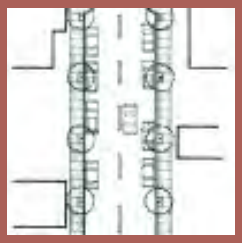
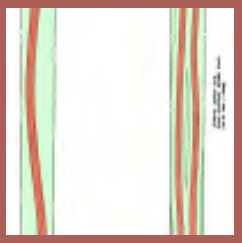
Landscape Architect

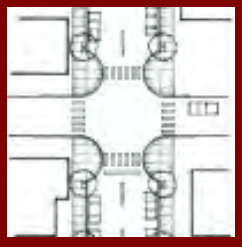
Design & Alignment Concepts
















US 93 DESIGN DISCUSSIONS

Project Committee:

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Evaro to Polson, Montana

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

SKILLINGS CONNOLLY

December 20, 2000

JONES JONES
Architects & Landscape Architects

Landscape Architect
Design and Alignment Concepts

1. Steps in the Design Process – Setting, Initial Goals, Spirit of Place
2. Steps in the Design Process – Landscapes, Cultural and Historic Resources, Wildlife Crossing Research
3. Steps in the Design Process - Opportunities and Constraints, Design and Alignment Concepts
4. Steps in the Design Process - Design Concepts, Use of Design and Alignment Concepts
5. Spirit of Place Photomontage
6. Spirit of Place – Landscape Continuum
7. Landscapes
8. Landscapes – Photomontage #1
9. Landscapes – Photomontage #2
10. Landscapes – Photomontage #3
11. Landscapes – Photomontage #4
12. Fish & Wildlife Crossings – Migration Patterns
13. Fish & Wildlife Crossings – Examples of crossing structures #1
14. Fish & Wildlife Crossings – Examples of crossing structures #2
15. Fish & Wildlife Crossings – Examples of crossing structures #3
16. Fish & Wildlife Crossings – Examples of crossing structures #4
17. Fish & Wildlife Crossings – Examples of crossing structures #5
18. Evaro to Arlee Design and Alignment Concept 18
19. Evaro Hill Wildlife Crossings
20. Arlee Design Concept
21. Arlee to Ravalli Design and Alignment Concept
22. Ravalli Hill Design Concept
23. St. Ignatius Design and Alignment Concept
24. The Value of Ninepipe
25. Road Effects of Existing Alignment in Ninepipe
26. Ninepipe Design and Alignment Concepts
27. Ronan Alignment Concepts
28. Ronan to Polson Design and Alignment Concepts
29. Ronan to Polson Design and Alignment Concepts
30. Pablo Design and Alignment Concept Cross-sections
31. Caffery Road to Route 35 Design and Alignment Concept
32. Fish & Wildlife Crossings – Proposed Crossing Structures for US 93
33. Wildlife Fencing – Concepts for US 93 #1
34. Wildlife Fencing – Concepts for US 93 #2

STEPS IN THE DESIGN PROCESS FOR US 93

Setting

US 93 traverses the Flathead Indian Reservation, which is located on the west side of the Rocky Mountains in western Montana. Picturesque mountains and mountain valleys, with the broad Flathead Valley to the North and the majestic Mission Mountains to the East, characterize this part of Montana. The area is home to a wide variety of wildlife, including Grizzly Beer, White-tailed Deer, Mule Deer, Pronghorn, Elk, Painted Turtles, Bighorn Sheep, and a number of fish and bird species. It is also home to the Confederated Salish and Kootenai Tribes of the Flathead Nation (CSKT).

Initial Goals

In order to be respectful of the land, the people, and the wildlife, initial goals were established:

- Develop an understanding of the land and the relationship the Salish and Kootenai people have with the land.
- Find ways the land can shape or influence the road
- Develop concepts that respect the integrity and character of the place, people, and wildlife
- Restore habitat areas that have been fragmented by the road and surrounding development
- Respect and restore the way of life in small communities along the road
- Create a better visitor understanding of the place that the Salish and Kootenai people call their homeland.

One of the first steps was a review of reports, studies, surveys, photographs, and other documents related to the highway corridor and the natural resources. In addition, an initial reconnaissance of the highway corridor was conducted to identify scenic, aesthetic, and cultural resources. This review and reconnaissance helped build a strong base of knowledge that served as the foundation for subsequent design discussions and decisions.

Spirit of Place

Before any design concepts for the road were conceived, it was essential to get a better understanding of the land, what makes it unique, and how the Salish and Kootenai people relate to the land. The design of the reconstructed highway is premised on the idea that the road is a visitor and that it should respond to and be respectful of the land and the Spirit of Place. Understanding the Spirit of Place — the whole continuum of what is seen, touched, felt, and traveled through — provides inspiration and guidance, and leads to design solutions uniquely suited to the special qualities of the place.

The Spirit of Place includes more than just the road and adjacent areas – it consists of the surrounding mountains, plains, hills, forest, valley, and sky, and the paths of waters, glaciers, winds, plants, animals, and native peoples. (Spirit of Place - Photomontage, p. 5) The Spirit of Place encompasses the entire Mission Valley, Mission and Salish Mountains, Jocko Valley, and Rattlesnake Divide. This broader environmental continuum has distinct landscapes like large outdoor rooms, which the existing road bisects. (Spirit of Place – Landscape Continuum, p. 6)

Landscapes

By examining the Flathead Reservation's big "rooms", we were able to define fourteen landscapes, each with its own unique visual and physical characteristics. (Landscapes, p. 7) These landscapes have visual and ecological qualities that the road must respond to and respect. The informal landscape place references used in the graphic are derived from a dominant landscape feature or characteristic, and from design team and committee input.

By looking at these individual landscapes, ideas began to form of how the road should be influenced by, and respond to, the land. (Landscapes – Photomontages, pp. 8-11) The Pablo Pines landscape, for example, is characterized by pine-covered sand hills that were formed when winds blew down off the glaciers that created Flathead Lake. In this area, a responsive design approach would maintain and restore the pines and rolling character of the sandy hills close to the road. This would also increase the perception that the road is integrated with the land rather that slicing through it. In contrast, the Ronan Spring Creek landscape consists of gently rolling low hills of pasture and cropland, and the road should reflect this rolling, undulating character.

Cultural and Historic Resources

One aspect of this project that makes it so unique is that the highway is located entirely within the Flathead Indian Reservation. As a consequence, much of our research focused on the cultural and historic resources of the area.

The CSKT wanted to ensure cultural concerns were addressed in the design alternatives without having to identify individual ritual and sacred sites. After considering several options on how to communicate the cultural importance, the decision was made to associate cultural information with wildlife issues. As a result, discussions about wildlife habitat, wildlife migration, and habitat restoration imparted cultural issues and concerns as well.

Wildlife Crossing Research

In the United States, an estimated one million vertebrates-amphibians, reptiles, birds, and mammals are killed on roads and highways each day. In short, roads have a tremendous impact upon wildlife. American Indians are particularly sensitive to this issue. Since the CSKT recognize the Flathead / Mission / Jocko Valleys are their homeland as well as the homeland for a variety of wildlife, it was important that any new road design allow wildlife to cross the road safely. Roads disrupt natural migration patterns, destroying habitat areas and connections between habitat patches. Due to the impacts of roads, populations of some species have declined dramatically, ecological balance has been changed, wildlife is being forced into more developed areas, where human-wildlife encounters have increased considerably.

By working with scientists and wildlife specialists, we were able to identify habitat areas and migration patterns for specific wildlife. In particular, we looked at road-kill data, tracking information, and sightings to determine where wildlife currently cross the US 93 corridor. (Fish & Wildlife Crossings – Migration Patterns, p. 12) We also were interested in identifying historic migration patterns that have been interrupted by the current US 93. Perhaps it would be possible to restore those traditional wildlife movement patterns if the road was not such a barrier.

We also analyzed current construction techniques for wildlife crossings in order to determine an approach that would work best for US 93. In particular, we studied the wildlife crossings that have been developed for several different highway projects, including the Linn Cove Viaduct (Blue Ridge Parkway, North Carolina), Interstate 70 (Glen Canyon, Colorado), Interstate 75 (Florida), Trans-Canada Highway (Banff, Canada), US Highway 2 (Montana), and State Highway 58 (San Bernadino County, California). (Fish & Wildlife Crossings – Examples of crossing structures, pp. 13-17) Various types of crossing structures were evaluated as to their size, cost, design intent, types of animals they are suitable for, the effectiveness of a specific type of crossing, and what animals use the crossings. In doing this evaluation, we could begin to make determinations about which types of crossings are best suited for specific situations along US 93.

All of this research was incorporated into the design and alignment concepts, and the result was a series of proposed wildlife crossing structures for the entire length of the project. (Fish & Wildlife Crossings – Proposed Crossing Structures for US 93, p. 32) Each individual crossing is presented in greater detail in the ***Wildlife Crossings Workbook.***

For many of the wildlife crossing structures to function properly, it will be necessary to use some type of fencing to help control movement and funnel wildlife toward the crossing structure. Eight-foot high page wire fencing designed specifically for wildlife control is recommended for segments of the reconstructed US 93. This fencing is similar to that used for the Trans-Canada Highway in Banff. (Wildlife Fencing – Concepts for US 93, pp. 33-34)

Opportunities and Constraints

The inventory and analysis phases of the project lead to the delineation of "Opportunities and Constraints" areas based on the landscape and cultural context. The opportunities and constraints mapping identified zones of opportunity where natural, cultural, and scenic resources can be dodged or only minimally affected by potential highway improvements, and areas of constraint where resources would be adversely affected by highway improvements. This information was used as the basis for developing initial design concepts for the reconstructed road and roadside improvements and visitor amenities.

In order to make the project more manageable, the fourteen landscapes were combined into five separate design segments. The five segments are as follows:

- Evaro Design and Alignment Concept (p. 18)
- Arlee to Ravalli Design and Alignment Concept (p. 21)
- St. Ignatius Design and Alignment Concept (p. 23)
- Ninepipe Design and Alignment Concept (p. 26)
- Ronan to Polson Design and Alignment Concept (pp. 28-29)

Design and Alignment Concepts

For each design segment, we explored a wide range of design concepts and recommendations for the reconstructed road. The three governments agreed that all design concepts should be considered unless there was consensus to remove one from consideration. An iterative process was developed for each design segment that consisted of generating the conceptual ideas, reviewing those concepts with the three governments – Federal Highway Administration (FHWA), Montana Department of Transportation (MDT), and the Confederated Salish and Kootenai Tribes (CSKT) – and the prime consultant – Skillings-Connolly, Inc. – and then refining the design concept.

In formulating the design concepts over the length of the road corridor, a decision was made to start on the south end of the reservation at the community of Evaro and proceed north with the concept development. For each of the five design segments, ideas and concepts were generated for road alignment, lane configuration, fish and wildlife crossing structures, wildlife fencing locations, interpretive opportunities, community entry signs, and other roadway features.

In addition to the general recommendations for the five design segments, detailed concepts were developed for specific areas along the corridor where there were special concern.

Following is a brief overview of the places where additional focus was needed to address the unique conditions and issues associated with that place.

- The Evaro Hill area is a major wildlife corridor that links the grizzly populations of the Mission Range / Bob Marshall to the Bitterroot grizzly bear recovery zone to the west. How wildlife crossings are incorporated into the road design is critical if wildlife is going to be able to move safely through the area. (Evaro Hill Wildlife Crossings, p. 19)

- In the community of Arlee, we looked at how a "couplet" could improve traffic flow and safety while maintaining the visual and physical character of the community. (Arlee Design Concept, p. 20)

- Ravalli Hill was identified as a possible site for a new visitor center; our concept was to relocate the visitor center to the west of the existing road in order to take advantage of views of the mountains and valley, and to have closer proximity to the Bison Range. (Ravalli Hill Design Concept, p. 22)

- The Ninepipe area is significant from both a cultural and ecological standpoint. Because of the sensitivity and complexity of the thousands of potholes that make up this rich and diverse habitat, it was imperative to look at the highway within the context of the surrounding landscape. (The Value of Ninepipe, p. 24) Due to the ecological importance of the wetland complex, the appropriateness of mitigating problems caused by the current alignment came into question. As a result, an alignment that would swing westward around the wetland complex was also considered. (Road Effects of Existing Alignment in Ninepipe, p. 25) Both of these concepts were explored on a conceptual level in order to determine the most appropriate actions for the Ninepipe area, and to see if additional research was needed before final design decisions could be made. (Ninepipe Design and Alignment Concepts, p. 26)

For the community of Ronan, alignment concepts were evaluated for a full range of alternatives, including keeping the new road on existing alignment with some improvements to providing a bypass around the community. (Ronan Alignment Concepts, p. 27) In Pablo, a cross-section was developed to accommodate four lanes of traffic while still maintaining the character and identity of the community. (Pablo Design and Alignment Concept Cross-sections, p. 30)

For the highway segment between Caffery Road and Route 35, we were concerned with integrating the horizontal and vertical alignment of the reconstructed road with the hilly terrain and maintaining views of Flathead Lake. (Caffery Road to Route 35 Design and Alignment Concept, p. 31)

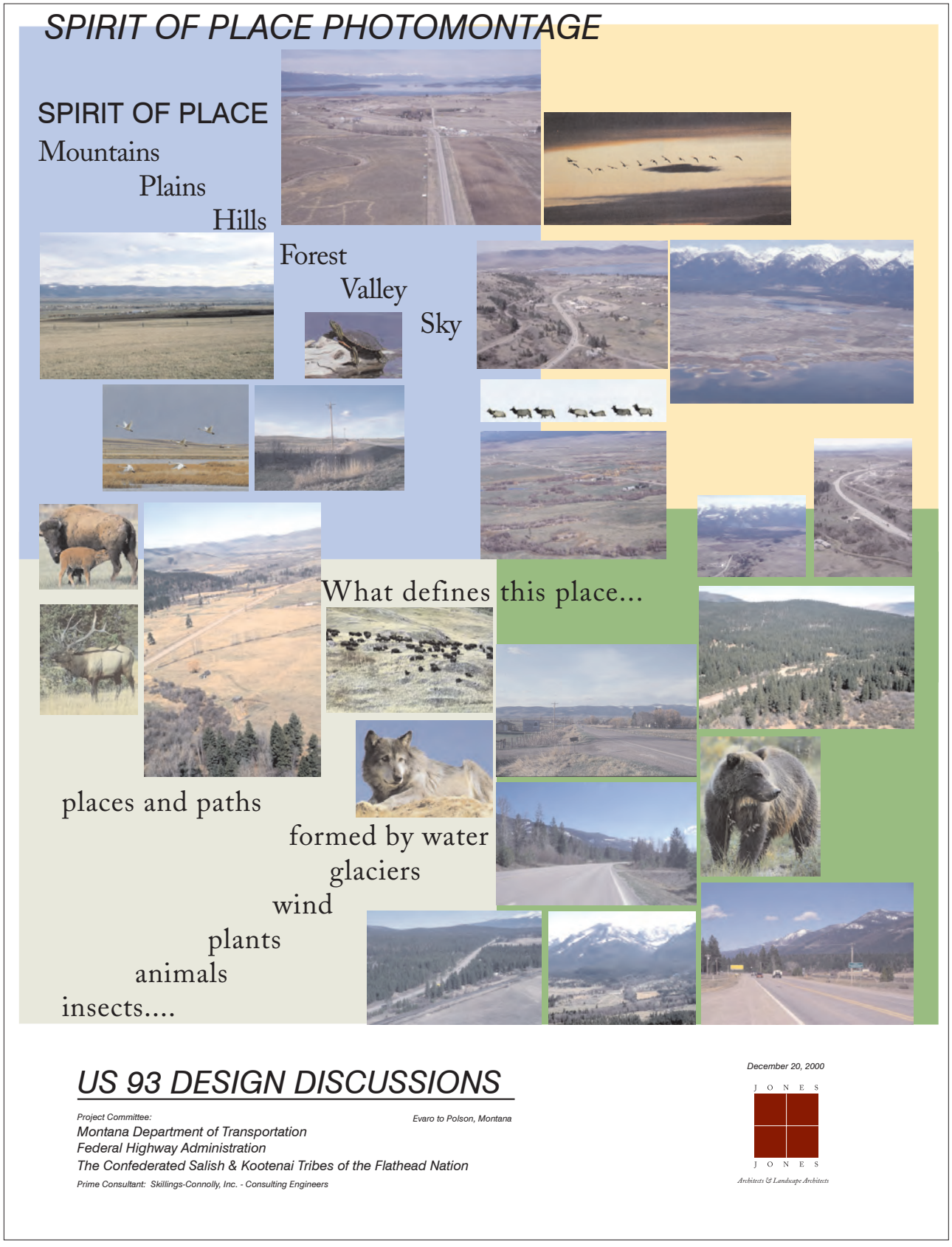
Use of Design and Alignment Concepts

These ***Landscape Architects Design and Alignment Concepts***, as presented herein, represent a consensus among the three governments – FHWA, MDT, and CSKT – regarding the design direction and standards for the reconstruction of US 93 from Evaro to Polson. What are not shown are the dozens of ideas and concepts that were explored and evaluated. Some of these concepts were quickly discarded, others were revised, discussed, and then rejected, and finally some evolved into the design and alignment concepts contained in this document. The graphics represented in this report are reproductions of larger presentation boards. As a result, some labels and notes may not be legible. Refer to page 35 for clarification on the content of these labels and notes.

Since it was important that the entire project setting be seen as a whole (Sense of Place Continuum), decision making was never broken into increments. Final consensus was not sought until design and alignment concepts had been developed for the entire corridor.

The ***Design Components Workbook*** was completed to record the spatial location of the components (as recommended in the ***Landscape Architects Design and Alignment Concepts*** herein) as well as specific areas for land use control and environmental mitigation identified by the CSKT.

The ***Design Guidelines and Recommendations*** build upon the ideas established in the ***Landscape Architects Design and Alignment Concepts*** and are intended to provide landscape architects, designers, planners, engineers, and others involved with transportation-related activities on the Flathead Indian Reservation with a consistent design philosophy and design style.



The landscape of the Flathead Indian Reservation is a dynamic collection of plants, landforms, animals, and special places. This graphic illustrates the variety of unique features on the reservation, and illustrates how US 93 currently interacts with these features. This graphic was used as a starting point in the process of creating a road that responds to and reflects the character of the landscape and people.

SPIRIT OF PLACE—The Landscape Continuum

US 93 DESIGN DISCUSSIONS

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Evaro to Polson, Montana

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

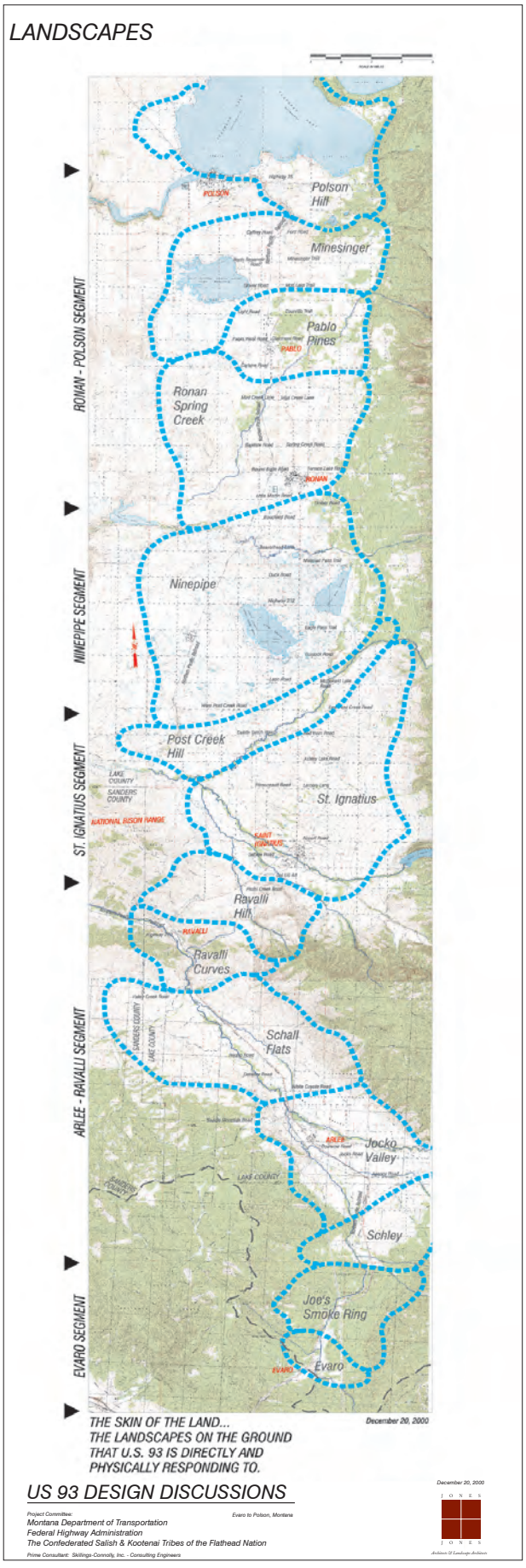
December 20, 2000

J O N E S

J O N E S

Architects & Landscape Architects

One of the many things that makes the Flathead Indian Reservation unique is the continuum of the valleys and mountain ranges that defines it. The mountains encompass large valleys and create large, definable spaces that can be seen as big “rooms” of the landscape. This graphic was used to remind us that the road corridor is just a small part of a larger landscape continuum.



By examining the Flathead Reservation's big "rooms", we were able to define fourteen landscapes, each with its own unique visual and physical characteristics. These landscapes have visual and ecological qualities that the road must respond to and respect. The informal landscape place references used in the graphic are derived from a dominant landscape feature or characteristic, and from design team and committee input.

LANDSCAPES—Photomontage #1

Jocko Valley... Jocko River to N of East Fork River

The land: *valley widens out to flat and gently rolling glacial outwash plain surrounded by dense vegetation and steep slopes...*

Ways the land could shape the road: *minimize impacts to natural resources...*




Schley...

North of East Fork River to Schley Creek

The land: *transition between the open, gently rolling Jocko Valley and the steep, densely vegetated Joe's Smoke Ring...*

Ways the land could shape the road: *follow and traverse slopes...*

Joe's Smoke Ring...

Schley Creek to Finley Creek

The land: *dense evergreen vegetation on steep and rolling terrain...*

Ways the land could shape the road: *maintain rolling, enclosed character of the landscape...*


Evaro... Finley Creek to Evaro

The land: *relatively narrow valley confined by steep and rolling hills...*

Ways the land could shape the road: *minimize impacts to Evaro and maintain open character of the landscape...*



US 93 DESIGN DISCUSSIONS

Project Committee:

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

Evaro to Polson, Montana

December 20, 2000

J O N E S

J O N E S

Architects & Landscape Architects

This graphic describes topographic and vegetative features of the Jocko Valley, Schley Slope, Joe's Smoke Ring, and Evaro landscapes. It also provides recommendations regarding how the road can be shaped to respond to these particular landscapes.

LANDSCAPES—Photomontage #2

Ravalli Hill... *Foot of Ravalli Hill to the crest*

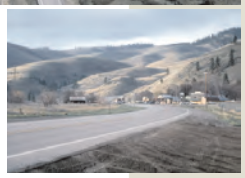
The land: *high rolling hills define/create a powerful divide between Mission Valley and Ravalli Canyon*

Ways the land could shape the road: *heal scars from road cuts... follow the flow of the land...*

Ravalli Curves...
crest of Ravalli Hill to Valley Creek

The land: *narrow river valley flanked by steep hills...*

Ways the land could shape the road: *heal scars from road cuts and follow meandering canyon...*



Schall Flats...
Valley Creek to Jocko River Bridge

The land: *relatively flat pastures and fields transected by streams & strikeridges and surrounded by steep rolling hills...*

Ways the land could shape the road: *follow the flow of the land and provide occasional changes in orientation to increase views of mountain landmarks*

US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

J O N E S

J O N E S

Architects & Landscape Architects

This graphic describes topographic and vegetative features of the Ravalli Hill, Ravalli Curves, and Schall Flats landscapes. It also provides recommendations regarding how the road can be shaped to respond to these particular landscapes.

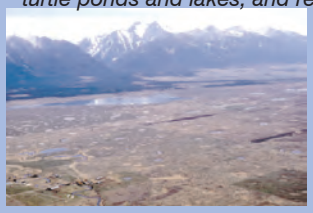
LANDSCAPES—Photomontage #3

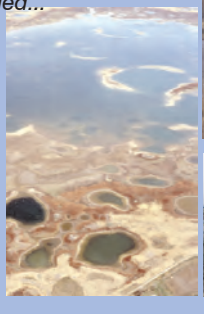
Ninepipe...

Ronan/Timber Road to Post Creek Hill

The land: *flat, with numerous turtle ponds and lakes dominant...*

Ways the land could shape the road: *dodge and maintain integrity of turtle ponds and lakes, and restore those that have been divided...*






Post Creek Hill...

Ninepipe to Post Creek

The land: *on a strongly defined tilted plane... glacial moraine is the dominant feature in the landscape...*

Ways the land could shape the road: *traverse with the slope of the tilted plane.*

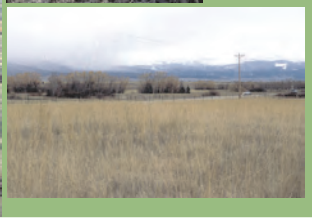




St. Ignatius... *Post Creek to foot of Ravalli Hill*

The land: *etched by dendritic (fern-like branching) drainage patterns... sense of broad valley prevails...*

Ways the land could shape the road: *follow the flow of the land... accentuate dendritic pattern of the streams and natural vegetative patterns that follow the streams...*



US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

J O N E S

J O N E S

Architects & Landscape Architects

This graphic describes topographic and vegetative features of the Ninepipe, Post Creek Hill, and St. Ignatius landscapes. It also provides recommendations regarding how the road can be shaped to respond to these particular landscapes.

LANDSCAPES—Photomontage #4

Polson Hill... highway 35 to top of ridge

The land: *high, rounded, glacial moraine terraces... serves as the entry into Polson and Flathead Lake...*

Ways the land could shape the road: *weave and traverse the steep glacial moraine terraces*




Minesinger... top of glacial moraine ridge to Pablo/Mud Lake Trail

The land: *relatively level to gently rolling series of glacial meltwater creeks and bankslopes...*

Ways the land could shape the road: *fit road to the rolling, curvilinear hills and follow the pattern of the creeks...*


Pablo Pines... Pablo/Mud Lake Trail to Mud Creek

The land: *pine covered sand hills that were formed by winds blowing down off the glaciers that created Flathead Lake...*

Ways the land could shape the road: *maintain and restore pines and rolling character of the sandy hills close to the road... minimize perception that road is cutting through the landscape... pull in and meander edges*




Ronan Spring Creek...

Pablo/ Mud Creek to Ronan

The land: *gently rolling low hills of mostly pasture and cropland...*

Ways the land could shape the road: *respond to the rolling, undulating character of the terrain...*



US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

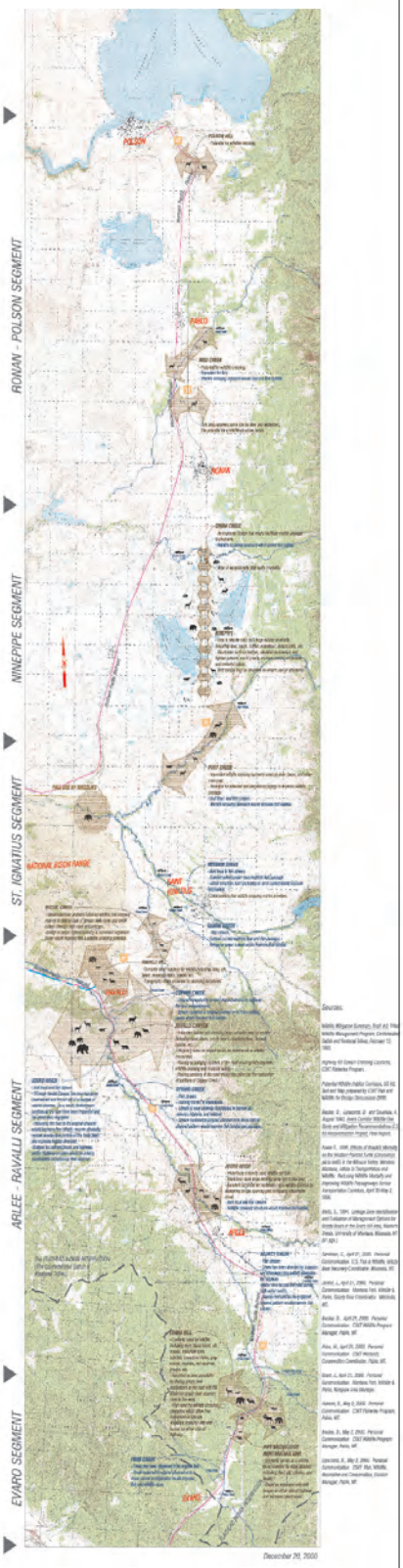
J O N E S

J O N E S

Architects & Landscape Architects

This graphic describes topographic and vegetative features of the Polson Hill, Minesinger, Pablo Pines, and Ronan Spring Creek landscapes. It also provides recommendations regarding how the road can be shaped to respond to these particular landscapes.

FISH & WILDLIFE CROSSINGS—
Migration Patterns



By working with scientists and wildlife specialists, we were able to identify habitat areas and migration patterns for specific wildlife. In particular, we looked at road kill data, tracking information, and sightings to determine where wildlife currently cross the US 93 corridor. We also were interested in identifying historic migration patterns that may have been interrupted by the current roadway and alignment of US 93.

FISH & WILDLIFE CROSSINGS—Crossing Structures #1
CONCRETE CULVERTS

Pipe Culvert (before construction)

Box Culvert (after construction)

Photos by Washington Deptartment of Fish and Wildlife - FHWA Web Page

Concrete Box Culvert

Location: Rasmussen Creek Clallam County, Washington - State Route 112.
Why built: Culverts had been built on a steep slope - the water velocity was too high for most fish swimming upstream.
Suitable for: Fish and amphibians.
Effectiveness: The project added nearly 7/8ths of a mile of stream habitat - post-project surveys reported salmon, trout and other fish in upstream areas where they had not been before.

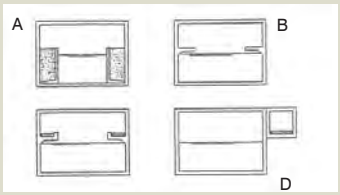
Concrete Box Culvert
Red Earth Underpass

Location: Banff National Park, Canada - Trans-Canada Highway
Size: 3.0 M. X 2.5 M.
Why built: To facilitate safe wildlife passage across highway.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians and reptiles.
Effectiveness: Black bear, cougar, coyote, and ungulates have used the underpass (11/96-6/00).

Bear Underpass

Location: Florida - State Road 46
Size: 47' (14.3 M.) long, 24' (7.3 M.) wide and 8' (2.4M.) high.
Why built: Bears were using similarly designed panther crossings on Interstate 75. Placement of underpass locations were based on bear kill data along the road.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians and reptiles.

Photo by Steve Homan - FHWA Web Page



Possibilities for integrating a wildlife passage with large, newly installed culverts:
A. Over-dimensioning in combination with artificial soft banks for fauna.
B. Integrated concrete fauna ledges.
C. Integrated concrete fauna ledges with raised edges and soil cover.
D. Creation of wildlife tunnel parallel to culvert.

Source: Habitat Fragmentation and Infrastructure in the Netherlands and Europe, In: Proceedings of the International Conference on Wildlife Ecology and Transportation.

ConSpan, 1563 E. Dorothy Lane, Dayton, OH 45429 PH: 1-800-526-3999

Prefabricated Concrete Arch Culverts

Size: Up to 10' high and 24' wide.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians and reptiles.

Photo by Washington Deptartment of Fish and Wildlife - FHWA Web Page

US 93 DESIGN DISCUSSIONS

Evaro to Polson, Montana

December 20, 2000

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

JONES JONES
Architects & Landscape Architects

In order to facilitate the safe movement of wildlife across the landscape, wildlife crossing structures are necessary in many locations along US 93. This graphic looks at how wildlife crossings have been used successful for other projects across North America. In particular, this sheet depicts concrete box culverts, and prefabricated arch culverts. By examining different types of crossing structures, we can determine which types of crossings are best suited for US 93.

FISH & WILDLIFE CROSSINGS—Crossing Structures #2
BRIDGES

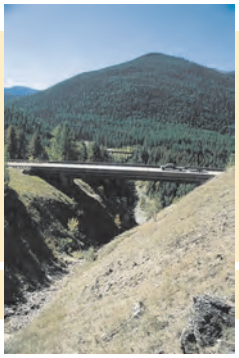


Photo by Chris Peterson - FHWA Web Page

Open Span Bridge - US HWY 2

Location: Montana
Why built: To accommodate motorists. A passage underneath was built with FHWA funds to facilitate mountain goat passage (Constructed in 1980).
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians, and reptiles.
Effectiveness: 4 years after completion, all "crossing goats" in the area are now using the underpasses.

FHWA Web Page

Open Span Bridges - Trans-Canada Highway

Location: Banff National Park, Canada
Why built: 5-Mile Bridge was built to accommodate motorists. All other bridges shown were built to reduce roadkill and facilitate wildlife movement.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians, and reptiles.
Effectiveness: The 22 underpasses over a 28 mile stretch of road have reduced ungulate roadkills by 96 percent (FHWA web page). Bridges that span both water and land are considered by experts to be optimal for carnivores.See individual photos for more detail.

Photos by Anthony Clevenger

Healy
Effectiveness: Four grizzly crossings (same bear). Frequent use by black bears, wolves, cougar, coyote, and ungulates (11/96-6/00).

Vermilion
Effectiveness: Used by black bears, wolves, cougar, coyote, and ungulates. (11/96-6/00).

Duthil
Effectiveness: Two grizzly crossings. Frequent use by black bears, wolves, cougar, coyote, and ungulates. (11/96-6/00).

Carrot Creek Bridge
Effectiveness: Two grizzly crossings. Frequent use by black bears, wolves, cougar, coyote, and ungulates. (11/96-6/00)

5 Mile Bridge
Effectiveness: This is an unconventional wildlife underpass, characterized by great breadth and openness. One of the few places large carnivores choose to cross the TCH (Clevinger, 1998).

US 93 DESIGN DISCUSSIONS

Evaro to Polson, Montana

December 20, 2000

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

JONES JONES
Architects & Landscape Architects

In order to facilitate the safe movement of wildlife across the landscape, wildlife crossing structures are necessary in many locations along US 93. This graphic looks at how wildlife crossings have been used successful for other projects across North America. In particular, this sheet depicts open span bridges. By examining different types of crossing structures, we can determine which types of crossings are best suited for US 93.

FISH & WILDLIFE CROSSINGS—Crossing Structures #3
CULVERTS

Photo by Dwight Forsyth - FHWA Web Page

Wall with Lip and Culvert

Location: Central Florida - US 441
Size: 3.5 ft. (1.1M.) concrete wall with 6" (15.2 cm) lip at the top.
Why built: To deter amphibians and reptiles from crossing over the road and funnel them to underpass culverts. (Construction began in December 1999).
Suitable for: Small mammals, reptiles and amphibians
Effectiveness: Wall will be monitored for effectiveness.

Photo by Dwight Forsyth - FHWA Web Page

Medium Culvert

Location: California, San Bernadino County - State Highway 58
Why built: To allow slow moving desert tortoises to safely cross the road.
Suitable for: Small mammals, reptiles and amphibians.
Effectiveness: Monitoring system confirms multiple tortoises using the culverts with frequency.

Photo by William Boarman - FHWA Web Page

Photos by Tony Clevenger

Large Elliptical Metal Culvert - Castle

Location: Banff National Park, Canada Trans-Canada Highway
Size: 4M X 7M
Why built: To facilitate safe wildlife passage across highway.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians and reptiles.
Effectiveness: One grizzly has used the underpass as well as many black bear, wolves, coyotes, and ungulates (from 11/96-6/00).

Photos by Tony Clevenger

Large Round Metal Culvert Morrison Coulee

Location: Banff National Park, Canada Trans-Canada Highway
Size: 4M
Why built: To facilitate safe wildlife passage across highway.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians and reptiles.
Effectiveness: Black bear, wolves, cougars, coyotes and ungulates have used the underpass. (from 11/96-6/00).

US 93 DESIGN DISCUSSIONS

Evaro to Polson, Montana

December 20, 2000

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

JONES JONES
Architects & Landscape Architects

In order to facilitate the save movement of wildlife across the landscape, wildlife crossing structures are necessary in many locations along US 93. This graphic looks at how wildlife crossings have been used successful for other projects across North America. In particular, this sheet depicts various types of culvert. By examining different types of crossing structures, we can determine which types of crossings are best suited for US 93.

FISH & WILDLIFE CROSSINGS—Crossing Structures #4

OVERPASSES

Visual Simulation by Florida Department of Transportation - FHWA Web Page

Wildlife Overpass

Location: Florida, Marion County - Interstate 75
Size: 52.5' wide and 200' long.
Why built: Vegetated wildlife crossing. Construction is scheduled to be completed in July, 2000.
Suitable for: Ungulates, small mammals, and reptiles.
Cost: 3.4 million or $327.00 per square foot (cost includes all construction costs and landscaping of approaches, FHWA Web Page).
Effectiveness: Camera monitoring is being considered for installation.

Wildlife Overpass - Red Earth

Photos by Tony Clevenger

Location: Banff National Park, Canada
Trans-Canada Highway
Size: 50 M. Wide
Suitable for: Carnivores, ungulates, small mammals and reptiles.
Cost: 2-3 million (included construction costs and landscaping of approaches, Clevenger).
Effectiveness: One grizzly, three black bear, and fifty-four coyotes crossed this structure. It is also frequently used by ungulates (11/96-6/00, Clevenger).

Wildlife Overpass - Wolverine

Location: Banff National Park, Canada
Trans-Canada Highway
Size: 50 M. Wide
Suitable for: Carnivores, ungulates, small mammals and reptiles.
Cost: 2-3 million (included construction costs and landscaping of approaches, Clevenger).
Effectiveness: Three black bear, two wolves, twelve cougars, and thirty-eight coyotes crossed this structure. It is also frequently used by ungulates. (11/96-6/00, Clevenger)

Other Examples of Wildlife Overpasses

Photos by Scott Jackson - FHWA Web Page

US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

JONES JONES
Architects & Landscape Architects

IIn order to facilitate the safe movement of wildlife across the landscape, wildlife crossing structures are necessary in many locations along US 93. This graphic looks at how wildlife crossings have been used successful for other projects across North America. In particular, this sheet depicts wildlife overpasses. By examining different types of crossing structures, we can start to make determine which types of crossings are best suited for US 93.

FISH & WILDLIFE CROSSINGS—Crossing Structures #5

ROADS ON PIERS

Photo by Frederick Gottemoeller - Bridge Aesthetics Around The World

Linn Cove Viaduct - Blue Ridge Parkway

Location: North Carolina
Why built: To minimize impact to sensitive natural resources.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians, and reptiles.

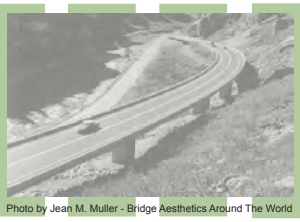


Photo by Jean M. Muller - Bridge Aesthetics Around The World

Interstate 70

Location: Glenwood Canyon, Colorado
Size: 5 precast segmental bridges, totaling 2,970' in length.
Why built: To minimize impact to sensitive natural resources.
Suitable for: Carnivores, ungulates, small mammals, fish, amphibians, and reptiles.

Interstate 75

Location: Florida
Size: 70' long, 7' high with 10' high chain link fencing to funnel wildlife to the underpass.
Why built: To allow the endangered Florida panther and other wildlife, to cross the busy interstate.
Suitable for: Carnivores,ungulates, small mammals, fish, amphibians, and reptiles.

Ecology of Greenways, Smith D.S., and P.C. Hellmund (eds.),

BARRIERS

Fence with apron

Location: Banff, Trans-Canada Highway
Size: 8'-0" ht.
Why built: To funnel animals toward crossings and prevent them from reaching highway.

Perforated Jersey Barrier

Location: Banff, Trans-Canada Highway
Why built: To allow small mammals through passage.
Suitable for: Small mammals, reptiles, and amphibians.

US 93 DESIGN DISCUSSIONS

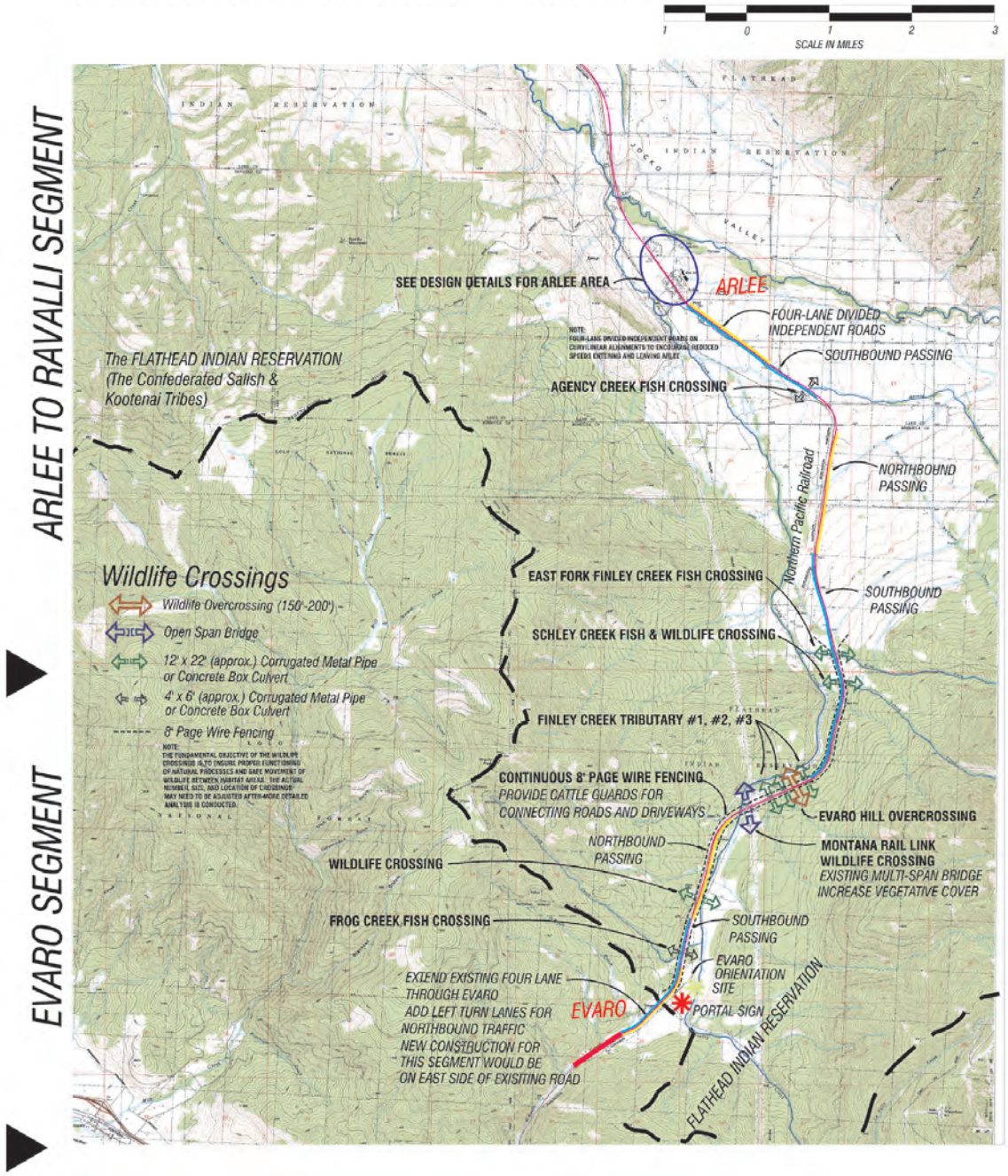
Project Committee: *Evaro to Polson, Montana*
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

JONES JONES
Architects & Landscape Architects

In order to facilitate the safe movement of wildlife across the landscape, wildlife crossing structures are necessary in many locations along US 93. This graphic looks at how wildlife crossings have been used successfully for other projects in North America. In particular, this sheet depicts roads on piers and on barriers. By examining these different types of crossing structures, we can determine which types of crossings are best suited for US 93.

EVARO TO ARLEE DESIGN AND ALIGNMENT CONCEPT



US 93 DESIGN DISCUSSIONS

Evaro to Polson, Montana

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

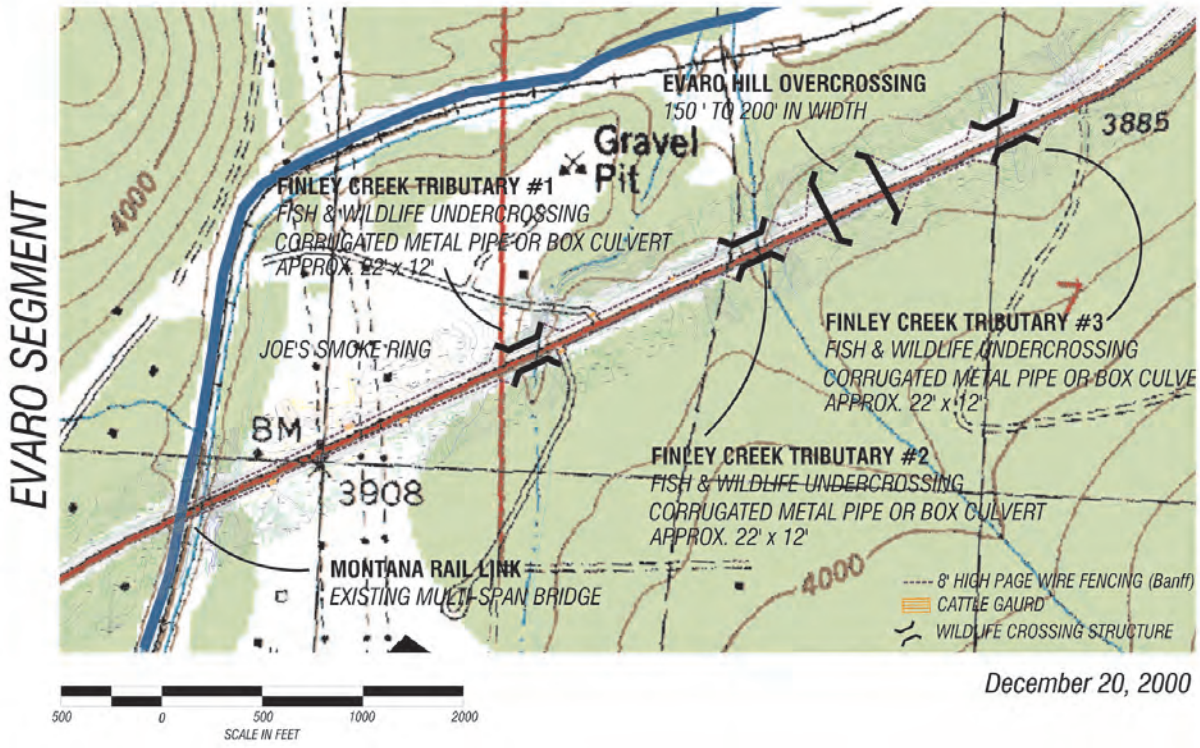
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

JONES
Architects & Landscape Architects

This graphic provides a detailed representation of the design and alignment concepts for the highway segment between Evaro and Arlee. Information provided includes road alignment, lane configuration, fish and wildlife crossing structures, wildlife fencing locations, interpretive opportunities, portal/boundary entry sign, and other design features. Of particular concern is the Evaro Hill area, which is a major crossing point for wildlife.

EVARO HILL WILDLIFE CROSSINGS



US 93 DESIGN DISCUSSIONS

Evaro to Polson, Montana

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

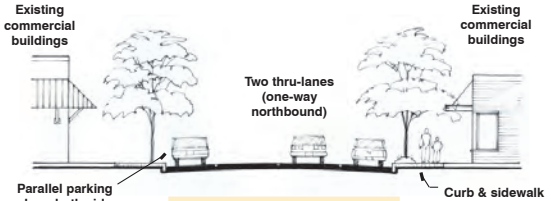
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

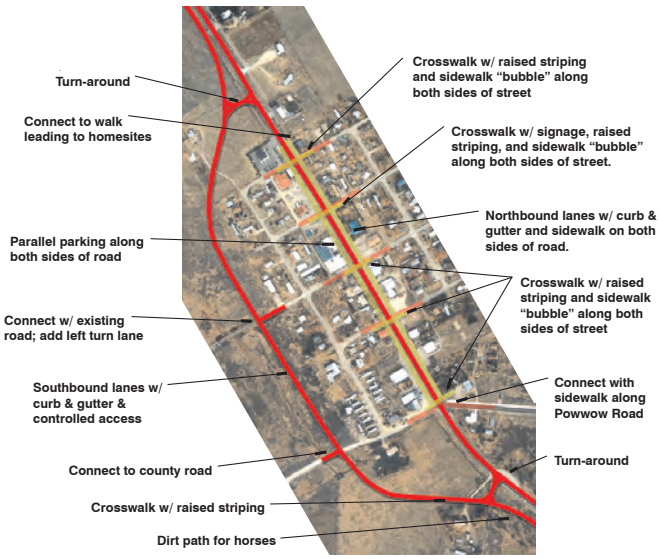
JONES JONES
Architects & Landscape Architects

The Evaro Hill area offers high quality habitat for a variety of species because it is undeveloped, heavily forested, and adjacent to the Finley Creek drainage area. This area represents the last opportunity for a link between the Mission Range / Bob Marshall grizzly populations to the east and the Bitterroot grizzly bear recovery zone to the west. This drawing describes the size, type and locations of recommended crossing structures.

ARLEE DESIGN CONCEPT

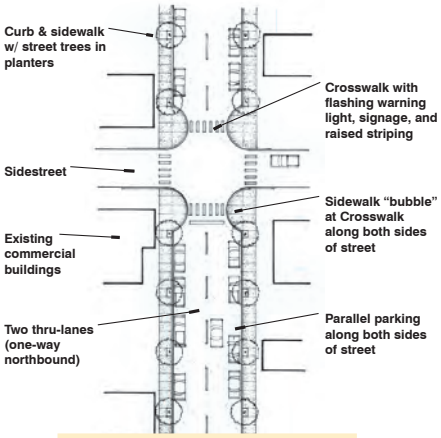


Typical Section



Detailed Plan

Alignment & Lane Configuration



Plan of Street Layout

US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

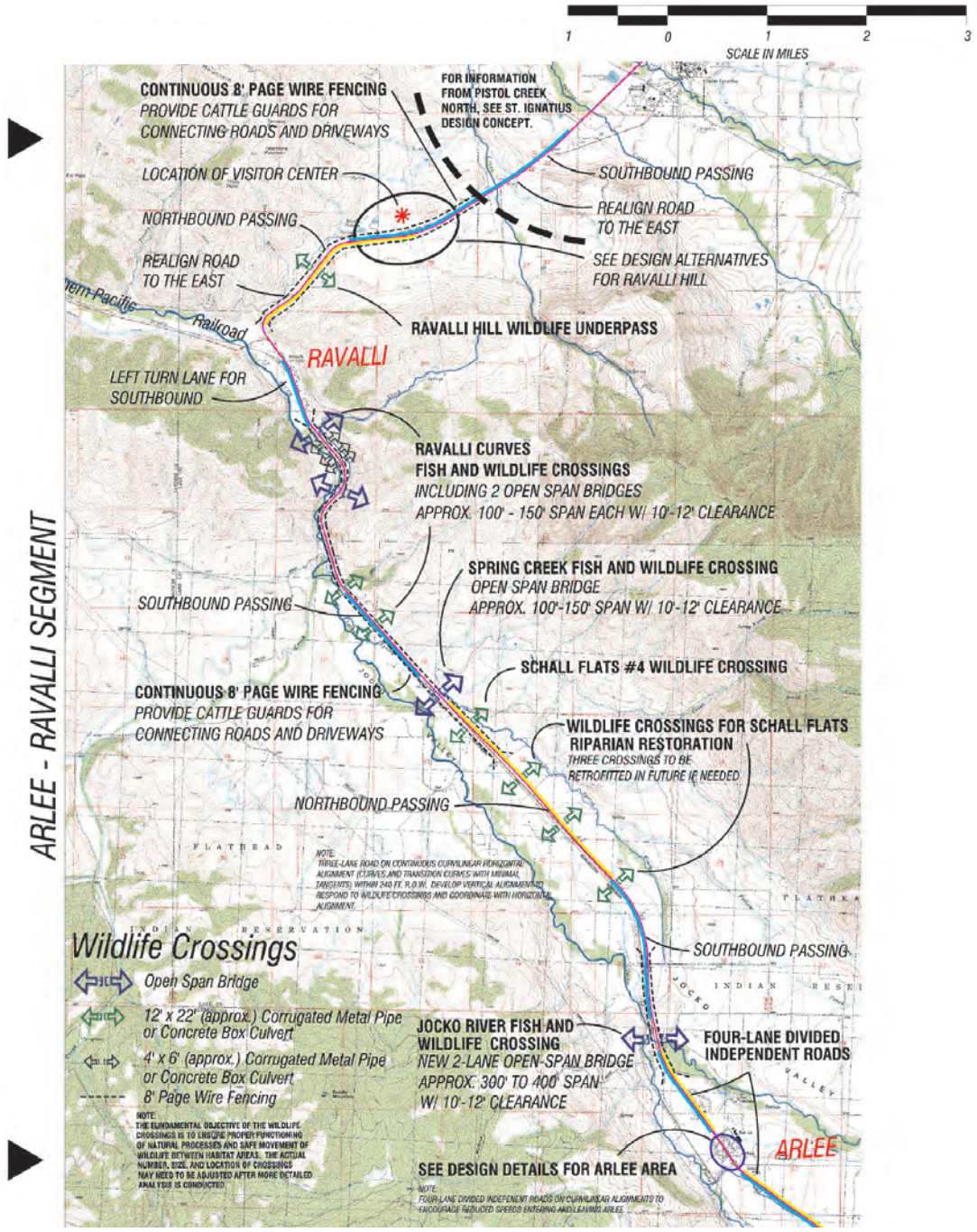
December 20, 2000

J O N E S J O N E S

Architects & Landscape Architects

The community of Arlee is greatly impacted by US 93, which essentially cuts through the middle of the town. This graphic presents a design concept that maintains two lanes through town for northbound traffic with the addition of parallel parking, sidewalks, and crosswalks in the town. A couplet would be added to the west of Arlee for southbound traffic.

ARLEE TO RAVALLI DESIGN AND ALIGNMENT CONCEPT



US 93 DESIGN DISCUSSIONS

December 20, 2000

Project Committee: *Evaro to Polson, Montana*

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

JONES JONES
Architects & Landscape Architects

This graphic provides a detailed representation of the design and alignment concept for the highway segment between Arlee and Ravalli. Information presented here includes road alignment, lane configuration, fish and wildlife crossing structures, wildlife fencing locations, interpretive opportunities, a visitor center, and other design features. Of particular concern are the wildlife crossings at the Jocko River and through the Ravalli Curves.

RAVALLI HILL DESIGN CONCEPT

Relocate Visitor Center North of US 93

Future discussions with the Bison Range need to be considered in order to address issues such as:
(1) Relocating the entrance to the Bison Range to this location
(2) Possible modifications to existing fencing for the Bison Range in order to minimize barriers to movement of deer and other wildlife
(3) Interpretive planning options for visitors who want to view the Bison Range.

Aerial view of existing (right side of photo) and proposed (left side of photo) Ravalli Hill Visitor Center site.

View of Mission Mountains looking north on US 93 from the top of Ravalli Hill

US 93 DESIGN DISCUSSIONS

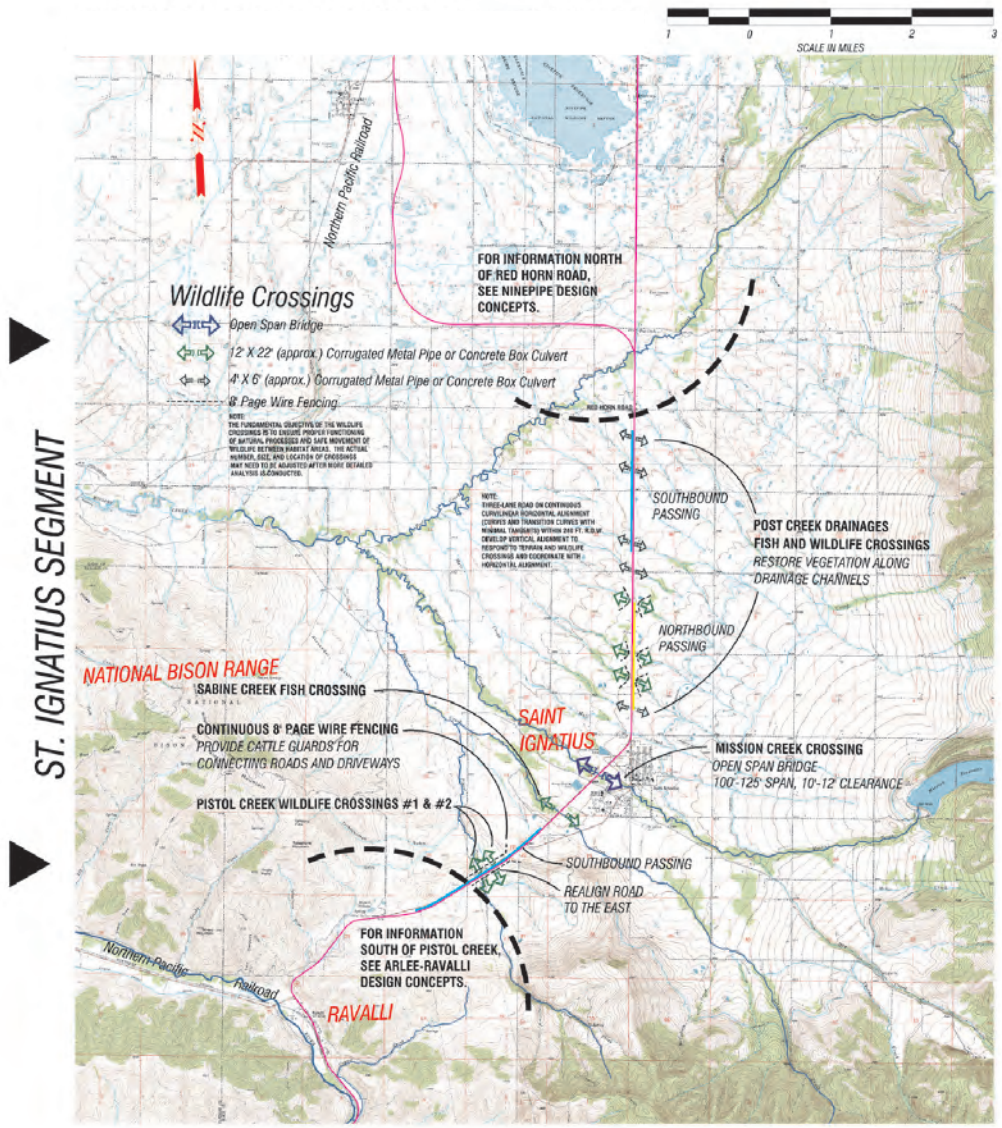
Project Committee: *Evaro to Polson, Montana*
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

JONES JONES
Architects & Landscape Architects

Ravalli Hill has been identified as a possible site for a new visitor center for travelers using US 93. This graphic presents a conceptual site and circulation plan for the site. The concept calls for the relocation of the visitor center to the west of the existing road in order to take advantage of views of the mountains and valley, and to provide closer proximity to the Bison Range.

ST. IGNATIUS DESIGN AND ALIGNMENT CONCEPT



US 93 DESIGN DISCUSSIONS

Evaro to Polson, Montana

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

JONES

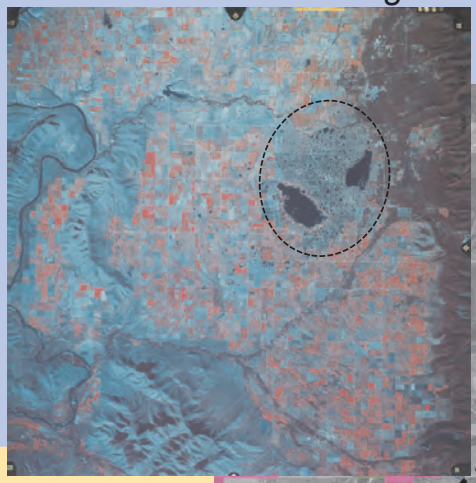
JONES

Architects & Landscape Architects

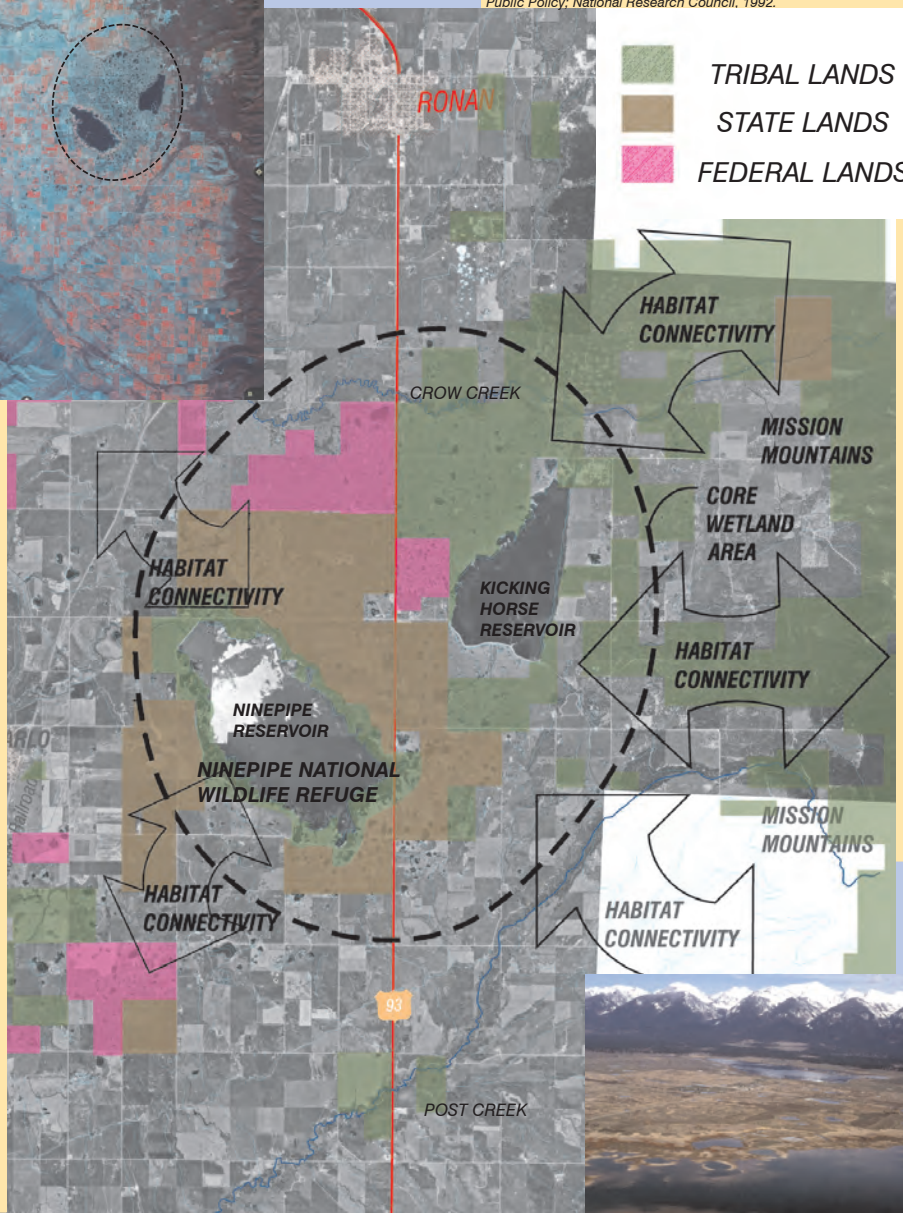
This graphic provides a detailed representation of the design and alignment concept for the highway segment between St. Ignatius and Post Creek. Information shown here includes road alignment, lane configuration, fish and wildlife crossing structures, wildlife fencing locations, interpretive opportunities, and other design features. Of particular concern are wildlife crossings at Mission Creek, Post Creek, and the numerous streams that make up the Post Creek drainage basin.

THE VALUE OF NINEPIPE

-As reflected by government land ownership and National Wildlife Refuge designation



"The public has begun to realize that wetlands are valuable systems providing many benefits to society."
-Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy. Committee on Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy; National Research Council, 1992.



NATURE & WETLAND CONNECTIVITY

"The value of a wetland is a measure of its importance to society. Wetland functions are valued to various degrees by society, but there is no precise, general relationship between wetland functions and the value of wetlands to society, and values can be difficult to determine objectively. A wetland's value can be weighted directly or relative to other uses that could be made of the site. For this reason, the location of a wetland may affect its value to society.
- Wetlands: Characteristics and Boundaries (1995), The National Academy of Sciences.

"With scarcity of wetland resources comes greater dependence of biota on wetlands for water and food, greater vulnerability of species when a wetland ***or unity of wetland area*** *is lost, greater public concern over wetland loss, and greater need to protect the appropriate distribution of wetland patches that can sustain biodiversity.*
- Wetlands: Characteristics and Boundaries (1995), The National Academy of Sciences.

US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

J O N E S
J O N E S
Architects & Landscape Architects

The Ninepipe area is significant from both a cultural and ecological standpoint. The satellite image on this sheet shows that the Ninepipe wetland complex is at the central core of an area that includes thousands of potholes and is an incredibly rich and diverse wildlife habitat area. This graphic shows the lands in the Ninepipe area that are managed by federal, state, and Tribal agencies specifically for wildlife habitat.

ROAD EFFECTS
of existing alignment in Ninepipe

ROAD - EFFECT ZONE
DEFINED BY ECOLOGICAL EFFECTS EXTENDING DIFFERENT DISTANCES FROM A ROAD. MOST DISTANCES ARE BASED ON SPECIFIC STUDIES (FORMAN, 1995).

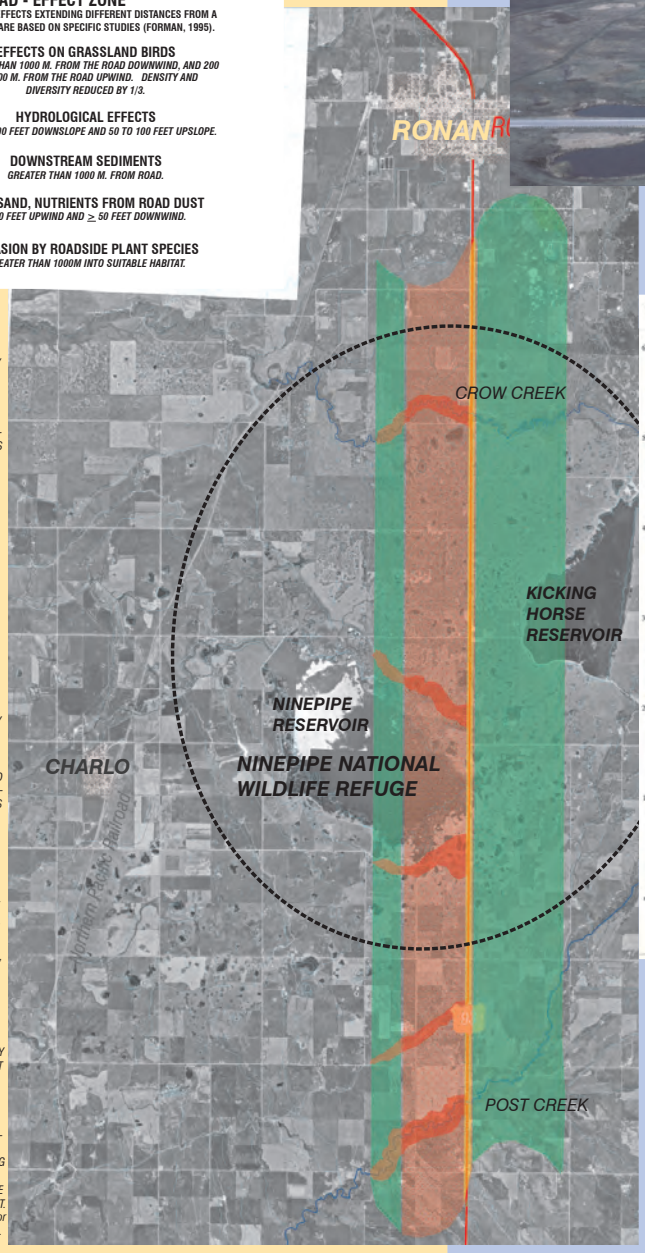
EFFECTS ON GRASSLAND BIRDS
GREATER THAN 1000 M. FROM THE ROAD DOWNWIND, AND 200 TO 1000 M. FROM THE ROAD UPWIND. DENSITY AND DIVERSITY REDUCED BY 1/3.

HYDROLOGICAL EFFECTS
200 TO 1000 FEET DOWNSLOPE AND 50 TO 100 FEET UPSLOPE.

DOWNSTREAM SEDIMENTS
GREATER THAN 1000 M. FROM ROAD.

SILT, SAND, NUTRIENTS FROM ROAD DUST
>50 FEET UPWIND AND ≥ 50 FEET DOWNWIND.

INVASION BY ROADSIDE PLANT SPECIES
GREATER THAN 1000M INTO SUITABLE HABITAT.



THE ROAD-EFFECT ZONE NOT ONLY VARIES IN WIDTH ALONG A ROAD, BUT ALSO EXHIBITS HIGHLY CONVOLUTED MARGINS. FURTHERMORE, AT ANY GIVEN POINT THE ROAD-EFFECT ZONE IS USUALLY ASYMMETRIC WITH SIGNIFICANT ECOLOGICAL IMPACTS EXTENDING FURTHER ON ONE SIDE THAN ON THE OTHER. THREE EXTRINSIC FACTORS DETERMINE THE DEGREE OF ASYMMETRY. TOPOGRAPHY, WITH UPSLOPE-DOWNSLOPE DIFFERENCES, PRIMARILY AFFECTS HYDROLOGY AND WATER-TRANSPORTED MATERIALS. WIND DIRECTION, WITH UPWIND-DOWNWIND DIFFERENCES, MAINLY AFFECTS WIND-TRANSPORTED ITEMS, INCLUDING PARTICULATE MATTER AND TRAFFIC NOISE. FINALLY, THE SURROUNDING HABITAT COMMONLY DIFFERS IN QUALITY OR SUITABILITY ON OPPOSITE SIDES OF A ROAD. THIS DIFFERENCE PRINCIPALLY AFFECTS THE SPREAD OF SPECIES, SUCH AS INVASIVE ROADSIDE PLANTS, AS WELL AS HUMANS THAT ENTER THE MATRIX AND CAUSE DISTURBANCE. - Forman, R.T. 1999. Horizontal Processes, Roads, Suburbs, Societal Objectives, and Landscape Ecology. In: Landscape Ecological Analysis, Issues and Applications, pp. 35-53. Klopatek and Gardner (eds.), Springer-Verlag, New York, Inc.

THE ECOLOGICAL EFFECT OF ROAD AVOIDANCE CAUSED BY TRAFFIC DISTURBANCE IS PROBABLY MUCH GREATER THAN THAT OF ROADKILLS SEEN SPLATTERED ALONG THE ROAD. TRAFFIC NOISE SEEMS MOST IMPORTANT, ALTHOUGH VISUAL DISTURBANCE, POLLUTANTS, AND PREDATORS MOVING ALONG A ROAD ARE ALTERNATIVE HYPOTHESIS AS THE CAUSE OF AVOIDANCE. Forman, R.T. 1999. Roads and Their Major Ecological Effects. In Annu. Rev. Ecol. Syst. 29:207-31.

GRAPHIC: Fowle, S., 1996, Effects of Roadkill Mortality on the Western Painted Turtle (Chrysemys picta bellii) in the Mission Valley, Western Montana, Article in Transportation and Wildlife: Reducing Wildlife Mortality and Improving Wildlife Passageways Across Transportation Corridors, April 30 - May 2, 1996.

National Wetland Inventory and Turtle Mortality Along Highway 93

Photo courtesy of: Mary Price, CSKT Natural Resources and Dale Becker, CSKT Wildlife Management Program

US 93 DESIGN DISCUSSIONS

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Evaro to Polson, Montana

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

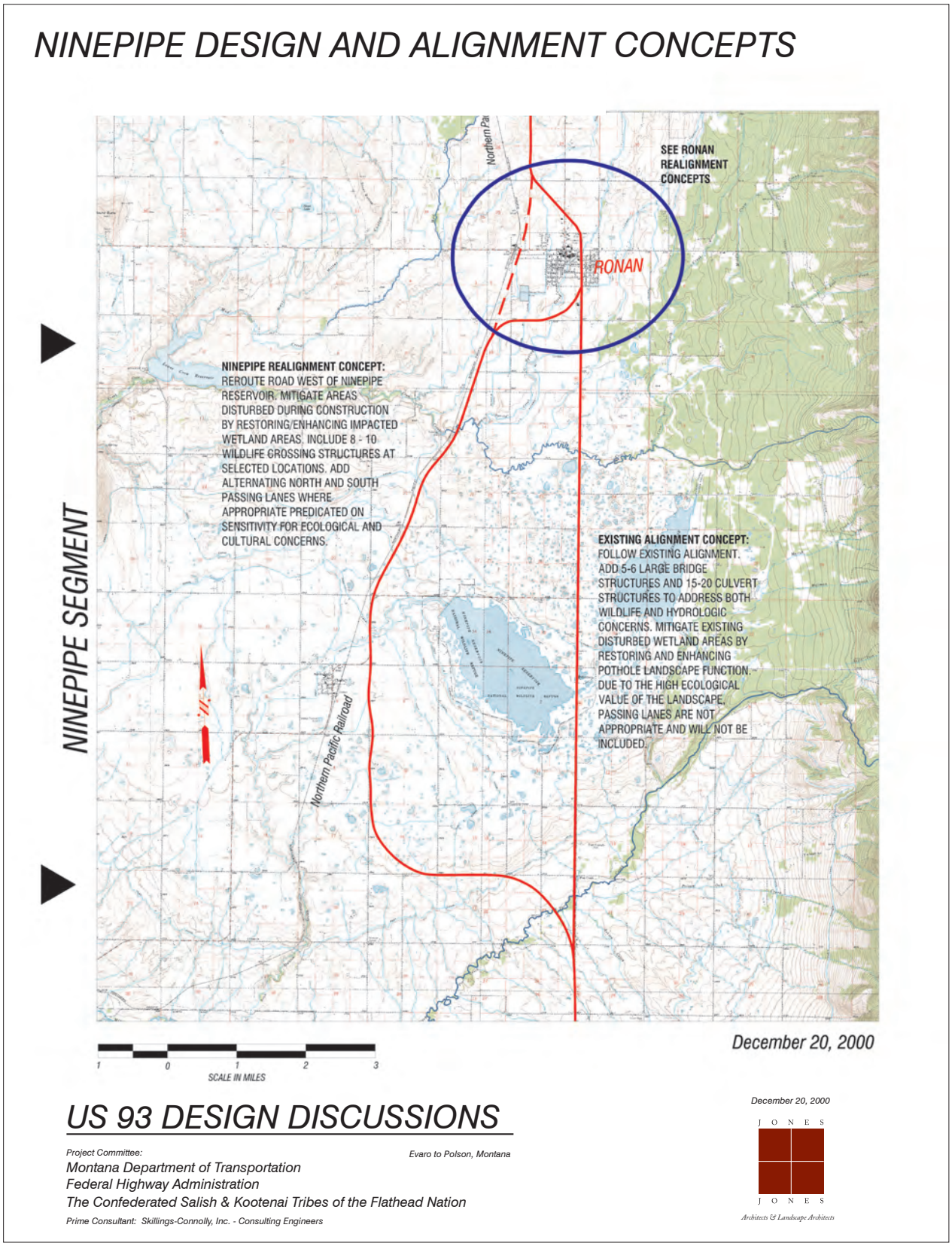
December 20, 2000

J O N E S

J O N E S

Architects & Landscape Architects

The existing alignment of US 93 through Ninepipe has resulted in significant adverse ecological and cultural impacts. Although the road corridor is only a couple of hundred feet wide, the road-effect zone, which defines the ecological effects to wildlife and the environment, is more than a thousand meters wide. The graphic also presents current research on turtle mortality in the area.



This graphic provides a detailed representation of the design and alignment concepts for the Ninepipe area. One concept follows the existing alignment and would require the addition of numerous wildlife crossing and drainage structures and other mitigation measures. The second concept would reroute US 93 west of Ninepipe Reservoir and remove sections of the existing road in the core wetland area. These alignments, and others, were explored on a conceptual level in order to determine if additional research was needed before final design decisions can be made.

RONAN ALIGNMENT CONCEPTS

CONCEPT "A"

Follow existing alignment through Ninepipe. Maintain existing alignment through Ronan. Expand to four-lane (or five-lane with center turn) and connect with twin bifurcated roads to the north of Ronan. Add stop lights at the intersections of Little Martin, Eisenhower, Main and Roundbutte.

CONCEPT "B"

Follow proposed Ninepipe realignment to Ronan. Maintain existing alignment through Ronan. Expand to four-lane (or five-lane with center turn) and connect with twin bifurcated roads to the north of Ronan. Add stop lights at the intersections of Eisenhower, Main and Roundbutte.

CONCEPT "C"

Follow proposed Ninepipe realignment to Ronan. Maintain existing alignment and lane configuration through Ronan for use as a local/commercial route. Add a two-lane road west of Ronan for use as an express route around the town. Realign railroad as indicated. Connect with twin bifurcated roads to the north of Ronan.

CONCEPT "D"

Follow proposed Nine pipe realignment to Ronan. Add a four-lane road west of Ronan for use as an express/bypass around the town. Realign railroad as indicated. Connect with twin bifurcated roads to the north of Ronan.

US 93 DESIGN DISCUSSIONS

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

Evaro to Polson, Montana

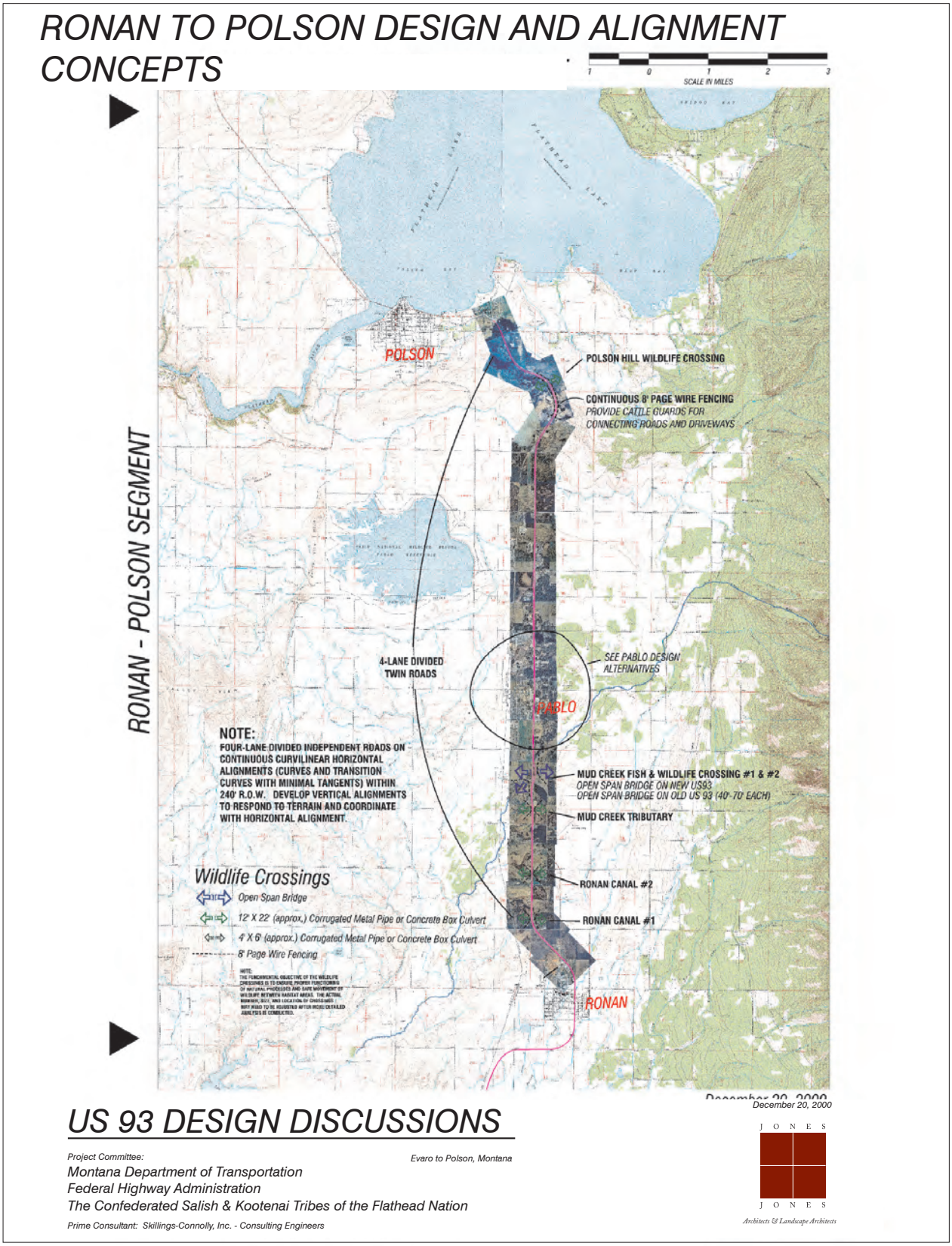
December 20, 2000

J O N E S

J O N E S

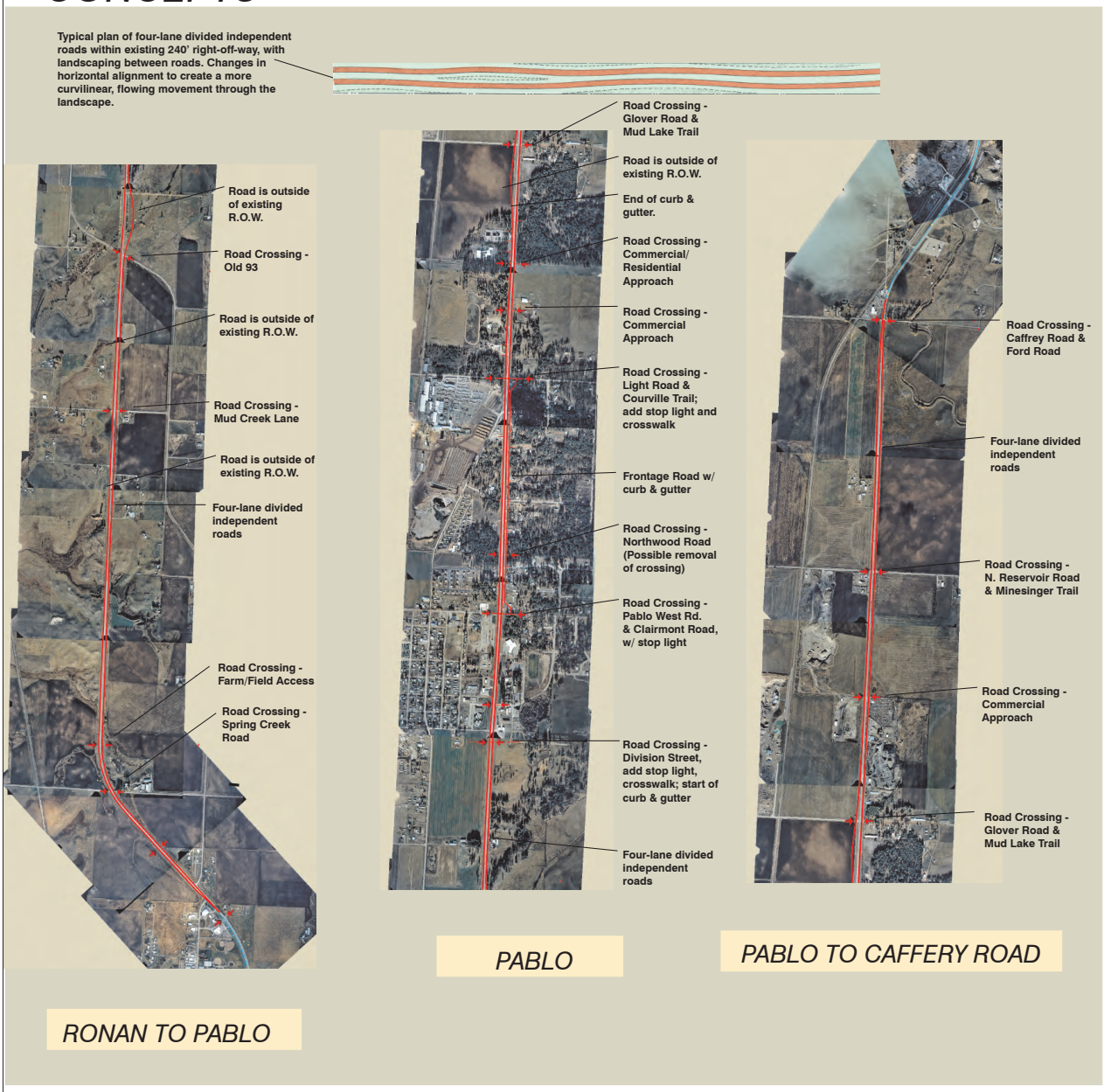
Architects & Landscape Architects

This graphic illustrates four design and alignment concepts for the reconstructed highway through the community of Ronan. These alignment concepts were intended to provide a full range of alternatives which include remaining on the existing alignment with some improvements to providing a bypass around the town.



This graphic provides a representation of the design and alignment concept for the design segment between Ronan and Polson. Information presented here includes road alignment, lane configuration, fish and wildlife crossing structures, wildlife fencing locations, interpretive opportunities, and other design features. Of special concern is the design of a four-lane road with divided independent sections that responds to the land.

RONAN TO CAFFERY ROAD DESIGN AND ALIGNMENT CONCEPTS



US 93 DESIGN DISCUSSIONS

Project Committee:
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

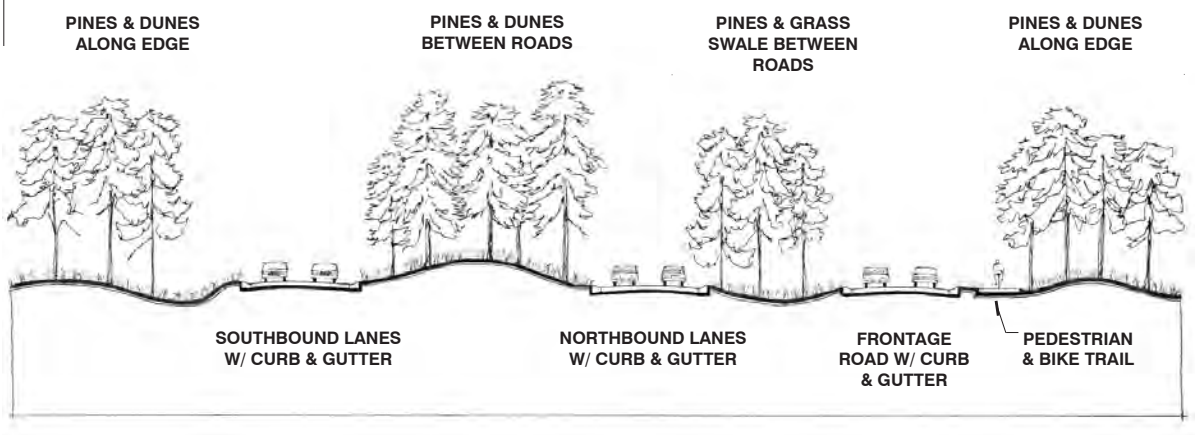
Evaro to Polson, Montana

December 20, 2000

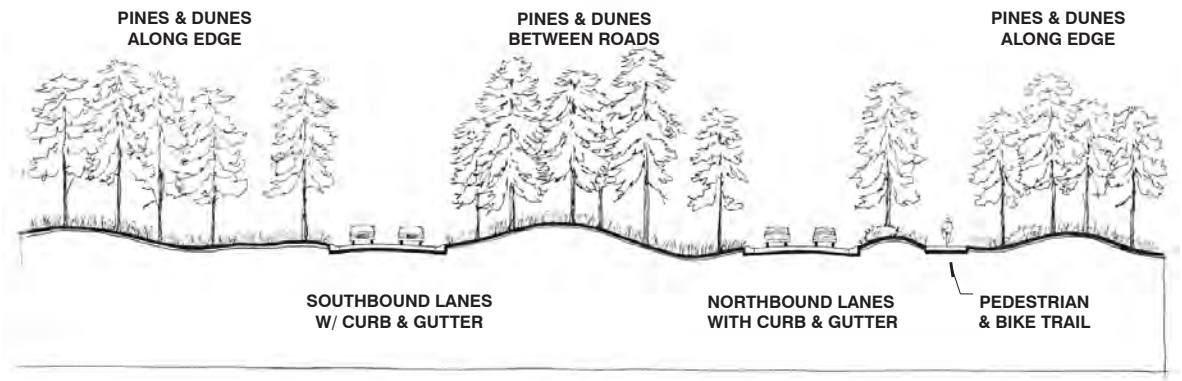
JONES
JONES
Architects & Landscape Architects

This graphic shows design and alignment concepts for the highway segment between Ronan and Caffery Road. Information presented here includes road alignment, lane configuration, fish and wildlife crossing structures, wildlife fencing locations, interpretive opportunities, and other design features. Of special concern is the design of a four-lane road with divided independent sections that responds to the land.

PABLO DESIGN AND ALIGNMENT CONCEPT CROSS-SECTIONS



4 LANE DIVIDED HIGHWAY IN AREAS WITH FRONTAGE ROAD
PABLO SEGMENT



4 LANE DIVIDED HIGHWAY IN AREAS WITHOUT FRONTAGE ROAD
PABLO SEGMENT

US 93 DESIGN DISCUSSIONS

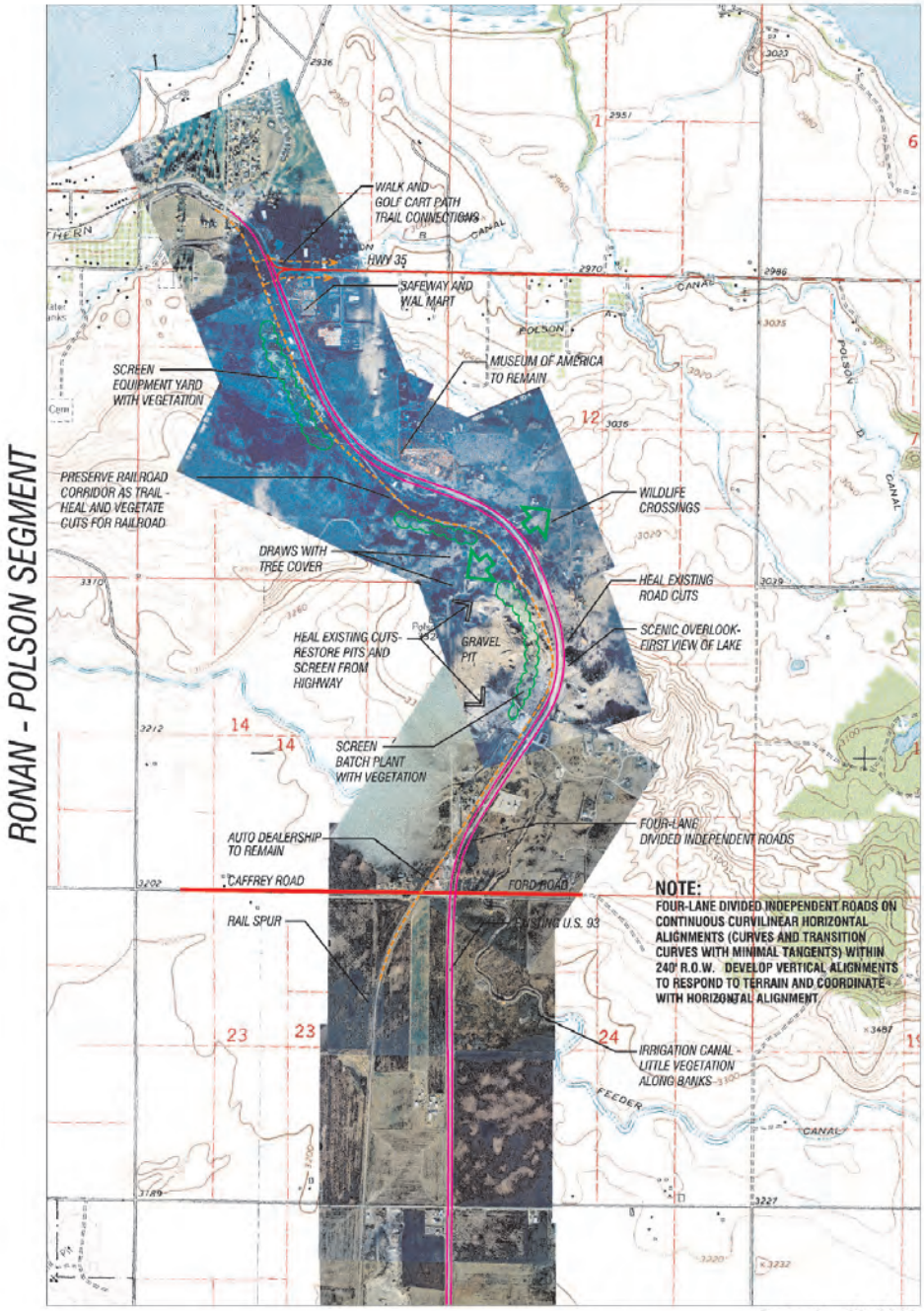
Project Committee: *Evaro to Polson, Montana*
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation
Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

JONES JONES
Architects & Landscape Architects

This graphic provides a detailed representation of the design and alignment concept for Pablo. Information provided includes road alignment and cross-section, pedestrian and bike trails, curb and gutter, frontage roads, and the integration of pines and dunes as part of the road corridor. Of particular concern is how to accommodate four lanes of traffic in Pablo and maintain the pine dune landscape of the town next to the road.

CAFFERY ROAD TO ROUTE 35 DESIGN AND ALIGNMENT CONCEPT



US 93 DESIGN DISCUSSIONS

December 20, 2000

Project Committee: *Evaro to Polson, Montana*

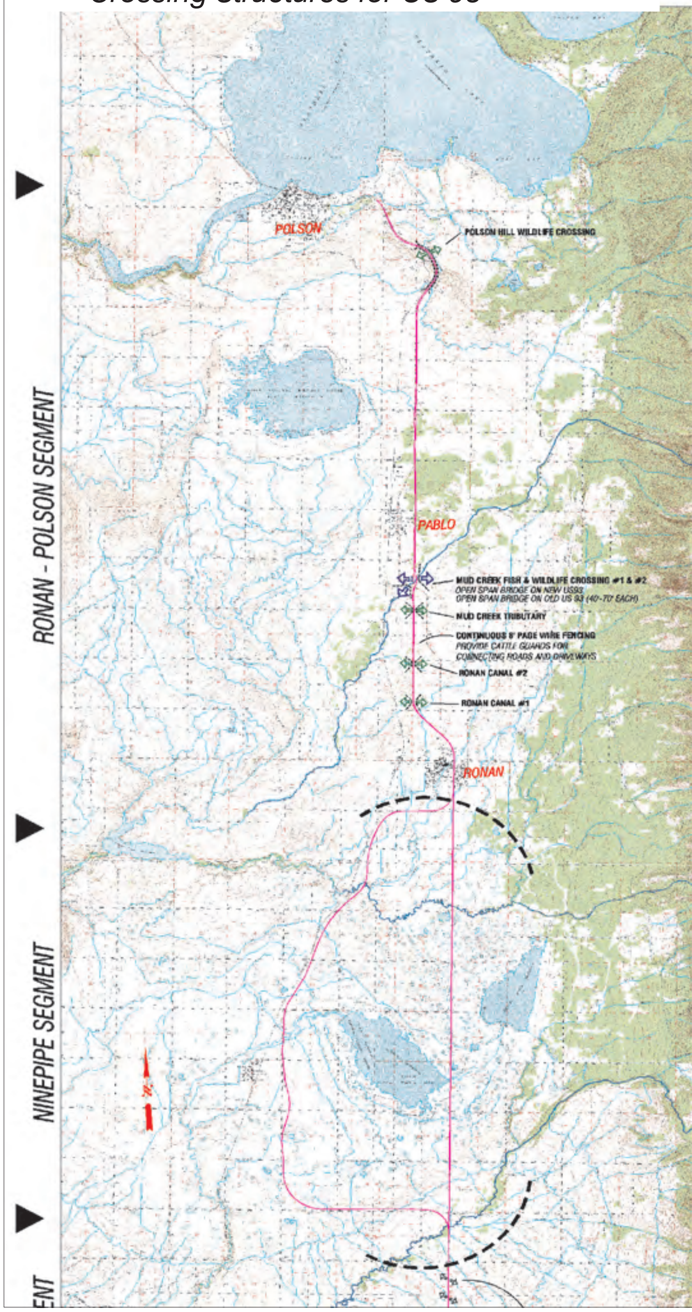
Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

JONES JONES
Architects & Landscape Architects

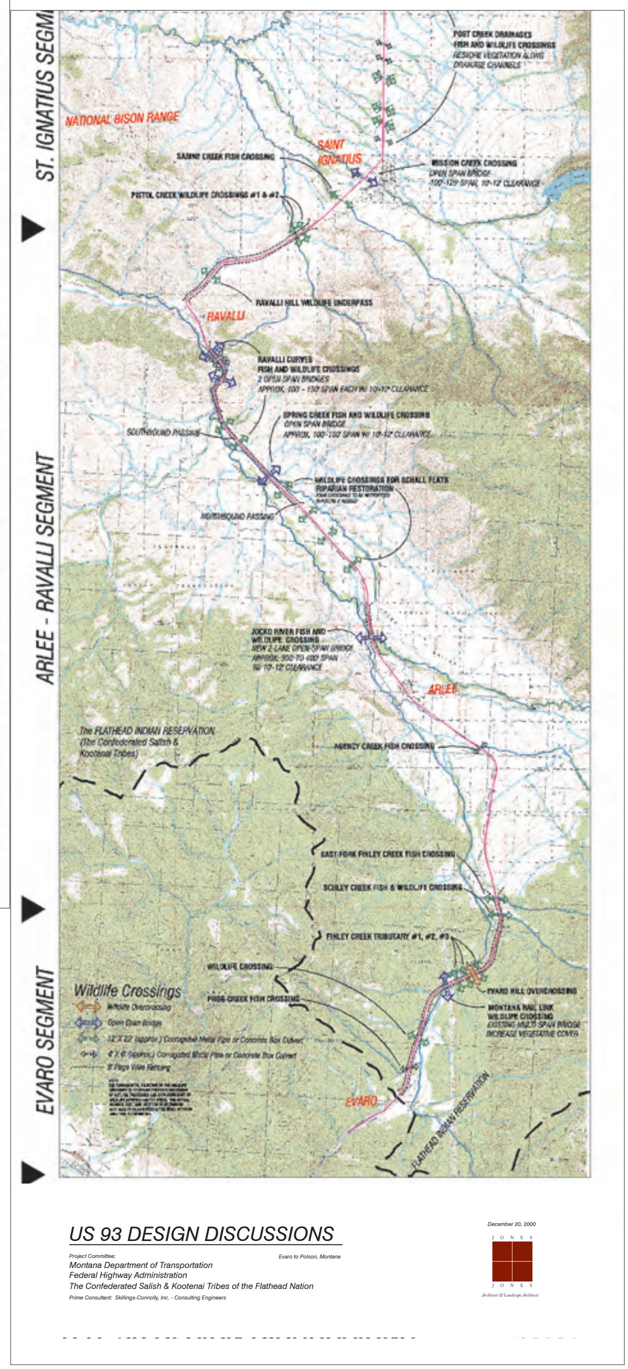
This graphic provides a detailed representation of the design and alignment concept for the design segment between Caffery Road to Route 35. Information provided includes road alignment, lane configuration, fish and wildlife crossing structures, wildlife fencing locations, interpretive opportunities, and other design features. Of particular concern is developing a curving horizontal and vertical alignment that fits the terrain while maintaining views of Flathead Lake.

FISH & WILDLIFE CROSSINGS—Proposed Crossing Structures for US 93



(continues at top of adjacent image)

(continues at bottom of adjacent image)



This graphic illustrates all of the proposed wildlife crossing structures for US 93 from Evaro to Arlee. (Crossing structures for the Ninepipe area have not been included.) The structures shown here are also represented on the Design and Alignment Concepts for each of the design segments. The exact size, location, type, and number of crossings will be determined during the design phase.

WILDLIFE FENCING—Concepts for US 93 #1

Typical vegetative cover and fencing in median betweenfour-lane divided independent road. Use as necessary between Ronan and Polson.

Typical continuous fencing for pipe or box culverts. Where continuous fencing is not appropriate, use wing fencing at a 45 degree angle for approximately 150' from crossing structure. Examples for use on U.S. 93 include undercrossing structures at Agency and Sabine Creeks.

Typical continuous fencing for open span bridges. Where continuous fencing is not appropriate, use wing fencing at a 45 degree angle for approximately 150' from crossing structure. Examples for use on U.S. 93 include open span bridges at Post Creek and Jocko River.

Typical continuous page wire fencing for overcrossing structure. For use at the Evaro Hill overcrossing.

Typical wildlife jump-outs to allow animals trapped between continuous fencing to escape to safety. Use on either side of open span bridges and other select locations where continuous fencing occurs. Proposed for use at Evaro Hill, Ravalli Curves, and Ravalli Hill.

US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

J O N E S

J O N E S

Architects & Landscape Architects

In order for wildlife crossing structures to function properly, it is necessary to use some type of fencing to help control animal movement and funnel wildlife toward the various crossings. Eight ft. high page wire fencing designed specifically for wildlife control is recommended for US 93. This graphic shows typical fencing applications and illustrates jump-outs that provide an escape opportunity for wildlife trapped along the road.

WILDLIFE FENCING—Concepts for US 93 #2

Typical continuous chain link apron dig barrier located below grade at a 45 degree angle. Dig barrier joins typical fence mesh pattern at 12”-18” above grade.

Typical continuous fencing for open areas similar to those found near Spring Creek in Schall Flats.

Typical continuous fencing for wooded areas similar to those found in Evaro Hill, Ravalli Curves, and Ravalli Hill.

Typical cattle guard (size varies). Crossbars approximately 8” on center. Use guards on all roads and driveways connecting to U.S. 93 in areas with continuous fencing.

Typical 8‘ high page wire fencing. Posts are approximately 10’ on center.

Typical maintenance gate. Spacing and locations to be determined.

US 93 DESIGN DISCUSSIONS

Project Committee: *Evaro to Polson, Montana*

Montana Department of Transportation
Federal Highway Administration
The Confederated Salish & Kootenai Tribes of the Flathead Nation

Prime Consultant: Skillings-Connolly, Inc. - Consulting Engineers

December 20, 2000

J O N E S

J O N E S

Architects & Landscape Architects

In order for wildlife crossing structures to function properly, it is necessary to use some type of fencing to help control animal movement and funnel wildlife toward the various crossings. Eight ft. high page wire fencing designed specifically for wildlife control is recommended for US 93. This graphic shows typical fencing applications as well as illustrating dig barriers, cattle guards, and maintenance gates.

Notes from pages 18, 21, 23, 28

The following note is common to all four pages and is found at the bottom of the Wildlife Crossings legend.

NOTE:
THE FUNDAMENTAL OBJECTIVE OF THE WILDLIFE CROSSINGS IS TO ENSURE PROPER FUNCTIONING OF NATURAL PROCESSES AND AND SAFE MOVEMENT OF WILDLIFE BETWEEN HABITAT AREAS. THE ACTUAL NUMBER, SIZE, AND LOCATION OF CROSSINGS MAY NEED TO BE ADJUSTED AFTER MORE DETAILED ANALYSIS IS CONDUCTED.

The following note is found on pages 18 and 21.

NOTE:
FOUR-LANE DIVIDED INDEPENDENT ROADS ON CURVILINEAR ALIGNMENTS TO ENCOURAGE REDUCED SPEEDS ENTERING AND LEAVING ARLEE.

The following note is found on pages 21 and 23.

NOTE:
THREE-LANE ROAD ON CONTINUOUS CURVILINEAR HORIZONTAL ALIGNMENT (CURVES AND TRANSITION CURVES WITH MINIMAL TANGENTS) WITHIN 240 FT. R.O.W. DEVELOP VERTICAL ALIGNMENT TO RESPOND TO WILDLIFE CROSSINGS AND COORDINATE WITH HORIZONTAL ALIGNMENT.

The following note is found on page 28.

NOTE:
FOUR-LANE DIVIDED INDEPENDENT ROADS ON CONTINUOUS CURVILINEAR HORIZONTAL ALIGNMENT (CURVES AND TRANSITION CURVES WITH MINIMAL TANGENTS) WITHIN 240 FT. R.O.W. DEVELOP VERTICAL ALIGNMENT TO RESPOND TO TERRAIN AND COORDINATE WITH HORIZONTAL ALIGNMENT.