which is dependent on vegetation used for surface habitat design.

SPAN

Bridge span must accommodate the PEIS Preferred Alternative of 6 lanes (2 additional lanes to the existing 4 lane highway with shoulders) and an Advanced Guideway System (AGS) for elevated commuter rail. The AGS is proposed to be in the central median, with an expected clearance of 5.5 meters or 18 feet above grade to accommodate oversized truck traffic and to facilitate maintenance. The right-of-way for the AGS is expected to be 10.4 meters or 34 feet. The span must also include the approach ramps on either side of the roadway; these must be designed with the topography to tie most effectively into habitat conditions on either side of I-70.

WIDTH

Based on background research and preliminary concept studies, overpass structures of at least 50 meters or 165 feet appear to better mitigate highway noise, light, and other potential disturbances. Scientific evidence suggests that the overpasses in Banff, Canada (52 meters / 170 feet) appear to mitigate traffic disturbances well and are used by many of the same species of mammals that are target species for the competition site. As such, 50 meters or 165 feet is considered to be the minimum effective width for the structure. Teams should consider widths of 50-70 meters or 165-230 feet using the research provided. However, some overpass designs are parabolic in shape, with wider spans at the approach ramps (e.g. 70-90 meters or 230- 295 feet) and a narrower center (e.g. 35-50 meters or 115-165 feet). Teams are encouraged to consider the range of background research as it relates to the potential for various shapes and forms of the structure.

SURFACE HABITAT & TARGET SPECIES

The vegetated surface of the overpass structure will be an opportunity to establish a new typology of landscape architectural design that integrates infrastructure with dynamic ecosystem conditions. The structural surface and approach ramps must function as viable native habitat specific to the area such that they encourage use by the greatest variety of local biodiversity (e.g. plant and animal species including but not limited to soil microbes, insects, reptiles, amphibians, birds, along with large and small mammals. The target list of species and their habitat requirements is found in Table 1 of Felsburg, Holt & Ullevig (2009) as well as in other references in the Technical Appendices). The type and amount of vegetation proposed for the structure and ramps will be dependent on the target species, which have different cover preferences and requirements for activities such as foraging, daily and seasonal movements, breeding and dispersal.

SOIL

Soil quality is widely understood to be the most important factor for vegetation success on overpass structures. The soil depth, type, characteristics and quality proposed for the structure's surface will depend on the vegetation plan and planting design; these will directly influence the successful establishment of vegetation and associated microhabitats on the overpass. Concept designs must include a detailed vegetation and microhabitat plan for the structural surface and ramps specific to, and suitable for, target species and therefore representative of a full complement of local biodiversity. Teams are encouraged to use the background research to ensure appropriate design for the full range of species. In addition, teams should consider new research and emerging evidence that suggests habitat shifts and wildlife migrations anticipated under climate change.

COST ESTIMATE

Teams should provide a schematic design cost estimate for construction of the structure. The cost estimate should be developed in accordance an ASTM UNIFORMAT II, Level 3 classification (see Charette and Marshall, 1999). As a point of reference, conventional bridge structures that have been used as wildlife crossings in Banff and elsewhere typically cross 4 lanes and are currently in the range of US$10-15M. It is the express aim of ARC to reduce these costs for more cost-effective and widespread deployment of wildlife overpass structures. Cost reduction is probable when reduced load requirements, materials innovation and maintenance, flexibility, modularity or mobility are factored into costs. Where feasible, teams should also consider and address anticipated maintenance costs.

MAINTENANCE

Design of the structure and site should consider and address maintenance operations and costs. Maintenance operations include and affect the habitat on the surface and ramps, the fencing, the viewing platform(s), the roadway under the structure and the structure itself. The site at West Vail Pass is subject to extreme weather, including heavy snow loads; regular maintenance operations for I-70 involve snow removal by plows. (Historical weather information for the area is available from the National Weather Service at http://www.weather.gov). Teams should note that abrasive and corrosive materials such as sand and salt are routinely used in road maintenance and that tunnel effects of the overpass such as wind, surface water, and ice should be considered and addressed.

DISTURBANCE MITIGATION

Traffic noise, light, vibration, and visual disturbance from moving vehicles all have the potential to cause stress for some wildlife species; these disturbances may affect wildlife movement patterns and use of the structure. Research indicates that such disturbances should be minimized and mitigated using various design strategies for both the structure itself, and the site area. Much of the traffic noise can be minimized by the mass of structure itself, while other disturbances may be mitigated through use of fencing and other barriers or berms. However, design teams are encouraged to review the research carefully, and some types of mitigation barriers themselves can be disturbing to certain wildlife species. Teams should propose and articulate mitigation strategies in their schemes with attention to the research provided.

EXCLUSIONARY FENCING

Exclusionary fencing will be an important design element used to guide wildlife to the overpass crossing and to prevent wildlife from crossing the highway at grade. Teams should design and integrate a fencing system into their concept design for the structure and site. The type and projected extent of fencing should be depicted in the site plan and fencing or other barriers should also be incorporated into the surface of the structure to guide wildlife across the overpass. Teams should consider and address maintenance and capital costs of the fencing structure in their schemes.

VIEWING PLATFORM(S)

To facilitate mobility of wildlife and for the safety of humans and animals, citizens are not permitted on an overpass structure. However, ARC recognizes that I-70 travelers may have a natural curiosity about the wildlife crossing. Indeed it is the mandate of ARC to encourage the use of the structure for long-term wildlife conservation education goals, and as such the structure should have broad appeal to the public. As such, teams should consider the design of a viewing platform together with appropriate traffic pullouts to provide for discrete observation from a safe distance, rationalized with reference to the scientific literature. Access to this viewing platform should be from an area separated from the mainline roadway. A four-vehicle parking area is recommended, but other justified configurations may be suggested. The parking area and the connector roads including deceleration and acceleration lanes should follow the design guidance as adopted by CDOT in *A Policy on Geometric Design of Highways and Street*s, 5th Edition (2004).

LAND TENURE & RIGHTS-OF-WAY

CDOT is responsible for and oversees the I-70 highway corridor. Lands on either side of the Vail Pass site are in the purview of the United States Forest Service (USFS). CDOT and the US Forest Service have a Memorandum of Understanding where easements on either side of the highway can be adjusted as needed, however construction and maintenance operations should not routinely intrude on or degrade adjacent habitat. The recommended site boundary should be sufficient for the concept designs being developed, although if teams feel the need to extend the site into the National Forest lands, this must be clearly rationalized with specific reference to the concept design. Teams should be familiar with the White River National Forest Management Plan in this context.

CREATIVE PARTNERSHIPS

Finalist teams are encouraged to develop and propose creative partnerships to deliver innovation in materials and engineering design. ARC is committed to pioneering new materials through the use of emerging research in the context of the competition; teams are invited to explore opportunities for new materials for which the development of a research or production partnership may hold value.

PUBLIC ENGAGEMENT

The wildlife crossing structure represents a significant opportunity to engage, inspire and educate the public in matters of wildlife conservation, ecosystem protection and ecological literacy generally. The structure itself should at once signify and demonstrate the importance of landscape linkages for wildlife conservation, and in so doing, advance the wider project of reweaving landscape. As such, the overpass structure, the viewing platform(s) and the site plan should be employed as engaging and educational devices within an overall landscape narrative. Teams are encouraged to develop such a narrative for the structure and the site plan to engage with and communicate these objectives to the public. Teams are challenged to ensure that their proposed designs are legible at a high speed and from a distance, as well as responsive and sensitive to the local environment and the target wildlife for the structure.

KEY DOCUMENTS

The following documents, additional site data and maps are available to finalist teams in the Technical Appendices on the ARC website at http://www.arc-competition.com.

American Association of State Highway and Transportation Officials (AASHTO), (2004). A Policy on Geometric Design of Highways and Streets, 5th Edition. Washington D.C.. See: http:www.transportation.org

Bonaker, P., Huyett, A., & Kintsch, J. (2010). I-70 Eco-logical Monitoring 2009 Progress Report. Unpublished report prepared by Center for Native Ecosystems and ECO-resolutions, LLC for the Colorado Department of Transportation as part of the Federal Highway Administration's Eco-Logical grant program.

Charette, R. P. & Marshall, H. E. (1999). UNIFORMAT II Elemental Classification for Building Specifications, Cost Estimating, and Cost Analysis. U.S. Department Of Commerce, Technology Administration National Institute of Standards and Technology, NISTIR 6389.

Clevenger, A. P. (2005). Conservation value of wildlife crossings: measures of performance and research directions. GAIA 14, 124–129.

Clevenger, A. P. & Waltho, N. (2005). Performance indices to identify attributes of highway crossing structures facilitating movement of large mammals. Biological

Conservation 121, 453–464.
Colorado Department of Transportation (CDOT), 2005. Context Sensitive Solutions – CSS – A Vision for CDOT. Policy Memo 26, October 2005. See: http://www.coloradodot.info/business/designsupport/policy-memos/026-context-sensitive-solutions-css-vision-for.pdf/view
Colorado Department of Transportation (CDOT), 2010. Context Sensitive Solutions on the I-70 Mountain Corridor. See: http://i70mtncorridorcss.com/css.
Felsburg, Holt & Ullevig. (2009). I-70 West Vail Pass Habitat Linkage Structure Location, Design Criteria, and Conceptual Design Report.
Heller, N. E., & Zavaleta, E. S. (2009). Biodiversity management in the face of climate change: A review of 22 years of recommendations. Biological Conservation 142, 14-32.
Kintsch, J. (2008). Vail Pass Wildlife Linkage White Paper – DRAFT. Unpublished report, Southern Rockies Ecosystem Project, Denver CO.
Southern Rockies Ecosystem Project. (2008) Wildlife Bridge at West Vail Pass. See: http://www.restoretherockies.org/wildlife_bridge.html
Transportation Research Board (TRB), 2002. A Guide to Best Practices for Achieving Context Sensitive Solutions. National Cooperative Highway Research Program, Report #480. Washington DC, 2002. See: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_480.pdf
US Department of Transportation, Federal Highway Administration, and Colorado Department of Transportation (2004). I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS). See:
Executive Summary: http://i70mtncorridorcss.com/docs/peis
Overview:
http://www.coloradodot.info/projects/i-70mountaincorridor/
Draft PEIS 2004:
http://www.coloradodot.info/projects/i-70mountaincorridor/programmaticEIS/
Revised Draft:
http://www.coloradodot.info/projects/i-70mountaincorridor/revised-draft-peis.html
Preferred Alternative:
http://www.coloradodot.info/projects/i70mountaincorridor/programmaticEIS/2.0_Chapter_2.pdf
US Forest Service (2002). White River National Forest Management Plan. See: http://www.fs.fed.us/r2/whiteriver/ (click “Land & Resources Management”)

CONTEXT

THE ARC PARTNERSHIP

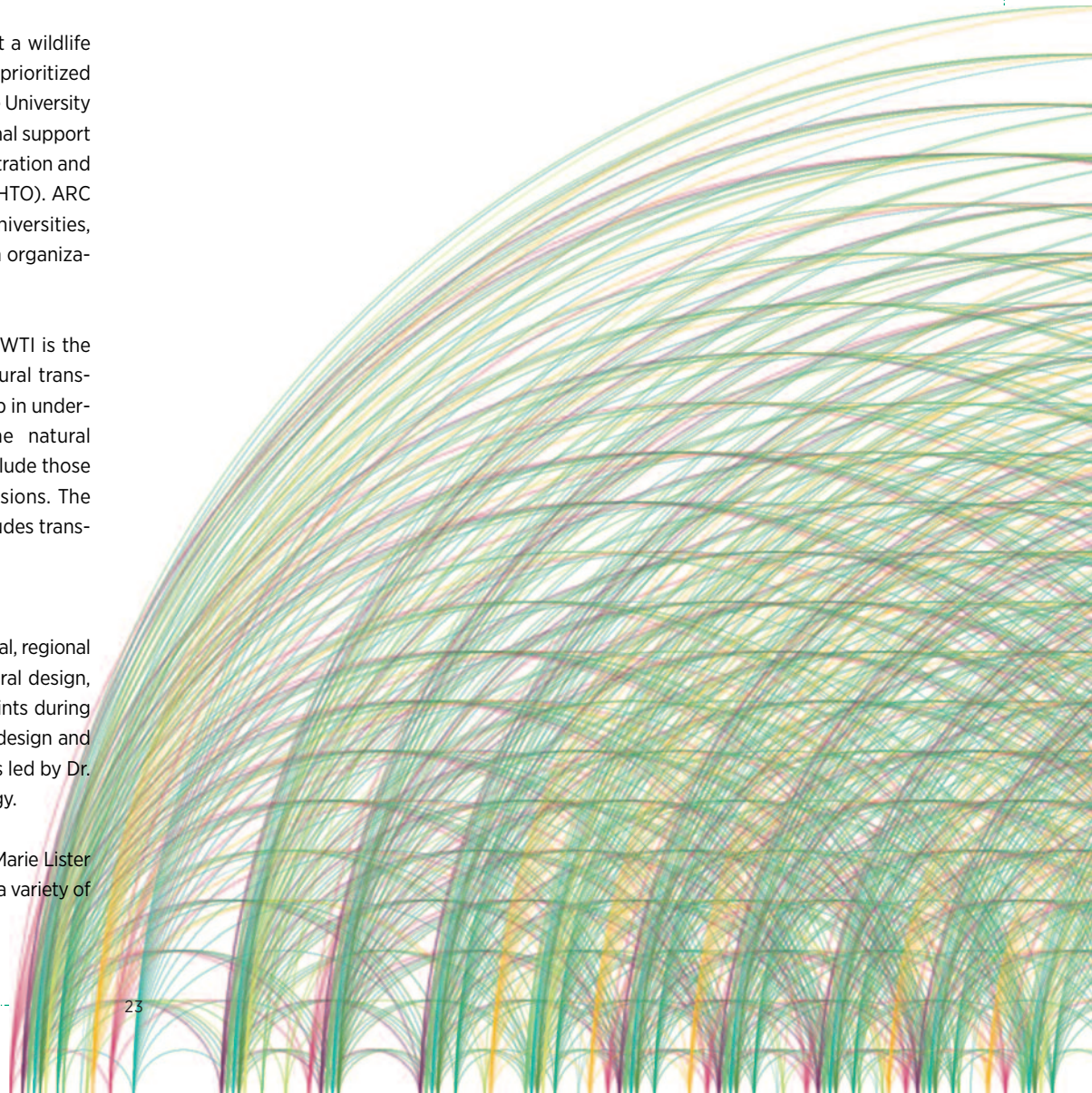
ARC is a partnership that was created in 2008 to develop and implement a wildlife crossing infrastructure design competition at a high-profile, ecologically prioritized site. Initiated by the Western Transportation Institute (WTI) at Montana State University and the Woodcock Foundation in New York City, ARC quickly drew additional support from the Edmonton Community Foundation, the Federal Highway Administration and the American Association of State Highway Transportation Officials (AASHTO). ARC continues to draw mounting support from federal and state agencies, universities, professional associations, private foundations and non-profit conservation organizations in the United States and Canada.

ARC is managed by WTI in partnership with the Woodcock Foundation. WTI is the largest national University Transportation Center in the US focused on rural transportation issues. WTI's Road Ecology program provides national leadership in understanding the interaction between roads, natural resources and the natural environment. WTI's research, development and implemented solutions include those that address wildlife movement near highways and wildlife-vehicle collisions. The Woodcock Foundation is a private foundation whose funding interest includes transboundary habitat and corridor conservation for wildlife.

ADVISORS

ARC is supported by a Technical Advisory Committee (TAC) comprised of local, regional and national experts in wildlife biology, ecology, landscape and architectural design, engineering and transportation. The TAC provides expert advice at key points during the competition, including background research, site selection criteria, site design and program criteria, and engineering and ecological specifications. The TAC is led by Dr. Tony Clevenger at WTI, a leading wildlife scientist specializing in road ecology.

The ARC competition is overseen by a Professional Advisor, Professor Nina-Marie Lister at Ryerson University, Toronto, whose work in ecological planning appears in a variety of international design competitions and commissions.



ARC AND THE I-70 MOUNTAIN CORRIDOR

Through a partnership with CDOT and the selection of the West Vail Pass site, the ARC design competition will contribute to a state-level initiative to improve wildlife mobility and address natural resource protection issues in Colorado. Demand for safe travel is increasing in the I-70 Mountain Corridor between Glenwood Springs and C470 in Denver. In response to that demand, CDOT released the Draft I-70 Programmatic Environmental Impact Statement (PEIS) in December 2004 to disclose preliminary transportation alternatives, environmental impacts and potential associated mitigations (SREP 2008).

The PEIS recognizes that the benefits derived from a transportation system supporting Colorado citizens, local communities and economic interests can come at a cost to other resources, including interference with the ability of wildlife to use the landscape in a manner that maintains population viability. It is acknowledged that the I-70 Mountain Corridor fragments and isolates existing habitats, interferes with free movement of animals within their habitat, and reduces remaining quality wildlife habitat by making such habitat less accessible to many native species. In addition, high traffic volumes form a barrier to wildlife movement, often resulting in wildlife-vehicle collisions and serious levels of mortality for some rare or wide-ranging species (ALIVE MOU, 2008).

To improve conditions for wildlife in the I-70 Mountain Corridor, CDOT convened the ALIVE Committee, a technical advisory committee consisting of biologists from local and regional government agencies. The ALIVE Committee developed a landscape-based ecosystem approach for consideration of wildlife needs and conservation measures, and recommended measures to improve habitat connectivity across the I-70 Mountain Corridor between Glenwood Springs and C470 in Denver (ALIVE MOU, 2008).

The ALIVE committee identified important areas designated as Linkage Interference Zones (LIZ) for wildlife movement throughout the corridor. The LIZ locations were determined by integrating local expert knowledge concerning wildlife within the corridor, habitat characteristics and a GIS analysis of potential roadway barriers. A wildlife overpass at West Vail Pass was first recommended as a priority through the ALIVE committee in early 2000 (Felsburg, Holt & Ullevig, 2009).

A bipartisan effort in the US Congress recently allocated $500,000 in public funds for the wildlife overpass structure from the 2005 Appropriations Bill through the Public Lands Discretionary funding source. Due to the efforts of the Southern Rockies Ecosystem Project (SREP) and Wilderness Workshop, $420,000 was allotted in November 2005 to CDOT to undertake preliminary analysis and site assessment for a wildlife bridge structure near West Vail Pass (SREP 2008). Given the constraints of the allocation, the proposed location at milepost 187.4 on I-70 was determined to be the most appropriate location to consider a wildlife overpass.

The Collaborative Effort, a 27-member group including CDOT and the Federal Highway Administration, represents varied interests of the corridor. The group was convened to reach consensus on a recommended transportation solution for the I-70 Mountain Corridor and was to be informed by solutions to improve safety and mobility for all users while preserving and restoring or enhancing ecosystem functions. The Collaborative Effort's recommendation for the corridor (referred to as the Preferred Alternative in the I-70 Mountain Corridor Draft PEIS, 2004) is a multi-modal transportation solution including non-infrastructure components, a commitment to evaluation and implementation of a rail-based Advanced Guideway System (AGS) and highway improvements. Non-infrastructure-related components include increased enforcement, driver education and bus service. AGS is a central part of the recommendation and envisions the implementation of rail passenger service in the corridor. Highway improvements include the addition of two auxiliary lanes, truck pullouts and parking and improvements to interchanges (I-70 Coalition, 2008).

KEY DOCUMENTS

The following documents, additional site data and maps are available to finalist teams in the Technical Information section of the ARC website at http://www.arc-competition.com.

Colorado Department of Transportation, Federal Highway Administration, U.S. Fish and Wildlife Service, U.S.D.A. Forest Service, U.S. Bureau of Land Management, Colorado Department of Natural Resources, Division of Wildlife. (2008). ALIVE Memorandum of Understanding among the Colorado Department of Transportation Federal Highway Administration, US Fish and Wildlife Service, the USDA Forest Service, US Bureau of Land Management, Colorado Department of Natural Resources, Division of Wildlife. Retrieved from: http://i70mtncorridorcss.com/pdf/alive/Signed_ALIVE_MOU.pdf

Felsburg, Holt & Ullevig. (2009). I-70 West Vail Pass Habitat Linkage Structure Location, Design Criteria, and Conceptual Design Report.

I-70 Coalition (2008). I-70 Coalition Preferred Alternatives Consensus Recommendation Document. Retrieved from: http://cdot.i70css.webfactional.com/cdot/pdf/Collaborative_Effort_Consensus_Recommendation.pdf/

US Department of Transportation, Federal Highway Administration, and Colorado Department of Transportation (2004). I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS). See:

Executive Summary: http://i70mtncorridorcss.com/docs/peis

Overview:
http://www.coloradodot.info/projects/i-70mountaincorridor/

Draft PEIS 2004:
http://www.coloradodot.info/projects/i-70mountaincorridor/programmaticEIS/

Revised Draft:
http://www.coloradodot.info/projects/i-70mountaincorridor/revised-draft-peis.html

Preferred Alternative:
http://www.coloradodot.info/projects/i70mountaincorridor/programmatic-EIS/2.0_Chapter_2.pdf

Sato, J.F. and Associates (2007). A Landscape Level of Integrated Valued Ecosystems (ALIVE) Program and its Contribution to the I-70 Mountain Corridor Programmatic Environmental Impact Statement. Prepared for Southern Rockies Ecosystem Project and the Colorado Department of Transportation, Region 1. Littleton, Colorado.

Southern Rockies Ecosystem Project. (2008) Wildlife Bridge at West Vail Pass. See: http://www.restoretherockies.org/wildlife_bridge.html

PROCESS

The ARC International Design Competition is a two-phase design competition for the proposed wildlife crossing structure.

Phase 1 was a Call for Expressions of Interest (EOI) in which over 100 firms in 36 respondent teams from 9 countries submitted their qualifications and design approaches for evaluation by the ARC Selection Committee. Phase 1 of the competition closed on July 30, 2010. By responding to the Phase 1 EOI, teams were deemed to have agreed that the decision of the ARC Selection Committee is final and binding.

Based on the Phase 1 submissions, the ARC Selection Committee has invited five (5) finalist teams to participate in Phase 2 of the design competition. Commencing September 7, 2010, Phase 2 is an intensive, eight (8) week design exercise undertaken by the five (5) finalist teams. The finalist teams are challenged to develop and submit a bold, innovative and buildable concept design for the wildlife crossing structure at the proposed location near West Vail Pass. Phase 2 design concept submissions will be sufficiently detailed so as to convey all design intent and character of the intended project and its site context. A jury of international experts will evaluate the finalist submissions and decide upon a winning design concept for the competition, and its decision will be final and binding. More details are provided under Jury in this document.

All finalist submissions will be presented and exhibited in January 2011 at the Transportation Research Board Annual Conference in Washington, DC as part of a special workshop on Wildlife Crossings and Road Ecology. Following the workshop, the winner will be announced at the ARC awards ceremony on Tuesday, January 25, 2011. As part of a larger outreach and education campaign, a wider public exhibition of the finalists' schemes and winning design(s) may follow at times and places to be determined.

ARC reserves the right to amend this information and/or the competition documentation at any time as deemed necessary.

Wildlife crossings may be underpasses or overpasses, although underpasses are the more common and less costly typology. Overpasses are useful to many species of wildlife because the landscape surface is more familiar to traveling animals and less intimidating than other crossing structure types (photos: WTI & T. Clevenger).

At a minimum, finalist submissions will be published on the ARC website following the competition at www.arc-competition.com.

TEAM STRUCTURE

Finalist design teams must include a minimum of two (2) registered professional firms with current licenses in landscape architecture and civil or structural engineering. Teams may opt to include a Registered Architect as well as other specialists. International and out-of-state licenses were acceptable for Phase 1 of the competition. However in Phase 2, at least one (1) team member on each of the finalist teams must hold (or be qualified to hold) a current professional civil or structural engineering license to practice in the state of Colorado. Firms are not required to be exclusive to one team, with the exception of the identified lead firm or firms in joint venture. ARC encourages interdisciplinary collaboration and expects that respondent teams will also include wildlife biologists, ecologists, transportation specialists, and others deemed necessary to the context. Teams are also encouraged to include other experts they feel will enhance both the local sense of place and the international interest in the Rocky Mountain Corridor.

JURY

A jury of distinguished, internationally acclaimed experts in landscape architecture, engineering, architecture, ecology and transportation will review and judge the finalist teams' design submissions with input and advice from ARC's Professional and Technical Advisors and the ARC Steering Committee. The jury will prepare a report on the finalist submissions to be delivered to ARC following the competition adjudication. The decision of the jury shall be final and binding.

The competition jury members are:

MARC MIMRAM
Architect-Engineer, Principal of Marc Mimram Architects, Paris, France
PROFESSOR CHARLES WALDHEIM (Jury Chair)
John E. Irving Professor and Chair of Landscape Architecture,
Harvard University, Graduate School of Design
WILLIAM L. WITHUHN
Curator Emeritus, History of Technology and Transportation, Smithsonian Institution
PROFESSOR JANE WOLFF
Associate Professor and Director of Landscape Architecture, John H. Daniels Faculty of Landscape, Architecture and Design, University of Toronto

A fifth jury member with expertise in conservation biology and wildlife ecology will be announced shortly.

Short biographies of the jury members are provided on the ARC website at:
http://www.arc-competition.com under "Jury".

WINNING DESIGN

The ARC International Wildlife Crossing Infrastructure Design Competition is one of many steps in a larger mitigation effort for Colorado's I-70 Mountain Corridor and the region beyond. The winning design selected for the competition site may be implemented at the West Vail Pass location or it may be utilized at additional or different sites along the I-70 corridor at the discretion of CDOT, pending the results of the

understand that the ARC competition does not preclude or minimize the collaborative stakeholder process. Furthermore, the ARC design competition has no formal relationship to the PEIS and does not indicate a decision on the part of CDOT to build a wildlife overpass at West Vail Pass. CDOT may choose to enter into contract with the winning team for the development and implementation of a design for a wildlife crossing structure. CDOT may also opt not to enter into any contracts for reasons that are at the sole discretion of the agency.

With respect to the winning design concept for the ARC competition, CDOT and ARC have agreed on the following terms in the Memorandum of Understanding signed by both parties in December 2009:

- All submissions to the competition will become the property of ARC, which, as the sponsor of the competition, will be permitted to use those designs in publications, exhibits, or other public venues. The winning design will not be the property of CDOT unless purchased from the design teams in the form of a tender or other contract. However, the design teams will retain the intellectual property and copyright to their designs (CDOT and WTI/ARC MOU, 2009).
- Provided that the design teams submit to CDOT the required Pre-Qualification documentation, hold the required professional licenses to practice business in the state of Colorado and have built portfolios that meet CDOT's usual criteria for project management expertise, the winning design team(s) of the design competition will be considered "pre-qualified" and eligible to participate in any subsequent process for design development and construction of an overpass structure on the I-70 corridor (CDOT and WTI/ARC MOU, 2009)
- If CDOT wishes to use any aspect of the winning design or a finalist's design, CDOT will enter into an agreement with the team (or teams) directly, independent of any input from WTI/ARC (CDOT and WTI/ARC MOU, 2009).
- WTI/ARC recognizes that there is no guarantee that wildlife crossing structures will be part of the I-70 reconstruction at Vail Pass (CDOT and WTI/ARC MOU, 2009).

OWNERSHIP AND COPYRIGHT

As indicated in the MOU with CDOT, all materials submitted to the competition become the property of ARC, and may be retained for archival purposes and possible exhibition and publication. Each competition entrant will retain full copyright of all their materials and will always be given appropriate credit if and when their material is utilized.

EXHIBITION AND PUBLICATION

ARC will publish the results of the competition online, and potentially in print form. ARC may also use the submissions in a public exhibition at a future date to be determined. In any exhibition, publication, or website, ARC will make every effort to properly credit the appropriate competitors. As ARC retains ownership of all competition materials (see "Ownership and Copyright", above), it reserves the right to utilize the competition submissions with appropriate credit and acknowledgement in any publication, educational or promotional endeavor in perpetuity and without compensation to entrants.

HONORARIA

All short-listed teams invited to participate in the design competition and who submit a complete concept design proposal with the required components will be awarded a US$15,000 honorarium subject to the submission criteria set out in this Brief. Honoraria will be paid by check to the lead firm identified by each of the finalist design teams; honoraria will be distributed to the team leads at the ARC awards ceremony on January 25, 2010 in Washington DC.

The winning team, whose submission is decided upon by the jury, will receive a prize of US$40,000 subject to the conditions set out in this Brief. The winner will be announced and prize monies paid at the ARC awards ceremony on January 25, 2010 in Washington DC.

Honoraria and prize monies are paid by ARC as a gesture only and do not imply a contract to build. However, as noted in the Winning Design section of this document, CDOT may choose to enter into contract with the winning team for the development and implementation of a design for a wildlife crossing structure. CDOT may also opt not to enter into any contracts for reasons that are at the sole discretion of the agency.

COMMUNICATIONS

Questions during the ARC design competition may only be submitted by email to **questions@arc-competition.com** between September 27th and October 8th, 2010. The question period will close at 5 pm local time on Friday October 8th, 2010. The source of all questions will remain confidential. Questions with repetitive content will be provided with one common answer.

No other means of communication will be acknowledged. Questions and answers during the competition will be posted on the competition website in a single collated document which will be updated regularly throughout the question and answer period. It is the responsibility of the respondents to check the competition website for updates and responses to questions. It is also respondents' responsibility to seek clarification of any matters they deem to be unclear. ARC shall not be responsible for any misunderstanding by finalist teams, the competition brief or any associated documents. ARC reserves the right to make changes to these documents and the competition process at any time deemed necessary.

Finalist teams should channel all communications regarding the competition to the ARC team by email at: questions@arc-competiton.com. Finalist teams must not attempt to make contact with any member of ARC's Steering Committee, Technical Advisors, Professional Advisor or supporting agencies or jurors. Any and all communications made by the finalist teams outside of the formal question and answer protocol will not be acknowledged.

Infrared camera images capture the range of wildlife movement on the crossing structures in Banff National Park, Alberta, Canada (photos: WTI & T. Clevenger, 2008).

SITE VISIT

All finalist teams are required to attend a **mandatory site visit on Saturday September 25, 2010.** The site visit will include a short briefing on the ARC project, its partners, stakeholders and agencies, including representatives from the Colorado Department of Transportation (CDOT), Federal Highway Administration (FHWA), US Forest Service, the Governor's Office, the Congressman's Office and representatives of the media. The finalist teams will participate in a press briefing followed by an opportunity to meet with local and national media representatives. Following lunch, the finalist teams will be taken by van to the West Vail Pass site for a site tour guided by representatives of ARC, CDOT and the FHWA. A short question and answer period will follow the site visit, and any additional technical addenda will be distributed at this time. Further details and an agenda will be communicated to all finalist teams following the launch of the competition phase.

SUBMISSION

The finalist teams are required to submit the following materials on which their concept designs for the overpass structure, the site and program are elaborated using full colour graphics with minimal text. The finalist submissions become the property of ARC and will not be returned.

Submissions must include:

A. Four (4) ISO A1 standard presentation panels, mounted on 5mm (1/4″) thick foam core backing (Dimensions of ISO A1 panels are 594mm x 841mm or 23.4″ x 33.1″)

- At a minimum, the panels must provide a narrative summary of the design scheme and show a detailed site plan at 1:1000 and a concept plan at 1:200.
- The panels may be aligned to read as a single narrative, or as discrete components.
- Panels must show a variety of sections, elevations, axonometric and/or transverse views at appropriate scales to provide elaboration and detail of the structure, surface vegetation, fencing, ramping, and other features of the concept scheme.

B. A physical scale model of the overpass structure.

- The model is to be constructed at a scale of 1:200 and mounted under a clear plexiglas cover on a base measuring not more than an A1 panel size.
- The construction material for the scale model is at the discretion of each team.
- The model should show the structure, the vegetated habitat surface, and selected elements of the site program that best depict each team's concept design.

C. Eight (8) copies of a bound booklet of not more than 15 single sided pages, printed in full colour on 11″ x 17″ or 28cm x 43cm paper.

- The booklet should represent the comprehensive, formal submission and should contain all imagery and text.
- The booklet must contain images of each panel reduced to fit one per page
- The booklet should NOT contain information that does not appear or is not referenced on the presentation panels. The only exception to this requirement is the cost estimate, which should be included in the booklet only.
- The booklet may be used to elaborate on innovations and technical specifications related to material presented on the panels.
- The booklet should contain a complete list of the design team members, their key contact information and any supporting firms. Teams may also use this section to list any industry, research or corporate partners.

D. A CD or DVD containing the following information:

- digital files for all four (4) presentation panels in both high resolution (TIFF or PSD format, minimum 350 dpi at the scale of the presentation panels) and low resolution (JPG format, 150 dpi at 20 cm x 25 cm or 8″ x 10″) PDF formats;
- the booklet in PDF format; and
- a minimum of one high-resolution digital photograph (TIFF or PSD format, minimum 350 dpi at 28 cm x 43 cm or 11″ x 17″) of the physical model.

SUBMISSION LOCATION & DEADLINE

All final submission materials must be received in hard copy no later than 5 pm local time on Tuesday November 2nd, 2010 at this address:

Roger W. Surdahl, P.E.
Technology Delivery Engineer
Federal Highway Administration
Central Federal Lands Highway Division
12300 W. Dakota Avenue, Suite 210B
Lakewood, CO, USA 80228
(720) 963-3768, (720) 963-3752 fax
(888) 739-1055 #3768

Late submissions will not be accepted.

Please note that the submission contact information is provided solely for the purpose of establishing the delivery point for the submissions. As previously instructed, questions about the competition may only be submitted by email to questions@arc-competition.com.

SELECTION

In evaluating the finalist teams' submissions, the jury will be briefed by the ARC Professional Advisor and the Technical Advisor. The jury will be instructed to look for design excellence in submissions that fulfill and advance the competition objectives while meeting the technical requirements of site and program in the competition brief. In evaluating the submissions, the jury will place high value on the following criteria (not necessarily listed in order of importance):

1. INNOVATIVE DESIGN

A concept design that goes beyond conventional solutions and emphasizes:

RISK-TAKING

Not accepting received wisdom but starting with fundamentals to go beyond easy and safe design solutions while exploring new methods, new materials and new thinking.

INSPIRATION

A new typology of infrastructure that is extraordinary in its ability to reconcile the mobility of humans and wildlife, while elevating people's everyday experience of landscape.

EDUCATION

An engaging design that inspires and compels people to seek the story behind the structure in the wider context of landscape connectivity, wildlife conservation and ecological literacy.

ADAPTATION

An adaptive design that offers flexibility and potential modularity for wildlife mobility under dynamic ecosystem conditions, including climate change.

SYNTHESIS

An intelligent scheme that synthesizes complex or competing agendas in an energetic way so that the whole is greater than the sum of the parts and the design challenge is met at several scales.

2. QUALITY OF DESIGN

A superlative concept design that demonstrates:

SPECTACULAR INFRASTRUCTURE

An innovative concept design that is both iconic and feasible; a structure that is at once daring in aspiration but safe in function; beautiful yet ecologically responsive.

SUSTAINABILITY

A scheme that exhibits extraordinary design excellence with an emphasis on environmental consciousness and sustainability to create long-lasting economic, ecological and social value.

EXPERTISE WITH SCALE

A concept design that demonstrates a nuanced understanding of scale and connection beyond the immediate site, and addresses the reciprocal relationship of local and regional development.

THOUGHTFUL RESOLUTION OF COMPETING DEMANDS

A layered concept design that understands, addresses and attempts to resolve the sometimes competing ecological, architectural, engineering, transportation, landscape and socio-cultural demands of the site.

3. COST-EFFECTIVE DESIGN

A concept design that demonstrates cost-effectiveness through:

- Innovative materials choice;
- Sensitivity in both capital costs and long-term maintenance; and
- Creative partnerships with industry, corporate or research agencies to experiment, test, demonstrate or advance the use of new materials and/or new approaches.

The Jury will communicate its decision with comments on the finalists' submissions in a Jury Report. The Jury Report will be submitted to ARC following the adjudication in November 2010, but before the Award Ceremony in January 2011. The Jury Report will be made available on the ARC website at: www.arc-competition.com.

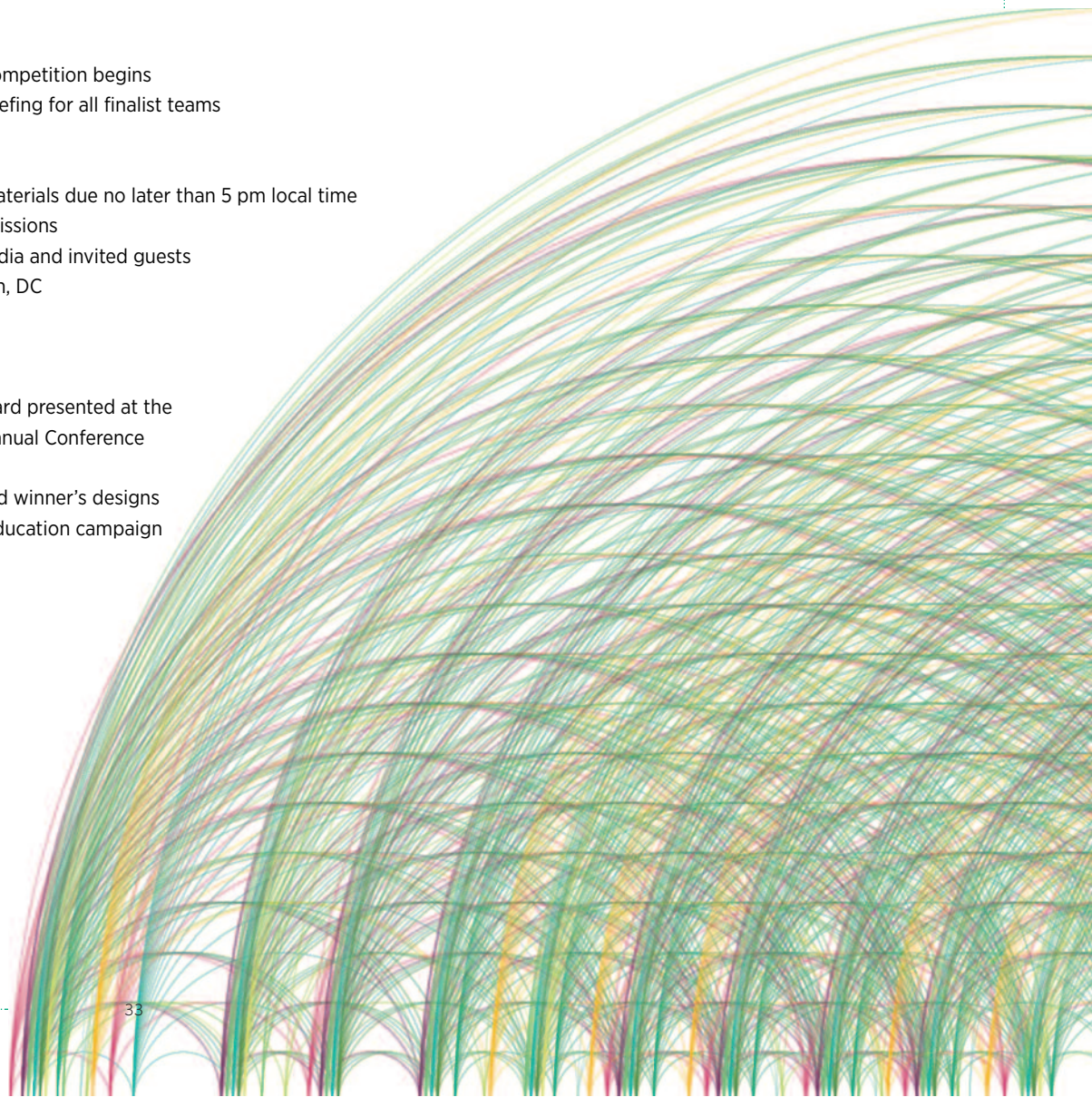
TIMELINE

PHASE 1

September 7, 2010:	Finalists announced and design competition begins
September 24-26, 2010:	Mandatory site visit and media briefing for all finalist teams
September 27-October 8, 2010:	Question and answer period
October 8, 2010:	Question period closes
November 2, 2010:	Phase 2 deadline — submission materials due no later than 5 pm local time
November 12-14, 2010:	Jury convenes to adjudicate submissions
January 25, 2011:	Winner announced — finalists, media and invited guests at Award Ceremony in Washington, DC

POST-COMPETITION

January 23-25, 2011:	Finalist Projects and Winner's Award presented at the Transportation Research Board Annual Conference in Washington, D.C.
Winter/Spring 2011:	Potential exhibition of finalists' and winner's designs as part of a larger outreach and education campaign (under development).



REFERENCES

Documents referred to in this Brief along with more detailed technical and site-specific information are available at the ARC website, http://www.arc-competition.com under “Technical Appendices”. This portion of the website is accessible only to finalist teams.