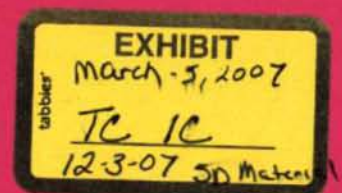


TC 1C

EXHIBIT C

5 MARCH 2007



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MAC

Metcalf Archaeological Consultants, Inc.

January 19, 2006

Ms. Paige Hoskinson, Historical Archaeologist
South Dakota State Historical Society
900 Governors Drive
Pierre, South Dakota 57501-2217

RE: Keystone Pipeline Project Survey Report

Dear Ms. Hoskinson,

Enclosed is a copy of the final survey report for fieldwork conducted during 2006 for the Keystone Pipeline Project.

After you have had the opportunity to review, please contact the MAC Bismarck office, as well as the client, with your comments:

Ms. Kim Munson, Anthropologist
ENSR International
1601 Prospect Parkway
Fort Collins, Colorado 80525

If you should you have any questions please contact the MAC Bismarck office.

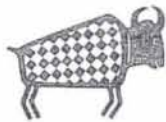
Sincerely,

Amy Bleier
Staff Archaeologist

cc: Ms. Kim Munson

enclosure

CONFIDENTIAL



MAC

Metcalf Archaeological Consultants, Inc.

January 19, 2006

Ms. Jane Watts
South Dakota Archaeological Research Center
P.O. Box 1257
Rapid City, South Dakota 57709-1257

RE: Keystone Pipeline Project Site Forms

Dear Ms. Watts:

Enclosed are final copies of 15 site forms (five railroad sites, two foundation/depression sites, two rock cairn sites, one farmstead site, one foundation site, one artifact scatter site and two isolated find locales) that were encountered and recorded during fieldwork conducted in 2006 within the corridor surveyed for the proposed Keystone Pipeline.

Should you have any comments or questions in regards to these site forms, please contact the MAC Bismarck office.

Sincerely,

Amy Bleier
Staff Archaeologist

cc: Ms. Kim Munson

enclosure:	39BE2072 (Update)	39YK77
	39CK50	39YK78
	39DA70	39YK79
	39DA71	39YK2003 (Update)
	39DA2000 (Update)	
	39HT133	
	39HT134	
	39KB2003 (Update)	
	39ML2000 (Update)	
	39YK75	
	39YK76	



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MAC

Metcalfe Archaeological Consultants, Inc.

March 7, 2007

Mr. Albert M. LeBeau III
Tribal Historic Preservation Officer
Cheyenne River Sioux Tribe Cultural Preservation Office
P.O. Box 590
Eagle Butte, South Dakota 57625

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. LeBeau III,

In response to your request at the February 21, 2007, Corps of Engineers meeting in Pierre, South Dakota, Kim Munson with ENSR International requested that our office send the enclosed copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota* and *Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalfe Archaeological Consultants, Inc., the subcontractor who conducted the investigations, is sending these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

Elizabeth A. Orlando, Esq.
US Department of State
OES/ENV
Foreign Affairs Officer
Multilateral Team
Telephone: 202-647-4284
Fax: 202-647-1052
Cell: 240-723-3157
orlando2@state.gov

Sincerely,

Suzanne Nelsen
Office Manager

cc: Kim Munson

enclosures

(701) 258-1215
Fax (701) 258-7156
P.O. Box 2154
Bismarck, North Dakota 58502
e-mail: macnodak@metcalfarchaeology.com

(970) 328-6244
Fax (970) 328-5623
P.O. Box 899
Eagle, Colorado 80502
e-mail: mac@metcalfarchaeology.com

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MAC

Metcalfe Archaeological Consultants, Inc.

February 7, 2007

Mr. James Whitted
Tribal Historic Preservation Officer
Sisseton-Wahpeton Oyate Planning and Development
Old Agency
P.O. Box 509
Sisseton, South Dakota 57262-0509

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Whitted,

Upon review we noticed that the cover letter with the reports we sent out January 22, 2007, was inadvertently addressed to Mr. Frankly and Mr. CrowsBreast. We apologize for the oversight and do hope that no harm has been caused by the error. It is our hope that you received the copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota* and *Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalfe Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

Elizabeth A. Orlando, Esq.
US Department of State
OES/ENV
Foreign Affairs Officer
Multilateral Team
Telephone: 202-647-4284
Fax: 202-647-1052
Cell: 240-723-3157
orlandoea2@state.gov

Sincerely,

Ed Stine
Staff Archaeologist

cc: Kim Munson
enclosures

(701) 258-1215
Fax (701) 258-7156
P.O. Box 2154
Bismarck, North Dakota 58502
e-mail: macnodak@metcalfarchaeology.com

(970) 328-6244
Fax (970) 328-5623
P.O. Box 899
Eagle, Colorado 81621
e-mail: mac@metcalfarchaeology.com

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M A C

Metcalf Archaeological Consultants, Inc.

January 22, 2007

Mr. Franky Jackson
Tribal Historic Preservation Officer
Sisseton-Wahpeton Oyate Planning and Development
Old Agency
P.O. Box 509
Sisseton, South Dakota 57262-0509

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Crows Breast,

Enclosed are copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota* and *Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalf Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

Elizabeth A. Orlando, Esq.
US Department of State
OES/ENV
Foreign Affairs Officer
Multilateral Team
Telephone: 202-647-4284
Fax: 202-647-1052
Cell: 240-723-3157
orlandoea2@state.gov

Sincerely,

Amy Bleier
Staff Archaeologist

cc: Kim Munson

enclosures

(970) 328-6244
FAX: (970) 328-5623
P.O. Box 899
Eagle, CO 81631
e-mail: mac@metcalfarchaeology.com

(701) 258-1215
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P.O. Box 2154
Bismarck, ND 58502
e-mail: macnodak@metcalfarchaeology.com

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MAC

Metcalf Archaeological Consultants, Inc.

January 22, 2007

Mr. Calvin Grinnell
Tribal Historian
Mandan, Hidatsa, Arikara Nation
220 8th Avenue North
New Town, North Dakota 58673

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Grinnell,

Enclosed are copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota* and *Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalf Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

Elizabeth A. Orlando, Esq.
US Department of State
OES/ENV
Foreign Affairs Officer
Multilateral Team
Telephone: 202-647-4284
Fax: 202-647-1052
Cell: 240-723-3157
orlando2@state.gov

Sincerely,

Amy Bleier
Staff Archaeologist

cc: Kim Munson

enclosures

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MAC

Metcalf Archaeological Consultants, Inc.

January 22, 2007

Mr. Elgin Crows Breast
Cultural Resource Program Director
Mandan, Hidatsa, Arikara Nation
P.O. Box 673
New Town, North Dakota 58673

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Crows Breast,

Enclosed are copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota* and *Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalf Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

Elizabeth A. Orlando, Esq.
US Department of State
OES/ENV
Foreign Affairs Officer
Multilateral Team
Telephone: 202-647-4284
Fax: 202-647-1052
Cell: 240-723-3157
orlandoea2@state.gov

Sincerely,

Amy Bleier
Staff Archaeologist

cc: Kim Munson

enclosures

(970) 328-6244
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e-mail: mac@metcalfarchaeology.com

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FAX: (701) 258-7156
P.O. Box 2154
Bismarck, ND 58502
e-mail: macnodak@metcalfarchaeology.com

Overview – Keystone Pipeline Project Cultural Resource Surveys and Reports

March 2007

Cultural Resource Surveys and Reports

Construction and operation of the Keystone Pipeline Project (Keystone) may affect cultural resources protected under the National Historic Preservation Act (NHPA), and by individual State legislation. During 2006, Keystone initiated contact with the State Historic Preservation Officer (SHPO) in each state to identify known cultural resource sites, and to develop survey plans. Keystone submitted records searches and research designs to each state for review and approval. Agency coordination documentation and survey protocols were filed by Keystone with the Department of State (DOS) on September 15, 2006.

Cultural resource field surveys along the proposed Keystone Mainline pipeline right-of-way were initiated in the spring and summer of 2006, and were completed in the fall of 2006. These surveys were conducted along the pipeline route alignment that was filed with the DOS on September 15, 2006. Additional field surveys will be conducted during the spring and summer of 2007 to survey pipeline reroutes, pump stations, certain pipe storage yards and contractor yards, access roads, and pipeline segments where access was not previously available. Field surveys will be conducted along the Cushing Extension and on pump station sites, pipe storage yards and contractor yards associated with the extension in 2007.

Keystone reached an agreement with Kinder Morgan to purchase the cultural resources survey reports for the proposed Rockies Express Pipeline (REX) segment that will be located parallel to the Keystone pipeline route in Nebraska, Kansas, and Missouri. The REX reports and concurrence letters received from the SHPO in each state were included in the November 17, 2006, supplemental filing. Site testing along the REX corridor is ongoing and results will be provided when available.

Keystone initiated discussions with the Nebraska, Kansas, and Missouri SHPOs to define a process for incorporating the REX survey results into the Keystone Pipeline project. Keystone prepared maps of its proposed construction surface disturbance footprint in relation to the REX cultural resources survey corridor. These maps documented the portion of the REX survey corridor that includes the proposed Keystone surface disturbance. The SHPOs reviewed this submittal and provided concurrence letters for the portion of the Keystone Project located within the REX survey corridor. The concurrence letters were included in the January 2007 supplemental filing.

Keystone documented proposed surface disturbance located outside the REX survey corridor and began field surveys of these areas in January 2007. The status of surveys conducted to date along deviations from the REX corridor will be submitted to the SHPOs in a separate Keystone report and are included in this filing.

Results of the pedestrian survey along the Mainline pipeline right-of-way in North/South Dakota, Nebraska, Missouri, and Illinois were submitted to the North/South Dakota, Nebraska, and Missouri SHPOs. As directed by the Illinois SHPO, the survey report will not be submitted to the SHPO until survey is completed along the Illinois segment of the Mainline. The Nebraska and North Dakota SHPOs have concurred with the findings in the cultural resources survey reports. The North Dakota SHPO will not provide NRHP determinations until requested in writing by the DOS. Copies of the letters from the North Dakota and Nebraska SHPOs are included in this filing. Concurrence from the South Dakota and Missouri SHPOs is pending and will be submitted in a supplemental filing.

Site testing to determine National Register eligibility was conducted in North Dakota, Missouri, and Illinois. The results of site testing in Missouri and Illinois can be found in the testing reports included in January 2007 supplemental filing. Two sites were tested in North Dakota, and both sites were recommended as ineligible. Results of testing in North Dakota will be included in this filing. Site testing

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has not yet been conducted at two sites in Missouri due to lack of access. All potentially eligible sites in South Dakota and Nebraska were avoided by reroutes; therefore, no site testing was conducted in these states. With the exception of Illinois, the site testing reports were submitted to SHPOs for review and concurrence. A copy of the North Dakota SHPO letter is included in this filing. Concurrence on the Missouri site testing report is pending and will be included in a supplemental filing.

Cushing Extension

Pedestrian survey along the Cushing Extension in Nebraska, Kansas, and Oklahoma began in January 2007. To date, survey of the Nebraska segment is complete; surveys in Kansas and Oklahoma are ongoing and scheduled for completion in summer 2007. The status reports for survey conducted to date are included in this filing and will be submitted to the Nebraska, Kansas, and Oklahoma SHPOs. Keystone will file cultural resource status reports for remaining segments of the Cushing Extension, as well as addendum reports for Mainline reroutes, ancillary facilities, and any additional site testing (if required) in the next supplemental filing.

Table 1 outlines the process for the collection and submission of cultural resource data.

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Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
North Dakota	Field Survey Completion Status as of March 2007: • Pedestrian Survey – 88% • Site Testing – 100% Spring 2007 – follow up surveys as needed for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms, site testing methodology).	Compilation of 2006 surveys (pedestrian and geomorphological surveys).	SHPO Concurrence, 2 sites. Site testing report, 2 sites, February 2007. SHPO Concurrence on Class I-III report submitted to DOS January 2007. Site Forms Errata submitted to DOS January 2007. Transmittal Letters to Tribes	May or June 2007 Reports will include survey results for pipeline reroutes and ancillary facilities, and site testing (if required).
South Dakota	Completion Status as of March 2007: • Pedestrian Survey – 86% • Site Testing – no sites Spring 2007 – follow up surveys as needed for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms, site testing methodology).	Compilation of 2006 surveys (pedestrian and geomorphological surveys).	Transmittal Letter for 2006 Survey Reports Transmittal Letter - 15 site forms recorded in 2006 survey reports Transmittal Letters to Tribes	May or June 2007 Reports will include survey results for pipeline reroutes and ancillary facilities, and site testing (if required).

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Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
Nebraska	Mainline Completion Status as of March 2007: • Pedestrian Survey – 97% • Site Testing – no sites • Cushing Extension 100% Spring 2007 – Mainline follow up surveys; Cushing Extension.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms). Rockies Express (REX) Cultural Surveys in NE (pedestrian survey results and SHPO concurrence for segments where REX and Keystone are co-located).	Compilation of 2006 surveys (pedestrian and geomorphological surveys). Map documentation of Keystone proposed construction ROW overlap with REX cultural resource survey areas and SHPO concurrence.	Cushing Extension field surveys – status report.	May or June 2007 Reports will include Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required). Cushing Extension – Pedestrian survey results; site testing (if required).
Kansas	Field Survey Completion Status as of March 2007: • Mainline Pedestrian Survey – 99% • Mainline Site Testing – 0% • Cushing Extension – 100% 2007 Spring – Mainline Follow up surveys; Cushing Extension.	Cultural resources record search; Survey protocols and survey areas.	REX Cultural Surveys in KS (pedestrian survey results and SHPO concurrence for segments where REX and Keystone are co-located).	Map documentation of Keystone proposed construction ROW overlap with REX cultural resource survey areas and SHPO concurrence. Cushing Extension Revised research design (maps included) and SHPO concurrence.	Mainline field survey status report for any areas outside REX survey area. Cushing Extension field surveys – status report. Cushing Extension Tribal Letters.	May or June 2007- Reports will include Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required). Cushing Extension – Pedestrian survey results; site testing (if required).

Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
Missouri	Field Survey Completion Status as of March 2007: • Mainline Pedestrian Survey – 79% • Mainline Site Testing – 44% Spring 2007 – Follow up surveys for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian and geomorphological survey results and site forms) REX Cultural Surveys in MO (pedestrian survey results and SHPO concurrence for segments where REX and Keystone are co-located.	Compilation of 2006 surveys (pedestrian and geomorphological surveys and site testing). Map documentation of Keystone proposed construction ROW overlap with REX cultural resource survey areas and SHPO concurrence.	SHPO Concurrence on 2006 Phase II (11 Sites) Report REX Deviations Phase I Cultural Survey status report.	May or June 2007 Reports will include Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required).
Illinois	Field Survey Completion Status as of March 2007: • Pedestrian Survey – 89% • Site Testing – 33% Spring 2007 – Follow up surveys for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms).	Compilation of 2006 surveys (pedestrian and geomorphological surveys, and site testing).	Wood River Terminal Pump Station survey status report.	May or June 2007 Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required).

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Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
Oklahoma	Spring 2007 Pedestrian and geomorphological surveys; site testing, if required. • Cushing Extension – 81%	Cultural resources record search; Survey protocols and survey areas.	No information filed.	No information filed.	Cushing Extension field surveys – status report. Cushing Extension Revised research design (maps included) and SHPO concurrence. Cushing Extension Tribal Letters	May or June 2007 Cushing Extension survey results for pipeline reroutes, ancillary facilities; site testing, if required.

CONTENTS
SUPPLEMENTAL FILING, MARCH 2007

KEYSTONE MAINLINE

- **NORTH DAKOTA**
 - Metcalf report transmittal letter sites 32RM160 and 32RMx89 February 2007
 - Letter from North Dakota SHPO, concurrence on sites 32RM160 and 32RMx89
 - Testing Report for sites 32RM160 and 32RMx89, February 2007
 - SHPO Concurrence on Class I-III Report submitted to DOS January 2007
 - Metcalf letter to SHPO forwarding site form updates on above testing report
 - Metcalf letter to SHPO forwarding reports submitted to DOS January 2007
 - Site Forms Errata from ND Class I, II, III Cultural Resource Investigations in Eastern, North Dakota, submitted to DOS in January 2007
- **SOUTH DAKOTA**
 - Letters (2) from Metcalf to SD SHPO - survey reports (DOS January 2007 submission)
- **NORTH DAKOTA AND SOUTH DAKOTA LETTERS TO TRIBES (5)**
- **MISSOURI**
 - MO SHPO concurrence on Phase II (11 sites) – (January 2007 DOS submission)
 - ARG transmittal letter – Phase II (11 sites) Report

REX DEVIATIONS SURVEYS

- **KANSAS**
 - REX Deviations Phase I Cultural Survey Status Report, March, 2007
- **MISSOURI**
 - REX Deviations Phase I Cultural Survey Status Report, March, 2007

CUSHING EXTENSION

- **NEBRASKA**

- Cultural Survey Status Report March 2007

- **KANSAS**

- Cultural Survey Status Report March 2007
- Letters to Tribes

- **OKLAHOMA**

- Cultural Survey Status Report March 2007
- Letter to Oklahoma SHPO from ARG requesting concurrence on Phase I Surveys, February, 2007
- Proposed Methods for Phase I Cultural Surveys, Oklahoma, February 2007
- Letter from Oklahoma SHPO – Phase I Concurrence
- Letters to Tribes

**Environmental Permitting Coordination for the Keystone Pipeline Project
Coordination Summary – Biological Resources**

March 2007

Supplemental State Agency and USFWS Consultation

This biological consultation package includes documentation of consultation with state agencies and the United States Fish and Wildlife Service (USFWS) regarding the Keystone Mainline and Cushing Extension following the January 2007 supplemental filing with the Department of State (DOS). These correspondence summaries include species specific survey information and continued consultation with the state and federal agencies regarding coordination of the 2007 biological surveys and additional biological concerns for the Keystone Pipeline Project.

In January 2007, ENSR sent a biological survey package to all state agencies involved in the Keystone Pipeline Project, and to the lead USFWS office. Each 2007 biological survey consultation package contained information regarding the sensitive species, survey locations, survey windows, and survey protocols that ENSR is proposing to include during the 2007 biological survey field effort. Concurrence forms were also contained in each biological survey package, and ENSR requested that each state agency and the USFWS approve, or provide recommended changes to ENSR's 2007 survey plan before Keystone initiates biological surveys in 2007. Concurrence forms were received from the following state agencies: North Dakota, South Dakota, Nebraska, Missouri, and Oklahoma. The Illinois Department of Natural Resources declined ENSR's request to send ENSR a signed concurrence form.

In February 2007, ENSR met with state agencies and the USFWS to review the biological survey package material that was sent to each agency in January 2007 and the biological survey reports that were sent to the agencies in December 2006, and to discuss additional concerns, if any, that the agencies had regarding the Keystone Pipeline Project. The meeting minutes from each agency meeting are included in this consultation package.

The majority of remaining consultation material included in this package details follow-up with agencies with regard to specific action items from the state and USFWS agency meetings.

Based on the consultation with state agencies and the USFWS in January and February 2007, ENSR obtained approval for the proposed 2007 biological surveys from all of the state agencies and the USFWS. Continuing consultation will take place to follow up with survey results, and to continue to discuss other agency concerns, if any, that may arise as the Keystone Pipeline Project moves forward.

**Environmental Permitting Coordination for the Keystone Pipeline Project
Coordination Summary – Wetlands**

This wetlands consultation package includes documentation of consultation with federal agencies regarding the Keystone Mainline and Cushing Extension following the January 2007 supplemental filing with the DOS. These correspondence summaries include detailed wetland mapping information and continued consultation with the federal agencies regarding coordination of the 2007 wetlands surveys and additional wetlands-related concerns for the Keystone Pipeline Project.

In February 2007, ENSR met with the U.S. Army Corps of Engineers (USACE) (Omaha District) and the USFWS in North Dakota and South Dakota to review potential impacts to protected wetlands found on wetland easements, the Section 404 permitting process and to discuss additional concerns, if any, that the agencies had regarding the Keystone Pipeline Project. The meeting minutes from each agency meeting are included in this consultation package.

The majority of remaining consultation included in this package details follow-up with agencies with regard to specific action items from USACE and USFWS agency meetings.

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Continuing consultation will take place to discuss other agency concerns that may surface as the Keystone Pipeline Project moves forward.

CONTENTS REVISED 3/23/07
SUPPLEMENTAL FILING MARCH 2007

BIOLOGICAL RESOURCES – AGENCY CONSULTATION

U.S. Fish and Wildlife Service

Type/Date	To /From	Content
E-mail, March 7, 2007	MO FWS (Milligan) to ENSR	Biological Opinion for Missouri DNR Confluence State Park provided to ENSR
E-mail, March 6, 2007	MO FWS (Scott) to ENSR	Response to 021207 Meeting Minutes with MO USFWS and ENSR
E-mail, March 6, 2007	NE FWS (Cochnar) to ENSR	Best Management Practices for Dakota Skipper and Native Prairie Crossings
E-mail, March 5, 2007	ENSR (Stribley) to NE FWS (Cochnar)	Best Management Practices for Dakota Skipper and Native Prairie Crossings
E-mail, March 5, 2007	ENSR (Stribley) to NE FWS (Cochnar)	Acreage of Sensitive Habitat affected by Keystone Project in regards to MBTA Negotiations
E-mail, February 26, 2007	ENSR (Castle) to NE FWS (Cochnar)	Circulation of 020507 Meeting Minutes
E-mail, February 21, 2007	SD FWS (Bessken) to ENSR (Stribley)	Response to Request for Native Grassland Crossings/Dakota Skipper Best Management Practices
E-mail, February 21, 2007	ENSR (Stribley) to SD FWS (Bessken)	Request for Native Grassland Crossings/Dakota Skipper Best Management Practices
Phone Communication, February 16, 2007	ENSR (Stribley) to SD FWS (Bessken)	Follow-up to South Dakota Topeka Shiner Report and South Dakota Stream Crossing Best Management Practices
Meeting Minutes, February 12, 2007	ENSR and MO FWS	Treatment of Federally Threatened and Endangered Plants on Private Lands
Meeting Minutes, February 12, 2007	ENSR and MO FWS	FWS Concerns Regarding Wetlands, and Threatened and Endangered Species and Sensitive Lands Associated with Wetlands in St. Charles County, MO
E-mail, February 9, 2007	ENSR (Stribley) to NE FWS (Cochnar)	re: Meeting on February 5, 2007
E-mail, January 24, 2007	NE FWS (Cochnar) to ENSR	Response to Information Request Regarding Aerial Bald Eagle Surveys, and February 5, 2007 Meeting
E-mail, January 23, 2007	ENSR (Caddis) to NE FWS (Cochnar)	Aerial Bald Eagle Surveys

U.S. Fish and Wildlife Service

Type/Date	To /From	Content
Meeting Minutes, January 23, 2007	ENSR, Keystone, REX-West, and MO FWS	Conservation Opportunities for the Indiana Bat
Phone Communication, January 22, 2007	ENSR (Stark) to SD FWS (Bessken)	Follow-up Regarding Topeka Shiner Report
Phone Communication, January 22, 2007	ENSR (Stark) to KS FWS (Tabor)	Follow-up Regarding Topeka Shiner Report
Consultation Package, January 17, 2007	ENSR (Johnson) to NE FWS (Cochnar)	Distribution of 2007 Biological Survey Package (material not included in consultation package; see specific state for details on duplicate information that was sent to the NE FWS)
E-mail, January 16, 2007	NE FWS (Cochnar) to ENSR	Response to Request from ENSR to Discuss Concerns Regarding Keystone and REX-West Projects
Phone Communication, January 16, 2007	ENSR (Stark) to MO FWS (Hansen)	Follow-up Regarding Topeka Shiner Report
Phone Communication, January 16, 2007	ENSR (Stark) to SD FWS (Gates)	Follow-up Regarding Topeka Shiner Report

North Dakota Game and Fish Department

Type/Date	To /From	Content
Phone Communication, March 5, 2007	ENSR (Stribley) to NDGFD	Best Management Practices for Streams, Wetlands, Sensitive Species
Concurrence Form, February 12, 2007	NDGFD (Dyke) to ENSR	2007 Biological Survey Signed Concurrence Form
Concurrence Form, February 12, 2007	NDGFD (Dyke) to ENSR	2007 Biological Survey Schedule Concurrence Form
Phone Communication, February 12, 2007	NDGFD (Schumacher) to ENSR	Follow-up to 2007 Biological Survey Package Information
Phone Communication,	ENSR (Stribley) to McKenna	Follow-up to 2007 Biological Survey Package Information

North Dakota Game and Fish Department

Type/Date	To /From	Content
February 9, 2007		
Consultation Package, January 17, 2007	ENSR (Johnson) to NDGFD	Distribution of 2007 Biological Survey Package

South Dakota Game, Fish, and Parks

Type/Date	To /From	Content
E-mail, February 26, 2007	ENSR (Castle) to SDGFP	Circulation of 020607 Meeting Minutes
E-mail, February 9, 2007	ENSR (Stribley) to SDGFP	RE: 020607 Meeting
Phone Communication, February 9, 2007	ENSR (Stribley) to SDGFP	T&E state permit requirements
Concurrence Form, February 5, 2007	SDGFP (Backlund) to ENSR	2007 Biological Survey Signed Concurrence Form
Meeting Material, February 2, 2007	SDGFP (Backlund) to ENSR	Material provided to ENSR by the SDGFP at the 020207 Meeting: 1) SDGFP Public Lands http site, and 2) South Dakota Game Production Area Map
Comment Forms, February 2, 2007	SDGFP to ENSR	Signed Topeka Shiner, Unionid, and Native Grassland Comment and Recommendation Forms from the SDGFP
E-mail, January 29, 2007	SDGFP (Backlund) to ENSR	Accepted Invitation for 020207 Meeting with ENSR
Consultation Package, January 17, 2007	ENSR (Johnson) to SDGFP	Distribution of 2007 Biological Survey Package

Nebraska Game and Parks Commission

Type/Date	To /From	Content
E-mail, March 5, 2007	ENSR (Stribley) to Jorgensen	Piping Plover and Least Tern Survey Protocol
E-mail, March 5, 2007	ENSR (Stribley) to Wilson	River Otter Survey Protocol
Phone Communication, March 5, 2007	ENSR (Stribley) to Fritz	Scientific Collector's Permit
E-mail, February 26,	ENSR (Castle) to	Circulation of 020507 Meeting Minutes

Nebraska Game and Parks Commission

Type/Date	To /From	Content
2007	NGPC	
Letter, February 21, 2007	ENSR (Johnson) to Grell	Revised 2007 Biological Survey Protocols and Schedule
E-mail, February 9, 2007	ENSR (Stribley) to NGPC	RE: 0205007 Meeting
Consultation Package, January 17, 2007	ENSR (Johnson) to Grell	Distribution of 2007 Biological Survey Package

Kansas Department Of Wildlife and Parks

Type/Date	To /From	Content
Phone Communication, March 5, 2007	Davis to ENSR (Stribley)	Stream Crossing Best Management Practices, Neosho Madtom, and SINC species
Phone Communication, February 12, 2007	Davis to ENSR (Stribley)	Biological Survey Report and 2007 Biological Survey Proposal Follow-up
E-mail, February 4, 2007	Davis to ENSR (Johnson)	Formal response to Keystone Biological Survey Reports and 2007 Biological Survey Package. Attached Spawning Date Restrictions for Kansas Action Permit Conditions
E-mail, January 22, 2007	Davis to ENSR (Stribley)	Response to Request for Fish Survey Protocols
Consultation Package, January 17, 2007	ENSR (Johnson) to Davis	Distribution of 2007 Biological Survey Package
E-mail, January 15, 2007	ENSR (Stribley) to Davis	Request for Fish Survey Protocols
Phone Communication, January 12, 2007	ENSR (Stark) to Davis	Follow-up with Topeka Shiner Report
E-mail, January 8, 2007	Davis to ENSR (Stribley)	Response to February 2007 Meeting with ENSR

Missouri Department of Conservation

Type/Date	To /From	Content
E-mail, March 2, 2007	Brown to ENSR (Stribley)	Response to Request for Ornithologist Contact Information

Missouri Department of Conservation

Type/Date	To /From	Content
E-mail, February 27, 2007	Brown to ENSR (Lorenz)	MDC Massasauga and Western Fox Snake Survey Requirements
E-mail, February 26, 2007	ENSR (Castle) to MDC	Circulation of 020607 Meeting Minutes
E-mail, February 23, 2007	ENSR to ENSR	MO FWS Topeka Shiner Spawning Stream Restrictions for Missouri Stream Crossings
E-mail, February 22, 2007	ENSR to ENSR	MDC Survey Requirements for the Greater Prairie Chicken
E-mail, February 16, 2007	ENSR to ENSR	MDC Survey Requirements for the Massasauga and Western Fox snake
E-mail, February 15, 2007	ENSR to ENSR	MDC Survey Requirements and Survey Protocol for the King Rail
E-mail, February 9, 2007	ENSR (Stribley) to Brown	RE: Massasauga/Western Fox Snake Report
Letter, February 9 2007	ENSR (Johnson) to Brown	Distribution of Massasauga/Western Fox Snake Report
E-mail, February 9, 2007	ENSR (Stribley) to MDC	RE: 020607 Meeting
Concurrence Form, February 6, 2007	Brown to ENSR	Signed 2007 Survey Schedule Concurrence Form
Concurrence Form, February 6, 2007	Brown to ENSR	Signed 2007 Survey Protocol Concurrence Form
Letter, February 6, 2007	MDC to ENSR	Affects of Keystone Mainline on Missouri Conservation Opportunity Areas. Attached Cuivre River and Confluence COA Guidance Documents.
E-mail, January 30, 2007	Brown to ENSR (Stribley)	Response to Meeting Confirmation
E-mail, January 29, 2007	ENSR (Stribley) to Brown	020607 Meeting Confirmation
Consultation Package, January 17, 2007	ENSR (Johnson) to Brown	Distribution of 2007 Biological Survey Package
Phone Communication, January 16, 2007	ENSR (Stark) to Novinger	Follow-up to Missouri Topeka Shiner Survey Report

Missouri Department of Conservation

Type/Date	To /From	Content
Phone Communication, January 16, 2007	ENSR (Stark) to Brown	Follow-up to Missouri Topeka Shiner Survey Report

Illinois Department of Natural Resources

Type/Date	To /From	Content
E-mail, March 1, 2007	Esker to ENSR (Stribley)	Contact Information
Phone Communication, March 1, 2007	Esker to ENSR (Stribley)	Survey Protocols for Illinois Bird Surveys
E-mail, February 26, 2007	ENSR (Castle) to IDNR and USACE	Circulation of 020607 Meeting Minutes
E-mail, February 15, 2007	Pietruszka to ENSR (Stribley)	Response to Follow-up Question regarding State Listed Plants from 020607 Meeting
E-mail, February 14, 2007	Hammel to ENSR (Stribley)	Response to Follow-up Question regarding State Listed Bird Surveys from 020607 Meeting
Letter, February 14, 2007	Kruse to ENSR (Stribley)	Transmittal of Example IDNR Conservation Plan for ITA Permit Application
E-mail, February 14, 2007	ENSR (Stribley) to Hammel	Follow-up Questions from 020607 Meeting
E-mail, February 14, 2007	ENSR (Stribley) to Kruse	Request for Habitat Conservation Plan Example
E-mail, February 9, 2007	ENSR (Stribley) to IDNR	RE: 020607 Meeting
Phone Communication, January 30, 2007	ENSR to Smothers	Scheduling 020607 Meeting with IDNR and USACE
E-mail, January 30, 2007	ENSR to Hammel	Scheduling 020607 Meeting with IDNR and USACE
E-mail, January 29, 2007	ENSR to Hammel	Scheduling 020607 Meeting with IDNR and USACE
E-mail, January 24, 2007	Pietruszka to ENSR (Stribley)	Incidental Take Permit Recommendation from the IDNR for Massasauga and Kirtland's snake. Attached example of ITA Permit Application.

Illinois Department of Natural Resources

Type/Date	To /From	Content
Consultation Package, January 17, 2007	ENSR (Johnson) to Hammel	Distribution of 2007 Biological Survey Package
Consultation Package, January 17, 2007	ENSR (Johnson) to Pietruszka	Distribution of 2007 Biological Survey Package
E-mail, January 16, 2007	Hammel to ENSR (Stribley)	Response to 020607 Meeting Request
E-mail, January 5, 2007	Pietruszka to ENSR (Stribley)	Response to 020607 Meeting Request

Oklahoma Department of Wildlife Conservation

Type/Date	To /From	Content
E-mail, February 13, 2007	ENSR (Stribley) to Howery	Receipt of Signed 2007 Biological Survey Concurrence Forms
Concurrence Form, February 7, 2007	Howery to ENSR	Signed 2007 Biological Survey Schedule Concurrence Form
Concurrence Form, February 7, 2007	Howery to ENSR	Signed 2007 Biological Survey Protocol Concurrence Form
E-mail, January 30, 2007	Howery to ENSR (Stribley)	Response to Follow-up with 2007 Biological Survey Package
E-mail, January 30, 2007	ENSR (Stribley) to Howery	Follow-up with 2007 Biological Survey Package
Phone Communication, January 16, 2007	ENSR (Stribley) to Howery	Request to Meet with the OKDWC in February
Consultation Package, January 17, 2007	ENSR (Johnson) to Howery	Distribution of 2007 Biological Survey Package (see Appendix A for oversized charts and maps)

WETLANDS – AGENCY CONSULTATION

US Army Corps of Engineers

Type/Date	To /From	Content
E-mail, January 31, 2007	ENSR (Walsh) to Denny Needham (Ellis and Assoc.)	Milford Lake, KS, wetland information/maps
Meeting Minutes February 21, 2007		USFWS, USACE, SDDOE, SDGFP, NRCS Pierre, SD
Meeting Minutes February 22, 2007		USFWS, USACE, NDGFP, NDBR, NDDOT, NRCS Bismarck, ND
Meeting Minutes February 27, 2007		USFWS Tewaukon WMD, Waubay WMD, Cayuga ND
Meeting Minutes February 28, 2007		USFWS Huron WMD, Lake Andes WMD, Huron SD
Meeting Minutes March 1, 2007		USFWS Madison WMD, Madison SD

US Fish and Wildlife Service

Type/Date	To /From	Content
E-mail, January 9, 2007	ENSR (Walsh) to Meendering	Request for "Exhibit A" maps of protected wetlands within FWS easements in the Valley City WMD
E-mail, January 23, 2007	Meendering to ENSR (Walsh)	Confirmation of maps mailed to ENSR
Letter, January 15, 2007	Meendering to ENSR (Walsh)	Maps of protected wetlands in Valley City WMD
E-mail, February 1, 2007	ENSR (Walsh) to Meendering	Map receipt confirmation
E-mail, March 12, 2007	ENSR (Walsh) to Tom Tornow	Confirm preparation on new maps for Madison WMD

NATIONAL PARK SERVICE – AGENCY CONSULTATION

National Park Service

Type/Date	To /From	Content
Document, October 9, 2006		HDD Crossing Plan and Maps for the Missouri River crossing at Yankton, South Dakota
Meeting Minutes, February 8, 2007		ENSR, TROW, Universal, National Park Service, Yankton, SD

National Park Service

Type/Date	To /From	Content
Document, October 9, 2006		HDD Crossing Plan and Maps for the Missouri River crossing at Yankton, South Dakota
Meeting Minutes, February 8, 2007		ENSR, TROW, Universal, National Park Service, Yankton, SD

Stribley, Sara

From: Castle, Carla
Sent: Monday, February 26, 2007 11:07 AM
To: John.c.kirk@state.sd.us; Leslie.Pertersen@state.sd.us; Doug.Backlund@state.sd.us;
David.Ode@state.sd.us; Andrew.Burgess@state.sd.us
Cc: Johnson, Charlie; Stribley, Sara
Subject: Keystone Pipeline Meeting Minutes
Attachments: SDGFP Minutes 020207D.doc

Thank you for meeting with ENSR representatives for the Keystone Pipeline Project on February 6, 2007. Please find attached the Draft Minutes for your review. Please reply to all in this e-mail with comments. The meeting minutes will be finalized and posted to the Keystone Sharepoint website on Thursday, March 1st. Thank you for your time.

Janie Castle
Project Coordinator
ENSR
1601 Prospect Parkway
Fort Collins, CO 80525
T (970) 493-8878
F (970) 493-0213
ccastle@ensr.aecom.com

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**Draft - South Dakota Game, Fish, and Parks Division of Wildlife; Foss Bldg,
Pierre, SD
February 2, 2007. 9:00am – 10:25am**

Attendees:

Charles Johnson (ENSR)
Jon Alstad (ENSR)
John Kirk (SDGFP)
Doug Backlund (SDGFP)
Leslie Peterson (SDGFP)
Andy Burgess (SDGFP)
David Ode (SDGFP)

Meeting Objectives

ENSR met with the SDGFP to discuss issues pertaining to wildlife and special status species that could potentially occur along the Keystone Project route. The goal of this discussion was to: discuss the 2006 survey results for sensitive mussels, Topeka shiner, and native grassland habitat surveys for Dakota skipper and western prairie fringed orchid; proposed 2007 survey protocol and survey locations; and other issues or concerns that SDGFP have regarding the project.

Response Overview

A number of general questions from SDGFP regarding the project (e.g., size of pipe, width of construction ROW, number of construction spreads, number of construction workers/spread, trenching, laying of pipe, etc.) were answered (in general terms) by ENSR.

ENSR indicated that there are ongoing discussions with the USFWS regarding the Hecla reroute.

Agency Issues, Concerns, and Recommendations:

ENSR should follow-up with DENR regarding possible issues pertaining to the crossing of the Crow Creek Ditch along Hecla reroute. There could be a potential conflict from the Upper and Lower Drainage Districts.

Bald Eagle. No issues with survey protocol and survey locations.

Interior Least Tern/ Piping Plover. No issues with survey protocol and survey locations.

Topeka Shiner. Areas identified in the tables and march-chart is correct as far as SDGFP is aware. Andy Burgess will review the 2006 Topeka Shiner Report and provide input, if necessary.

Recommendations:

- Based on the results from the survey report, SDGFP indicated that they are only concerned with the 5 sites that were identified as having potential habitat for Topeka shiner (sites 1, 7, 10, 11, and 13). Topeka shiner is known to occur within these streams. As a result, SDGFP indicated that presence should be assumed at these locations.
- The SDGFP is not concerned with any of the other streams that were analyzed for the Topeka shiner in 2006.
- Review the Biological Opinion developed for stream crossing methods in South Dakota. This document is located on the South Dakota Department of Transportation website. These measures should be used for all stream crossings in South Dakota.

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- If the DOT stream crossing methods are implemented, construction would be able to proceed in Topeka shiner habitat during the spawning period (May through August).

Conclusion: Although SDGFP has provided recommendations that would protect the Topeka shiner and its habitat, they would defer the species issue to USFWS.

Higgin's Eye Pearlymussel/ Scaleshell Mussel/ Winged Mapleleaf. The SDGFP concurs with the 2006 survey report. The SDGFP indicated that although no special status mussels (Higgin's Eye Pearlymussel/ Scaleshell Mussel/ Winged Mapleleaf) were located during the 2006 surveys, a relatively large population of mussels was documented within the construction ROW.

Recommendations:

- Move mussels upstream from the construction ROW prior to construction at the James River crossing. If mussels were moved in 2007, no further mussel surveys or relocation would be required prior to construction. SDGFP recommends Keith Perkins (University of Sioux Falls).

Dakota Skipper. The SDGFP concurs with the 2006 Native grassland survey report and habitat for the Dakota skipper. Habitat surveys will be completed for the Hecla reroute to determine suitable habitat for the Dakota skipper.

Recommendations:

- Change survey window for Dakota skipper to June 1 – June 15.
- Surveyor should contact the SDGFP or Dennis Skaskden in mid-June to determine status of skipper emergence prior to initiating surveys.

Western Prairie Fringed Orchid. The SDGFP concurs with the 2006 Native grassland survey report and habitat for the western prairie fringed orchid. Habitat surveys will be completed for the Hecla reroute to determine suitable habitat for the orchid.

Stribley, Sara

From: Stribley, Sara
Sent: Friday, February 09, 2007 3:26 PM
To: 'Backlund, Doug'; 'Andy.Burgess@state.sd.us'; 'Leslie.Petersen@state.sd.us'; 'John.Kirk@state.sd.us'; 'Dave.Ode@state.sd.us'
Cc: Johnson, Charlie
Subject: Thank you

Doug, Andy, Leslie, John, and Dave,
Charles and I just wanted to quickly thank all of you again for taking time to meet with us last week. We will be distributing meeting minutes for you review in the next few days to ensure that we accurately represented the information we discussed at our meeting. We really appreciate your feedback and input, and your willingness to work with us so that we can get accomplished all that we need to do on a project of this size! Once again, if you ever have any concerns or questions, please feel free to give us a call or send us an email! Thanks again.
Sincerely,
Sara

Sara Stribley
Environmental Coordinator
ENSR | AECOM
1601 Prospect Pkwy
Ft. Collins, Colorado 80525
970.493.8878
970.4930213
sstribley@ensr.aecom.com
www.ensr.aecom.com

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FOR INTERNAL KEYSTONE PROJECT USE ONLY

TransCanada – Keystone Pipeline Contact Summary Form

Location of Meeting ENSR
Date/Time of Meeting 2/9/07
Keystone Team Member(s) Sara Stribley

Contact Information:

Name	Doug Backlund
Title	Wildlife Biologist
Organization	South Dakota Game, Fish, & Parks
Address	Foss Building, 523 East Capitol Pierre, South Dakota 57501-3182
County	
Phone	605-773-3381
mail address	Doug.Backlund@state.sd.us

Meeting Information:

Type of Contact (phone, in-person, etc.): E-mail

Issue: Clarification on Mussel Surveys

Concern Level: High ___ Moderate ___ Low ___

Description:

I called Doug to check on any state T&E permits Keystone may need in order to move any species within the ROW. Doug directed me to the SDGF website and stated that the only two permits we may possibly need are the 1) the Scientific Collector's Permit, and 2) the State Endangered Species Permit. These permits only apply to *state listed species*. He did not know of any other permit requirements.

Issue: _____

Concern Level: High ___ Moderate ___ Low ___

Description:

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Keystone Pipeline Project Survey Protocol Concurrence Form

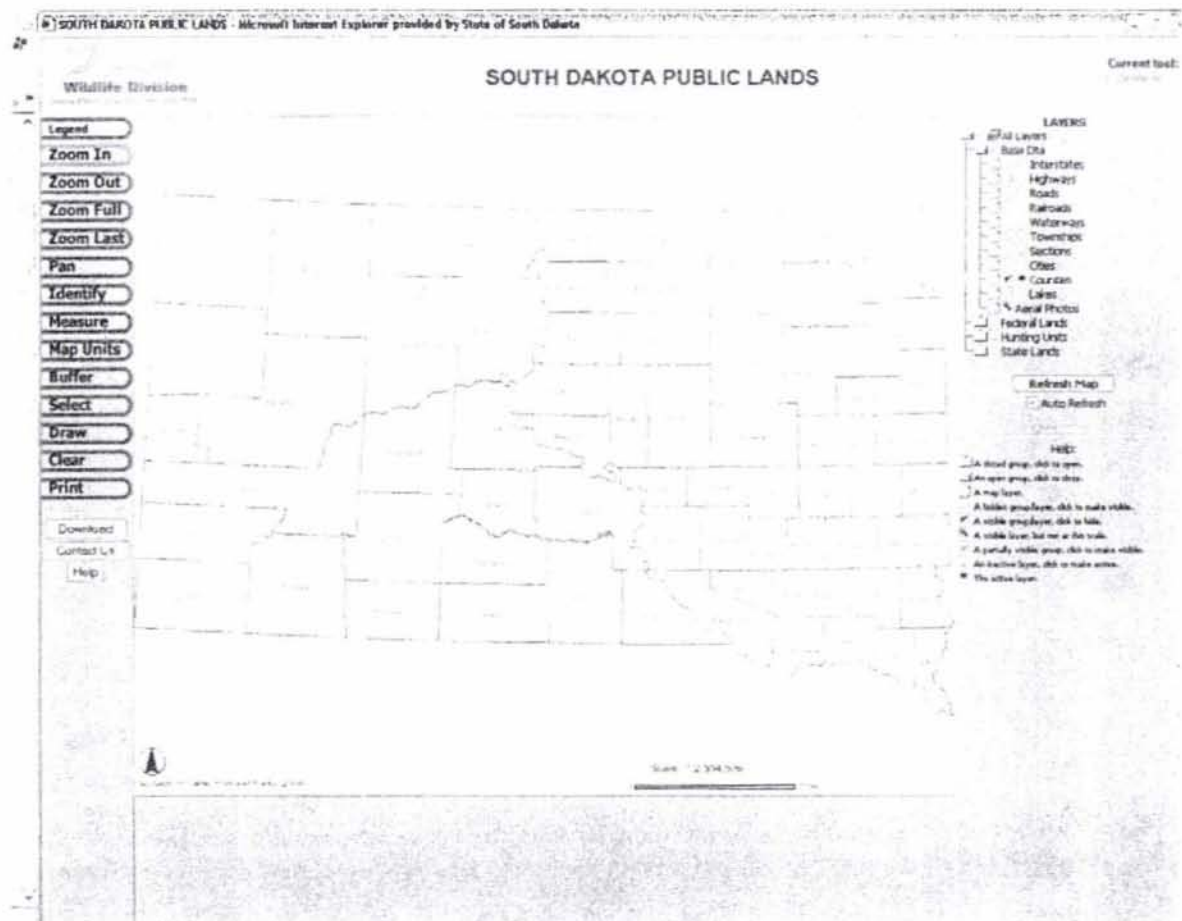
☒ CONCUR	Signature: <u>Douglas Backlund</u>
☐ DO NOT CONCUR	Name: <u>Douglas Backlund</u> Title: <u>Wildlife Biologist</u> Date: <u>2/5/2007</u>

If you checked "DO NOT CONCUR," please provide reasons and specific directions in the space provided below on how survey protocols should be changed to meet your acceptance:

--

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<http://www.sdgap.info/Wildlife/PublicLands/PubLand.htm>



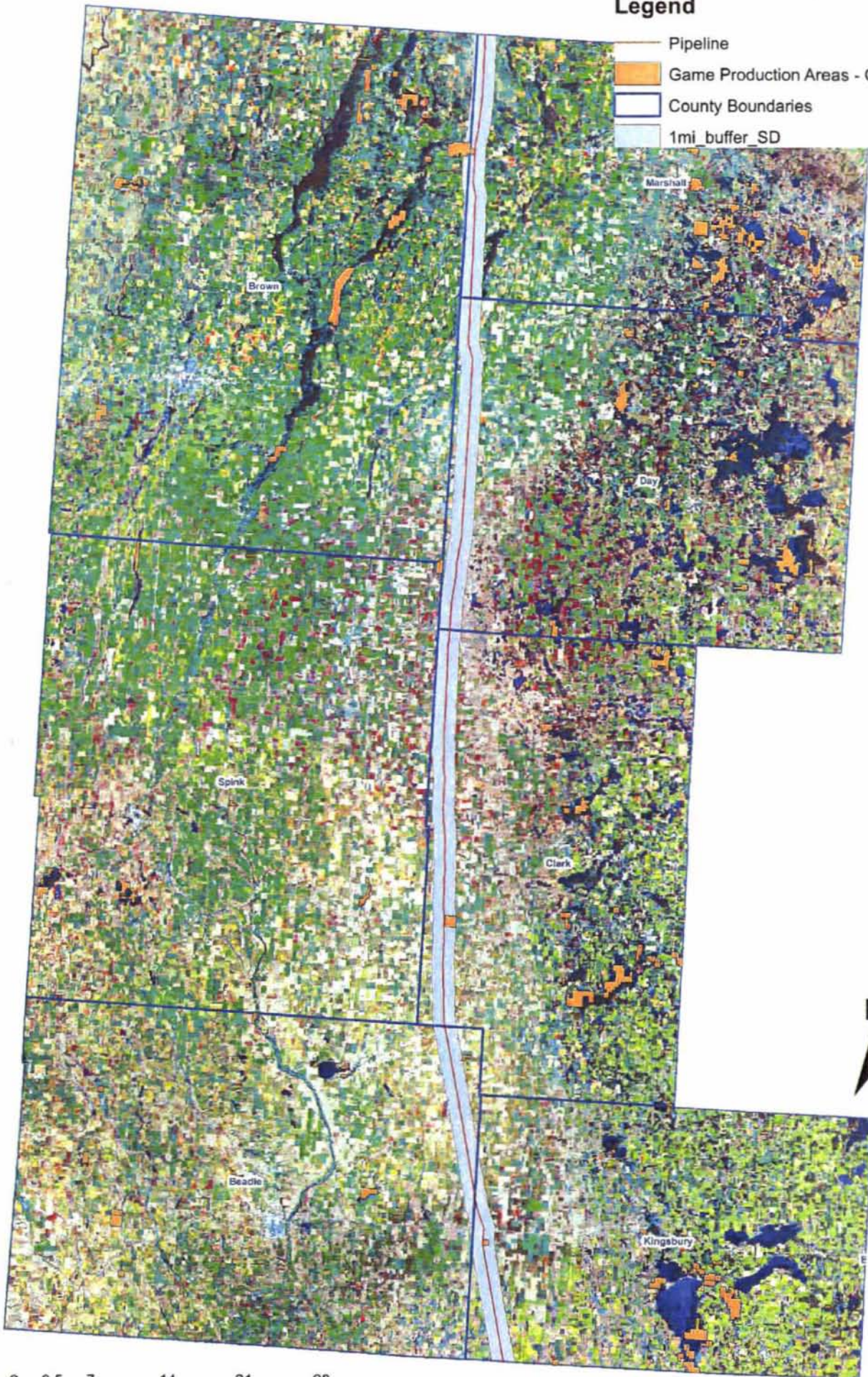
Legend

Pipeline

Game Production Areas - GFP

County Boundaries

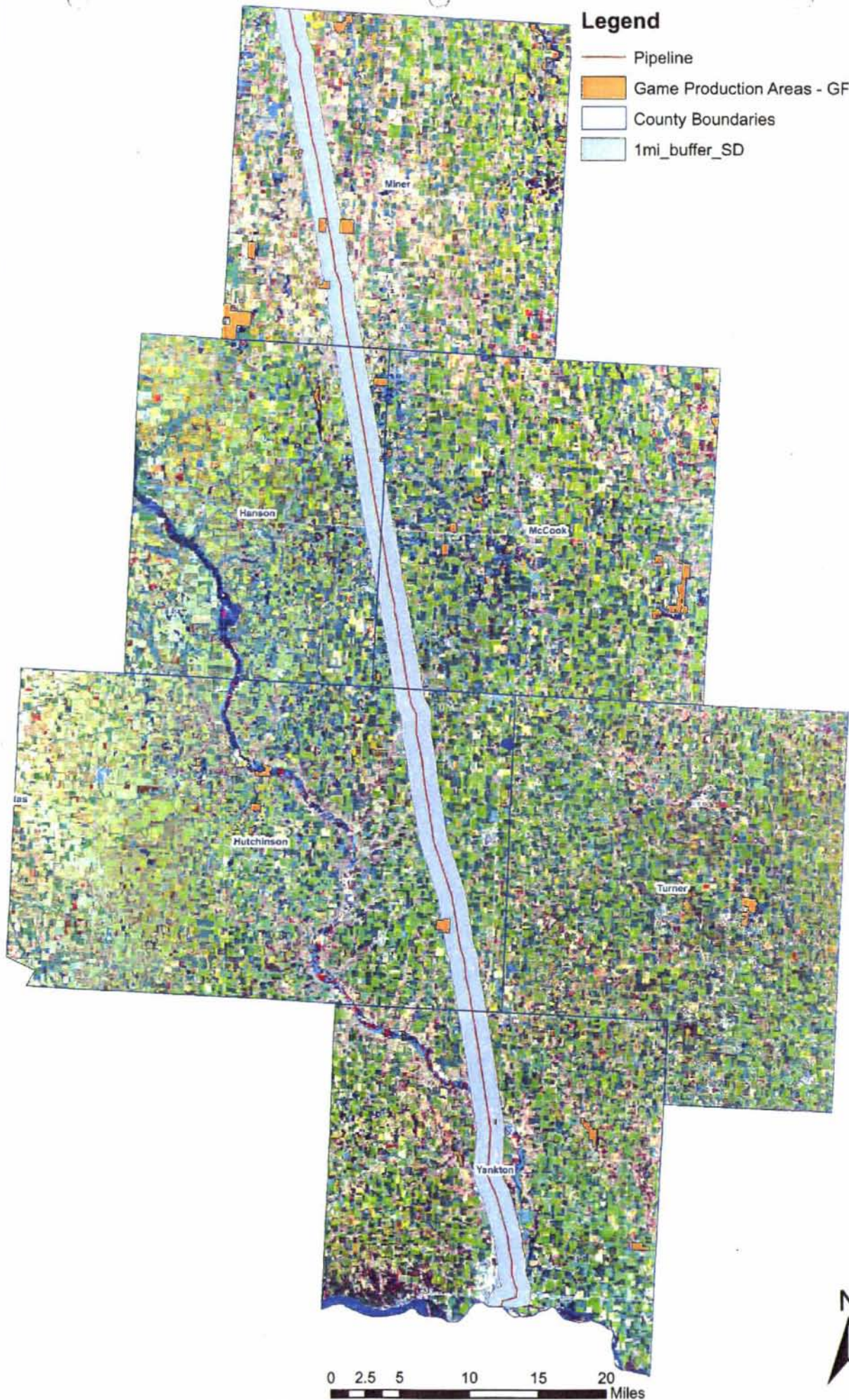
1mi_buffer_SD



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0 3.5 7 14 21 28 Miles



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Doug Backlund
December 19, 2006
Page 3

Keystone Pipeline Project Survey Report (Topeka Shiner) Comment and Recommendation Form

Sect. #	Para. #	Specific Comments
3	2	See Include site 7 as well as as well as sites listed in Para #3 (1,10,11,13) as assumed TS sites
3	3	Include all of these sites as assumed Topeka shiner sites and apply SDDOT road crossing protocol

Recommendations
Refer to SD Dept of Transportation stream crossing protocol for Topeka shiner streams when crossing Assumed Topeka Shiner Streams listed in your report (1, 7, 10, 11, 13). Use SDDOT protocols and avoid construction during TS spawning season in SD (May-Aug). - Seek additional details from FWS (Natalie Gates?) in Pierre.

Andy Burgess
Name

Aquatic Ecologist
Title

2/2/07
Date

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Doug Backlund
December 19, 2006
Page 4

Keystone Pipeline Project Survey Report (Unionids) Comment and Recommendation Form

<u>Sect. #</u>	<u>Para. #</u>	<u>Specific Comments</u>

Recommendations

Even though no T+E species were found, the survey documented 5 species that are considered rare in S.D. I recommend that freshwater mussels in the area of the proposed pipeline crossing be moved upstream. The distance downstream for mussel removal can be determined by your consultant.

Also, I commend ENSR for the great job you've done on this issue.

Doug Backlund
Name

Wildlife Biologist
Title

2/2/2007
Date

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Doug Backlund
December 19, 2006
Page 5

Keystone Pipeline Project Survey Report (Native Grassland) Comment and Recommendation Form

Sect. #	Para. #	Specific Comments
Appendix II	Page 2	<i>Liatris mucronata</i> (or <i>L. punctata</i> var <i>mucronata</i>) has not yet been found in SD. A specimen is needed to prove its existence in the state. (Also Appendix I - Site SD19443)
Appendix II	Page 1	<i>Juniperus scopulorum</i> / <i>Juniperus virginiana</i> - substantial introgression in SD, taxonomists usually restrict <i>scopulorum</i> to w/ of SD
Appendix II	P. 5	<i>Typha angustifolia</i> is pretty well now recognized as an exotic spp in central N. Am. Phalaris, Phragmites have exotic ecotypes

Recommendations
Nice job - Keep up the good work & good luck in 2007.

Doug Backlund
Name

Botanist / Ecologist
Title

JAN 2007
Date

Stribley, Sara

From: Doug Backlund@state.sd.us
Sent: Monday, January 29, 2007 9:37 AM
To: Stribley, Sara
Subject: RE: Accepted: Keystone ENSR - Meeting with the SDGFP

Yes, I've reserved the small conference room for this meeting. Just ask the secretary where that is when you come in.

See you then.

Doug

-----Original Message-----

From: Stribley, Sara [mailto:sstribley@ensr.aecom.com]
Sent: Monday, January 29, 2007 10:27 AM
To: Backlund, Doug
Cc: Johnson, Charlie
Subject: RE: Accepted: Keystone ENSR - Meeting with the SDGFP

Hi Doug,

I just wanted to confirm our meeting this Friday at 9:00 in Pierre, and that you received the package of survey information that I sent out last week? Charles Johnson and I will be attending the meeting. Please let me know if you would like any additional materials, and I can plan on brining those to our meeting on Friday.

Thanks Doug!
 Sara

Sara Stribley
 Environmental Coordinator
 ENSR | AECOM
 1601 Prospect Pkwy
 Ft. Collins, Colorado 80525
 P: 970.493.8878
 F: 970.4930213
sstribley@ensr.aecom.com
www.ensr.aecom.com

From: Backlund, Doug [mailto:Doug.Backlund@state.sd.us]
Sent: Thursday, January 11, 2007 8:29 AM
To: Stribley, Sara
Subject: Accepted: Keystone ENSR - Meeting with the SDGFP
When: Friday, February 02, 2007 9:00 AM-11:00 AM (GMT-07:00) Mountain Time (US & Canada).
Where: Pierre, South Dakota

1/29/2007

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ENSR | AECOM

ENSR

1601 Prospect Parkway, Fort Collins, Colorado 80525
T 970.493.8878 F 970.493.0213 www.ensr.aecom.com

January 17, 2007

Doug Backlund
South Dakota Department of Game, Fish and Parks
Foss Building
523 East Capitol
Pierre, SD 57501-3182

Dear Mr. Backlund:

At this time, ENSR Corporation (ENSR) is providing you with information regarding the implementation of the 2007 biological survey program for the Keystone Mainline Pipeline Project in South Dakota, and requesting your feedback and concurrence on certain proposed actions.

Project Description

As provided in previous communications, TransCanada is planning to construct and operate an approximately 1,845-mile-long interstate crude oil transmission system from an oil supply hub near Hardisty, Alberta, Canada, to destinations in the Midwestern United States (U.S.). The proposed Project would consist of approximately 1,078 miles of new pipeline constructed from the U.S.-Canada border in Cavalier County, North Dakota, to terminals and refineries in Wood River (Madison County) and Patoka (Marion County), Illinois. This pipeline is referred to as the Keystone Mainline. Approximately 283 miles of the Keystone Mainline would parallel the proposed Rockies Express Pipeline - West (REX-West) Project in Kansas and Missouri. In addition, TransCanada proposes to construct a 292-mile pipeline extension (Cushing Extension) that would extend from the Keystone Mainline south from the Nebraska/Kansas border to Cushing, Oklahoma. TransCanada proposes to begin construction of the Keystone Mainline in early 2008, with the system in-service by the end of 2009. Work on the Cushing Extension will begin in late 2009 or early 2010, with a Cushing Extension in-service date of 2010. The project also will require the construction of pump stations, valves, meters, and other ancillary facilities. The hydraulic characteristics of the pipeline will determine pump station and valve locations. Electrical powerlines and facility upgrades will be required in some locations to provide power for the new pump stations, though these facilities will be constructed by local utility companies, not Keystone.

Biological Survey Program

In 2006, biological surveys were initiated for several species potentially located along the Keystone Mainline Project route in South Dakota. ENSR sent these 2006 biological survey reports to the South Dakota Game, Fish and Parks (SDGFP), and the U.S. Fish and Wildlife Service (USFWS) in December, for review and evaluation. Additional surveys are planned throughout 2007 for the species surveyed in 2006, and for the majority of remaining sensitive species that may be located within the Keystone Mainline Project vicinity (see attached survey schedule). Sensitive species and survey locations have been determined through consultation with the SDGFP, the South Dakota Natural Heritage Program, and the USFWS. Some survey areas have been refined based on information obtained through habitat surveys conducted in 2006. To facilitate your review of the 2007 Keystone Mainline biological survey program, ENSR is providing you with the following materials, and asking for your signed concurrence on several proposed actions:

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Doug Backlund
January 17, 2007
Page 2

- Proposed Threatened and Endangered Species Survey Schedule (2006-2007) – This document is provided to give an overview of when and where species specific surveys have been, and will be conducted in South Dakota. Please sign and return the survey schedule concurrence form as "concur" or "do not concur." Please also provide specific comments in the area provided if you "do not concur," in order for ENSR to promptly address concerns.
- Biological Survey March-Charts (2007) – These charts are provided as a visual tool to guide your assessment of the proposed Threatened and Endangered species surveys. The y-axis provides information on approximate survey windows. This axis shows the general timeframe in which ENSR proposes to complete the surveys for a specific species (based on nesting, spawning, flowering periods, etc.) The x-axis provides information on the Mainline milepost marker where appropriate habitat has been determined to exist for a species. This axis shows where ENSR proposes to complete species specific surveys.
- Survey Protocols – These documents provide detailed information on how specific surveys will be conducted for Threatened and Endangered species. Wherever possible, survey protocols were produced directly from state or federal agency feedback. Please sign and return the survey protocol concurrence form as "concur" or "do not concur." Please also provide specific comments in the area provided if you "do not concur," in order for ENSR to promptly address concerns.
- 1:100k U.S. Geological Survey (USGS) Topographic Maps of the Keystone Mainline in South Dakota – Provided for geographic reference to the Project.

Additional copies of these materials are enclosed for distribution to other state wildlife representatives. Copies of these reports also have been sent to John Cochran (Nebraska USFWS – Project Lead). ENSR also would like to meet with you in early February to discuss this material in further detail, and you should have already been contacted by ENSR regarding a meeting date and time. If you have any questions regarding the enclosed materials, please contact me at (970) 493-8878 ext. 181 or email cjohnson@ensr.aecom.com.

Sincerely,



Charles Johnson
Senior Wildlife Biologist

CJ/ss

Ref: 10623-004

Enc: Proposed Threatened and Endangered Species Survey Schedule
Biological Survey March-Charts
Survey Protocols
1:100k USGS Topographic Maps

Keystone Pipeline Project
Proposed Survey Schedule for South Dakota
2006 - 2007

Completed 2006 Surveys					
Species & Status	Approximate Survey Dates	Specific Survey Areas (by County & MP)	Survey Description	Surveyor	Comments
Raptors	April 26 – May 2, 2006	MP: 217 – 436 (Marshall, Day, Clark, Beadle, Kingsbury, Miner, Hanson, McCook, Hutchinson, Yankton counties)	An aerial survey was conducted to identify raptor nest sites and breeding territories within at least 0.25 miles of the proposed ROW.	Karen Caddis, Charles Johnson – ENSR wildlife biologists	
Native Prairie	September 11-16, 2006	Marshall: 228.4-228.9 Day: 258.6-258.8, 260.0-260.8, 261.4-262.6, 264.5-264.8, 265.2-266.2, 267.2-267.7, 270.6-271.6 Clark: 272.3-273.3, 277.2-277.9, 278.4-279.2, 280.1-280.5, 280.8-281.1, 285.3-285.7, 293.7-294.1, 296.9-297.9 Kingsbury: 325.1-326.4 Miner: 342.9-344.0, 358.5-359.9 McCook: 383.9-384.5 Hutchinson: 389.7-390.6, 390.9-391.7 Yankton: 418.7-419.2, 419.6-420, 420.6-420.8, 421.8-422.1, 423.5-423.8, 426.7-428.9	Habitat evaluations were conducted within the construction ROW to determine potential habitat for the Dakota Skipper and Western Prairie Fringed Orchid.	Don Hazlet, Ph.D. - ENSR Botanist	
Topeka shiner <i>Notropis Topeka</i> FE; SD-SC	September 14-19, 2006	Beadle: 309.5 (Trib. of Shue Creek), 313.2 (Shue Creek), 317.8 (Middle Pearl Creek) Clark: 298, 299 (Foster Creek), 304.2 (Trib. of Shue Creek)	Habitat surveys were conducted to document habitat suitability; intermittent/ perennial flow; and spawning habitat.	William J. Stark, Ph.D. - ENSR Aquatic Biologist	

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Keystone Pipeline Project
Proposed Survey Schedule for South Dakota
2006 - 2007

Completed 2006 Surveys					
Species & Status	Approximate Survey Dates	Specific Survey Areas (by County & MP)	Survey Description	Surveyor	Comments
		Hanson: 375.7 (Wolf Creek). Hutchinson: 391 (Wolf Creek), 391.4, 394.8 (Trib. of Wolf Creek). Kingsbury: 326.2 (South Fork Pearl Creek), 334.8 (Redstone Creek), 337.3 (W. Redstone Creek). McCook: 384 (Wolf Creek). Miner: 343 (Redstone Creek), 362.1 (Rock Creek). Yankton: 417.7 (Trib. of James River), 421.8 (James River), 423.5 (Trib. of James River), 427.9 9 (Beaver Creek), 425.7 (Missouri River).			
Higgins'-eye pearly mussel <i>Lampsilis higginsii</i> Scaleshell mussel <i>Leptodea leptodon</i> Winged mapleleaf <i>Quadrula gragosa</i> FE; SD-SC	September 9 and 16, 2006	Yankton: 421.8-421.9 (James River).	Habitat and occurrence surveys were conducted to determine potential presence at the James River crossing.	Keith Perkins, Ph.D. – ENSR Mussel Expert	

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Keystone Pipeline Project
Proposed Survey Schedule for South Dakota
2006 - 2007

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Proposed 2007 Surveys					
Species & Status	Approximate Survey Dates	Specific Survey Areas (by County & MP)	Survey Description	Surveyor	Comments
Bald eagle <i>Haliaeetus leucocephalus</i> FT; SD-T	January	Yankton: 434.9-435.1 (Missouri River)	Aerial survey to locate winter roosts and eagle nests along major river crossings in ROW. Survey will be conducted 1-mile from the construction ROW.	Mike Phelan, Karen Caddis – ENSR wildlife biologists	See attached survey protocol. 2008 pre-construction surveys will not be required if construction occurs outside of the breeding/winter roost seasons for this species.
Raptors	March – April	MP: 217-436 (Brown, Marshall, Day, Clark, Beadle, Kingsbury, Miner, Hansen, McCook, Hutchinson, Yankton counties)	Aerial survey to locate active and inactive nest sites and breeding territories within at least 0.25 miles of the proposed ROW.	Qualified ENSR biologist and/or contractor.	See attached survey protocol. 2008 pre-construction surveys will not be required if construction occurs outside of the breeding season.
Interior Least Tern <i>Sterna antillarum athalassos</i> FE; SD-E Piping Plover <i>Charadrius melodus</i> FT; SD-T	Nesting period: 15-April to 15-Sept.	Yankton: 434.9-435.1 (Missouri River)	One ground or aerial survey will be conducted 0.25-mile from the construction ROW.	Qualified ENSR biologist and/or contractor.	See attached survey protocol. 2008 pre-construction surveys will not be required if construction occurs outside of the breeding season.

Keystone Pipeline Project
Proposed Survey Schedule for South Dakota
2006 - 2007

Proposed 2007 Surveys					
Species & Status	Approximate Survey Dates	Specific Survey Areas (by County & MP)	Survey Description	Surveyor	Comments
Dakota Skipper <i>Herperia dacotae</i> FC; SD-SC	Emergence: mid-June to 1-Aug. Peak - 1 st week of July.	Clark: 296.9-297.9 Day: 265.2-266.2 Hutchinson: 390.9-391.7 Yankton: 419.6-420.0, 420.6-420.8, 421.8-422.1	One survey will be conducted during the appropriate survey period to determine presence within the construction ROW.	Qualified ENSR biologist and/or contractor.	See attached survey protocol. <i>2008 pre-construction surveys would only be required in areas where this species was observed in 2007.</i>
Topeka shiner <i>Notropis Topeka</i> FE; SD-SC	Spawning season: 15-May to 31-July	Beadle: 309.5 (Trib. of Shue Creek), 313.2 (Shue Creek), 317.8 (Middle Pearl Creek) Clark: 298, 299 (Foster Creek), 304.2 (Trib. of Shue Creek) Hanson: 375.7 (Wolf Creek). Hutchinson: 391 (Wolf Creek), 391.4, 394.8 (Trib. of Wolf Creek). Kingsbury: 326.2 (South Fork Pearl Creek), 334.8 (Redstone Creek), 337.3 (W. Redstone Creek). McCook: 384 (Wolf Creek). Miner: 343 (Redstone Creek), 362.1 (Rock Creek). Yankton: 417.7 (Trib. of James River), 421.8	One sampling survey to determine species presence at stream crossings, if needed.	Topeka shiner expert and ENSR biologist.	See attached survey protocol. <i>In 2008, if stream channels identified in 2007 as having t. shiner populations are dry, open cut crossing would be appropriate. If stream channels are running, or if pools of water occur, construction should occur outside of the spawning period, and further consultation will be necessary.</i> <i>Obtain necessary permits from the state and federal agencies if salvage and relocation is conducted prior to</i>

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Keystone Pipeline Project
Proposed Survey Schedule for South Dakota
2006 - 2007

Proposed 2007 Surveys					
Species & Status	Approximate Survey Dates	Specific Survey Areas (by County & MP)	Survey Description	Surveyor	Comments
		(James River), 423.5 (Trib. of James River), 427.9 9 (Beaver Creek), 425.7 (Missouri River).			<i>construction.</i>
Western Fringed Orchid <i>Platanthera praeclara</i> FT; SD-SC	Flowering period: 15-June to 15-July.	Clark: 277.2-277.9, 278.4-279.2 Day: 258.6-258.8 Hutchinson: 390.9-391.7 McCook: 383.9-384.5	One survey will be conducted during the flowering period to determine presence within the construction ROW.	Qualified ENSR biologist and/or contractor	See attached survey protocol. <i>2008 pre-construction surveys would only be required in areas where this species was observed in 2007.</i>

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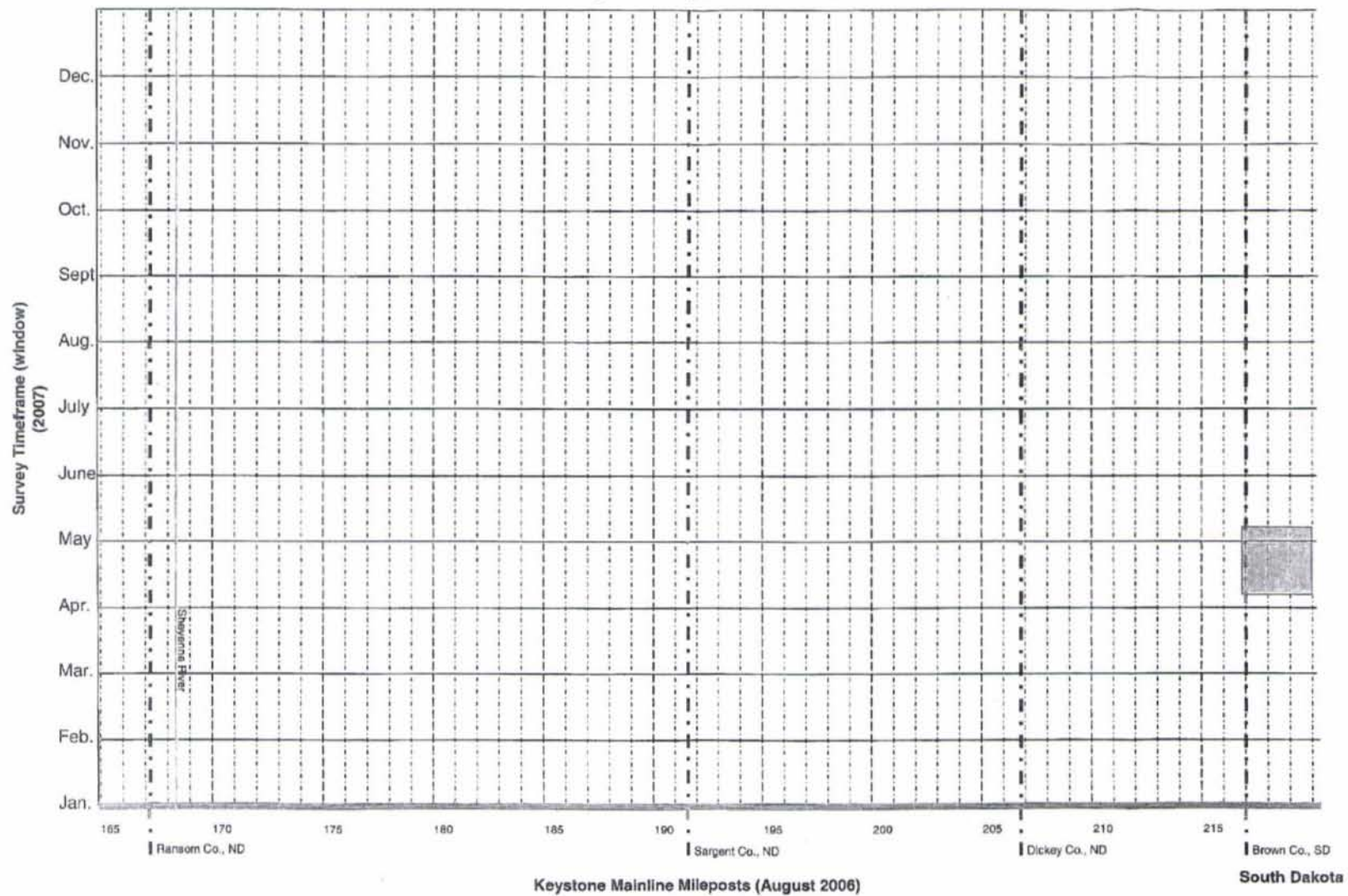
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Keystone Pipeline Project Proposed Survey Schedule for South Dakota 2006-2007

ID	Task Name	Qtr 2, 2006			Qtr 3, 2006			Qtr 4, 2006			Qtr 1, 2007			Qtr 2, 2007			Qtr 3, 2007				
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Completed Raptor Surveys	Completed Raptor Surveys																			
2	Completed Native Prairie Habitat Surveys	9/11 ☐ 9/16 Completed Native Prairie Habitat Surveys																			
3	Completed Topoka Shiner Habitat Surveys	9/14 ☐ 9/17 Completed Topoka Shiner Habitat Surveys																			
4	Completed Freshwater Mussel Surveys	9/9 ☐ 9/15 Completed Freshwater Mussel Surveys																			
5	Bald Eagle Winter Flock and Nest Surveys	7/28 ☐ 2/10 Bald Eagle Winter Flock and Nest Surveys																			
6	Raptor Surveys	3/16 ☐ 9/1 Raptor Surveys																			
7	Interior Least Tern & Piping Plover Surveys	4/15 ☐ 9/15 Interior Least Tern & Piping Plover Surveys																			
8	Topoka Shiner Fish Surveys	6/15 ☐ 7/31 Topoka Shiner Fish Surveys																			
9	Western Prairie Fringed Orchid Surveys	6/18 ☐ 7/15 Western Prairie Fringed Orchid Surveys																			
10	Dakota Skipper Surveys	6/15 ☐ 8/1 Dakota Skipper Surveys																			

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Keystone Pipeline Project Biological Survey March-Chart 2007

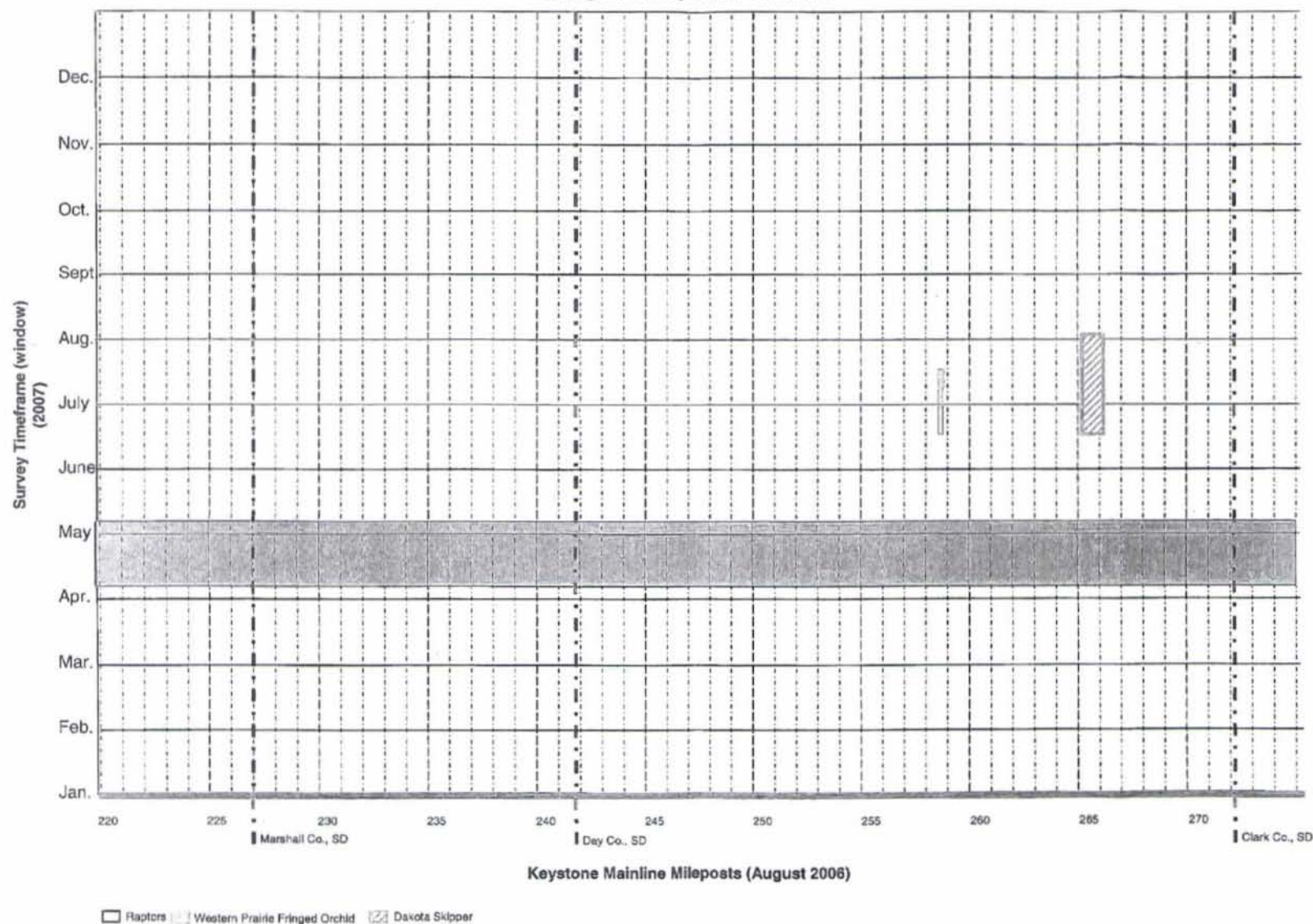


Note: Survey timeframe represents window biological surveys should be completed within, not the actual time it will take to complete surveys.

January 2007

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Keystone Pipeline Project Biological Survey March-Chart 2007

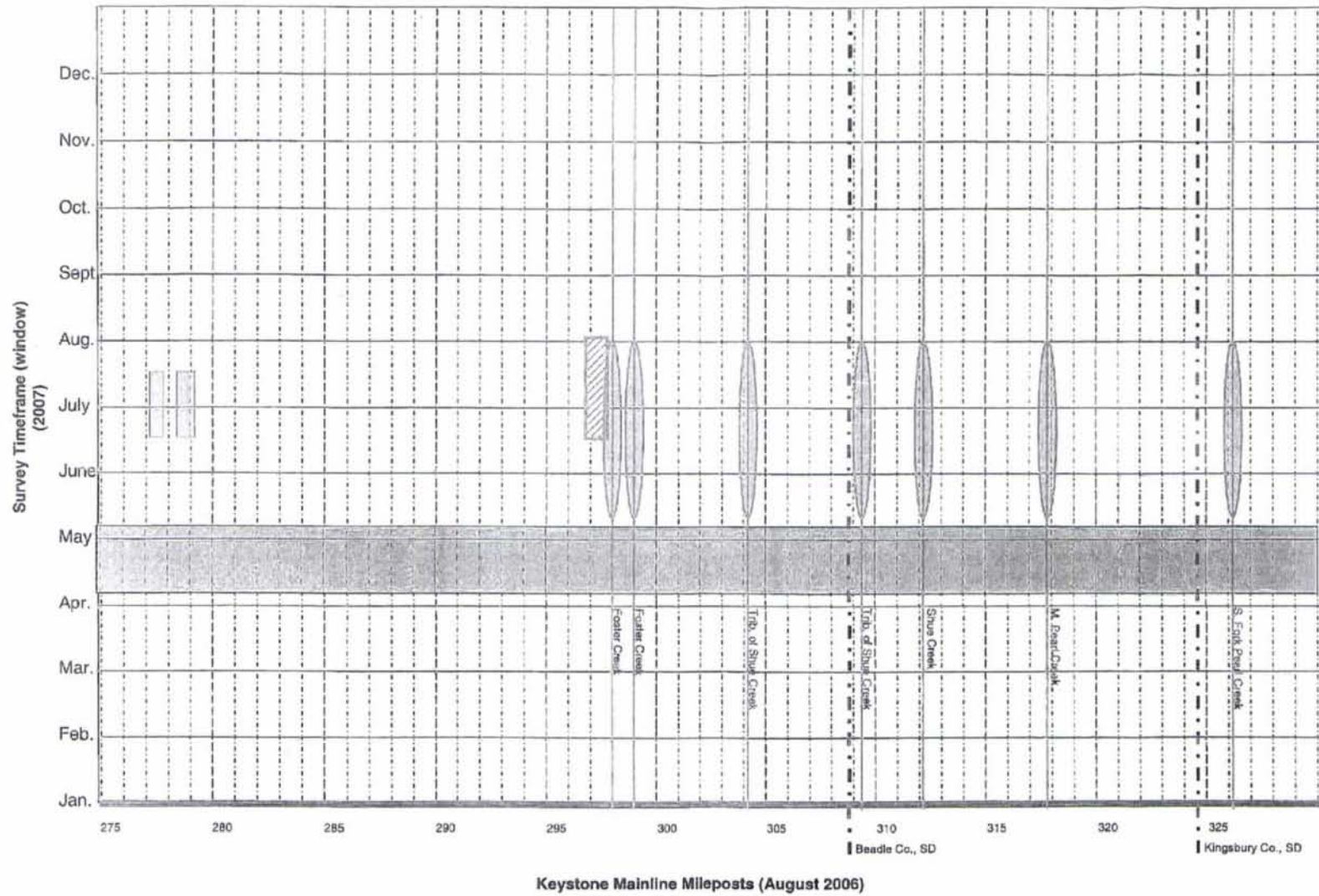


Note: Survey timeframe represents window biological surveys should be completed within, not the actual time it will take to complete surveys.

January 2007

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Keystone Pipeline Project Biological Survey March-Chart 2007

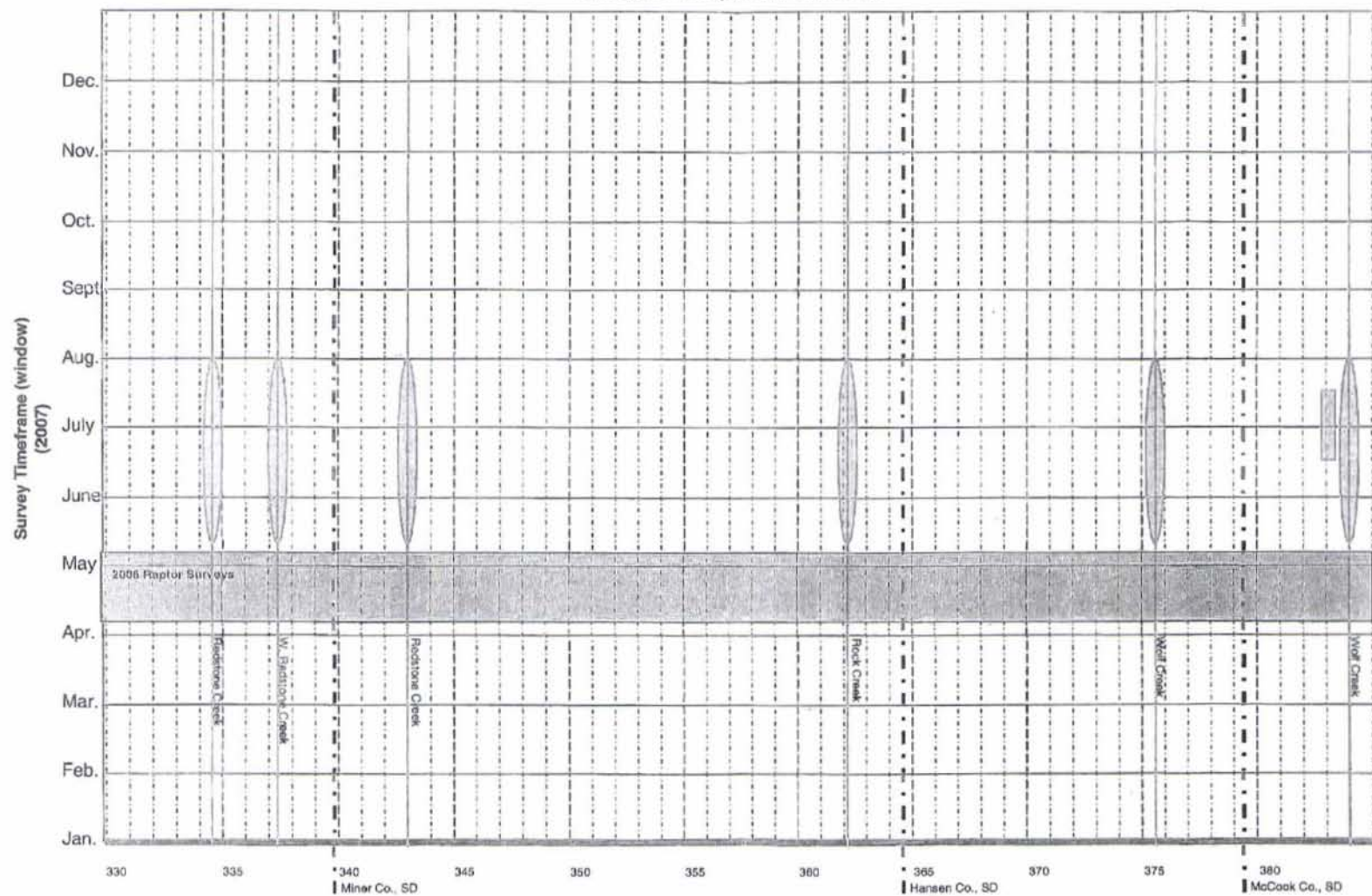


Note: Survey timeframe represents window biological surveys should be completed within, not the actual time it will take to complete surveys.

January 2007

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Keystone Pipeline Project Biological Survey March-Chart 2007



Keystone Mainline Mileposts (August 2006)

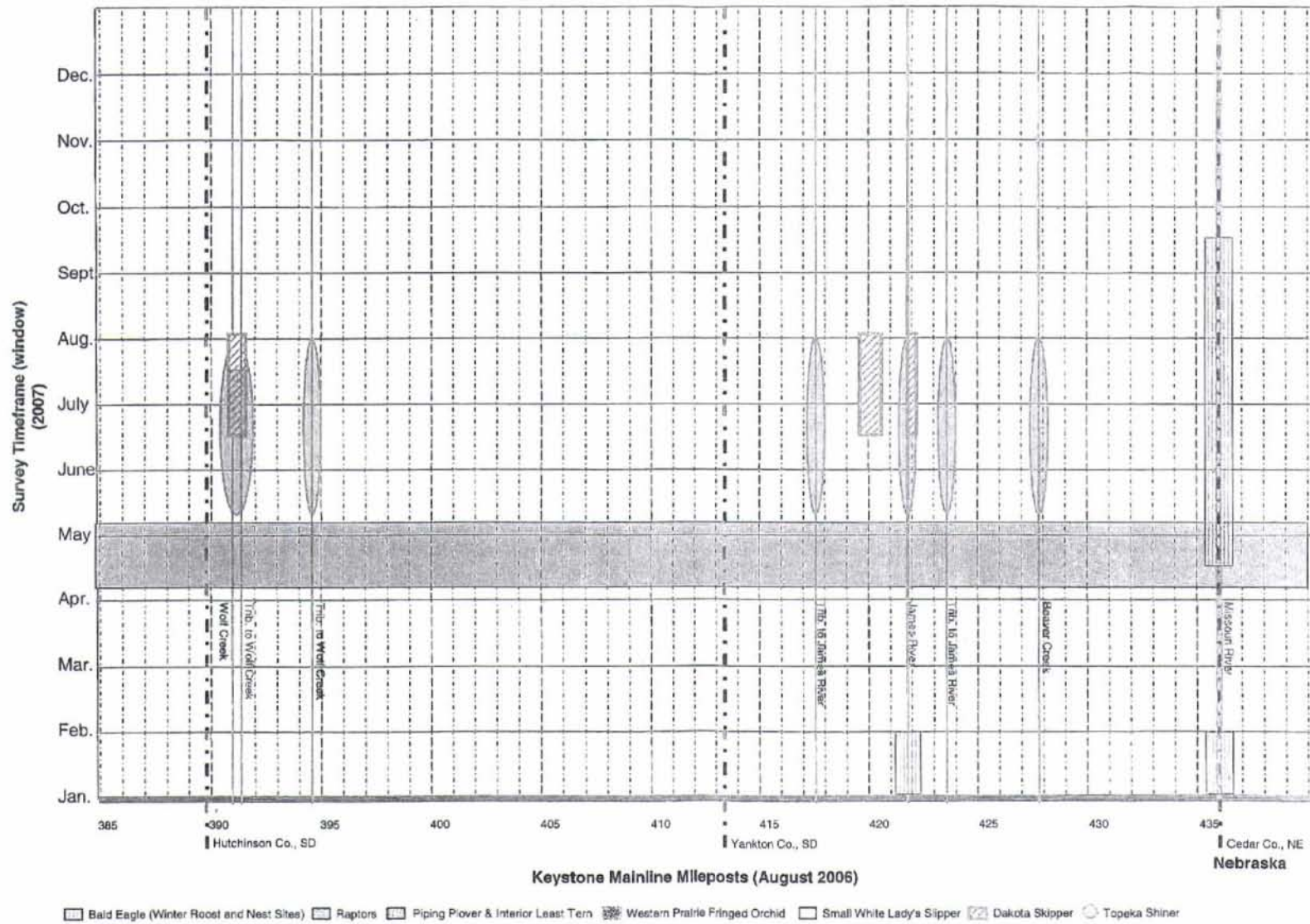
□ Raptor ▨ Western Prairie Fringed Orchid ▤ Topeka Shiner

Note: Survey timeframe represents window biological surveys should be completed within, not the actual time it will take to complete surveys.

January 2007

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Keystone Pipeline Project Biological Survey March-Chart 2007



Note: Survey timeframe represents window biological surveys should be completed within, not the actual time it will take to complete surveys.

January 2007

Keystone Pipeline Project
Survey Protocols for South Dakota Special Status Species

Species & Status	Survey Protocol
Bald Eagle <i>Haliaeetus leucocephalus</i> FT; SD-T	Survey Frequency: Aerial bald eagle surveys will be conducted for nest sites and winter roost sites in 2007. Surveys may also be required prior to construction in 2008, if pipeline construction occurs during the breeding season (1-February through 15-August) or winter roosting season (1-November through 1-April). Procedures: 1. The bald eagle surveys will be conducted along river corridors or historical bald eagle nest/winter roosting sites that occur within 1-mile from the project Right-of-Way (ROW). Stands of coniferous or deciduous trees will be surveyed for active nest sites during the breeding season 2. Stands of coniferous or deciduous trees will be surveyed for active winter roost sites from 1 hour before sunrise or sunset to 1 hour after sunrise or sunset. 3. A helicopter will be used for the surveys. Whenever possible, two observers will be used to conduct the surveys. 4. Observations of individual eagles, nests, or roosting eagles will be recorded using Global Positioning Systems (GPS). The date, location, nest condition, activity status, nest condition, and habitat will be recorded for each sighting. 5. Qualifications of the surveyor, method of survey, and results of the survey will be submitted to the SDGFP and the appropriate U.S. Fish and Wildlife Service (USFWS) field office.
Raptors	Survey Frequency: A raptor survey (aerial helicopter survey) was conducted within 0.25- to 0.50-mile from the edge of the construction ROW in April of 2006, to identify active and inactive nest sites along the project route. A raptor report was submitted to the USFWS in January 2007. A second raptor survey effort will be conducted prior to leaf-out in the spring of 2007. The focus of this survey is to identify nest sites that would be directly impacted from construction activities. Procedures: 1. Raptor surveys will be conducted along the entire proposed project route, focusing on active and inactive nest sites that occur within the construction ROW.

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Keystone Pipeline Project
Survey Protocols for South Dakota Special Status Species

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Species & Status	Survey Protocol
	2. A helicopter will be used for the raptor surveys. Whenever possible, two observers will be used to conduct the surveys. 3. Observations of raptors and nest sites will be recorded using GPS. The date, location, nest condition, activity status, raptor species, and habitat will be recorded for each sighting. 4. Qualifications of the surveyor, method of survey, and results of the survey will be submitted to the SDGFP and the appropriate USFWS field office.
Interior Least Tern <i>Sterna antillarum</i> <i>athalassos</i> FE; SD-E Piping Plover <i>Charadrius melodus</i> FT; SD-T	Survey Frequency: Surveys will be conducted in 2007 at the Missouri River crossing during the breeding season (15-April to 15-September) to identify occupied nest sites. Surveys may also be required prior to construction in 2008, if pipeline construction occurs during the breeding season. Procedures: 1. Surveys will be conducted between April 15 and September 15 at the Missouri River crossing in Yankton County, SD. Surveys will extend 0.25-mile on either side of the construction ROW, depending on access. 2. Surveys will be conducted by a biologist familiar with the species and familiar with identifying tern and plover nests. 3. Surveys will be conducted from sunrise to approximately 1000, or approximately 1700 to sunset. 4. All plover or terns located within the survey area will be observed long enough to determine if the area is occupied by these species and if a nest is present. 5. Observations of plover and terns will be recorded using GPS. Date, time, observations, and habitat type will be recorded for each sighting. 6. Surveys will not be conducted in poor weather (i.e., high wind, precipitation, etc). 7. Qualifications of the surveyor, method of survey, and results of the survey will be submitted to the SDGFP and the appropriate USFWS field office.
Dakota Skipper <i>Herperia dactotae</i>	Survey Frequency: Habitat surveys were conducted in the fall of 2006 to determine areas of potentially suitable native grassland habitat for this species.

Keystone Pipeline Project
Survey Protocols for South Dakota Special Status Species

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Species & Status	Survey Protocol
FC; SD-SC	Surveys will be conducted in 2007 to determine if the species occurs within the ROW. 2008 pre-construction surveys would be conducted only in areas where this species was observed in 2007. Procedures: 1. Surveys will occur in suitable habitat that was identified during the 2006 habitat surveys. 2. Surveys will occur within the construction ROW for the project. 3. The surveyor will have previous experience with Hesperineae, including sight identification and capture experience (Endangered Species Permit Required) 4. The surveyor will have experience with collecting and preparing voucher specimens of Lepidoptera 5. Surveys will be attempted within 2 weeks of detection of emergence because of the short flight period of the species. 6. Surveys will be completed between the hours of 1000 and 1800. 7. If cloud cover is 0-50%, surveys will not be conducted unless the minimum temperature is at least 75° F; if cloud cover is 50-80%, surveys will not be conducted unless the minimum temperature is at least 80° F; if cloud cover is greater than 80%, surveys will not be conducted. 8. Surveys will not be conducted when wind speeds are greater than 20 mph. 9. Observations of skippers will be recorded using GPS. Date, time, land use and/or habitat type, and weather conditions will be recorded for each area surveyed. 10. Qualifications of the surveyor, method of survey, and results of the survey will be submitted to the SDGFP and the appropriate Service field office.
Topeka Shiner <i>Notropis topeka</i> FE; SD-SC	Survey Frequency: Habitat surveys were conducted in the fall of 2006 at specific Topeka shiner stream crossings to document habitat suitability, stream characteristics (intermittent/perennial flow, water quality), and spawning habitat. One sampling (occurrence) survey will be conducted at each site in 2007 to determine species presence at the stream crossings, in coordination with the USFWS, if needed.

Keystone Pipeline Project
Survey Protocols for South Dakota Special Status Species

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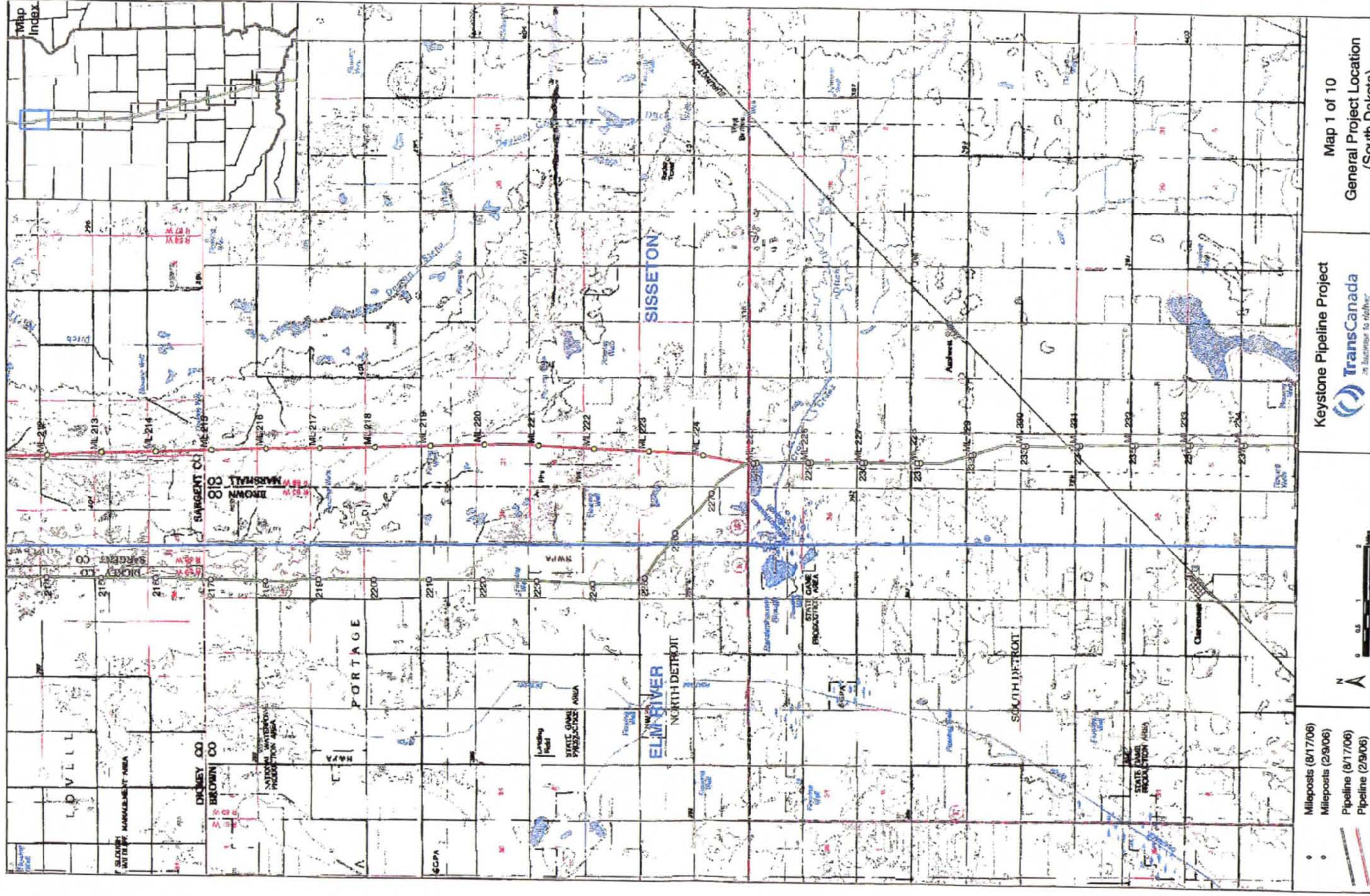
Species & Status	Survey Protocol
	Procedures: 1. Sampling surveys will be conducted only at locations identified as suitable habitat for Topeka shiners, in coordination with the USFWS. 2. Surveys will be conducted within a 200-m site that includes 100-m both upstream and downstream of the pipeline crossing, depending on private access. 3. Fish will be collected throughout the site using a 30x6-ft or 8x6-ft drag seine with ¼-inch mesh netting. 4. All fish collected will be identified to species to establish presence/absence of Topeka shiners. 5. Fish collected in the seine will be transferred immediately into a bucket of freshwater or live cage placed in a suitable part of the stream to minimize injuries and mortalities to fish during processing. 6. If Topeka shiners are present, 1 to 3 voucher specimens may be retained by fixing in 10% formalin and preserving in 70% ethanol and identification verified by USFWS or SDGFP staff. 7. GPS coordinates, detailed locality information, date, collector, and habitat information will be collected for each voucher specimen. 8. Other documentation and data management protocols will follow collection permit requirements. 9. Qualifications of the surveyor, method of survey, and results of the survey will be submitted to the SDGFP and the appropriate USFWS field office.
Western Prairie Fringed Orchid <i>Platanthera praeclara</i> FT; SD-SC	Survey Frequency: Habitat surveys were conducted in the fall of 2006 to determine areas of potentially suitable native grassland habitat for this species. Surveys will be conducted in 2007 to determine if the species occurs within the ROW. 2008 pre-construction surveys would be conducted only in areas where this species was observed in 2007. Procedures: 1. Occurrence surveys will occur in areas of "good" habitat that was identified during the 2006 habitat surveys including: a. Low (wet) prairie dominated by bluestem grasses, wood lily, harebell, and smooth camas

Keystone Pipeline Project
Survey Protocols for South Dakota Special Status Species

Species & Status	Survey Protocol
	b. Upland (dry) prairie on ridges and hillsides dominated by bluestem grasses, needlegrass, pale purple and upright coneflowers and blanketflower. 2. Occurrence surveys will occur within the construction ROW for the project. 3. Surveys will be conducted during the flowering period (15-June through 15-July) by a qualified botanist familiar with the species and trained to conduct rare plant surveys. 4. Date, time, land use and/or habitat type, and number of orchids observed will be recorded for each sighting. Observations of orchids will be recorded using GPS. 5. Qualifications of the surveyor, method of survey, and results of the survey will be submitted to the SDGFP and the appropriate Service field office.
Migratory Birds	TBD

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• Mileposts (8/17/06)
 • Mileposts (2/9/06)
 — Pipeline (8/17/06)
 — Pipeline (2/9/06)

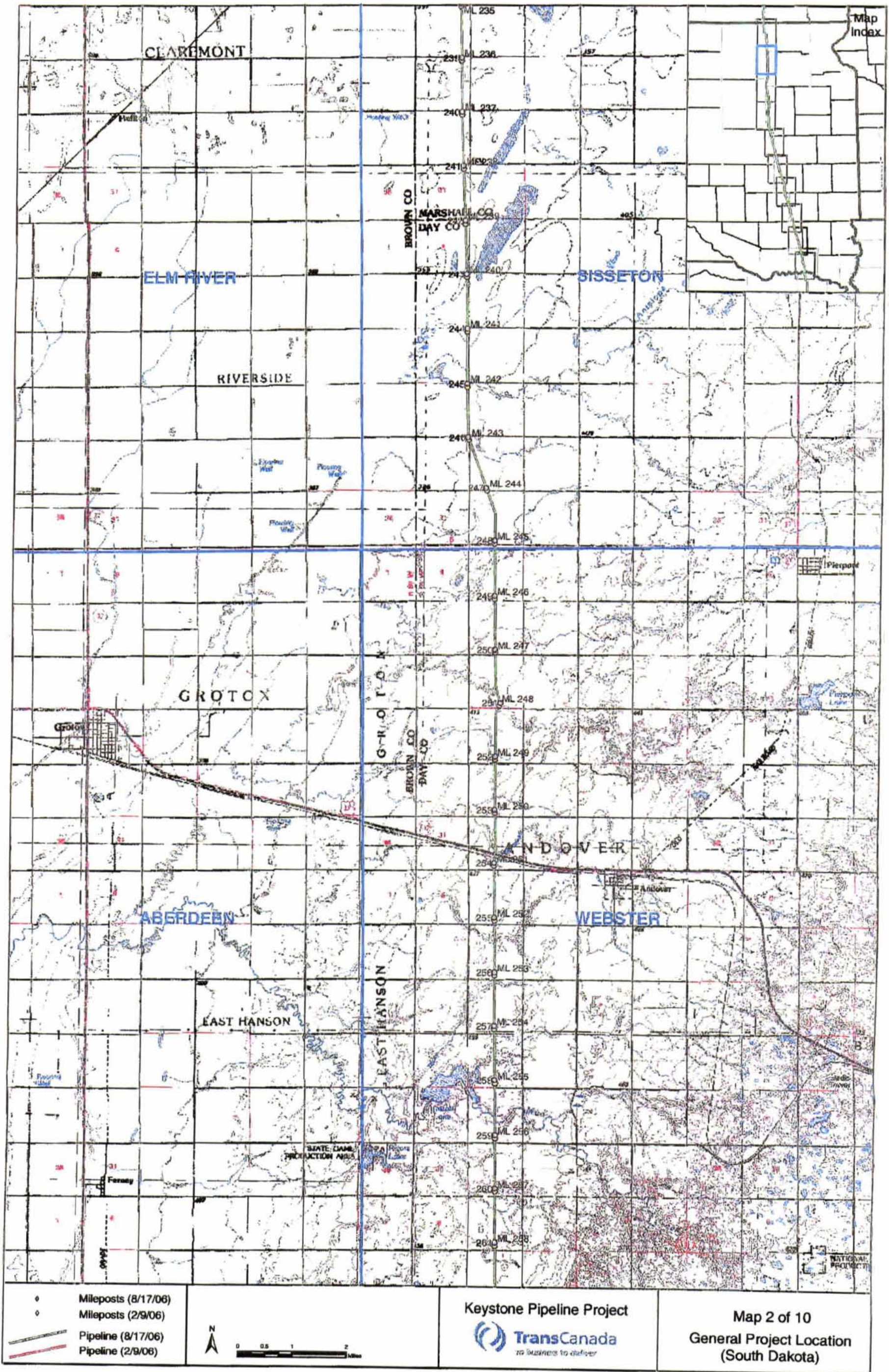


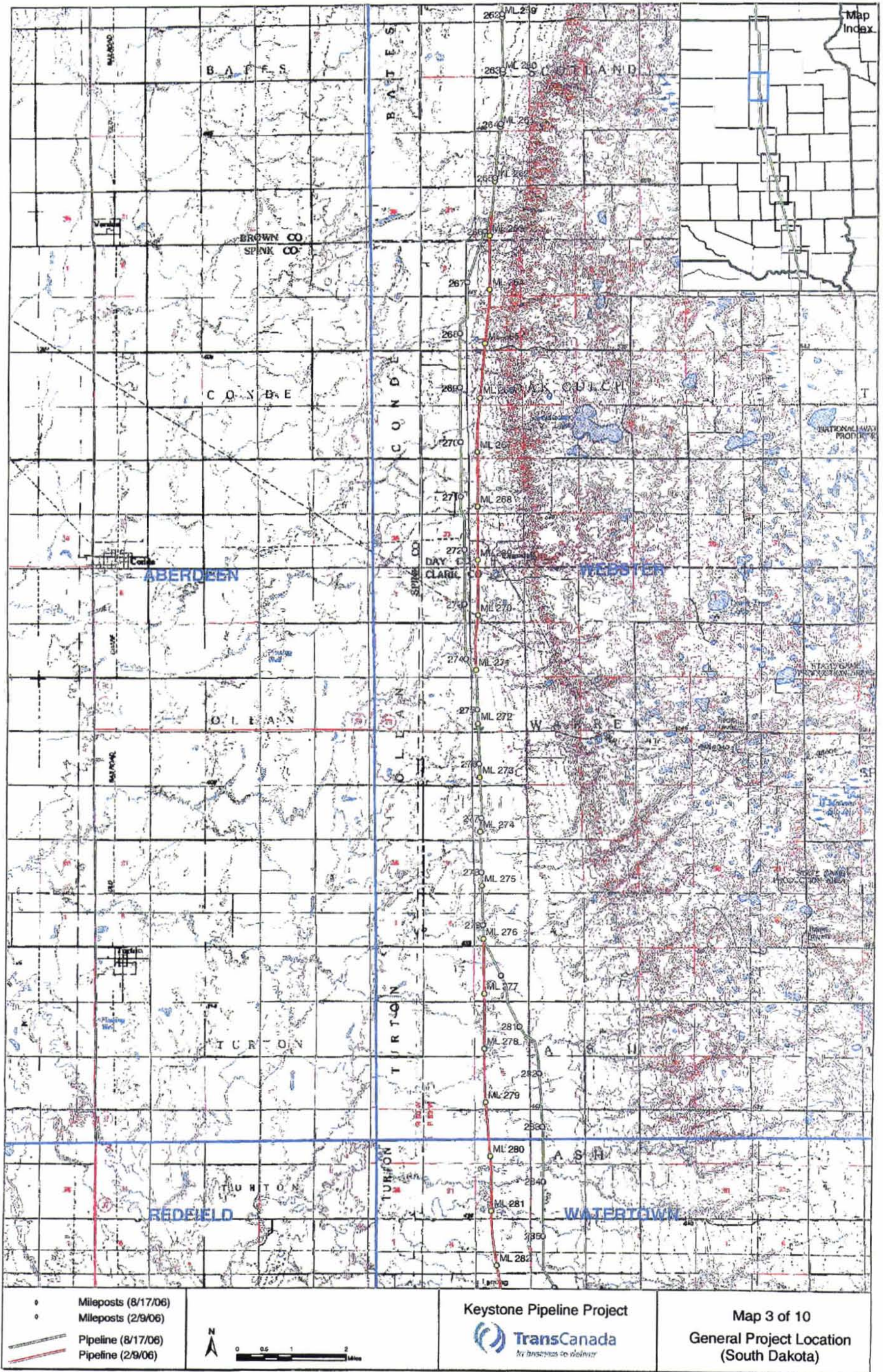
Keystone Pipeline Project

 an Enbridge to northern

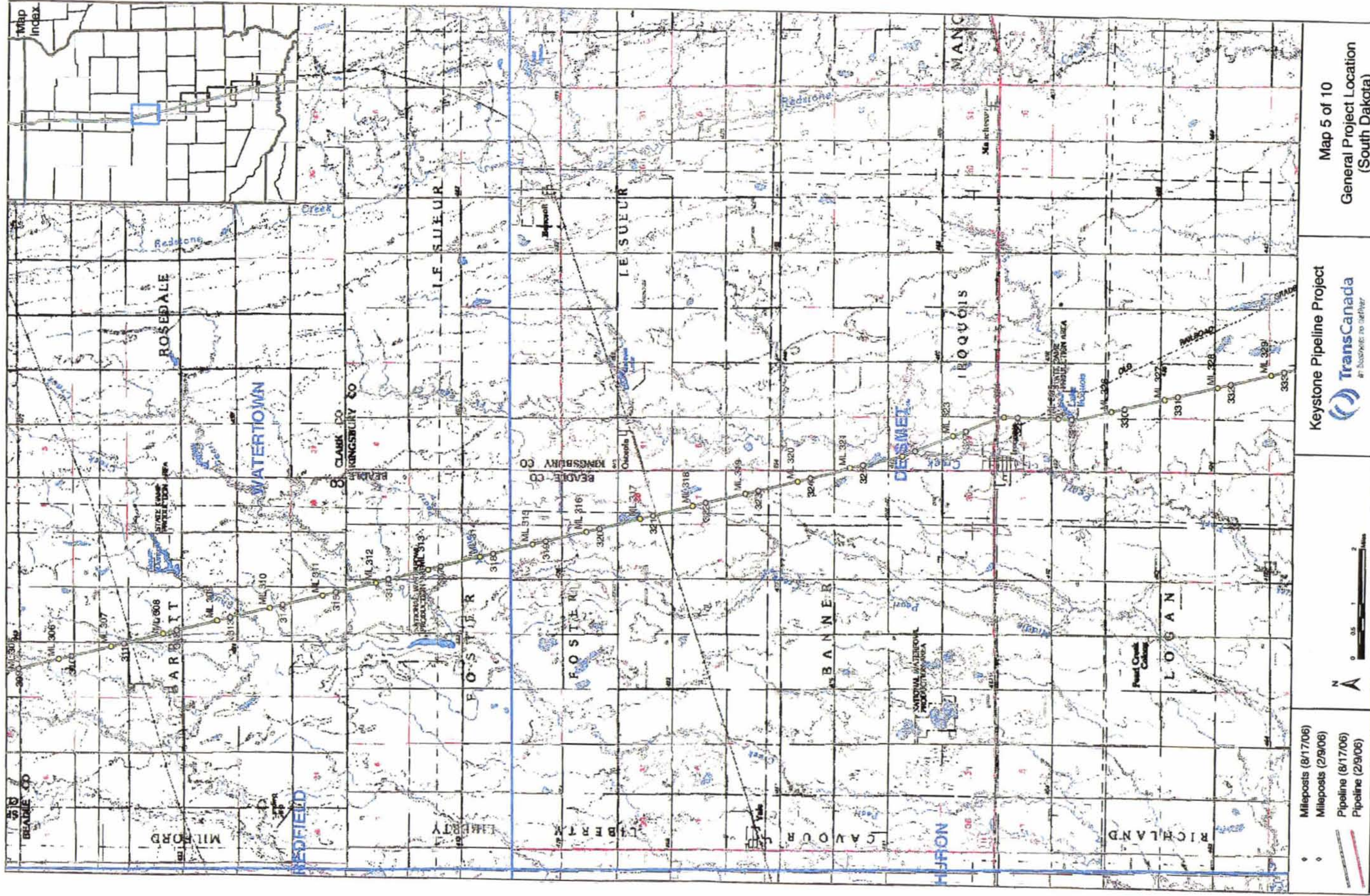
Map 1 of 10
 General Project Location
 (South Dakota)

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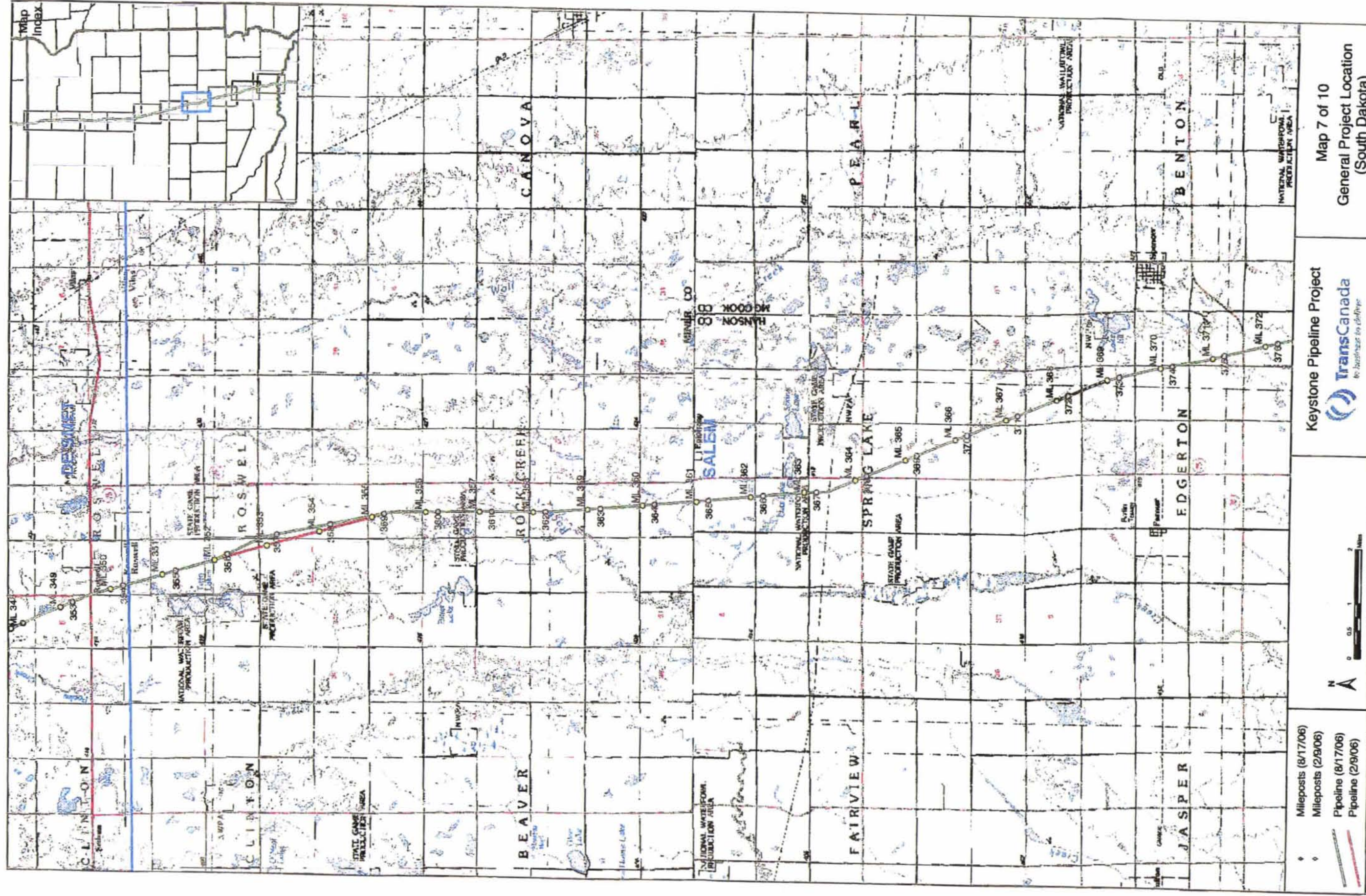




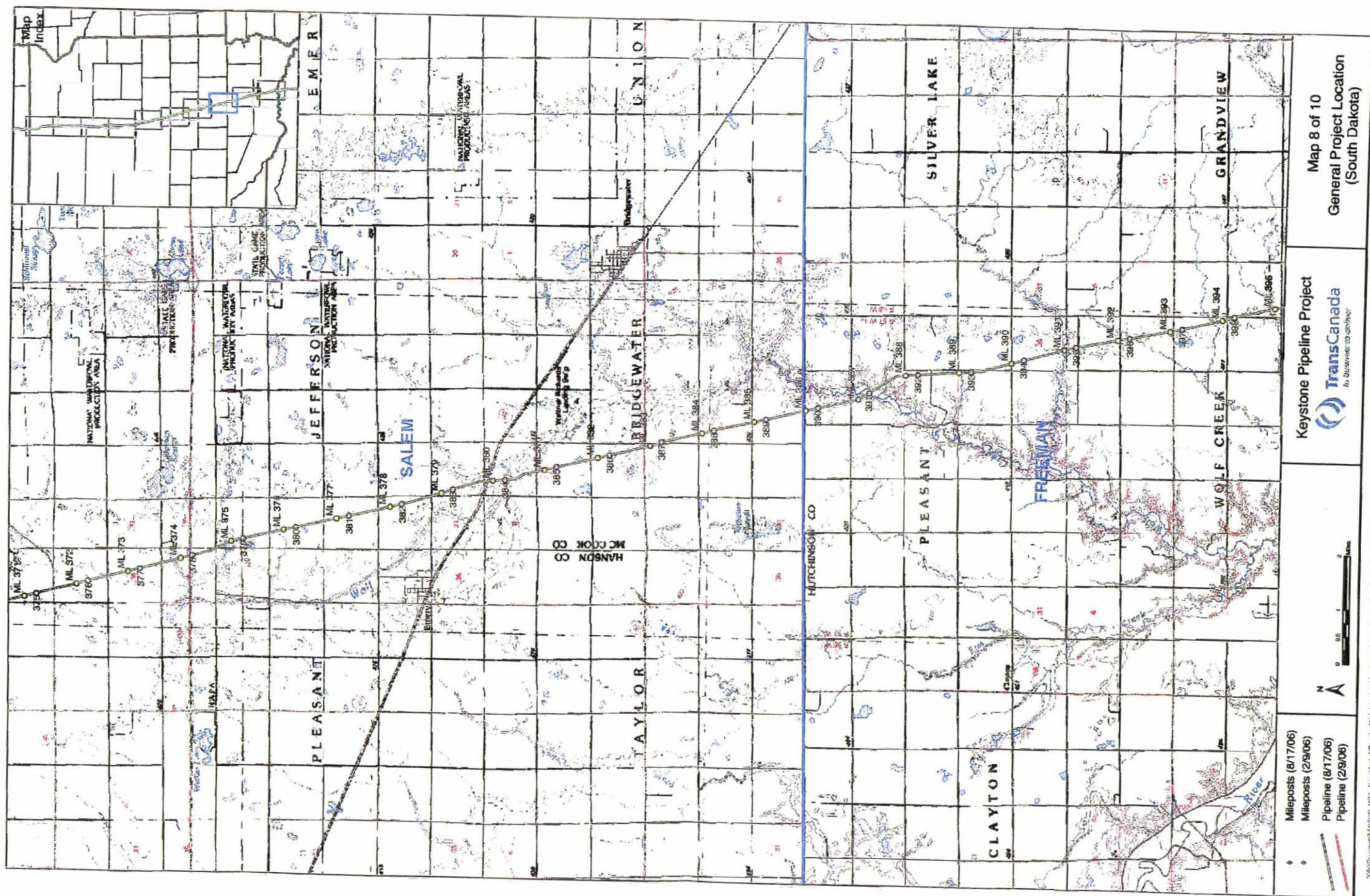
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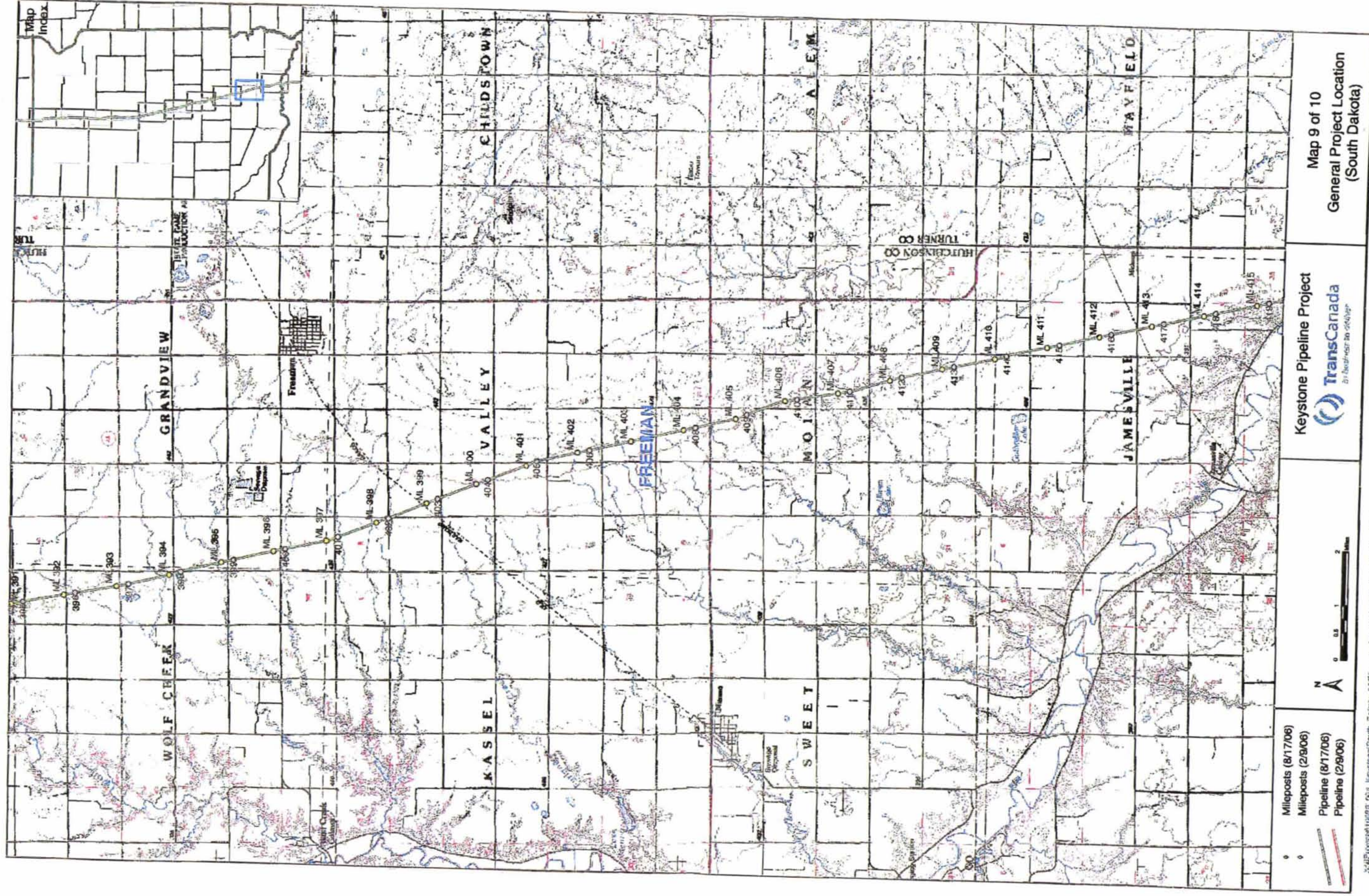


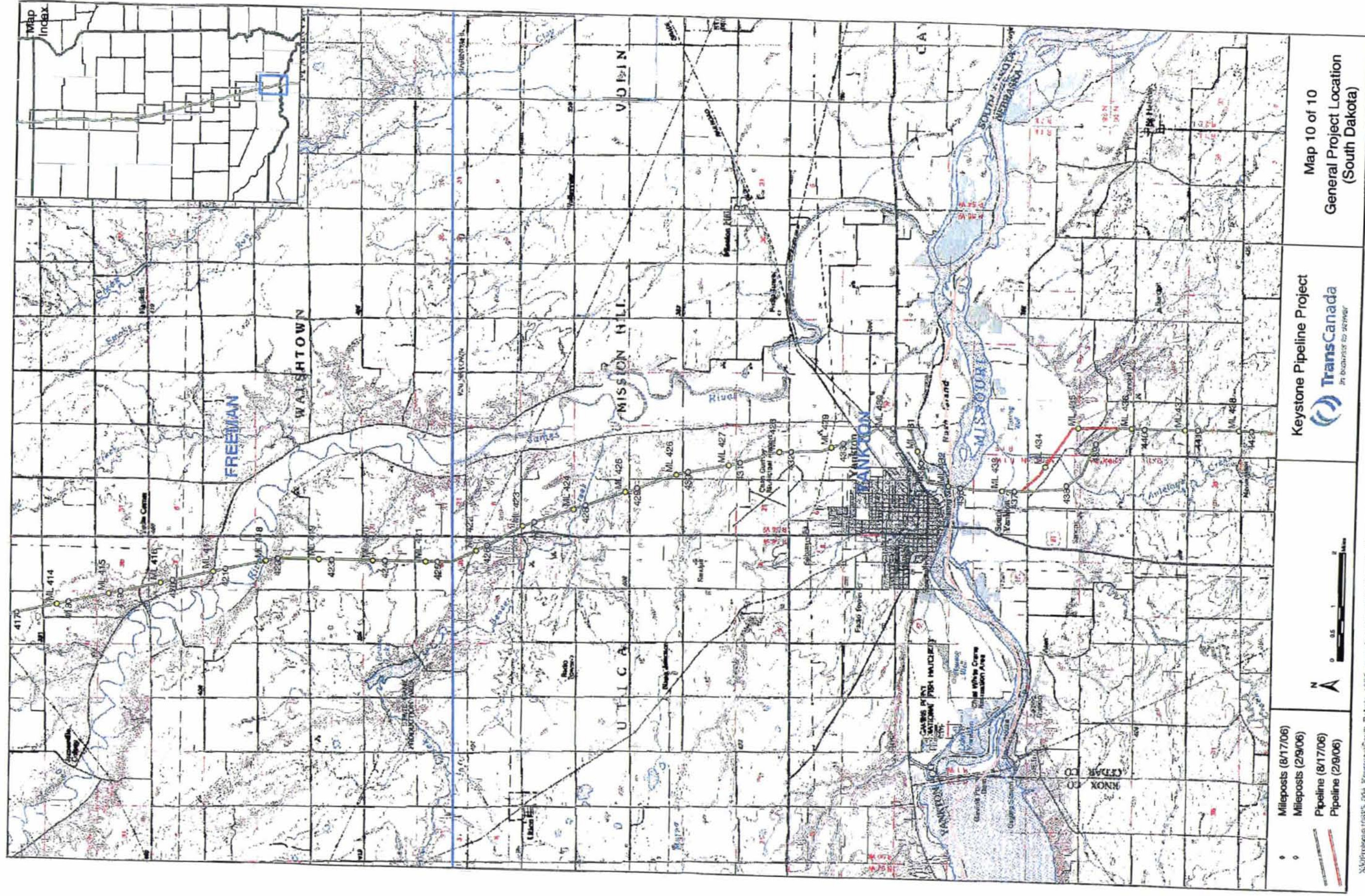
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Castle, Carla

From: Walsh, James
Sent: Wednesday, January 31, 2007 9:24 AM
To: 'Denny Needham'
Cc: Ellis, Scott; Hope, Benjamin; Castle, Carla
Subject: Milford Lake Wetlands
Attachments: milford-wetland.pdf; Milford.ppt; Milford_aerial.PDF

Denny,

Attached, please find three documents pertaining to the COE lands crossed by the Cushing extension. Milford Reservoir and the adjacent lands are owned by the COE and managed by the Kansas Dept. of Wildlife and Parks as a State Park and Wildlife Area. I have attached PDF documents of the Cushing centerline on aerial photographs at two resolutions, a coarser-scale GIS screenshot depicting the CL and boundaries of the COE lands (Milford Reservoir in purple, park and wildlife area in blue), and a PDF showing the wetlands restoration projects in the immediate vicinity of the current centerline.

Additional information on this area may be found at the COE website (<http://www.nwk.usace.army.mil/projects/milford/>) or from KDWP (http://www.kdwp.state.ks.us/kdwp_info/locations/wildlife_areas/region_2/milford).

ENSR will be contacting the Kansas City District of the COE to discuss this current alignment. I will keep you updated with any new information. If there are any questions in the meantime, please don't hesitate to contact me.

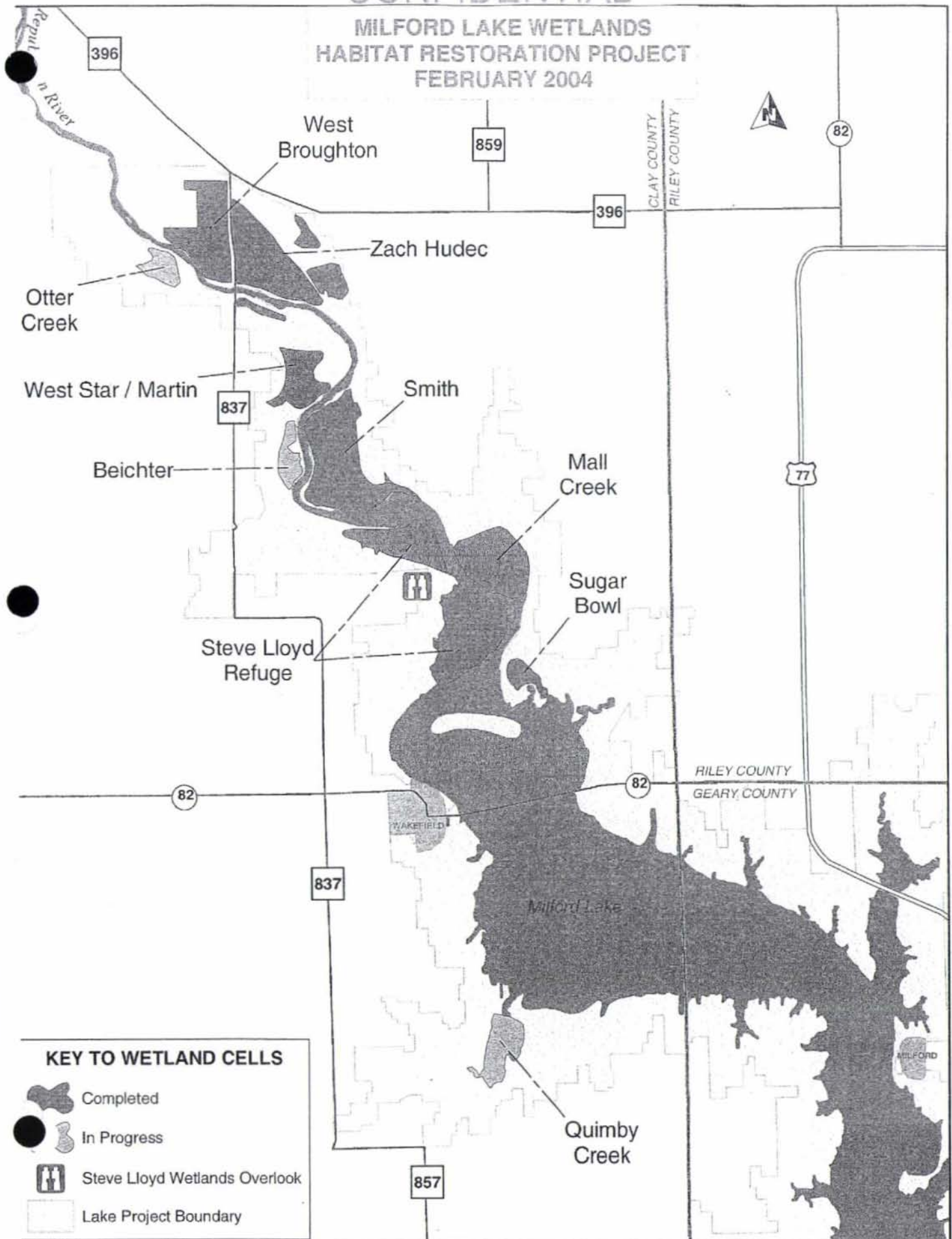
Randy

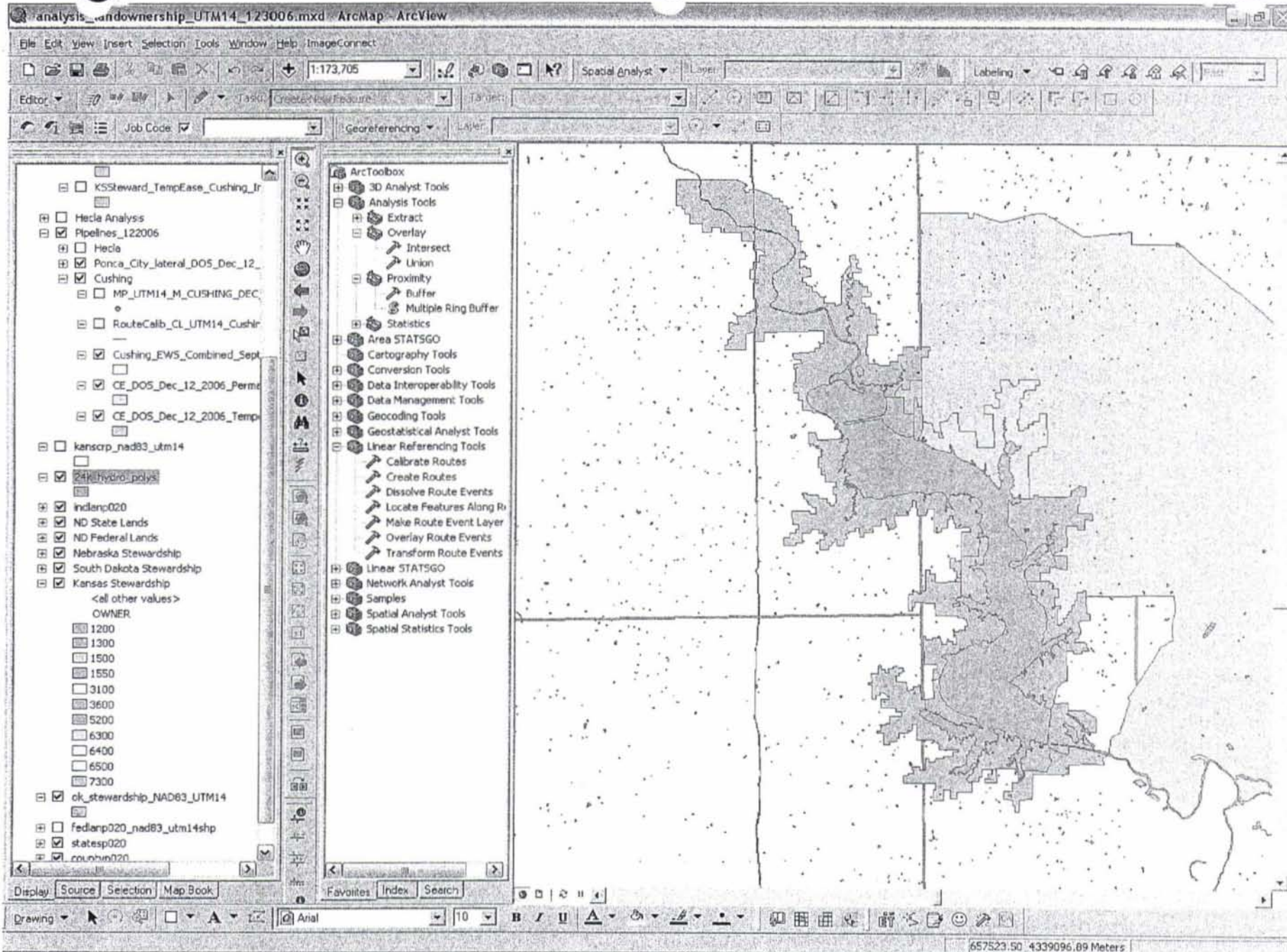
J. Randall Walsh

Ecologist
ENSR/AECOM
1601 Prospect Parkway
Fort Collins, CO 80525
office: (970) 493-8878 ext. 180
jwalsh@ensr.aecom.com

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MILFORD LAKE WETLANDS
HABITAT RESTORATION PROJECT
FEBRUARY 2004





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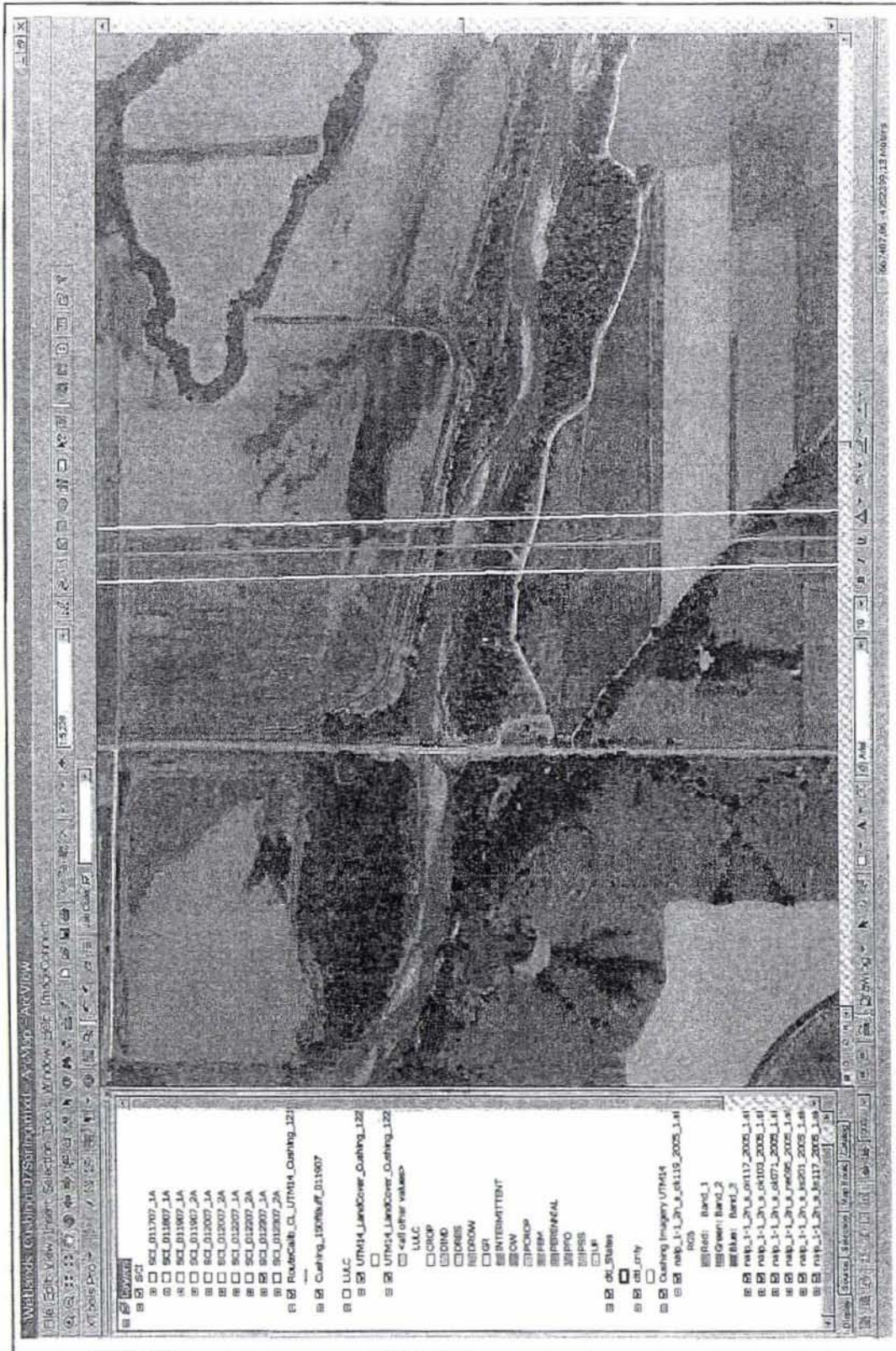
Milford Lake Wetlands, KS

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Milford Lake Wetlands, KS

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Draft – U.S. Army Corps of Engineers; Oahe Project Office, Pierre, SD
February 21, 2007. 9:00-11:00 am

Attendees:

Keystone Staff:

Mike Koski (Trow)
Dana Greene (Universal)
Scott Ellis (ENSR)
Randy Walsh (ENSR)

Agency Staff:

Jeff Breckenridge, USACE
Steve Naylor, USACE
John Miller, SD Dept. of Environment & Natural Resources
Albert LeBeau, Cheyenne River Sioux Tribe (CRST)
Bob Walters, CRST Council
Paige Hoskinson, SD SHPO
Charlene Bessken, USFWS-Pierre
Leslie Petersen, SD Game & Fish
Sara Thompson, NRCS
Cindy Steele, NRCS
Dan Shurtliff, NRCS

Meeting Objectives

Keystone (ENSR, Trow, and Universal) met with USACE and other agencies to discuss issues pertaining to 404 permitting for the Project in South Dakota. The goals of this meeting were to discuss: 1) the overall current status of the Keystone Pipeline Project; 2) 2006 wetlands/waters survey results; 3) the process and components necessary to complete USACE Application filing in 2007; 4) other issues or concerns the USACE or other agencies may have regarding the Project.

Project Overview

Keystone provided a brief overview of the Project including project purpose, technical specifications, in-service date, and current status of the NEPA process.

Field Work and Coordination

Keystone discussed routing issues in the Hecla Sandhills area. A short history of route changes in the area was presented and the "preferred alternative" route was explained in-depth. USFWS wetland/grassland easements, wetland abundance, minimizing crossing distances of shallow aquifers, and pump station logistics all influenced the routing of the preferred alternative.

The need to delineate protected wetlands located on USFWS easements in conjunction with USFWS district staff in Spring 2007 was addressed.

Cultural and Wetlands/Waters of the U.S. survey methodologies were reviewed and a summary of 2006 survey progress was presented.

404 Permit Components and Process

The preliminary 404 application should include:

1. Wetland Tables – which include
 - o Wetland
 - o Type

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- o Acreage
- o Location (lat, long)
- o Acreage
- o Distance crossed
- o Special requirements
- o Rationale
- 2. Stream Tables, same basic components as wetlands
- 3. Procedures
- 4. Site Specific Figures – examples handed out
 - o 1:6000 aerial
 - o 1:6000 topo
 - o Depicts CL, wetland boundaries, workspace easement
 - o Impact area discussion (temporary/permanent meanings defined)
 - o Can not discharge to a waterbody classified as a "lake" by the state of South Dakota (lakes are not under Corps jurisdiction but are regulated by SD Dept. of Environment and Nat. Res.)
- 5. Site-specific construction plans

Prior to formally filing the 404 permit application, Keystone will submit a "preliminary" application to the Corps for informal review. The purpose of this draft application is to identify any issue or problems prior to initiation of the formal application process. This process will also provide the Corps opportunity to evaluate the project prior to formal filing.

Agency Issues, Concerns, and Recommendations:

USDA-NRCS Easements – Sara Thompson, NRCS

- NRCS wetland easements will be impacted in the Hecla area
- Majority of wetland easements in SD are perpetual, though some are 30-year easements
- GIS shapefiles of these easements can be provided to the Project, though some of the easements in the area have never been formally delineated/mapped
- Coordination of the NRCS wetland easement issues should be discussed with the Federal Level of NRCS:
 - o Matthew Judy, Ft. Worth, (Western Regional) National Environmental Specialist
 - o Andre Duvarnan (?), Wash. D.C., National Environmental Specialist

State of South Dakota - John Miller, SD Dept. of Environment & Natural Resources

- Providing the State of SD signs-off on the 401, there will be no further permit process aside Nationwide/IP
- State of SD will need to approve hydrostatic testing
- State of SD may also require stormwater permitting (talk with Kelly Busher)

Action Items:

Provide a preliminary draft application to USACE prior to final application [ENSR]; time frame

Provide a Cultural Resources Report to Albert LeBeau, CRST HPO [ENSR]; due in 2 weeks.

Coordinate with NRCS-SD to verify any easements crossed by the Hecla Alternative [ENSR]; time frame

Verify that no designated lakes (as defined by SD Environment and Nat. Resources) are crossed by the Project [ENSR/Trow]; time frame

Refer to SD DOT website to identify waterbody crossing BMPs for streams in SD [ENSR/Trow]; time frame

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Draft – U.S. Army Corps of Engineers; Bismarck Regulatory Office, Bismarck, ND
February 22, 2007. 10:00-11:30 am

Attendees:

Keystone Staff:

Mike Koski (Trow)
Dana Greene (Universal)
Scott Ellis (ENSR)
Randy Walsh (ENSR)

Agency Staff:

Lloyd Jones, USFWS
Jeff Towner, USFWS
Doug VanDaalen, USDA-NRCS
Patsy Crooke, USACE
Dan Cimarosti, USACE
Sheri G. Lares, NDDOT
Kelly McPhillips, Bureau of Reclamation
John Schumacher, ND Game & Fish
Bruce Kreft, ND Game and Fish

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The need to delineate protected wetlands located on USFWS easements in conjunction with USFWS district staff in Spring 2007 was addressed.

Cultural and Wetlands/Waters of the U.S. survey methodologies were reviewed and a summary of 2006 survey progress was presented.

404 Permit Components and Process

The preliminary 404 application should include:

1. Wetland Tables – which include:
 - o Wetland I.D.
 - o Type
 - o Acreage
 - o Location (lat, long)

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- o Distance crossed
- o Special requirements/restrictions
- o Rationale
- 2. Stream Tables, same basic components as wetlands
- 3. Procedures
- 4. Site Specific Figures – examples handed out
 - o 1:6000 aerial
 - o 1:6000 topo
 - o Depicts CL, wetland boundaries, workspace easement
 - o Impact area discussion (temporary/permanent meanings defined)
 - o Can not discharge to a waterbody classified as a "lake" by the state of South Dakota (lakes are not under Corps jurisdiction but are regulated by SD Dept. of Environment and Nat. Res.)
- 5. Site-specific construction plans

Prior to formally filing the 404 permit application, Keystone will submit a "preliminary" application to the Corps for informal review. The purpose of this draft application is to identify any issue or problems prior to initiation of the formal application process. This process will also provide the Corps opportunity to evaluate the project prior to formal filing.

Agency Issues, Concerns, and Recommendations:

USFWS – Lloyd Jones

- A Compatibility Determination for North and South Dakota will be made in Bismarck.
- The Project will require a ROW Permit to cross USFWS easements in North and South Dakota. This application must be submitted fairly soon, as the process is often lengthy. A special use permit may be authorized to begin construction if the ROW permit is delayed.

NRCS – Doug VanDaalen

- NRCS will need to issue a Federal Impact Rating Statement (FIRS)
- NRCS in North Dakota has 30-year wetland easements which may be affected
- General seed mixes for the Project may be arranged through ND NRCS State Office

USACE – Dan Cimarosti

- Tributary and adjacent wetlands are jurisdictional (whether containing water or not)
- >180 days of temporary disturbance at a location triggers compensatory mitigation

USFWS – Jeff Towner

- MBTS issues regarding the Project
- Expecting John Cochran in Nebraska to address this issue District-wide (Ellis)

Action Items:

Provide a preliminary draft application to USACE prior to final application [ENSR]; time frame

NRCS-ND office will provide seed mixes for Project in ND (contact Doug VanDaalen) [ENSR]; time frame

Coordinate with NRCS-ND to verify any easements crossed by the Hecla Alternative [ENSR]; time frame

NRCS needs to determine internally if a FIRS (Federal Impact Rating Statement) needs to be prepared by their office for the Project [VanDaalen, NRCS]

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TransCanada – Keystone Pipeline Meeting Summary E-Mail Posting Form

Meeting Location: Tewaukon NWR, Cayuga ND

Date & Time: Tuesday, February 27, 2007; 9:00 am

Keystone Team Members: Walsh (ENSR), Greene (Universal)

Agency Contact Information:

Name	Organization	Title	Phone / E-mail address
Jack Lalor	Tewaukon NWR/WMA	Asst. Refuge Manager	(701) 724-3598 jack_lalor@fws.gov
Jeff King	Tewaukon NWR/WMD	Project Leader	(701) 724-3598 jeff_king@fws.gov
Doug Leschisin	Waubay NWR/WMD		(605) 947-4521 douglas_leschisin@fws.gov
Larry Martin	Waubay NWR/WMD	Project Leader	(605) 947-4521 larry_d_martin@fws.gov
Jarred Lee	Waubay NWR/WMD		(605) 947-4521 jarred_lee@fws.gov

Meeting Purpose:

The purpose of this meeting was to discuss, in general terms, the current proposed alignment of the Keystone Pipeline Project and associated temporary impacts on wetlands found on USFWS easements in the Tewaukon and Waubay Wetland Management Districts (WMDs) in North and South Dakota.

Action Items:

Issue Description/Responsible Parties/Concern Level

Protected wetland polygon maps (i.e. "exhibit A" maps) for each wetland easement crossed by the current alignment were provided by the FWS for both WMDs. These maps need to be scanned, digitized and converted into shapefiles for use in GIS. Due Date March 30 [ENSR]

Concern Level :

Moderate

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Issue Description/Responsible Parties/Concern Level

There was concern by the FWS that some of the information contained in the Construction/Mitigation Plan is outdated. Universal and ENSR will follow-up with the Tewaukon and Waubay Districts to determine which information is of specific concern to FWS. ENSR (Walsh) to follow up two weeks

Concern Level :

Moderate

Issue Description/Responsible Parties/Concern Level

Jack Lalor (FWS) provided a copy of the ROW permit application and instructions for filing to Randy Walsh (ENSR). This application should be submitted as soon as possible to the Regional Office in Denver. Part of easement acquisition-UEI/Lands

Concern Level :

Moderate

Follow-up Required / Requested

- If additional "exhibit A" maps are necessary for analysis of the proposed route, these can be provided by FWS Districts

Additional Comments

- Site visits to potentially impacted wetlands located within FWS easements will be required to delineate/ID these features in conjunction with FWS
- Interim special use permit(s) may be issued to commence construction if a formal ROW permit is not issued by the Regional Office at the time construction is set to begin

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TransCanada -- Keystone Pipeline Meeting Summary E-Mail Posting Form

Meeting Location: Huron WMD, Huron SD

Date & Time: Wednesday, February 28, 2007; 9:30 am

Keystone Team Members: Walsh (ENSR), Greene (Universal)

Agency Contact Information:

Name	Organization	Title	Phone / E-mail address
Harris Hoistad	USFWS - Huron WMD	Project Leader	(605) 352-5894 harris_hoistad@fws.gov
Mark Heisinger	USFWS -- Lake Andes WMD/NWR		(605) 487-7603 mark_heisinger@fws.gov
James Ward	USFWS -- Huron WMD		(605) 352-5894

Meeting Purpose:

The purpose of this meeting was to discuss, in general terms, the current proposed alignment of the Keystone Pipeline Project and associated temporary impacts on wetlands found on USFWS easements in the Huron and Lake Andes Wetland Management Districts (WMDs) in South Dakota.

Action Items:

Issue Description/Responsible Parties/Concern Level

Protected wetland polygon maps (i.e. "exhibit A" maps) for each wetland easement crossed by the current alignment were provided by the FWS for Lake Andes WMD. These maps need to be scanned, digitized and converted into shapefiles for use in GIS. Due March 30 [ENSR]

Concern Level :

Moderate

Issue Description/Responsible Parties/Concern Level

Based on the current alignment, Huron WMD will be sending "exhibit A" maps to ENSR for processing and integration into the geospatial database. Follow up before March 30 (ENSR).

Concern Level :

Moderate

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Issue Description/Responsible Parties/Concern Level

Concern Level :

Follow-up Required / Requested

Additional Comments

- Site visits to potentially impacted wetlands located within FWS easements will be required to delineate/ID these features in conjunction with FWS

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TransCanada – Keystone Pipeline Meeting Summary E-Mail Posting Form

Meeting Location: Madison WMD Office, Madison SD

Date & Time: Thursday, March 1, 2007; 9:00 am

Keystone Team Members: Walsh (ENSR), Greene (Universal)

Agency Contact Information:

Name	Organization	Title	Phone / E-mail address
Tom Tornow	USFWS - Madison WMD	Project Leader	(605) 256-2974 thomas_tornow@fws.gov
Bryan Schultz	USFWS – Madison WMD	Deputy Project Leader	(605) 256-2974 bryan_schultz@fws.gov

Meeting Purpose:

The purpose of this meeting was to discuss, in general terms, the current proposed alignment of the Keystone Pipeline Project and associated temporary impacts on wetlands found on USFWS easements in the Madison Wetland Management District (WMD) in South Dakota.

Action Items:

Issue Description/Responsible Parties/Concern Level

Based on the current alignment, Madison WMD will be completing their mapping efforts and sending "exhibit A" maps to ENSR for processing and integration into the geospatial database. [FWS-Madison].

Due date: ASAP, likely 2-3 weeks.

Concern Level :

Moderate

Issue Description/Responsible Parties/Concern Level

Concern Level :

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Follow-up Required / Requested

Additional Comments

- Most wetlands along the proposed route in this WMD will be shallow, depressional wetlands
- Site visits to potentially impacted wetlands located within FWS easements will be required to delineate/ID these features in conjunction with FWS

Castle, Carla

From: Walsh, James
Sent: Tuesday, January 09, 2007 9:36 AM
To: edward_meendering@fws.gov
Cc: Ellis, Scott; Castle, Carla; Swartzinski, Paul
Subject: Keystone pipeline wetland mapping

Ed,

It was a pleasure meeting you last month at the Keystone Pipeline meeting hosted by Jim Alonso in Devil's Lake. Now that the holidays are behind us, I have been continuing to coordinate the wetlands work for the Keystone Project. Using the paper maps and overlays provided to us by Scott Ralston, we have successfully completed the digital mapping of FWS protected wetland basins within easements in Nelson County. I was wondering if you might be able to provide me with similar maps applicable to wetland easements impacted by the Project in Steele County? I remember that you had mentioned that mapping efforts were not yet 100% complete for Steele County, but any information that you may be able to provide for easements relevant to the Project in the next few weeks would be extremely helpful. If I can be of any assistance, please do not hesitate to contact me.

Thanks very much,
Randy

J. Randall Walsh

Ecologist
ENSR/AECOM
1601 Prospect Parkway
Fort Collins, CO 80525
office: (970) 493-8878 ext. 180
cell: (970) 232-4058
jwalsh@ensr.aecom.com

2/2/2007

CONFIDENTIAL

Castle, Carla

From: Walsh, James
Sent: Tuesday, January 23, 2007 5:11 PM
To: Castle, Carla
Subject: FW: Keystone pipeline wetland mapping

Janie - For your files...Thanks

-----Original Message-----

From: Edward_Meendering@fws.gov [mailto:Edward_Meendering@fws.gov]
Sent: Monday, January 15, 2007 1:37 PM
To: Walsh, James
Subject: Re: Keystone pipeline wetland mapping

James:

I enjoyed meeting you at Devils Lake and appreciate your willingness in working with the U.S. Fish and Wildlife Service and our wetland easements. I mailed you a letter today with the maps that you requested which are complete. I should be able to have the remaining maps to you by the end of the month once they are completed. Please let me know if you have any questions or comments.

Thank you,
Ed

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United States Department of the Interior



FISH AND WILDLIFE SERVICE Mountain-Prairie Region

VALLEY CITY WMD
11515 River Road
Valley City, ND 58072-9619
January 15, 2007



Mr. James Walsh
1601 Prospect Parkway
Fort Collins, CO 80525

Barnes Easement #235X, 53X
Steele Easement #40X,1, 84X,1,2, 91X,1,2

Dear Mr. Walsh:

You requested that the U. S. Fish and Wildlife Service (Service) provide you with a map for protected wetlands located in section 17, NW1/4, S1/2, section 6, SE1/4, section 7, NE1/4 of T. 141 N., R. 57 W., Barnes County, North Dakota and section 21, Lots 1 and 2, E1/2SW1/4 of T. 144 N., R. 57 W., section 9, N1/2NW1/4 of T. 147 N., R. 57 W., section 28, N1/2 of T. 148 N., R. 57 W., Steele County, North Dakota.

The U. S. Fish and Wildlife Service has purchased and owns perpetual rights which restrict or prohibit the right to drain, burn, level, and fill any wetland basin on the ownership represented by this map. This map represents the Service's effort to depict the approximate location of all protected wetland basins based on information and maps available at the time this map was prepared. However, because climatological and other natural conditions may cause the shape and location of wetland basins to change over time and from time to time, this map may or may not show wetlands as they appear in any given year.

The water levels of these wetlands naturally increase and decrease depending on the natural water cycle. The Service has procedures which allow landowners to remove sheet water or water from wetlands that are affecting roads and buildings. If issues arise concerning individual wetland basins represented on the maps, each will be looked at on a case by case basis. It is the landowner's responsibility to contact the Service if there are any questions concerning the draining, burning, filling, and/or leveling of wetlands depicted on the easement wetland maps.

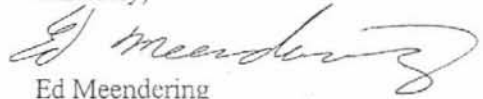
In Summary there are three points to remember about the wetland easement maps:

1. The maps do not and are not intended to provide the exact size or configuration of the wetlands protected by the provisions of the easement.
2. Any burning, draining, filling, or leveling of wetlands depicted on the wetland easement map without a permit issued by the Service is a violation of the provisions of the easement.
3. It is the landowner's responsibility to contact the Service if there are any questions concerning mapped wetlands.

If you have any questions about this map or the easement contract, please contact this office 701-845-3466.

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Sincerely,



Ed Meendering
Refuge Officer

Att: Maps (6), Barnes 235X, 53X
Steele 40X,1 section 21, 84X,1,2 section 9, 91X,1,2 section 28.

cc: WMD easement folder (w/o contract)

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EXHIBIT "A"

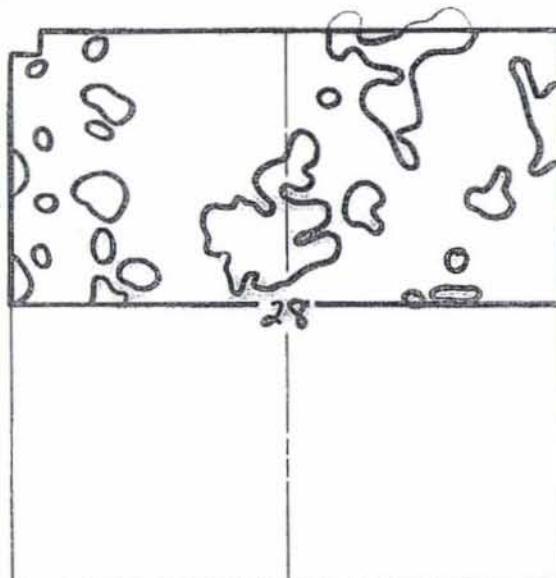
Map 2 of 2

TRACT (91X,1,2)

WATERFOWL PRODUCTION AREA STEELE COUNTY, STATE OF NORTH DAKOTA

EASEMENT AUTHORIZED BY MIGRATORY BIRD HUNTING STAMP ACT OF MARCH 16, 1934,
AS AMENDED.

T. 148 N., R. 57 W., 5th PRINCIPAL MERIDIAN
section 28, N $\frac{1}{2}$ except parcel of land conveyed for cemetery and church site as
recorded in Bk. H Deeds, p. 467.



Scale: 4 Inches = 1 Mile

This map delineates wetlands referred to in the easement conveyance dated April 27, 1977 which the parties of the first part agree to maintain as a waterfowl production area. The lands covered by this conveyance include any enlargements of the delineated wetland areas resulting from normal or abnormal increased water.

Arthur O. Ostenson
Landowner Signature
Arthur O. Ostenson

LEGEND

—————

Boundary of Easement Description



Wetlands covered by provisions of the easement



Nonfunctional drainage facilities which the landowner agrees NOT to repair or clean out

Prepared by: Robert S. Billings

Date: 4/27/77

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TRACT 84X, 1, 2

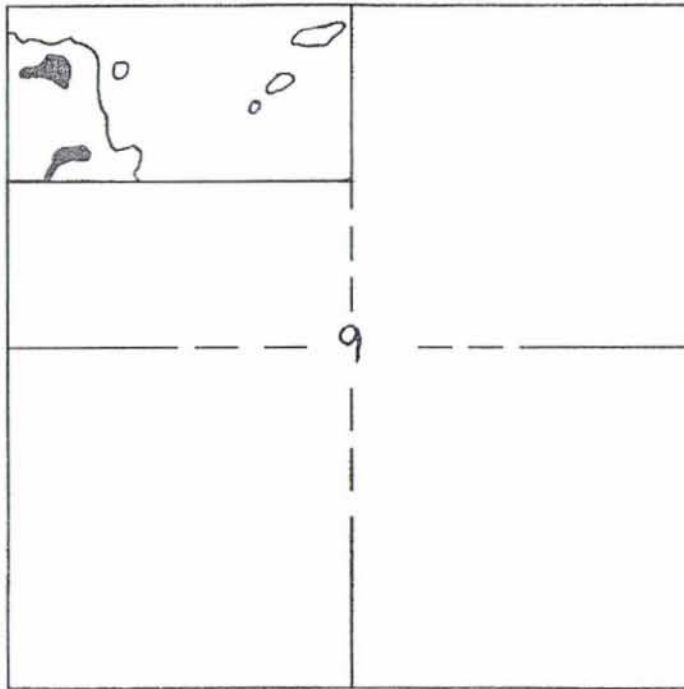
MAP 1 of 2

WATERFOWL PRODUCTION AREA STEELE COUNTY, STATE OF ND

EASEMENT AUTHORIZED BY MIGRATORY BIRD HUNTING STAMP ACT OF MARCH 16, 1934, AS AMENDED.

T. 147 N., R. 57 W., 5th PRINCIPAL MERIDIAN

Section 9, N $\frac{1}{2}$ NW $\frac{1}{4}$



Scale: 4 Inches = 1 Mile

The U.S. Fish and Wildlife Service (Service) has purchased and owns perpetual rights which restrict or prohibit the right to drain, burn, level, and fill any wetland basin on the ownership represented by this map. This map represents the Service's effort to depict the approximate location of all protected wetland basins based on information and maps available at the time this map was prepared. However, because climatological and other natural conditions may cause the shape and location of wetland basins to change over time and from time to time, this map may or may not show wetlands as they appear in any given year.

LEGEND

 Boundary of Easement Description

 Wetlands covered by provisions of the easement



Wetland deleted from easement by Drainage Facility Map prepared when the easement was purchased.

Prepared by:

Harris J. Husted

Date:

5-11-01

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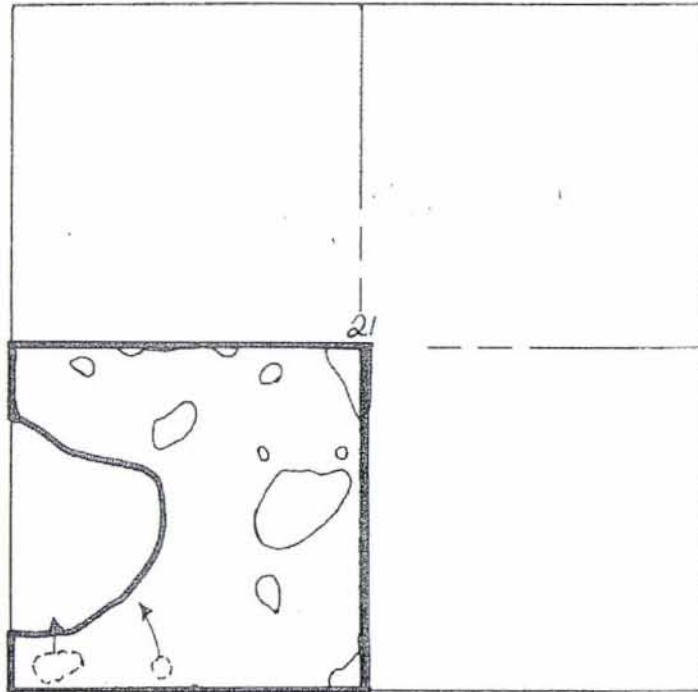
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

TRACT 40X,1

MAP 1 of 2

WATERFOWL PRODUCTION AREA Steele COUNTY, STATE OF NORTH DAKOTA
EASEMENT AUTHORIZED BY MIGRATORY BIRD HUNTING STAMP ACT OF MARCH 16, 1934, AS AMENDED.
T. 144 N., R. 57 W., 5TH PRINCIPAL MERIDIAN

Section: 21 Lots 1 and 2, E1/2SW1/4



Scale: 4 Inches = 1 Mile

The U.S. Fish and Wildlife Service (Service) has purchased and owns perpetual rights which restrict or prohibit the right to drain, burn, level, and fill any wetland on the ownership represented by this map. This map represents the Service's effort to depict the approximate location of all protected wetlands based on information and maps available at the time this map was prepared. However, wetlands are hydro logically dynamic systems, with regularly expanding and contracting water levels. This map is not meant to depict water levels in the wetland in any given year. The Service reserves the right to correct this map provided the mapped acreage remains consistent with the Easement's Summary Acres.

LEGEND

— Boundary of Easement Description
 Wetlands covered by provisions of the easement

 Wetland deleted from easement by Drainage Facility Map prepared when the easement was purchased.

Prepared by: Benjamin L. Cleghorn Date: 23 October 2006

Approved by: Ed Meendering Date: 23 October 2006

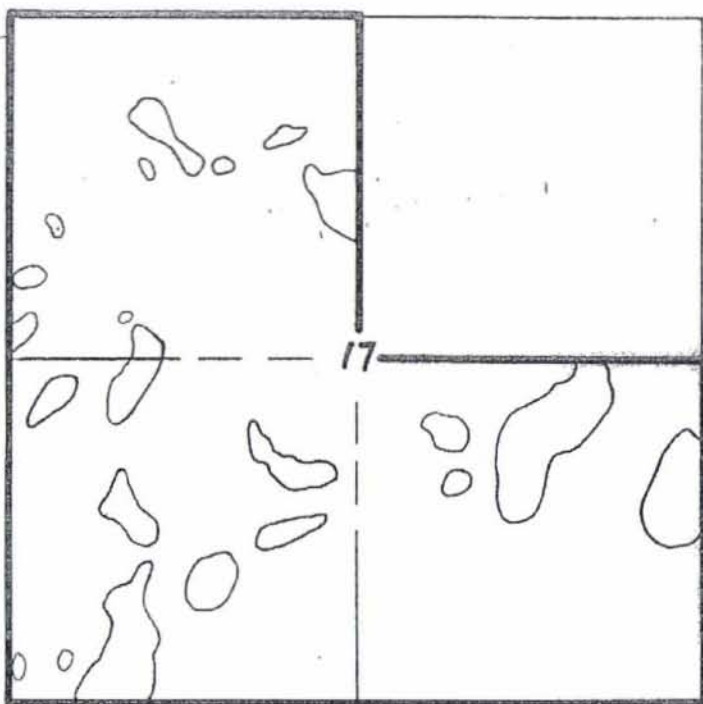
Revised: 4/5/2004

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TRACT 235X MAP 1 of 1
WATERFOWL PRODUCTION AREA Barnes COUNTY, STATE OF North Dakota
EASEMENT AUTHORIZED BY MIGRATORY BIRD HUNTING STAMP ACT OF MARCH 16, 1934, AS AMENDED.
T. 141 N., R. 57 W., 5th PRINCIPAL MERIDIAN

SECTION 17, NW1/4, S1/2



Scale: 4 Inches = 1 Mile

The U.S. Fish and Wildlife Service (Service) has purchased and owns perpetual rights which restrict or prohibit the right to drain, burn, level, and fill any wetland on the ownership represented by this map. This map represents the Service's effort to depict the approximate location of all protected wetlands based on information and maps available at the time this map was prepared. However, wetlands are hydrologically dynamic systems, with regularly expanding and contracting water levels. This map is not meant to depict water levels in the wetland in any given year. The Service reserves the right to correct this map provided the mapped acreage remains consistent with the Easement's Summary Acres.

LEGEND

— Boundary of Easement Description
Wetlands covered by provisions of the easement

Wetland deleted from easement by
Drainage Facility Map prepared
when the easement was purchased.

Prepared by: Jim F. Gahr Date: 4-27-06
Approved by: Ed Muenchinger Date: 4-27-06

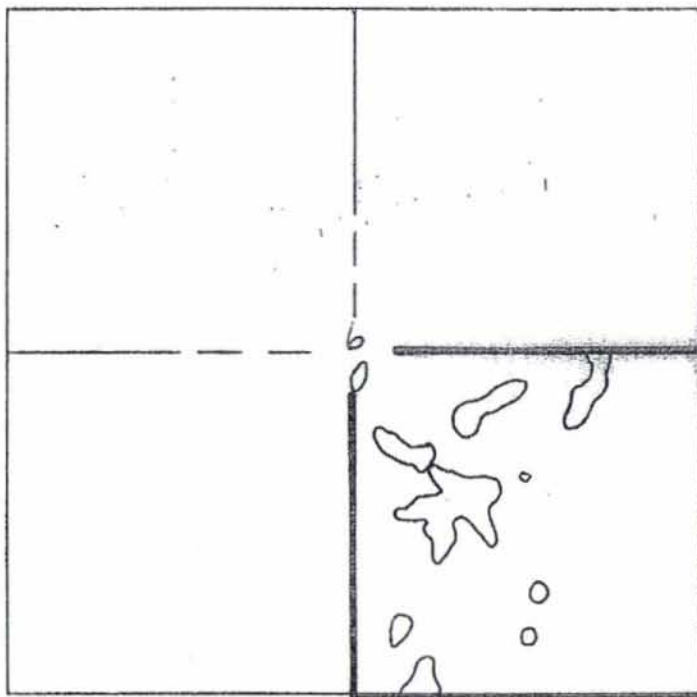
Revised: 4/5/2004

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UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE

TRACT 53X MAP 1 of 2
WATERFOWL PRODUCTION AREA Barnes COUNTY, STATE OF North Dakota
EASEMENT AUTHORIZED BY MIGRATORY BIRD HUNTING STAMP ACT OF MARCH 16, 1934, AS AMENDED.
T. 141 N., R. 57 W., 5th PRINCIPAL MERIDIAN

SECTION 6, SE1/4



Scale: 4 Inches = 1 Mile

The U.S. Fish and Wildlife Service (Service) has purchased and owns perpetual rights which restrict or prohibit the right to drain, burn, level, and fill any wetland on the ownership represented by this map. This map represents the Service's effort to depict the approximate location of all protected wetlands based on information and maps available at the time this map was prepared. However, wetlands are hydrologically dynamic systems, with regularly expanding and contracting water levels. This map is not meant to depict water levels in the wetland in any given year. The Service reserves the right to correct this map provided the mapped acreage remains consistent with the Easement's Summary Acres.

LEGEND

— Boundary of Easement Description
 Wetlands covered by provisions of the easement

 Wetland deleted from easement by
Drainage Facility Map prepared
when the easement was purchased.

Prepared by: Jim F. Goh Date: 4-26-06
Approved by: Ed Meandering Date: 4-26-06

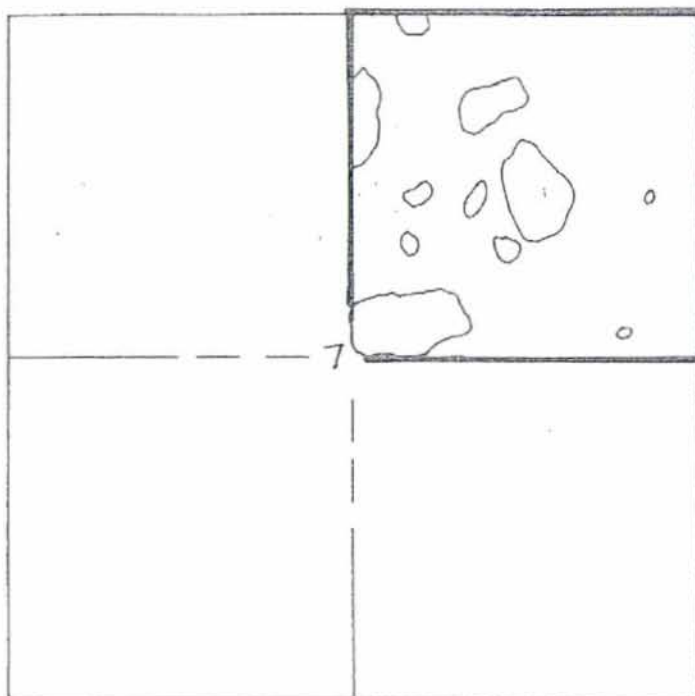
Revised: 4/5/2004

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TRACT 53X MAP 2 of 2
WATERFOWL PRODUCTION AREA Barnes COUNTY, STATE OF North Dakota
EASEMENT AUTHORIZED BY MIGRATORY BIRD HUNTING STAMP ACT OF MARCH 16, 1934, AS AMENDED.
T. 141 N., R. 57 W., 5th PRINCIPAL MERIDIAN

SECTION 7, NE1/4



Scale: 4 Inches = 1 Mile

The U.S. Fish and Wildlife Service (Service) has purchased and owns perpetual rights which restrict or prohibit the right to drain, burn, level, and fill any wetland on the ownership represented by this map. This map represents the Service's effort to depict the approximate location of all protected wetlands based on information and maps available at the time this map was prepared. However, wetlands are hydrologically dynamic systems, with regularly expanding and contracting water levels. This map is not meant to depict water levels in the wetland in any given year. The Service reserves the right to correct this map provided the mapped acreage remains consistent with the Easement's Summary Acres.

LEGEND

- Boundary of Easement Description
-  Wetlands covered by provisions of the easement
-  Wetland deleted from easement by Drainage Facility Map prepared when the easement was purchased.

Prepared by: Jim F. Gohn Date: 4-26-06

Approved by: Ed Mendenhall Date: 4-26-06

Revised: 4/5/2004

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Castle, Carla

From: Walsh, James
Sent: Thursday, February 01, 2007 3:29 PM
To: Edward_Meendering@fws.gov
Subject: RE: Keystone pipeline wetland mapping

Ed,

I just wanted to let you know that I received the wetland easement maps for Barnes and Steele counties that you mailed-out to me earlier this week. I greatly appreciate your help with this project.

Thanks again,
Randy

J. Randall Walsh
Ecologist
ENSR|AECOM
1601 Prospect Parkway
Fort Collins, CO 80525
office: (970) 493-8878 ext. 180
jwalsh@ensr.aecom.com

-----Original Message-----

From: Edward_Meendering@fws.gov [mailto:Edward_Meendering@fws.gov]
Sent: Monday, January 15, 2007 1:37 PM
To: Walsh, James
Subject: Re: Keystone pipeline wetland mapping

James:

I enjoyed meeting you at Devils Lake and appreciate your willingness in working with the U.S. Fish and Wildlife Service and our wetland easements. I mailed you a letter today with the maps that you requested which are complete. I should be able to have the remaining maps to you by the end of the month once they are completed. Please let me know if you have any questions or comments.

Thank you,
Ed

CONFIDENTIAL

Castle, Carla

From: Walsh, James
Sent: Monday, March 12, 2007 2:45 PM
To: thomas_tornow@fws.gov; dana.greene@keystone.trow.com
Subject: RE: Maps with centerline

Tom,

Thanks for the note and reminder. I am finally back in the office and will be coordinating the new map assembly over the next day or two. I am hopeful that I will have a new set of maps ready for FedEx to you by Thursday, so you can expect the new map book by early next week. I will e-mail you with an update once we complete the map production.

Randy

J. Randall Walsh
Ecologist
ENSR|AECOM
1601 Prospect Parkway
Fort Collins, CO 80525
office: (970) 493-8878 ext. 180
jwalsh@ensr.aecom.com

-----Original Message-----

From: thomas_tornow@fws.gov [mailto:thomas_tornow@fws.gov]
Sent: Thursday, March 08, 2007 10:47 AM
To: dana.greene@keystone.trow.com
Cc: Walsh, James
Subject: Maps with centerline

Randy and Dana,

I hope you made it home OK. Noel from our Huron office didn't make it home until Saturday afternoon. Colleen and Bryan are continuing with the mapping of easements that we know will be sure crossings. Send us your current map ASAP so we can meet your mapping needs. This will also be a good test on e-mail contact.

Tom Tornow
Madison WMD
U.S. Fish & Wildlife Service
605 256-2974
Thomas_Tornow@fws.gov



HDD Crossing Plan for the Missouri River at Yankton and NPS Meeting Minutes
March 2007

The Keystone pipeline proposes the HDD method of construction for crossing the Missouri River at Yankton, South Dakota. The Yankton crossing schematic is provided in this filing.

Keystone Project team representatives met with the National Park Service at Yankton, South Dakota on February 8th. The project team provided a brief update and overview of the Project and discussed the Missouri River HDD crossing plan at Yankton, SD. The meeting minutes are provided in this filing.

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Final

**National Park Service, Yankton, South Dakota
Wednesday, February 8, 9:30 – 11:00 AM**

Attendees:

Mike Koski (Trow)
Dana Green (UEI)
Scott Ellis (ENSR)
Tyler Cole (NPS, O'Neil NE)
Wayne Werkmeister (NPS, O'Neil NE)

Meeting Objectives

Keystone Project team representatives met with the National Park Service at Yankton, South Dakota to provide NPS with project updates, distribute and discuss the HDD crossing plan, and to discuss other issues or concerns that the NPS may have regarding the Project.

Meeting Overview/Summary

The project team provided a brief update and overview of the Project and began discussion on the Yankton HDD crossing.

During discussion, NPS requested a frac-out contingency plan for the Missouri River crossing. Mike Koski agreed to provide an example to NPS.

NPS asked whether geotechnical borehole information could be shared with USGS (is doing a study in the area) and Kaneb pipeline (to encourage Kaneb to drill the Missouri to replace the shallowly buried pipelines at the Yankton crossing). Separately, the City of Yankton directly requested that Keystone share the drilling data because they want to drill additional groundwater wells on the north side of the river. Mike Koski agreed to discuss sharing of information with TransCanada and will contact NPS and the City of Yankton with TransCanada's response.

The Dept. of State requested that the Coast Guard be contacted regarding the proposed Missouri River crossing. There are no major issues expected that would concern the Coast Guard because of the HDD crossing. NPS pointed out that there is a lot of boat recreational activity on the Missouri near the crossing point around July 4 and during Riverboat Days in late August. NPS (Wayne Werkmeister) will provide Mike Koski with the contact information for the Coast Guard representative located in Kansas City.

NPS recommended that Keystone contact the group that maintains the osprey hack site at the Yankton Paddlewheel Park to determine whether they intend to continue to use the hacking platform. There are potential seasonal conflicts with summer construction at that location.

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Action Items

Keystone will provide NPS with an example of a frac-out contingency plan for the Missouri River crossing within 2 weeks

Keystone will contact TransCanada to discuss geotechnical borehole information sharing with USGS and the Kaneb pipeline. Mike Koski will respond to NPS and City of Yankton within 30 days

NPS (Wayne Werkmeister) will provide the contact information for the Coast Guard representative in Kansas City. Keystone will contact the Coast Guard regarding the proposed Missouri River crossing

Keystone will contact the group that maintains the osprey hack site at the Yankton Paddlewheel Park. ENSR will follow up within 30 days

CONFIDENTIAL



Pipeline Risk Assessment and Environmental Consequence Analysis

March 2007

ENSR Corporation
March 2007
Document No.: 10623-004

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1.0 Project Overview

TransCanada Keystone Pipeline, L.P. (Keystone) proposes to construct and operate a crude oil pipeline and related facilities from Hardisty, Alberta, Canada, to Patoka, Illinois, in the United States (U.S.). The project, known as the Keystone Pipeline Project, initially will have the nominal capacity to deliver 435,000 barrels per day (bpd) of crude oil from an oil supply hub near Hardisty to existing terminals in Wood River and Patoka, Illinois. If market conditions warrant expansion in the future, additional pumping capacity could be added to increase the nominal average throughput to 591,000 bpd. Based on shipper interest, Keystone also is considering the construction of two pipeline extensions to take crude oil from terminals in Fort Saskatchewan, Alberta, and deliver to Cushing, Oklahoma.

In total, the Keystone Pipeline Project will consist of approximately 1,845 miles of pipeline, including about 767 miles in Canada and 1,078 miles within the U.S. (**Figure 1-1**). These distances will increase if the potential pipeline extension to Cushing, Oklahoma, is constructed as discussed below.

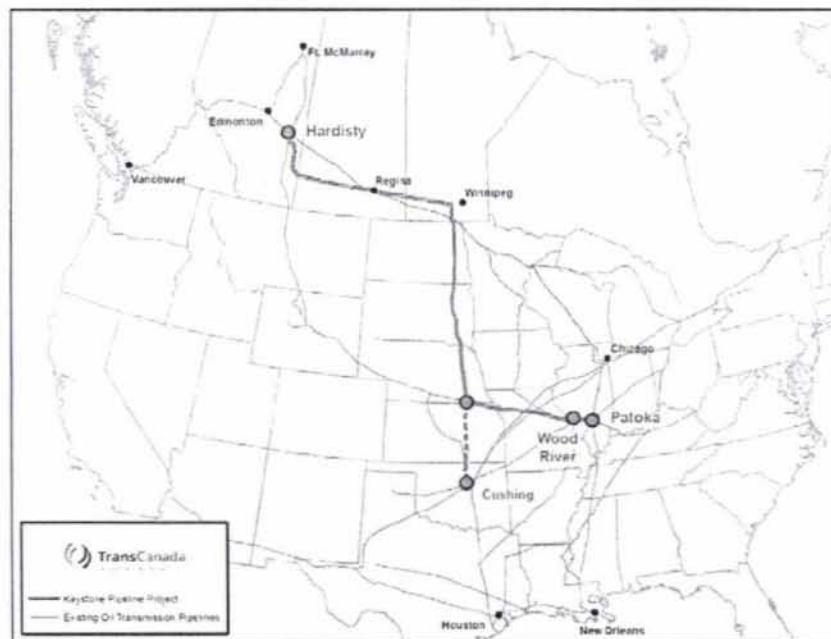


Figure 1-1 Overview Map of the Keystone Pipeline Project
(Potential Cushing Extension represented by the dotted line)

In the U.S., Keystone will construct and operate a new 1,078-mile pipeline (Keystone Mainline) that will transport crude oil from the Canadian border to existing terminals in the Midwest. The proposed pipeline will consist of 1,023 miles of 30-inch pipe between the Canadian border and Wood River, Illinois and a 55-mile segment of 24-inch pipeline between Wood River and Patoka, Illinois. Depending on the results of an additional binding Open Season held in early 2007, Keystone also may construct a 294-mile, 36-inch pipeline extension to Cushing, Oklahoma (Cushing Extension). Thus, there will be 1,372 total miles of new pipeline in the U.S. if the Cushing Extension is constructed. Unless specified, the remainder of this Risk Assessment describes and evaluates the U.S. portion of the Keystone Pipeline Project, including both the Keystone Mainline and Cushing Extension, and the additional facilities required to increase nominal capacity to 591,000 bpd.

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The Keystone Pipeline Project will require the issuance of a Presidential Permit by the U.S. Department of State (DOS) to cross the U.S./Canadian border. Issuance of the Presidential Permit is considered a federal action and is subject to environmental review pursuant to the National Environmental Policy Act (NEPA) (42 United States Code § 4321 et seq.). In conjunction with the NEPA analysis, a preliminary evaluation of spill risk, including the likelihood of an inadvertent release, the probable size of a release, and the potential impacts of an accidental release was submitted to the DOS on July 1, 2006 and updated in this report. This document represents the final spill, risk, and consequence evaluation for the NEPA analysis, based on updated HCA information and new information on commodity composition.

2.0 Introduction

This document represents Keystone's final evaluation of the risk of a pipeline disruption and its potential environmental consequences for NEPA analysis. This section focuses on the potential for spills during operations and the subsequent potential effects on sensitive resources and humans associated with major spills. Additional effects on public health and safety that could occur during project construction are discussed under other resource sections (e.g., air quality, water resources, transportation, land use, and aesthetics) within the Keystone Pipeline Project's Environmental Report (ER), which was submitted to the DOS on April 19, 2006. An updated ER was submitted on November 17, 2006, and updated ER tables were submitted January 26, 2007.

This report builds upon the baseline information presented in the July 10, 2006 submission to the DOS. The report presents the results of a pipeline oil spill frequency and spill analysis based on Keystone's design and operations criteria and applies the resulting risk probabilities to an environmental consequence analysis that incorporates project-specific environmental data. Specifically, this report evaluates the risk of crude oil spills during pipeline operations, including contribution of natural hazards to spill risk, and the subsequent potential effects on humans and other sensitive resources, called high consequence areas (HCAs), that include populated areas, drinking water areas, and/or ecologically sensitive areas.

3.0 Spill Frequency-Volume Study

An updated project-specific oil spill frequency and volume study for the Keystone Pipeline Project was conducted by DNV Consulting and is provided in Appendix A. DNV Consulting assessed the U.S. portion of the Keystone Pipeline in terms of frequency and volume of potential spills to quantify the likelihood of realistic maximum spill volumes. The study estimated the frequency and volume of releases for each defined pipeline segment for three postulated hole sizes and six distinct and independent failure causes and developed a frequency-volume curve for the pipeline as a whole.

The study is a quantitative assessment of spill potential for the entire pipeline system and of individual segments of the pipeline utilizing publicly available historical spill data collected from incident reports (Appendix A). The Keystone Pipeline system was partitioned into 1,720 segments (1,356 segments on the Keystone Mainline and 364 segments on the Cushing Extension) based on design, operational, terrain, and other potential risk parameters. Spill frequency was estimated for each segment along with potential spill volumes, based on small holes (0.06-inch diameter), medium holes (2-inch diameter), and large holes (10-inch-diameter). The study evaluated two throughput scenarios; a nominal throughput of 435,000 bpd and a maximum nominal throughput of 591,000 bpd. The two product types that will be transported, synthetic crude and diluted bitumen, were assessed. The simulation assumed the Cushing Extension would operate under 591,000 bpd and carry diluted bitumen.

3.1 Spill Frequency

Spill frequencies were estimated from publicly available historical data and modified by project-specific factors for the Keystone Pipeline system. Based on the available information, the study produced frequencies for spills ranging from 0.9 spills per 10 years (at a throughput of 435,000 bpd of synthetic crude oil over the Keystone Mainline) to a maximum frequency for spills of 1.5 spills per 10 years (for a throughput of 591,000 bpd of diluted bitumen over the entire pipeline system). These rates are equivalent to one spill every 11 or 7 years, respectively. **Table 3-1** shows the number of spills that might occur along the Keystone Pipeline system during the 10 years of service.

Table 3-1 Spill Occurrence Interval Associated with the Proposed Keystone Project over 10 Years

	Projected Number of Spills per 10 years ¹			
	Diluted Bitumen (350 cSt Crude) 435 bpd	Diluted Bitumen (350 cSt Crude) 591 bpd	Synthetic Crude 435 bpd	Synthetic Crude 591 bpd
Keystone Mainline (1,078 miles)	0.94	1.18	0.90	0.93
Cushing Extension (294 miles)	NA ²	0.32	NA ²	NA ²
Total Keystone Project (1,372 miles)	0.94	1.51	0.90	0.93

¹See Appendix A.

While future events cannot be known with absolute certainty, spill frequencies can be used to estimate the number of events that might occur. Actual frequency may differ from the predicted values of this analysis. Notably, with the implementation of U.S. Department of Transportation's (USDOT) Integrity Management Rule, the number of spills is expected to decline from historical levels observed on other pipelines. Incident frequencies have been steadily decreasing and are five times lower in recent years compared with thirty years ago (EGIG 2005).

3.2 Spill Volume

Estimated spill volumes were based on leak rate and time to isolate for throughputs of 435,000 and 591,000 bpd along the Keystone Pipeline system. The study currently assumes draindown within the affected segment. Actual incident data from the *Hazardous Liquid Pipeline Risk Assessment* (California State Fire Marshal [CSFM] 1993) indicate that spill volumes are significantly less than the potential draindown volume. For example, in 50 percent of the cases, the actual spill volume represented less than 0.75 percent of the maximum potential draindown volume. In 75 percent of the cases, the actual spill volume represented less than 4.6 percent of the maximum draindown volume. Procedures to reduce spill volume, such as by reducing draindown and depressurizing are not estimated or included in the analysis. If these procedures were included, it may significantly reduce the predicted spill volumes estimated for the Keystone Pipeline, bringing the spill volume distribution more in line with USDOT historical data.

Of the postulated maximum of 1.5 spills along the Keystone Pipeline system during a 10-year period, the project-specific spill and volume study's findings suggest that approximately 0.3 spills would be 50 barrels¹ or less; 0.5 spills would consist of between 50 and 1,000 barrels; 0.5 spills would consist of between 1,000 and 10,000 barrels; and 0.2 spills would contain more than 10,000 barrels (Appendix A).

This Pipeline Risk Assessment and Environmental Consequence Analysis report utilizes publicly available historical spill data collected from incident reports over a number of decades. However, these data are unsuitable to support a comparable risk analysis associated with spills smaller than 50 barrels, since the historical threshold for reportable spills was 50 barrels. This threshold was only recently reduced from 50 barrels to 5 gallons, effective February 2002. The results of the study are incorporated into the environmental consequence analysis presented in Section 4.0.

The most extensive database of pipeline spills less than 50 barrels is maintained by the State of California (CSFM 1993). Based on these historical data, the estimated occurrence intervals for a spill of 50 barrels or less occurring anywhere along the entire pipeline system is once every 9 years, a spill between 50 and 1,000 barrels might occur once in 38 years; a spill of 1,000 and 10,000 barrels might occur once in 89 years; and a spill containing more than 10,000 barrels might occur once in 625 years. Applying these statistics to a 1-mile section, the chances of a large spill (greater than 10,000 barrels) would be less than once every 857,000 years per mile.

Historically, large spills of 10,000 barrels or more are uncommon. In California, approximately 1 percent of the spills occurring between 1981 and 1990 resulted in 10,000 barrels or more, with the largest spill consisting of 31,000 barrels (CSMF 1993). These statistics are similar to nationwide incident rates. For crude oil pipelines, there were a total of 26 spills of greater than 10,000 barrels between 1986 to present, representing 1.3 percent of all crude oil spills. **Table 3-2** provides a summary of crude oil spills greater than 10,000 barrels. Since 1986, the greatest volume of crude oil spilled in the U.S. was 49,000 barrels.

Keystone has estimated the maximum spill volumes along the pipeline. The highest projected spill volume for any single segment was 40,600 barrels, while the median maximum spill volume for all segments of the Keystone Pipeline was 16,500 barrels. Again, the probability of a very large spill (>30,000 barrels) is under 0.1 percent. Consequently, this report grouped the risk of very large spills together with spills of over 20,000 barrels.

¹ A barrel of oil equals 42 gallons.

Table 3-2 Summary of Historic Crude Oil Pipeline Spills of 10,000 Barrels or Greater

Year	Volume (barrels)	
1986	10,020	
1986	12,500	
1986	14,000	
1986	18,000	
1988	20,554	
1988	23,534	
1988	10,000	
1989	12,000	
1989 ¹	31,300	
1990	20,027	
1990	12,000	
1991	40,500	
1991	28,200	
1995	30,000	
1997	11,206	
1998	12,884	
1998	17,806	
1998	32,903	
1999	10,500	
1999	15,007	
1999	10,205	
2000	11,644	
2005	25,435	
2005	23,614	
2005	10,380	
2006	49,000	
2006	15,000	
Total Number of Recorded Crude Oil Spills		1935
Spills >10,000 Barrels Crude Oil as Percent of Total Recorded Crude Oil Spills		1.4

¹Represents the largest spill reported in the California State Fire Marshal study (1993).

Note: Data represents information from the USDOT OPS Hazardous Liquid Accident Data databases (1986 to January 2002 and January 2002 to Present) (USDOT 2007).

4.0 Consequences of a Spill

4.1 Human Consequences

The risk associated with the Keystone Pipeline system can be compared with the general risk to the population encountered in everyday life. Proposed actions that result in negligible additional risk from any cause are generally acceptable. The National Center for Health Statistics (CDC 2003) overall average annual death rate for the general population in the U.S. is approximately 830 per 100,000. The USDOT reports the historical average risk to the general population per year associated with all hazardous liquids transmission pipelines, such as Keystone, is 0.004 in 100,000 (USDOT 2002). Therefore, the predicted risk of fatality to the public from incidents associated with the Keystone Pipeline over and above the normal U.S. death rate is negligible (<1 percent).

4.2 Environmental Consequences

The environmental risk posed by a crude oil pipeline is a function of 1) the probability of an accidental release, 2) the probability of a release reaching an environmental receptor (e.g., waterbody, fish), 3) the concentration of the contamination once it reaches the receptor, and 4) the hazard posed by that concentration of crude oil to the receptor. Based on spill probabilities and estimated spill volumes, this environmental assessment determines the probability of exposure to environmental receptors and the probable impacts based on a range of potential concentrations.

4.2.1 Environmental Fate of Crude Oil Spills

4.2.1.1 Crude Oil Composition

The composition of crude oil varies widely, depending on the source and processing. Crude oils are complex mixtures of hundreds of organic (and a few inorganic) compounds. These compounds differ in their solubility, toxicity, persistence, and other properties that profoundly affect their impact on the environment. The effects of a specific crude oil cannot be thoroughly understood without taking its composition into account.

Crude oil transported by the Keystone Pipeline Project is derived from the Alberta oil sands region. The oil extracted from the sands is called bitumen, which is highly viscous. In order for the bitumen to be transported by pipeline, it is either mixed with diluent and is transported as diluted bitumen or upgraded to synthetic crude oil. The precise composition of synthetic crude will vary by shipper and is considered proprietary information. For the purposes of this analysis, two product types of crude oil will be transported; synthetic crude and diluted bitumen. In general, the pipeline will contain batches of these two products and 10 percent of batches will be synthetic crude and 90 percent of batches will be diluted bitumen.

The primary classes of compounds found in crude oil are alkanes (hydrocarbon chains), cycloalkanes (hydrocarbons containing saturated carbon rings), and aromatics (hydrocarbons with unsaturated carbon rings). Most crude oils are more than 95 percent carbon and hydrogen, with small amounts of sulfur, nitrogen, oxygen, and traces of other elements. Crude oils contain lightweight straight-chained alkanes (e.g., hexane, heptane), cycloalkanes (e.g., cyclohexane), aromatics (e.g., benzene, toluene), cycloalkanes, and heavy aromatic hydrocarbons (e.g., polycyclic aromatic hydrocarbons [PAHs], asphaltines). Straight-chained alkanes are more easily degraded in the environment than branched alkanes. Cycloalkanes are extremely resistant to biodegradation. Aromatics (i.e., benzene, toluene, ethylbenzene, xylenes [BTEX compounds]) pose the most potential for environmental concern. Because of their lower molecular weight they are more soluble in water than alkanes and cycloalkanes.

4.2.1.2 Environmental Fate and Transport

Accidental releases of crude oil can occur during transport by pipeline. Once released into the terrestrial environment, the crude oil will pool in low-lying areas. Some lighter volatile constituents of the crude oil will evaporate into air, while other constituents will bind or leach into soils, or dissolve into water. Hydrocarbons that volatilize into the atmosphere are broken down by sunlight into smaller compounds. This process, referred to as photodegradation, occurs rapidly in air and the rate of photodegradation increases as molecular weight increases. If released onto soil, a portion of the crude oil will penetrate the soil as a result of the effects of gravity and capillary action. The rate of penetration will depend on the nature of the soil. Since crude oil is more viscous than water, crude oils penetrate soils less quickly. When released into water, a portion of the crude oil will tend to float to the surface where it can evaporate, other fractions will dissolve, and some material may descend to the bottom as sedimentation.

The spread of crude oil across water increases with wind and current speed and increasing temperature. Most crude oils spread across surface waters at a rate of 100 to 300 meters per hour. Surface ice will greatly reduce the spreading rate of oil across a waterbody. Spreading reduces the bulk quantity of crude oil present in the vicinity of the spill but increases the spatial area within which adverse effects may occur. Thus crude oil in flowing, as opposed to contained, waterbodies will be less concentrated in any given location, but may cause impacts, albeit reduced in intensity, over a much larger area. Spreading and thinning of spilled crude oil also increases the surface area of the slick, thus enhancing surface dependent fate processes such as evaporation, degradation, and dissolution.

Dispersion of crude oil increases with increasing surface turbulence. The dispersion of crude oil into water may serve to increase the surface area of crude oil susceptible to dissolution and degradation processes and thereby limit the potential for physical impacts.

Evaporation will be the primary mechanism of loss for low molecular weight constituents and light oil products. As lighter components evaporate, remaining crude oil becomes denser and more viscous. Evaporation thus tends to reduce crude oil toxicity but enhances crude oil persistence. Bulk evaporation of Alberta crude oil accounted for an almost 50 percent reduction in volume over a 12-day period (Shiu et al. 1988). Evaporation increases with increased spreading of a slick, increased temperature, and increased wind and wave action.

Dissolution of crude oil in water is not a significant process controlling the crude oil's fate in the environment, since most components of oils are relatively insoluble (Neff and Anderson 1981). Moreover, overall solubility of crude oils tend to be less than their constituents since solubility is limited to the partitioning between oil and water interface and individual compounds are often more soluble in oil than in water, thus they tend to remain in the oil. Nevertheless, dissolution is one of the primary processes affecting the toxic effects of a spill, especially in confined waterbodies. Dissolution increases with decreasing molecular weight, increasing temperature, decreasing salinity, and increasing concentrations of dissolved organic matter. Greater photodegradation also tends to enhance the solubility of crude oil in water.

Heavy molecular weight hydrocarbons will bind to suspended particulates, and this process can be significant in highly turbid or eutrophic waters. Organic particles (e.g., biogenic material) tend to be more effective at sorbing oils than inorganic particles (e.g., clays). Sorption processes and sedimentation reduce the quantity of heavy hydrocarbons present in the water column and available to aquatic organisms. However, these processes also render hydrocarbons less susceptible to degradation. Sedimented oil tends to be highly persistent and can cause shoreline impacts.

Photodegradation of crude oil increases with greater solar intensity. It can be a significant factor controlling the disappearance of a slick, especially of lighter oil constituents; but it will be less important during cloudy days and winter months. Photodegraded crude oil constituents tend to be more soluble and more toxic than parent compounds. Extensive photodegradation, like dissolution, may thus increase the biological impacts of a spill event.

In the immediate aftermath of a crude oil spill, natural biodegradation of crude oil will not tend to be a significant process controlling the fate of spilled crude oil in waterbodies previously unexposed to oil. Microbial populations must become established before biodegradation can proceed at any appreciable rate. Also, prior to weathering (i.e., evaporation and dissolution of light-end constituents), oils may be toxic to the very organisms responsible for biodegradation and high molecular weight constituents tend to be resistant to biodegradation. Biodegradation is nutrient and oxygen demanding and may be precluded in nutrient-poor aquatic systems. It also may deplete oxygen reserves in closed waterbodies, causing adverse secondary effects to aquatic organisms.

With time, however, microorganisms capable of consuming crude oil generally increase in number and the biodegradation process naturally remediates the previously contaminated soil. The biodegradation process is enhanced as the surface area of spilled oil increases (e.g., by dispersion or spreading). Biodegradation has been shown to be an effective method of remediating soils and sediments contaminated by crude oil.

Overall, the environmental fate of released crude oil is controlled by many confounding factors and persistence is difficult to predict with great accuracy. Major factors affecting the environmental fate include spill volume, type of crude oil, dispersal rate of the crude oil, terrain, receiving media, and weather. Once released, the physical environment largely dictates the environmental persistence of the spilled material. Along the Keystone Pipeline route, the primary habitats of concern include low gradient streams, rivers, and small intermittent ponds. Wetlands also occur along the proposed pipeline route. Estimates of the length of time materials could persist at potentially acute concentrations vary depending on the size of spill and environmental conditions. In warm summer months, the acutely toxic volatile component of crude oil will evaporate quickly, and a relatively small release into a high gradient stream would be expected to rapidly dissipate. In contrast, crude oil released into a small stream in winter could become trapped under pockets of ice and, thus persist longer.

4.2.2 Environmental Impacts

An evaluation of the potential impacts resulting from the accidental release of crude oil into the environment is discussed by environmental resource below.

4.2.2.1 Soils

Because pipelines are buried, soil absorption of spilled crude oil could occur, thus impacting the soils. Subsurface releases to soil tend to disperse slowly and are generally located within a contiguous and discrete area. Effects to soils can be quite slow to develop, allowing time for emergency response and cleanup actions to mitigate effects to potential receptors.

In the event of a spill, a portion of the released materials would enter the surrounding soil and disperse both vertically and horizontally in the soil. The extent of dispersal would depend on a number of factors, including size and rate of release, topography of the release site, vegetative cover, soil moisture, bulk density and soil porosity. High rates of release from the buried pipeline would result in a greater likelihood that released materials would reach the ground surface.

The majority of crude oil from an underground pipeline spill would likely reside in the less consolidated soil (lower soil bulk density) within the pipeline trench. If a release were to occur in sandy soils found throughout the Keystone pipeline or badland areas, it is likely that the horizontal and vertical extent of the contamination would be greater than in areas containing more organic soils. Crude oil released into sandy or badland soils would likely become visible to aerial surveillance due to product on the soils surface or discoloration of vegetation. If present, soil moisture and moisture from precipitation would increase the dispersion and migration of crude oil.

The vast majority of the Keystone pipeline is located in relatively flat terrain. In these flat locations, the oil would disperse horizontally within the pipeline trench with a smaller portion of the spilled oil moving into the

surrounding, more consolidated soil. If the spill were to occur on a steep slope, crude oil would likely pool primarily within the trench behind any trench breakers. If sufficient volume existed, the crude oil would breach the soil's surface as it extended over the top of the trench breaker. Once on the soil's surface, the release would be more apparent to leak surveillance patrols.

Both on the surface and in the subsurface, rapid attenuation of light, volatile constituents (due to volatilization) would quickly reduce the total volume of product, while heavier constituents would be more persistent. Except in cases of high rate and high total volume releases, and environmental settings characterized by steep topography or karst terrain, soil impacts would be confined to a relatively small, contiguous, and easily defined area. This would facilitate cleanup and remediation. Within a relatively short time, lateral migration would generally stabilize and downward vertical migration could begin to occur.

Keystone would be responsible for cleanup of contaminated soils. Once remedial cleanup levels were achieved in the soils, no adverse or long-term impacts would be expected.

The maximum volume of soil that would need to be removed was estimated for a conservative spill volume of 2,000 barrels (over 80 percent of historical spills from modern pipelines are smaller than this volume [OPS 2007]). The volume of soil requiring removal ranged from 2,100 to 2,000,000 cubic yards. Soil cleanup levels for benzene from petroleum releases vary by state (Nebraska: 3.63 parts per million [ppm]; Illinois: 1.6 ppm; South Dakota: 17 ppm; Kansas 9.8 ppm). The highest volume was calculated assuming uniform distribution of oil and removal to achieve the most stringent state recommended soil cleanup level (RCL) for benzene (1.6 ppm). The lowest volume estimated assumes the same 2,000 barrel release but calculates the volume of soil based on an estimated 30 percent soil porosity and a 10 percent soil moisture content. The actual remediation soil volume would likely be intermediate to these values, though closer to the lowest volume estimate.

These estimates are gross estimations. Release dynamics such as leak rate, leak duration, and effects of isolation controls would result in different surface spreading and infiltration rates, which in turn, affect the final volume of affected soil to be remediated.

4.2.2.2 Vegetation and Soil Ecosystems

Crude oil released to the soil's surface could potentially produce localized effects on plant populations. Terrestrial plants are much less sensitive to crude oil than aquatic species. The lowest toxicity threshold for terrestrial plants found in the USEPA ECOTOX database (USEPA 2001) was 18.2 ppm for benzene, higher than the 7.4 ppm threshold for aquatic species and the 0.005 ppm threshold for human drinking water. Similarly, available data from the USEPA database indicate that earthworms also are less sensitive than aquatic species (toxicity threshold was greater than 1,000 ppm). If concentrations were sufficiently high, crude oil in the root zone could harm individual plants and organisms.

Release of crude oil could result in the contamination of soils (see Soils, Section 4.2.2.1 above). Keystone would be responsible for cleanup of contaminated soils. Once remedial cleanup levels were achieved in the soils, no adverse or long-term impacts to vegetation would be expected.

4.2.2.3 Wildlife

Spilled crude oil can affect organisms directly and indirectly. Direct effects include physical processes, such as oiling of feathers and fur, and toxicological effects, which can cause sickness or death. Indirect effects are less conspicuous and include habitat impacts, nutrient cycling disruptions, and alterations in ecosystem relationships. The magnitude of effects varies with multiple factors, the most significant of which include the amount of material released, the size of the spill dispersal area, the type of crude oil spilled, the species assemblage present, climate, and the spill response tactics employed.

Wildlife, especially birds and shoreline mammals, are typically among the most visibly affected organisms in any crude oil spill. Effects of crude oil can be differentiated into physical (mechanical) and toxicological (chemical) effects. Physical effects result from the actual coating of animals with crude oil, causing reductions in thermal insulative capacity and buoyancy of plumage (feathers) and pelage (fur).

Crude oil released to the environment may cause adverse biological effects on birds and mammals via inhalation or ingestion exposure. Ingestion of crude oil may occur when animals consume oil-contaminated food, drink oil-contaminated water, or orally consume crude oil during preening and grooming behaviors.

Potential adverse effects could result from direct acute exposure. Acute toxic effects include drying of the skin, irritation of mucous membranes, diarrhea, narcotic effects, and possible death. While releases of crude oil may have an immediate and direct effect on wildlife populations, the potential for physical and toxicological effects attenuates with time as the volume of material diminishes, leaving behind more persistent, less volatile, and less water-soluble compounds. Although many of these remaining compounds are toxic and potentially carcinogenic, they do not readily disperse in the environment and their bioavailability is low, and therefore, the potential for impacts is low.

Unlike aquatic organisms that frequently cannot avoid spills in their habitats, the behavioral responses of terrestrial wildlife may help reduce potential adverse effects. Many birds and mammals are mobile and generally will avoid oil-impacted areas and contaminated food (Sharp 1990; Stubblefield et al. 1995). In a few cases, such as cave-dwelling species, organisms that are obligate users of contaminated habitat may be exposed. However, most terrestrial species have alternative, unimpacted habitat available, as will often be the case with localized spills (in contrast to large-scale oil spills in marine systems), therefore, mortality of these species would be limited (Stubblefield et al. 1995).

Indirect environmental effects of spills can include reduction of suitable habitat or food supply. Primary producers (e.g., algae and plants) may experience an initial decrease in primary productivity due to physical effects and acute toxicity of the spill. However, these effects tend to be short-lived and a decreased food supply is not considered to be a major chronic stressor to herbivorous organisms after a spill. If mortality occurs to local invertebrate and wildlife populations, the ability of the population to recover will depend upon the size of the impact area and the ability of surrounding populations to repopulate the area.

4.2.2.4 Water Resources

Crude oil could be released to water resources if the pipeline is breached or leaks occur. As part of project planning and in recognition of the environmental sensitivity of waterbodies, the Keystone Pipeline routing process attempted to minimize the number waterbodies crossed, including groundwater aquifers. Furthermore, valves have been strategically located along the Keystone Pipeline to help reduce the amount of crude oil that could potentially spill into waterbodies, if such an event were to occur. The location of valves, spill containment measures, and implementing actions in the Keystone Emergency Response Plan would mitigate adverse effects to both surface and groundwater.

Groundwater

Multiple groundwater aquifers underlie the proposed Keystone Pipeline system. Vulnerability of these aquifers is a function of the depth to groundwater and the permeability of the overlying soils. While routine operation of the Keystone Pipeline would not affect groundwater, there is the possibility that a release could migrate through the overlying surface materials and enter a groundwater system.

In general, the potential for groundwater contamination following a spill would be more probable in locations where a release into or on the surface of soils has occurred:

- Where a relatively shallow water table is present (as opposed to locations where a deeper, confined aquifer system is present);
- Where relatively porous soil conditions are present throughout the unsaturated zone; and
- Where, in cooperation with federal and state agencies, the USDOT has identified groundwater resources that are particularly vulnerable to contamination. These resources are designated as HCAs (Section 4.3.2).

Depending on soil properties, the depth to groundwater, and the amount of crude oil in the unsaturated zone, groundwater contamination can result from the migration of dissolved constituents and free crude oil. Movement in the dissolved phase typically extends for greater distances than movement of pure crude oil in the subsurface. Crude oil is less dense than water and initially would tend to form a floating pool after reaching the groundwater surface. This pool would tend to migrate laterally in the direction of groundwater flow, and the oil flow velocity would be a function of the soil properties and groundwater flow rate. Those compounds in the crude oil that are soluble in water will form a larger, dissolved "plume." This plume also would tend to migrate laterally in the direction of groundwater flow. The flow velocity of dissolved constituents also would be a function of the groundwater flow rate and would tend to migrate at a faster rate than free crude oil itself.

The extent to which groundwater may be contaminated by a release of crude oil depends upon the rate of contaminant transport in the subsurface. The rate of contaminant movement depends, in turn, on the rate of groundwater movement and the attenuation mechanisms that act to retard contaminant movement. In shallow aquifer systems where impacts from released crude oil are most likely, the rate of groundwater movement depends upon the hydraulic gradient, aquifer permeability and porosity, and the geometry of the aquifer system. Groundwater flow rates typically move less than 1 foot per year, though there can be much more rapid movement in individual locations (Wilson 1986). Individual constituents tend to move faster than the groundwater itself; however, contamination often takes years to decades to disperse one mile from the point of origin (Wilson 1986).

If exposure to humans or other important resources would be possible from a release into groundwater, then regulatory standards, such as drinking water criteria (maximum contaminant levels [MCL]) would mandate the scope of remedial actions, timeframe for remediation activities, and cleanup levels. The promulgated drinking water standards for humans vary by several orders of magnitude for crude oil constituents. For human health protection, the national MCL is an enforceable standard established by the U.S. Environmental Protection Agency (USEPA) and is designed to protect long-term human health. Of the various crude oil constituents, benzene has the lowest national MCL at 0.005 ppm² and, therefore, it was used to evaluate impacts on drinking water supplies, whether from surface waters or groundwaters.

However, response and remediation efforts have the potential for appreciable adverse effects from construction/cleanup equipment. If no active remediation activities were undertaken, natural biodegradation and attenuation would ultimately allow a return to preexisting conditions in both soil and groundwater. Depending on the amount of crude oil reaching the groundwater and natural attenuation rates, this would likely require up to tens of years. Keystone will utilize the most appropriate cleanup procedure as determined in cooperation with the applicable federal and state agencies.

Attenuation mechanisms that retard the movement of contaminants include dispersion, sorption, volatilization, abiotic chemical degradation, and biological degradation. The extent to which any of these mechanisms would retard contaminant movement at a given location depends upon site-specific conditions. In general, crude oil in groundwater tends to biodegrade as described for soil releases. Even in the case of large released volumes and floating free crude oil, dispersive forces become balanced with biodegradation and attenuation

² All affected states along the Keystone Pipeline route use the national MCL value of 0.005 ppm.

mechanisms, establishing degradation equilibrium. The typical result is a relatively limited zone of impact, typically 200 meters or less downgradient (USGS 1998). Over time, these natural degradation mechanisms, along with other natural attenuation mechanisms, including dispersion, result in the removal and/or destruction of crude oil materials; both in groundwater, and in overlying impacted soils. Observed degradation rates indicate this process would typically occur in timeframes measured in tens of years, depending on the concentration of crude oil in the groundwater.

Flowing Surface Waters

The USDOT, in cooperation with federal and state agencies, has identified surface water resources that are particularly vulnerable to contamination. These surface water resources are designated as HCAs (Section 4.3.2). Broadly, this report evaluated impacts to downstream drinking water sources by comparing projected surface water benzene concentrations with the national MCL for benzene. Rather than evaluate the risk to each waterbody crossed by the Keystone Pipeline, this risk assessment evaluated categories of streams, based on the magnitude of streamflow and stream width. **Table 4-1** summarizes the stream categories used for the assessment and identifies several representative streams within these categories.

Table 4-1 Stream Categories

	Streamflow (cubic feet per second; cfs)	Stream Width (feet)	Representative Streams
Low Flow Stream	10 – 100	<50	Shell Creek, Mill Creek
Lower Moderate Flow Stream	100 – 1,000	50 – 500	Pembina Creek, James River, Sheyenne River, Cuiivre River
Upper Moderate Flow Stream	1,000 – 10,000	500 – 1,000	Platte River, Chariton River, Missouri River
High Flow Stream	>10,000	1,000 – 2,500	Mississippi River

It was conservatively assumed that the entire volume of a spill was released directly into a waterbody and that complete, instantaneous mixing occurred. A 1-hour release period for the entire spill volume was assumed in order to maximize the product concentration in water. The estimated benzene concentrations were then compared with the human health drinking water MCL for benzene (**Tables 4-2 through 4-5**). Results suggest that most spills that enter a waterbody could result in exceedence of the national MCL for benzene. Although the assumptions used are highly conservative and, thus, overestimate potential benzene water concentrations, the results emphasize the need for rapid notification of managers of municipal water intakes downstream of a spill so that any potentially affected drinking water intakes could be closed to bypass river water containing crude oil.

In addition to evaluating a spill to generic flowing water, the potential for impacts to any specific waterbody were also evaluated. To do this, the occurrence interval for a spill at any one representative stream within one of the four stream categories was calculated based on spill probabilities generated from the USDOT database. To be conservative, a 500-foot buffer on either side of the river was added to the crossing widths identified in **Table 4-1**. The occurrence intervals shown on **Tables 4-2 through 4-5** indicate the chance of a spill occurring at any specific waterbody is very low. Depending on throughput and transported material, occurrence intervals for a spill at any representative stream within any of the stream categories ranged from about 250,000 years for a large waterbody to over 6,800,000 years for a small waterbody (less likely to occur in any single small waterbody than any single large waterbody). If any release did occur, it is likely that the total

Table 4-2 Comparison of Estimated Benzene Concentrations from 435,000 bpd Throughput Diluted Bitumen (350cSt Crude Oil) Release with the Benzene MCL

Throughput 435,000 bpd	Benzene MCL (ppm)	Stream Flow Rate (cfs)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	0.005	10	11	5,905,509	217	1,344,412	2175	1,877,913	4349	5,218,915
Lower Moderate Flow Stream	0.005	100	1	4,133,856	22	941,089	217	1,314,539	435	3,653,240
Upper Moderate Flow Stream	0.005	1,000	0.1	3,100,392	2.2	705,816	22	985,904	43	2,739,930
High Flow Stream	0.005	10,000	0.01	1,771,623	0.2	403,324	2.2	563,374	4.3	1,565,674

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport diluted bitumen (350 cSt crude oil) 90% of the time for the purposes of this analysis.
- Estimated concentration is based on release of benzene into water over a 1-hour period with uniform mixing conditions.
- Concentrations are based on a 0.15 percent by weight benzene content of the transported material.
- Shading indicates estimated benzene concentrations that could exceed the benzene MCL of 0.005 ppm.
- Occurrence intervals are based on an overall predicted incident frequency of 0.094 spills/year for 435,000 bpd along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-3 Comparison of Estimated Benzene Concentrations from 435,000 bpd Throughput Synthetic Crude Release with the Benzene MCL

Throughput – 435,000 bpd	Benzene MCL (ppm)	Stream Flow Rate (cfs)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	0.005	10	1	6,842,909	27	1,403,496	269	2,089,507	538	6,648,130
Lower Moderate Flow Stream	0.005	100	0.1	4,790,037	2.7	982,447	27	1,462,655	54	4,653,691
Upper Moderate Flow Stream	0.005	1,000	0.01	3,592,527	0.3	736,835	3	1,096,991	5.4	3,490,268
High Flow Stream	0.005	10,000	0.001	2,052,873	0.03	421,049	0.3	626,852	0.5	1,994,439

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.
- Estimated concentration is based on release of benzene into water over a 1-hour period with uniform mixing conditions.
- Concentrations are based on a 0.02 percent by weight benzene content of the transported material.
- Shading indicates estimated benzene concentrations that could exceed the MCL of 0.005 ppm.
- Occurrence intervals are based on an overall predicted incident frequency of 0.090 spills/year for 435,000 bpd along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-4 Comparison of Estimated Benzene Concentrations from 591,000 bpd Throughput Diluted Bitumen (350cSt Crude Oil) Release with the Benzene MCL

Throughput – 591,000 bpd	Benzene MCL (ppm)	Stream Flow Rate (cfs)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	0.005	10	11	1,494,147	217	857,465	2175	954,506	4349	2,402,322
Lower Moderate Flow Stream	0.005	100	1	1,045,903	22	600,226	217	668,154	435	1,681,625
Upper Moderate Flow Stream	0.005	1,000	0.1	784,427	2.2	450,169	22	501,116	43	1,261,217
High Flow Stream	0.005	10,000	0.01	448,244	0.2	257,240	2.2	286,352	4.3	720,697

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone pipeline is estimated to transport diluted bitumen (350 cSt crude oil) 90% of the time for the purposes of this analysis.

-Estimated concentration is based on release of benzene into water over a 1-hour period with uniform mixing conditions.

-Concentrations are based on a 0.15 percent by weight benzene content of the transported material.

-Shading indicates estimated benzene concentrations that could exceed the MCL of 0.005 ppm.

-Occurrence intervals are based on an overall predicted incident frequency of 0.151 spills/year for 591,000 bpd along the entire Keystone Pipeline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-5 Comparison of Estimated Benzene Concentrations from 591,000 bpd Throughput Synthetic Crude Release with the Benzene MCL (the Occurrence Interval)

Throughput – 591,000 bpd	Benzene MCL (ppm)	Stream Flow Rate (cfs)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	0.005	10	1	6,094,152	27	1,358,541	269	1,927,825	538	5,442,000
Lower Moderate Flow Stream	0.005	100	0.1	4,265,906	2.7	950,979	27	1,349,478	54	3,809,400
Upper Moderate Flow Stream	0.005	1,000	0.01	3,199,430	0.3	713,234	2.7	1,012,108	5	2,857,050
High Flow Stream	0.005	10,000	0.001	1,828,246	0.03	417,562	0.3	578,348	0.5	1,632,600

Notes:

-Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.

-The Keystone pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.

-Estimated concentration is based on release of benzene into water over a 1-hour period with uniform mixing conditions.

-Concentrations are based on a 0.02 percent by weight benzene content of the transported material.

-Shading indicates estimated benzene concentrations that could exceed the MCL of 0.005 ppm.

-Occurrence intervals are based on an overall predicted incident frequency of 0.093 spills/year for 591,000 bpd along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

release volume of a spill likely would be 50 barrels or less based on historical spill volumes, or less than 10,000 barrels based on the spill volume study (Appendix A).

In summary, while a release of crude oil directly into any given waterbody would likely cause an exceedance of drinking water standards, the frequency of such an event would be low. Nevertheless, streams and rivers with downstream drinking water intakes represent sensitive environmental resources and could be temporarily impacted by a crude oil release. The Emergency Response Plan contains provisions for protecting and mitigating potential impacts to drinking water.

Aquatic Organisms

The concentration of crude oil constituents in an actual spill would vary both temporally and spatially in surface water, however, localized toxicity could occur from virtually any size of crude oil spill. **Table 4-6** summarizes the acute toxicity values (USEPA AQUIRE database 2000) of various crude oil hydrocarbons to a broad range of freshwater species. Acute toxicity refers to the death or complete immobility of an organism within a short period of exposure. The LC_{50} is the concentration of a compound necessary to cause 50 percent mortality in laboratory test organisms. For aquatic biota, most acute LC_{50} s for monoaromatics range between 10 and 100 ppm. LC_{50} s for the polyaromatic naphthalene were generally between 1 and 10 ppm, while LC_{50} values for anthracene were generally less than 1 ppm.

Table 4-6 shows fish are among the most sensitive aquatic biota, while aquatic invertebrates generally have intermediate sensitivities, and algae and bacteria tend to be the least sensitive. Nevertheless, even when major fish kills have occurred as a result of oil spills, population recovery has been observed, and long-term changes in fish abundance have not been reported. Benthic (bottom-dwelling) aquatic invertebrates tend to be more sensitive than algae, but are equally or less sensitive than fish. Planktonic (floating) species tend to be more sensitive than most benthic insects, crustaceans, and molluscs.

In aquatic environments, toxicity is a function of the concentration of a compound necessary to cause toxic effects combined with the compound's water solubility. For example, a compound may be highly toxic, but if it is not very soluble in water then its toxicity to aquatic biota is relatively low. The toxicity of crude oil is dependent of the toxicity of its constituents. As an example, **Table 4-7** summarizes the toxicity of various crude oil hydrocarbons to the zooplankton, *Daphnia magna*. The relative toxicity of decane is much lower than for benzene or ethylbenzene because of the comparatively low solubility of decane. Most investigators have concluded that the acute toxicity of crude oil is related to the concentrations of relatively lightweight aromatic constituents, particularly benzene.

While lightweight aromatics such as benzene tend to be water soluble and relatively toxic, they also are highly volatile. Thus, most or all of the lightweight hydrocarbons accidentally released into the environment evaporate, and the environmental persistence of crude oil tends to be low. High molecular weight aromatic compounds, including PAHs, are not very water-soluble and have a high affinity for organic material. Consequently, these compounds, if present, have limited bioavailability, which render them substantially less toxic than more water-soluble compounds (Neff 1979). Additionally, these compounds generally do not accumulate to any great extent because these compounds are rapidly metabolized (Lawrence and Weber 1984; West et al. 1984). There are some indications, however, that prolonged exposure to elevated concentrations of these compounds may result in a higher incidence of growth abnormalities and hyperplastic diseases in aquatic organisms (Couch and Harshbarger 1985).

Significantly, some constituents in crude oil may have greater environmental persistence than lightweight compounds (e.g., benzene), but their limited bioavailability renders them substantially less toxic than other more soluble compounds. For example, aromatics with four or more rings are not acutely toxic at their limits of solubility (Muller 1987). Based on the combination of toxicity, solubility, and bioavailability, benzene was determined to drive toxicity associated with potential crude oil spills.

Table 4-6 Acute Toxicity of Aromatic Hydrocarbons to Freshwater Organisms

Species	Toxicity Values (ppm)				
	Benzene	Toluene	Xylene	Naphthalene	Anthracene
Carp (<i>Cyprinus carpio</i>)	40.4	---	780	---	---
Channel catfish (<i>Ictalurus</i>)	---	240	---	---	---
Clarias catfish (<i>Clarias</i> sp.)	425	26	---	---	---
Coho salmon (<i>Oncorhynchus kisutch</i>)	100	---	---	2.6	---
Fathead minnow (<i>Pimephales</i>)	---	36	25	4.9	25
Goldfish (<i>Carassius auratus</i>)	34.4	23	24	---	---
Guppy (<i>Poecilia reticulata</i>)	56.8	41	---	---	---
Largemouth bass (<i>Micropterus</i>)	---	---	---	0.59	---
Medaka (<i>Oryzias</i> sp.)	82.3	54	---	---	---
Mosquitofish (<i>Gambusia affinis</i>)	---	1,200	---	150	---
Rainbow trout (<i>Oncorhynchus mykiss</i>)	7.4	8.9	8.2	3.4	---
Zebrafish (<i>Therapon iarbua</i>)	---	25	20	---	---
Rotifer (<i>Brachionus calyciflorus</i>)	>1,000	110	250	---	---
Midge (<i>Chironomus attenuatus</i>)	---	---	---	15	---
Midge (<i>Chironomus tentans</i>)	---	---	---	2.8	---
Zooplankton (<i>Daphnia magna</i>)	30	41	---	6.3	0.43
Zooplankton (<i>Daphnia pulex</i>)	111	---	---	9.2	---
Zooplankton (<i>Diaptomus forbesi</i>)	---	450	100	68	---
Amphipod (<i>Gammarus lacustris</i>)	---	---	0.35	---	---
Amphipod (<i>Gammarus minus</i>)	---	---	---	3.9	---
Snail (<i>Physa gyrina</i>)	---	---	---	5.0	---
Insect (<i>Somatochloa cingulata</i>)	---	---	---	1.0	---
<i>Chlorella vulgaris</i>	---	230	---	25	---
<i>Microcystis aeruginosa</i>	---	---	---	0.85	---
<i>Nitzschia palea</i>	---	---	---	2.8	---
<i>Scenedesmus subspicatus</i>	---	130	---	---	---
<i>Selenastrum capricornutum</i>	70	25	72	7.5	---

¹Indicates no value was available in the database.

Note: Data summarize conventional acute toxicity endpoints from USEPA's ECOTOX database. When several results were available for a given species, the geometric mean of the reported LC50 values was calculated.

Table 4-7 Acute Toxicity of Crude Oil Hydrocarbons to *Daphnia magna*

Compound	48-hr LC ₅₀ (ppm)	Optimum Solubility (ppm)	Relative Toxicity
Hexane	3.9	9.5	2.4
Octane	0.37	0.66	1.8
Decane	0.028	0.052	1.9
Cyclohexane	3.8	55	14.5
methyl cyclohexane	1.5	14	9.3
Benzene	9.2	1,800	195.6
Toluene	11.5	515	44.8
Ethylbenzene	2.1	152	72.4
p-xylene	8.5	185	21.8
m-xylene	9.6	162	16.9
o-xylene	3.2	175	54.7
1,2,4-trimethylbenzene	3.6	57	15.8
1,3,5-trimethylbenzene	6	97	16.2
Cumene	0.6	50	83.3
1,2,4,5-tetramethylbenzene	0.47	3.5	7.4
1-methylnaphthalene	1.4	28	20.0
2-methylnaphthalene	1.8	32	17.8
Biphenyl	3.1	21	6.8
Phenanthrene	1.2	6.6	5.5
Anthracene	3	5.9	2.0
9-methylantracene	0.44	0.88	2.0
Pyrene	1.8	2.8	1.6

Note: The LC₅₀ is the concentration of a compound necessary to cause 50 percent mortality in laboratory test organisms within a predetermined time period (e.g., 48 hours) (USEPA 2000).

Relative toxicity = optimum solubility/LC₅₀.

Table 4-8 summarizes chronic toxicity values (most frequently measured as reduced reproduction, growth, or weight) of benzene to freshwater biota. Chronic toxicity from other oil constituents may occur, however, if sufficient quantities of crude oil are continually released into the water to maintain elevated concentrations.

Table 4-8 Chronic Toxicity of Benzene to Freshwater Biota

Taxa	Test species	Chronic Value (ppm)
Fish	Fathead minnow (<i>Pimephales promelas</i>)	17.2 *
	Guppy (<i>Poecilia reticulata</i>)	63
	Coho salmon (<i>Oncorhynchus kitsutch</i>)	1.4
Amphibian	Leopard frog (<i>Rana pipens</i>)	3.7
Invertebrate	Zooplankton (<i>Daphnia</i> spp.)	>98
Algae	Green algae (<i>Selenastrum capricornutum</i>)	4.8 *

Note: Test endpoint was mortality unless denoted with an asterisk (*). The test endpoint for these studies was growth.

The potential impacts to aquatic organisms of various-sized spills to waterbodies were modeled assuming the benzene content within each type of crude oil completely dissolved in the water. The benzene concentration was predicted based on amount of crude oil spilled and streamflow. The estimated benzene concentrations were compared to conservative acute and chronic toxicity values for protection of aquatic organisms. For aquatic biota, the lowest acute and chronic toxicity thresholds for benzene are 7.4 ppm and 1.4 ppm, respectively, based on standardized trout toxicity tests (USEPA 2000). These toxicity threshold values are considered protective of acute and chronic effects to aquatic biota. Although trout are not found in many of the habitats crossed by the project, trout are among the most sensitive aquatic species and reliable acute and chronic trout toxicity data are available.

Tables 4-9 to 4-16 summarize the predicted acute and chronic toxicity to aquatic resources. Broadly, acute toxicity could potentially occur if substantial amounts of crude oil were to enter most rivers and streams, as demonstrated by the Moderate and Large Spill Scenarios. If such an event were to occur within a small stream, aquatic species in the immediate vicinity and downstream of the rupture could be killed or injured. Chronic toxicity also could potentially occur in small and moderate sized streams and rivers. However, emergency response, containment, and cleanup efforts would help reduce the concentrations and minimize the potential for chronic toxicity. In comparison, relatively small spills (less than 50 barrels) into moderate and large rivers would not pose a major toxicological threat. In small to moderate sized streams and rivers, some toxicity might occur in localized areas, such as backwaters where concentrations would likely be higher than in the mainstream of the river.

The likelihood of a release into any single waterbody is low, with an occurrence interval of once every 250,000 to 6,800,000 years (**Tables 4-9 to 4-16**). If any release did occur, it is likely that the total release volume of a spill likely would be 50 barrels or less based on historical spill volumes, or less than 10,000 barrels based on the spill volume study (Appendix A). Maximum spill volumes for these rivers would be approximately 20,000 barrels.

Table 4-17 shows the likelihood of spills in selected river systems, as well as average flow of water available to dilute any potentially spilled material. Higher stream volumes correlate with more rapid dilution of any potentially spilled material and therefore lower toxicity.

Table 4-9 Comparison of Estimated Diluted Bitumen (350cSt Crude Oil) Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life (7.4 ppm) for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Diluted Bitumen)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	11	5,905,509	217	1,344,412	2175	1,877,913	4349	5,218,915
Lower Moderate Flow Stream	100	7.4	1	4,133,856	22	941,089	217	1,314,539	435	3,653,240
Upper Moderate Flow Stream	1,000	7.4	0.1	3,100,392	2.2	705,816	22	985,904	43	2,739,930
High Flow Stream	10,000	7.4	0.01	1,771,623	0.2	403,324	2.2	563,374	4.3	1,565,674

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport diluted bitumen (350 cSt crude oil) 90% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.
- Benzene concentrations are compared against the acute toxicity threshold for benzene.
- Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.094 spills/year along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-10 Comparison of Estimated Synthetic Crude Oil Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life (7.4 ppm) for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Synthetic Crude)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	1	6,842,909	27	1,403,496	269	2,089,507	538	6,648,130
Lower Moderate Flow Stream	100	7.4	0.1	4,790,037	2.7	982,447	27	1,462,655	54	4,653,691
Upper Moderate Flow Stream	1,000	7.4	0.01	3,592,527	0.3	736,835	3	1,096,991	5.4	3,490,268
High Flow Stream	10,000	7.4	0.001	2,052,873	0.03	421,049	0.3	626,852	0.5	1,994,439

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.
- Benzene concentrations are compared against the acute toxicity threshold for benzene.
- Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.090 spills/year along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-11 Comparison of Estimated Diluted Bitumen (350 cSt Crude Oil) Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Diluted Bitumen)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	11	1,494,147	217	857,465	2175	954,506	4349	2,402,322
Lower Moderate Flow Stream	100	7.4	1	1,045,903	22	600,226	217	668,154	435	1,681,625
Upper Moderate Flow Stream	1,000	7.4	0.1	784,427	2.2	450,169	22	501,116	43	1,261,217
High Flow Stream	10,000	7.4	0.01	448,244	0.2	257,240	2.2	286,352	4.3	720,697

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport diluted bitumen (350 cSt crude oil) 90% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.
- Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.151 spills/year along the entire Keystone Pipeline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-12 Comparison of Estimated Synthetic Crude Oil Concentrations Following a Spill to the Acute Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Synthetic Crude)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	1	6,094,152	27	1,358,541	269	1,927,825	538	5,442,000
Lower Moderate Flow Stream	100	7.4	0.1	4,265,906	2.7	950,979	27	1,349,478	54	3,809,400
Upper Moderate Flow Stream	1,000	7.4	0.01	3,199,430	0.3	713,234	2.7	1,012,108	5	2,857,050
High Flow Stream	10,000	7.4	0.001	1,828,246	0.03	417,562	0.3	578,348	0.5	1,632,600

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 1 hour of stream flow volume. The model assumes uniform mixing conditions.
- Benzene concentrations are compared against the acute toxicity threshold for benzene.
- Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.093 spills/year along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-13 Comparison of Estimated Diluted Bitumen (350 cSt Crude Oil) Concentrations Following a Spill to the Chronic Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Diluted Bitumen)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.1	5,905,509	1.3	1,344,412	13	1,877,913	26	5,218,915
Lower Moderate Flow Stream	100	1.4	0.01	4,133,856	0.1	941,089	1.3	1,314,539	2.6	3,653,240
Upper Moderate Flow Stream	1,000	1.4	0.001	3,100,392	0.01	705,816	0.1	985,904	0.3	2,739,930
High Flow Stream	10,000	1.4	0.0001	1,771,623	0.001	403,324	0.01	563,374	0.03	1,565,674

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport diluted bitumen (350 cSt crude oil) 90% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.
- The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.
- Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.
- Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.094 spills/year along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-14 Comparison of Estimated Synthetic Crude Oil Concentrations Following a Spill to the Chronic Toxicity Thresholds for Aquatic Life for Streams Crossed by the Proposed Action (435,000 bpd Throughput – Synthetic Crude)

Throughput 435,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.01	6,842,909	0.2	1,403,496	1.6	2,089,507	3.2	6,648,130
Lower Moderate Flow Stream	100	1.4	0.001	4,790,037	0.02	982,447	0.2	1,462,655	0.3	4,653,691
Upper Moderate Flow Stream	1,000	1.4	0.0001	3,592,527	0.002	736,835	0.02	1,096,991	0.03	3,490,268
High Flow Stream	10,000	1.4	0.00001	2,052,873	0.0002	421,049	0.002	626,852	0.003	1,994,439

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.
- The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.
- Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.
- Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.090 spills/year along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-15 Estimated Diluted Bitumen (350cSt Crude Oil) Concentrations Compared to the Chronic Toxicity Threshold for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Diluted Bitumen)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.1	1,494,147	1.3	857,465	13	954,506	26	2,402,322
Lower Moderate Flow Stream	100	1.4	0.01	1,045,903	0.1	600,226	1.3	668,154	2.6	1,681,625
Upper Moderate Flow Stream	1,000	1.4	0.001	784,427	0.01	450,169	0.1	501,116	0.3	1,261,217
High Flow Stream	10,000	1.4	0.0001	448,244	0.001	257,240	0.01	286,352	0.03	720,697

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport diluted bitumen (350 cSt crude oil) 90% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.15 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.15 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.
- The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.
- Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.
- Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.151 spills/year along the entire Keystone Pipeline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-16 Estimated Synthetic Crude Oil Concentrations Compared to the Chronic Toxicity Threshold for Aquatic Life for Streams Crossed by the Proposed Action (591,000 bpd Throughput – Synthetic Crude)

Throughput 591,000 bpd	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Small spill: 50 barrels		Moderate spill: 1,000 barrels		Large spill: 10,000 barrels		Very Large spill: 20,000 barrels	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.01	6,094,152	0.2	1,358,541	1.6	1,927,825	3.2	5,442,000
Lower Moderate Flow Stream	100	1.4	0.001	4,265,906	0.02	950,979	0.2	1,349,478	0.3	3,809,400
Upper Moderate Flow Stream	1,000	1.4	0.0001	3,199,430	0.002	713,234	0.02	1,012,108	0.03	2,857,050
High Flow Stream	10,000	1.4	0.0001	1,828,246	0.0002	417,562	0.002	578,348	0.003	1,632,600

Notes:

- Historical data indicate that the most probable spill volume would be less than 50 barrels. However, this analysis is based on the spill frequencies and volumes calculated from complete draindown (Appendix A), which overestimates the proportion of larger spills. Consequently, the assessment is conservative in its evaluation on the magnitude of environmental consequences.
- The Keystone pipeline is estimated to transport synthetic crude oil 10% of the time for the purposes of this analysis.
- Estimated proportion of benzene in the transported material is 0.02 percent, and is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.02 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.
- The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.
- Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.
- Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.093 spills/year along the Keystone Pipeline Mainline (Appendix A), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

Table 4-17 Large River Systems Crossed by the Proposed Keystone Pipeline¹

Major River/Major Lake	Annual Failure Frequency	Median Stream Flow (cfs) ²
Missouri River (SD/NE Border)	5.83×10^{-5}	20,100
Platte River	2.33×10^{-5}	18,00
Missouri River (KS/MO Border)	5.02×10^{-5}	45,700
Mississippi River	7.24×10^{-5}	146,200
Kaskaskia River/Carlyle Lake	1.60×10^{-5}	1,900

¹Due to Homeland Security issues, the precise maximum spill volume for specific location is considered highly sensitive and confidential, and is therefore not provided in this document.

²USGS 2007 average stream flow 1990-1995.

While a release of crude oil into any given waterbody might cause immediate localized toxicity to aquatic biota, particularly in smaller streams and rivers, the frequency of such an event would be low. Nevertheless, streams and rivers with aquatic biota represent the sensitive environmental resources that could be temporarily impacted by a crude oil release.

Wetlands/Prairie Potholes/Playa Lakes

Although planning and routing efforts have reduced the overall number of wetlands (including prairie potholes and playa lake environments) and static waterbody environments crossed by the Keystone Pipeline, wetlands and waterbodies with persistently saturated soils are present along and adjacent to the Keystone Pipeline route. The effects of crude oil released into a wetland environment will depend not only upon the quantity of oil released, but also on the physical conditions of the wetland at the time of the release. Wetlands include a wide range of environmental conditions. Wetlands can consist of many acres of standing water dissected with ponds and channels, or they may simply be areas of saturated soil with no open water. A single wetland can even vary between these two extremes as seasonal precipitation varies. Wetland surfaces are generally low gradient with very slow unidirectional flow or no discernable flow. The presence of vegetation or narrow spits of dry land protruding into wetlands also may isolate parts of the wetland. Given these conditions, spilled materials may remain in restricted areas for longer periods than in river environments.

Crude oil released from a subsurface pipe within a wetland could reach the soil surface. If the water table reaches the surface, the release would manifest as floating crude oil. The general lack of surface flow within a wetland would restrict crude oil movement. Where surface water is present within a wetland, the spill would spread laterally across the water's surface and be readily visible during routine right-of-way (ROW) surveillance. The depth of soil impacts likely would be minimal, due to shallow (or emergent) groundwater conditions. Conversely, groundwater impacts within the wetland are likely to be confined to the near-surface, enhancing the potential for biodegradation. If humans or other important resource exposures were to occur in proximity to the wetland, then regulatory drivers would mandate the scope of remedial actions, timeframe for remediation activities, and cleanup levels. However, response and remediation efforts in a wetland have the potential for appreciable adverse effects from construction/cleanup equipment. If no active remediation activities were undertaken, natural biodegradation and attenuation would ultimately allow a return to preexisting conditions in both soil and groundwater. This would likely require a timeframe on the order of tens of years. Keystone will utilize the most appropriate cleanup procedures as determined in coordination with the applicable federal and state agencies.

The chance of a spill occurring at any specific wetland along the pipeline is very low. Based on survey data and aerial interpretation, wetlands comprise 69.4 miles of the entire Keystone Pipeline system (Table 3.5-8 of the revised Keystone Environmental Report tables filed January 2007). Of the estimated maximum of 1.5 spills postulated to occur during a 10-year period within the entire pipeline system, about 0.08 spills would be

expected to occur within wetland areas (equivalent to one spill every 130 years). If any release did occur, it is likely that the total release volume of a spill likely would be 50 barrels or less based on historical spill volumes, or less than 10,000 barrels based on the spill volume study (Appendix A).

The predicted effects of a spill reaching standing water (e.g., reservoirs, prairie potholes) would depend largely upon the volume of crude oil entering the waterbody and the volume of water within the waterbody.

Table 4-18 summarizes the amount of water necessary to dilute spill volumes below aquatic toxicity and drinking water thresholds. While this preliminary approach does not account for fate and transport mechanisms, mixing zones, environmental factors, and emergency response capabilities, it does provide an initial benchmark for identifying areas of potential concern.

Table 4-18 Amount of Water Required to Dilute Crude Oil Spills Below Threshold Values

Barrels of Crude Oil	Volume of Water Required to Dilute Crude Oil Below Threshold (acre-feet) ¹		
	Acute Toxicity Threshold (7.4 milligrams per liter [mg/L])	Chronic Toxicity Threshold (1.4 mg/L)	Drinking Water MCL (0.005 mg/L)
Diluted Bitumen (350 cSt Crude)			
50	4.6	24.3	6,807
150	13.8	72.9	20,420
1,000	92.0	486	136,136
10,000	920	4,862	1,361,358
Synthetic Crude Oil			
50	0.57	3.0	841
150	1.7	9.3	2,524
1,000	11.4	60.1	16,826
10,000	114	601	168,258

¹Thresholds based on aquatic toxicity and drinking water thresholds established for benzene. The estimated benzene content of the diluted bitumen (350 cSt crude oil) is 0.15 percent by weight. The synthetic crude oil is estimated to have a benzene content of 0.02 percent by weight.

Based on a review of publicly available toxicity literature for wetland plant groups (i.e., algae, annual macrophytes, and perennial macrophytes), crude oil is toxic to aquatic plants but at higher concentrations than observed for fish and invertebrates. Therefore, spill concentrations that are less than toxic effect levels for fish and invertebrates (see Aquatic Organisms, above) also would be protective for wetland plant species.

In summary, while a release of crude oil into wetland and static waterbodies has the potential to cause temporary environmental impacts, the frequency of such an event would be low. Nevertheless, wetlands and static waterbodies represent sensitive environmental resources.

4.3 Risk to Populated and High Consequence Areas (HCAs)

Consequences of inadvertent releases from pipelines can vary greatly, depending on where the release occurs. Pipeline safety regulations use the concept of HCAs to identify specific locales and areas where a release could have the most significant adverse consequences. HCAs include populated areas, drinking water, and unusually sensitive ecologically resource areas (USAs) that could be damaged by a hazardous liquid pipeline release. **Table 4-19** identifies the types and lengths of HCAs crossed by the Keystone Pipeline Project. HCAs are subject to higher levels of inspection, per 49 CFR Part 195. These data are compiled from a

variety of data sources, including federal and state agencies (e.g., state drinking water agencies, the Environmental Protection Agency). The USDOT acknowledges that spills within a sensitive area might not actually impact the sensitive resource and encourages operators to conduct detailed analysis, as needed. Keystone has conducted a preliminary evaluation of HCAs crossed or located downstream of the pipeline (Appendix B). These HCAs will be subject to higher levels of inspection, as per 49 CFR Part 195. Furthermore, Keystone has subsequently evaluated the location of valves as a measure to reduce potential risk to HCAs. As a result of the preliminary HCA evaluation, some proposed valve locations were moved and additional valves were added to protect HCAs (see Keystone's March 2007 filing with the DOS).

Assuming that 1.5 spills occurred along the Keystone Pipeline system in a 10-year period, it is estimated that approximately 0.25 of these spills would occur in HCAs (**Table 4-19**). Although the number of predicted spills in HCAs is relatively small, the potential impacts of these individual spills are expected to be greater than in other areas due to the environmental sensitivity within these areas. **Table 4-20** also shows the number of spills and their predicted sizes.

4.3.1 Populated Areas

OPS-defined high population areas occur along 3.9 miles of the Keystone Pipeline system. These high population areas have been identified as HCAs by the USDOT based on U.S. Census data (**Table 4-19**). More than 99 percent of these miles are near St. Louis, Illinois. Keystone has reviewed and identified approximately 39 miles of other populated areas as HCAs in accordance with USDOT.

4.3.2 Drinking Water

USDOT defines identifies both surface water and groundwater as for drinking water USAs as defined in 49 CFR Part 195. Surface water USAs include intakes for community water systems and non-transient non-community water systems that do not have an adequate alternative drinking water source. Groundwater USAs include the source water protection area for community water systems and non-transient non-community water systems that obtain their water supply from a Class I or Class IIA aquifer and do not have an adequate alternative drinking water source. If the source water protection area is not available, the wellhead protection area (WHPA) becomes the USA.

Surface water USAs identified for their potential as a drinking water resource have a 5-mile buffer placed around their intake location. The groundwater USAs have buffers that vary in size. These buffers are designated by the state's source water protection program or their wellhead protection program and the buffer sizes vary from state to state.

Isolated segments of the Keystone Pipeline Project cross areas that are considered HCAs by the USDOT due to potential risks to sensitive drinking water resources (**Table 4-19**). These areas are scattered throughout both the Keystone Mainline and Cushing Extension Pipeline routes. Keystone has conducted a more thorough evaluation to identify HCAs associated with sensitive drinking water resources (Appendix B). Segments of the pipeline that could potentially affect HCAs will be subject to higher levels of inspection, as per 49 CFR Part 195. Based on Keystone's preliminary assessment, some valve locations have been moved and additional valves have been added to protect drinking water USAs. These updated locations have been submitted to the DOS in the March 2007 filing.

Table 4-19 Mileage Summary of USDOT-Defined HCAs Identified Along the Keystone Pipeline Project, Based on Centerline Filed December 2006

	Miles of Pipeline				Projected Number of Spills in 10 years (occurrence interval)			
	Populated Areas	Drinking Water	Ecologically Sensitive Area	Total in HCAs ¹	Populated Areas	Drinking Water	Ecologically Sensitive Area	Total HCAs ¹
North Dakota	0.0	2.1	2.0	4.1	NA	0.002 (4,300 yrs)	0.002 (4,550 yrs)	0.005
South Dakota	1.0	9.2	22.4	29.2	0.001 (9,100 yrs)	0.010 (990 yrs)	0.025 (405 yrs)	0.03
Nebraska	0.0	0.0	10.5	6.5	NA	NA	0.011 (865 yrs)	0.007
Kansas	0.0	8.9	18.6	27.5	NA	0.010 (1,020 yrs)	0.020 (490 yrs)	0.03
Missouri	2.1	3.8	59.4	69.5	0.002 (4,300 yrs)	0.004 (2,300 yrs)	0.065 (155 yrs)	0.08
Illinois	4.7	12.0	7.5	21.9	0.005 (1,900 yrs)	0.013 (760 yrs)	0.008 (1,200 yrs)	0.02
<i>Keystone Mainline subtotal</i>	7.8	36.1	120.4	158.8	0.008 (1,200 yrs)	0.040 (250 yrs)	0.13 (75 yrs)	0.17
Nebraska	0.0	0.0	0.0	0.0	NA	0.0	0.0	0.00
Kansas	0.0	35.9	47.8	67.0	NA	0.039 (250 yrs)	0.053 (190 yrs)	0.07
Oklahoma	0.8	11.4	7.5	16.1	0.001 (11,400 yrs)	0.012 (800 yrs)	0.008 (1,200 yrs)	0.02
<i>Cushing Extension Subtotal</i>	0.8	47.8	55.3	83.1	0.001 (11,400 yrs)	0.053 (190 yrs)	0.061 (165 yrs)	0.09
Project Total	8.6	83.5	175.7	241.9	0.009 (1,100 yrs)	0.092 (110 yrs)	0.19 (52 yrs)	0.27 (37 yrs)

¹Numbers are not additive because some miles overlap in the different types of HCAs.

Note: NA indicates no USDOT-defined populated area within the segment.

Projected number of spills in 10 years and occurrence interval were conservatively estimated based on the maximum probability of spills (1.5 spills in 10 years during operation at 591,000 bpd and transporting diluted bitumen). This estimates the maximum possible risk, and assumes risk is evenly disturbed along the entire proposed pipeline and Cushing Extension.

Table 4-20 Release and Spill Volume Occurrence Interval Associated with the Keystone Pipeline Project

	Miles of Pipe ¹	Total Number of Predicted Spills	<50 barrels (bbls)	50 to 1,000 bbls	1,000 to >10,000 bbls	>10,000 bbls
KEYSTONE MAINLINE						
Populated Areas	7.8	0.008 (1,200 years)	0.002 (5,750 years)	0.003 (3,300 years)	0.003 (3,650 years)	0.001 (9,250 years)
Drinking Water Areas	36.1	0.040 (250 years)	0.008 (1,250 years)	0.014 (710 years)	0.012 (190 years)	0.005 (2,000 years)
Ecologically Sensitive Areas	120.4	0.13 (75 years)	0.027 (370 years)	0.046 (210 years)	0.042 (240 years)	0.017 (600 years)
CUSHING EXTENSION						
Populated Areas ²	0.8	0.001 (11,400 yrs)	0.0002 (60,000 yrs)	0.0003 (32,100 yrs)	0.0003 (35,800 yrs)	0.0001 (90,000 yrs)
Drinking Water Areas	47.8	0.053 (190 years)	0.011 (940 years)	0.019 (540 years)	0.017 (600 years)	0.007 (1,500 years)
Ecologically Sensitive Areas	55.3	0.061 (165 years)	0.012 (810 years)	0.022 (460 years)	0.019 (520 years)	0.007 (1,300 years)

¹The amount of pipe located within HCAs was quantified by geographical information system (GIS) and was based on the intersection of a 1,000-foot-wide corridor (centered on the pipeline route) and USDOT-defined HCAs. Probability of a spill was based on the highest projected spill frequency rate on the Keystone pipeline of 0.151 spills per year (Appendix A).

4.3.3 Ecologically Sensitive Areas

Portions of the Keystone Pipeline Project cross areas that are considered HCAs by the USDOT due to potential risks to ecologically sensitive resources (**Table 4-19**). These areas focus on the characteristics of rarity, imperilment, or the potential for loss of large segments of an abundant population during periods of migratory concentration. These include;

- Critically imperiled and imperiled species and/or ecological communities,
- Threatened and endangered (T&E) species (or multi-species assemblages where three or more different candidate resources co-occur),
- Migratory waterbird concentrations.
- Areas containing candidate species or ecological communities identified as excellent or good quality, and
- Areas containing aquatic or terrestrial candidate species and ecological communities that are limited in range.

Portions of the Keystone Pipeline Project cross areas that are considered HCAs by the USDOT due to potential risks to ecologically sensitive areas (**Table 4-19**). These ecologically sensitive areas are frequently

associated with major river systems (e.g., Missouri, Platte, and Mississippi Rivers). As with other HCAs, these locations will be subject to higher levels of inspection, as per 49 CFR Part 195, in order to reduce the probability of pipeline incident.

4.3.4 Distribution of Risk Among HCAs

Up to this point in this document, risk was assumed to be uniformly distributed along the Keystone Pipeline system. This provides a broad overview of risk along the entire system. However, in reality risk is unevenly distributed along the pipeline. Due to Homeland Security reasons, the precise risk for specific locations is highly confidential. Nevertheless, Keystone is providing a preliminary evaluation of risk to HCAs that incorporates site-specific risk factors. Per federal regulations (Integrity Management Rule, 49 CFR Part 195), the site-specific evaluation of risk is an ongoing process and is regulated by the USDOT.

If risk was evenly distributed along the entire length of pipeline, then the sum of the maximum spill volumes from 430 of the 1,720 segments would account for 25 percent of the total maximum spill volume for the entire Keystone Pipeline system. However, risk is not distributed evenly across the system. By summing the higher maximum spill volumes, the number of segments accounting for 25 percent of the total maximum spill volume varies between 39 and 66 segments, depending on the type of product transported and the amount of throughput. **Table 4-21** quantifies the number of segments along the entire length of the Keystone Pipeline system that contribute the greatest amount to risk, defined as the number of segments that contribute 25 percent of the total maximum spill volume for the entire Keystone Pipeline system.

Table 4-21 Segments Accounting for 25 Percent of Total Maximum Spill Volume

	Diluted Bitumen		Synthetic Crude	
	435,000 bpd throughput	591,000 bpd throughput	435,000 bpd throughput	591,000 bpd throughput
Number of segments that contribute 25 percent of total maximum spill volume	66	39	62	66
Length of pipe that contributes to 25 percent of the total maximum spill volume (miles)	21	9	19	20

Many of these higher risk segments are not located within HCAs. **Table 4-22** identifies the miles of HCAs crossed by these higher risk segments. None of the higher risk segments are located within populated area HCAs. There are some ecologically sensitive areas and drinking water USAs that will be crossed by the higher risk segments. Appendix B incorporates the risk associated with each pipeline segment into Keystone's preliminary evaluation of risk to HCAs.

Table 4-22 Length of Higher Risk Segments Within HCAs (miles)

Type of HCA	Diluted Bitumen		Synthetic Crude	
	435,000 bpd throughput	591,000 bpd throughput	435,000 bpd throughput	591,000 bpd throughput
Populated Areas	0.0	0.0	0.0	0.0
Ecologically Sensitive Areas	8.0	6.6	11.0	11.2
Drinking Water	5.3	0.0	5.3	6.2

To protect these sensitive resources, HCAs would be subject to a higher level of inspection per USDOT regulations. Federal regulations require periodic assessment of the pipe condition and correction of identified

anomalies within HCAs. Keystone will develop management and analysis processes that integrate available integrity-related data and information and assess the risks associated with segments that can affect HCAs.

Based on Keystone's preliminary assessment of HCAs (Appendix B), some valve locations have been moved and additional valves have been added to protect HCAs. These updated locations have been submitted to the DOS in the March 2007 filing. In addition, Keystone will develop and implement a risk-based integrity management program (IMP). The IMP will use state-of-practice technologies applied within a comprehensive risk-based methodology to assess and mitigate risk associated with all pipeline segments including HCAs.

5.0 Keystone's Pipeline Safety Program

Pipelines are one of the safest forms of crude oil transportation and provide a cost effective and safe mode of transportation for oil on land. Overland transportation of oil by truck or rail produces higher risk of injury to the general public than the proposed pipeline (USDOT 2002). The Keystone Pipeline system will be designed, constructed and maintained in a manner that meets or exceeds industry standards.

Historically, the most significant risk associated with operating a crude oil pipeline is the potential for third-party excavation damage. The pipelines will be built within an approved right-of-way (ROW) and visible signs will be installed at all road, railway, and water crossings. Keystone also will mitigate third-party excavation risk by implementing a comprehensive Integrated Public Awareness program focused on education and awareness in accordance with 49 CFR 195.440 and API RP1162. Further, Keystone's operating staff will complete regular visual inspections of the ROW (at least once every 3 weeks and a minimum of 26 times per year) as per 49 CFR 195.412 and monitor activity in the area to prevent unauthorized trespass or access.

Keystone will have a maintenance, inspection, and repair program that ensures the integrity of its pipeline. Keystone's annual Pipeline Maintenance Program (PMP) will be designed to maintain the safe operation of the pipeline system. The PMP will include routine aerial patrol of the ROW, periodic inline inspections and cathodic protection readings underpinned by a company wide goal to ensure facilities are reliable and in service. Data collected in each year of the program will be fed back into the decision making process for the development of the following year's program. In addition, the pipeline system will be monitored 24 hours a day, 365 days a year from the oil control center using leak detection systems and supervisory control and data acquisition (SCADA). During operations, Keystone will have an Emergency Response Program in place to manage a variety of events.

6.0 Conclusion

In summary, this conservative analysis of the proposed Keystone Pipeline system shows that the predicted frequency of incidents is low, the probability of a large spill occurring is low, and, consequently, risk of environmental impacts is minimal. Compliance with regulations, application of Keystone's IMPs and its ERP, as well as adherence to safety procedures will help to ensure long-term environmentally sound and safe operation of the pipeline.

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8.0 Glossary

Accidental Release

An accidental release is an unplanned occurrence that results in a release of oil or natural gas from the pipeline.

Acute exposure

Exposure to a chemical or situation for a short period of time.

Acute toxicity

The ability of a substance to cause severe biological harm or death soon after a single exposure or dose.

Adverse effect

Any effect that causes harm to the normal functioning of plants or animals due to exposure to a substance (i.e., a chemical contaminant).

Algae

Chiefly aquatic, eucaryotic one-celled or multicellular plants without true stems, roots and leaves that are typically autotrophic, photosynthetic, and contain chlorophyll. They are food for fish and small aquatic animals.

Aquifer

An underground layer of water-bearing permeable rock, or unconsolidated materials (gravel, sand, silt or clay) from which groundwater can be usefully extracted using a water well.

Barrel

A barrel is a standard measure of a volume of oil and is equal to 42 gallons.

Benthic invertebrates

Those animals without backbones that live on or in the sediments of a lake, pond, river, etc.

Bioavailability

How easily a plant or animal can take up a particular contaminant from the environment.

Biodegradation

Biodegradation is the breakdown of organic contaminants by microbial organisms into smaller compounds. The microbial organisms transform the contaminants through metabolic or enzymatic processes. Biodegradation processes vary greatly, but frequently the final product of the degradation is carbon dioxide or methane.

BPD

Abbreviation for barrels per day

Cathodic Protection System

A technique to provide corrosion protection to a metal surface by making the surface of the metal object the cathode of an electrochemical cell. In the pipeline industry that is done using impressed current. Impressed current Cathodic Protection (ICCP) systems use an anode connected to a DC power source (a cathodic protection rectifier).

Chronic toxicity

The capacity of a substance to cause long-term poisonous health effects in humans, animals, fish, and other organisms. Biological tests that use sublethal effects such as abnormal development, growth, and reproduction, rather than solely lethality, as endpoints.

Contaminant

Any physical, chemical, biological, or radiological substance found in air, water, soil or biological matter that has a harmful effect on plants or animals; harmful or hazardous matter introduced into the environment.

Ecosystem

The sum of all the living plants and animals, their interactions, and the physical components in a particular area.

Emergency Flow Restricting Device (EFRD)

An emergency flow-restricting device is a device used to restrict or limit the amount of oil or gas that can release out of a leak or break in a pipeline. Check valves and remote control valves are types of EFRDs.

Exposure

How a biological system (i.e., ecosystem), plant, or animal comes in contact with a chemical.

Event

An event is a significant occurrence or happening. As applicable to pipeline safety, an event could be an accident, abnormal condition, incident, equipment failure, human failure, or release.

Facility

Any structure, underground or above used to transmit a product.

Failure Frequency

Failure frequency is the rate at which failures are observed or are predicted to occur, expressed as events per given timeframe.

Failure Probability

Failure probability is the probability that a structure, device, equipment, system, etc. will fail on demand or will fail in a given time interval, expressed as a value from 0 to 1.

Failure Rate

Failure rate is the rate at which failures occur. It is the number of failure events that occur divided by the total elapsed operating time during which those events occur or by the total number of demands, as applicable.

Geographical Information System (GIS)

A computer data system for creating and managing spatial data and associated attributes.

Habitat

The place where a population of plants or animals and its surroundings are located, including both living and non-living components.

High Consequence Area (HCA)

A high consequence area is a location that is specially defined in USDOT pipeline safety regulations as an area where pipeline releases could have greater consequences to health and safety or the environment. For oil pipelines, HCAs include high population areas, other population areas, commercially navigable waterways and areas unusually sensitive to environmental damage, including ecologically sensitive areas and drinking water resources. Regulations require a pipeline operator to take specific steps to ensure the integrity of a pipeline for which a release could affect an HCA and, thereby, provide protection of the HCA.

High Population Area

A high population area is an urbanized area, as defined and delineated by the U.S. Census Bureau, which contains 50,000 or more people and has a population density of at least 1,000 people per square mile. High population areas are considered HCAs.

Incident

As used in pipeline safety regulations, an incident is an event occurring on a pipeline for which the operator must make a report to the Office of Pipeline Safety. There are specific reporting criteria that define an incident that include the volume of the material released, monetary property damage, injuries, and fatalities (Reference 49 CFR 191.3, 49CFR 195.50).

Integrity Management Program

An IMP is a documented set of policies, processes, and procedures that are implemented to ensure the integrity of a pipeline. An oil pipeline operator's IMP must comply with the federal regulations (i.e., the Integrity Management Rule, 49 CFR 195).

Integrity Management Rule

The Integrity Management Rule specifies regulations to assess, evaluate, repair, and validate the integrity of hazardous liquid pipelines that, in the event of a leak or failure, could affect HCAs.

Invertebrates

Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.

LC₅₀

A concentration expected to be lethal to 50 percent of a group of test organisms.

Leak

A leak is a small opening, crack, or hole in a pipeline allowing a release of oil or gas.

Likelihood

Likelihood refers to the probability that something possible may occur. The likelihood may be expressed as a frequency (e.g., events per year), a probability of occurrence during a time interval (e.g., annual probability), or a conditional probability (e.g., probability of occurrence, given that a precursor event has occurred).

Maximum Contaminant Level (MCL)

The maximum level of a contaminant allowed in drinking water by federal or state law. Based on health effects and currently available treatment methods.

National Pipeline Mapping System (NPMS)

The National Pipeline Mapping System is a GIS database that contains the locations and selected attributes of natural gas transmission lines, hazardous liquid trunklines, and liquefied natural gas (LNG) facilities operating in onshore and offshore territories of the United States.

One-Call System

A one-call system is a system that allows excavators (individuals, professional contractors, and governmental organizations) to make one telephone call to underground facility operators to provide notification of their intent to dig. The facility operators or, in some cases, the one-call center can then locate the facilities before the excavation begins so that extra care can be taken to avoid damaging the facilities. All 50 states within the U.S. are covered by one-call systems. Most states have laws requiring the use of the one-call system at least 48 hours before beginning an excavation.

Other Populated Areas

An 'other populated area' is a census designated place, defined and delineated by the U.S. Census Bureau as settled concentrations of population that are identifiable by name but are not legally incorporated under the laws of the state in which they are located.

Operator

An operator is a person who engages in the transportation of gas (Reference 49 CFR 192.3) or a person who owns or operates pipeline facilities (Reference 49 CFR 195.2).

Polycyclic Aromatic Hydrocarbons (PAHs)

Group of organic chemicals.

Pipeline

Used broadly, pipeline includes all parts of those physical facilities through which gas, hazardous liquid, or carbon dioxide moves in transportation. Pipeline includes but is not limited to: line pipe, valves and other appurtenances attached to the pipe, pumping/compressor units and associated fabricated units, metering, regulating, and delivery stations, and holders and fabricated assemblies located therein, and breakout tanks.

Playa Lake

A rain-filled small, round depression in the surface of the ground.

Prairie Pothole

Water-holding depressions of glacial origin in the prairies of northern United States and southern Canada. Water is supplied by rainfall, basin runoff and seepage inflow of groundwater.

Receptor

The species, population, community, habitat, etc. that may be exposed to contaminants.

Risk

Risk is a measure of both the likelihood that an adverse event could occur and the magnitude of the expected consequences should it occur.

Sediment

The material of the bottom of a body of water (i.e., pond, river, stream, etc.).

Stressor

Any factor that may harm plants or animals; includes chemical (e.g. metals or organic compounds), physical (e.g. extreme temperatures, fire, storms, flooding, and construction/development) and biological (e.g. disease, parasites, depredation, and competition).

Supervisory Control and Data Acquisition System (SCADA)

A SCADA is a pipeline control system designed to gather information such as pipeline pressures and flow rates from remote locations and regularly transmit this information to a central control facility where the data can be monitored and analyzed.

Throughput

Amount of oil through a pipeline during a specified time.

Toxicity Testing

A type of test that studies the harmful effects of chemicals on particular plants or animals.

Toxicity Threshold

Numerical values that represent concentrations of contaminants in abiotic media (sediments, water, soil) or tissues of plants and animals above which those contaminants are expected to cause harm.

Unusually Sensitive Areas (USAs)

A USA is a drinking water or ecological resource area that is unusually sensitive to environmental damage from a hazardous liquid pipeline release, as defined in 49 CFR 195.6.

Zooplankton

Small, usually microscopic animals (such as protozoans) found in lakes and reservoirs.

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Appendix A

Frequency – Volume Study of Keystone Pipeline

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Appendix B

Preliminary HCA Evaluation

(to be filed April 2007)

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DNV ENERGY

Keystone Pipeline Frequency and Volume Analysis

Report for TransCanada Keystone Pipeline L.P.
Report no.: 70020509 Revision 3,
28 March 2007

MANAGING RISK



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28 March 2007

Keystone Pipeline Frequency and Volume Analysis Report 70020509 (rev 3)
TransCanada Keystone Pipeline L.P.

DNV ENERGY

Keystone Pipeline Frequency and Volume Analysis

for

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Client ref: Meera Kothari PEng

Report No.: 70020509

Subject Group:

Risk Management

Indexing terms: Pipeline, Risk, Frequency

Summary: DNV Energy is assisting Keystone with risk management and regulatory compliance for the Keystone Pipeline, specifically, assessing the U.S. portion of the Keystone Pipeline to quantify oil spill risk in terms of frequency and volume. This report documents the assumptions and results.

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Date of issue: 28 March 2007

Project No: 70020509

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TransCanada Keystone Pipeline L.P.

Page 1
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1.0 Introduction

TransCanada Keystone Pipeline, L.P. (Keystone) is proposing the Keystone Pipeline Project, which would transport a nominal 435,000 bpd (591,000 bpd maximum) of crude oil from facilities near Hardisty, Alberta, to Patoka, Illinois and Cushing, Oklahoma.

In the United States (U.S.), the Keystone Pipeline Project will require federal approvals from agencies such as the U.S. Department of State and the U.S. Army Corps of Engineers. In Canada, approvals from the National Energy Board (NEB) will be required. The project may also entail additional local, state, and regional approvals.

DNV Energy is assisting Keystone with risk management and regulatory compliance for the Keystone Pipeline, specifically, assessing the U.S. portion of the Keystone Pipeline to quantify oil spill risk in terms of frequency and volume of potential spills. The outputs will enable refinement of the ecological assessment being conducted for compliance with the National Environmental Policy Act.

This study focuses on quantifying the risk of a spill of crude oil, in terms of the frequency related to a given volume of oil that may potentially be spilled to the environment. This report encompasses an update of a previous study performed in 2006 (DNV 2006). This update estimates the frequency and volume of releases for each segment for three postulated hole sizes, and develops a frequency-volume curve for the pipeline as a whole.

Two throughput scenarios were evaluated, a 435,000 bpd throughput scenario (nominal case) and a 591,000 bpd throughput scenario for two different products: Diluted Bitumen and Synthetic Crude. Revision 0 of this report described the methodology and applied it to an early-design version of the hydraulic profile and design parameters. For this report, an updated hydraulic profile was utilized for the nominal and maximum throughput cases, together with updated information regarding the locations of pump stations, and other design details.

The project background is described briefly in Section 2.0. A methodology overview is presented in Section 3.0.

Section 4.0 describes the base leak frequencies and modification factors relevant for Keystone.

Section 5.0 describes the methodology used to calculate realistic maximum spill volumes

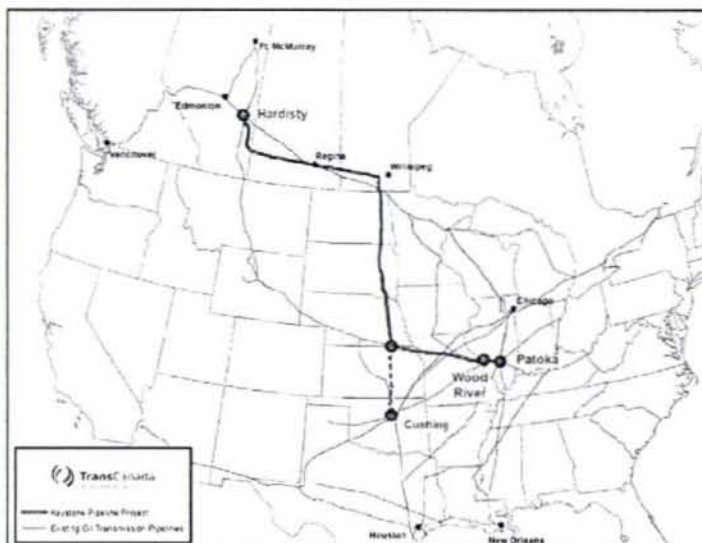
The final summary and conclusions are provided in Section 6.0.

This study is a quantitative assessment of risks for the pipeline as a whole and a screening-level assessment of individual segments of the pipeline. Each segment was defined so that it would comprise a virtually consistent risk profile, using the best available quantification techniques to estimate the risk profile of the pipeline.

2.0 Background

The total length of the proposed Keystone Pipeline is 1845 miles (mi), comprising about 767 mi in Canada and 1372 mi in the U.S. The U.S. portion consists of newly-constructed pipeline and up to 27 new pump stations.

The timeline for the project includes submission of major regulatory applications in the U.S. and Canada in Spring 2006, with completion of associated field studies and environmental assessments throughout 2006. Route refinement may continue as commercial requirements and input are gathered from agencies, stakeholders, and design teams.



In 2007, the engineering design is expected to be complete, with the necessary approvals and licenses. The construction and conversion of facilities and startup are anticipated in 2008 and 2009.

The pipeline is expected to be designed and operated within the following key parameters (Table 2-1) relevant to spill risk, which were provided by Keystone:

Table 2-1 Key Study Input Parameters

Parameter	Value
Diameter	30 inches and 24 inches (Keystone Mainline); 36 inches Cushing Extension
Above vs. belowground	Belowground mainline; aboveground within pump station battery limits
Pipe wall thickness	30 inch line: 0.375 inches; 24 inch line: 0.343 inches; 36 inch line: 0.45 inches
Remote block valves	26
Check valves	20, each associated with a (powered) manual block valve
Mainline location	In GIS
Pump station locations	In GIS
Leak detection	Capable of detecting a 5% leak in 90 min; and a 53% leak in 5 min
Surveillance	Within U.S. DOT requirements
Hydraulic profile	4 cases for analysis: • 435,000 bpd, Diluted Bitumen, density 940 kg/m³ • 435,000 bpd, Synthetic Crude, density 865 kg/m³ • 591,000 bpd, Diluted Bitumen, density 940 kg/m³ • 591,000 bpd, Synthetic Crude, density 865 kg/m³

3.0 Methodology

All crude pipeline spills begin with an initiator, or cause, of an initial loss of oil from the pipeline. Once the leak starts, the scenario unfolds in four phases: leak detection, mainline shutdown, leak isolation, and stoppage of flow from the pipe (if possible). The duration of each phase ultimately determines the quantity of crude spilled.

This study segmented the pipeline to allow estimation of leak frequency and realistic maximum leak volume for portions of the pipeline over which the frequency and volume were virtually constant. The frequency of failure for three hole sizes (small, medium, and large) was estimated for each segment by identifying the relevant failure mechanisms specific to the Keystone Pipeline that could impact the frequency (or volume) of leaks. Historical base frequencies were adjusted using project-specific modification factors for each cause of failure.

Each segment was analyzed to estimate the maximum realistic volume of a leak for each hole size from each failure cause. For small and medium hole leaks, it was assumed that a trained response crew would stop the leak within a specified timeframe.

The remainder of this section discusses the potential causes of spills, describes the methodology used for the segmentation process, and presents relevant baseline frequencies and Keystone Pipeline modification factors.

3.1 Causes of Spills

More than 17 factors (not necessarily independent) could influence pipeline spill initiation (**Table 3-1**). These factors were identified via literature review and DNV experience in assessing this type of pipeline risk. It should be noted that the factors are similar but not identical to the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA) categories of failure (e.g., third party harm is included as a portion of the excavation damage factor).

Table 3-1 Factors That Could be Considered for Pipeline Spill Initiation

Factor	Description
Flange, seal, and fitting leak	A leak from a flange, seal, or fitting.
Material defect or construction deficiency	Failures due to flaws within the material structure of the pipe, caused by material or manufacturing defects, improper welding, or installation errors.
Corrosion (external or internal)	Failures due to general and pitting type corrosion caused by fluids inside the pipeline or corrosive soils or conditions outside of the pipe.
Corrosion assisted initiators	These are several rather than one, and include operational transients, error in pressure setpoint control, material property deviations, etc.
Hydraulic (pressure surge) event	Overpressure caused by human or mechanical error, combined with overpressure protection failure.
Excavation damage	Excavation equipment damages to underground piping; by Keystone Pipeline maintenance personnel or by third parties. Third party is assumed to be the dominating factor.
Maintenance damage	A leak caused by crews conducting maintenance work on the pipeline.

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Factor	Description
Accidental acts	Accidental acts by a third party (such as a hunting accident) that cause a leak (vehicle, train, and aircraft operation were evaluated separately). This study scope excludes strategic, intentional acts, such as planned terrorist attacks.
Human/operator error	Improper performance of maintenance or operating procedures leading to a line failure.
Seismic event	Earthquake or other vigorous displacement of the pipeline due to seismic activity or ground movement.
Settlement	Thaw settlement or frost jacking causes line to buckle.
Slope instability	Avalanche damages piping or instability lead to loss of piping support.
Washout/bridge failure	River bottom pipe exposed by heavy runoff, line may float and buckle. Bridge supports may corrode and cause line failure (no bridge crossings are planned for the Keystone Pipeline System).
Vehicle impact	Line failure due to large vehicles, typically transport trucks, leaving the roadway and impacting the line.
Aircraft impact	Impact fractures underground piping
Train derailment	Impact fractures underground piping
External fire or explosion	Fire impinging on the pipe, or an explosion resulting in a leak.

From the above 17 factors that could influence pipeline spills, six distinct and practically independent causes (from a frequency estimation point of view) were identified as applicable to the Keystone Pipeline and evaluated in detail in this study (see Section 4.0).

1. Corrosion (external or internal)
2. Excavation damage
3. Material defect or construction deficiency
4. Hydraulic (pressure surge) event
5. Washout
6. Seismic events

Table 3-2 lists the factors that were not quantified as separate causes in this study, with explanation.

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Table 3-2 Factors not Individually Quantified in this Study

Factor	Reason
Corrosion assisted initiators	This failure frequency is incorporated into other historical causal frequencies (such as hydraulic event and corrosion).
Maintenance damage	This is included in the excavation cause for belowground pipeline
Accidental acts	Accidental harm to the pipeline was considered only credible for aboveground pipe. For the Keystone Pipeline, the only aboveground pipe is within pump stations, which are secured. As a result, this cause was deemed not relevant
Human/operator error	After detailed design and operating procedures are drafted, this cause can be evaluated in detail.
Flange, seal, and fitting leak	There are no flanges in the main pipeline; all valves are welded.
Settlement	Major settlement is often associated with thaw that causes a deformation of the pipe and subsequent pipe failure. DNV was unable to quantify this very low level of risk in the timeframe required with the conceptual level of design currently available for the pipeline. It is unlikely that this risk factor would contribute significantly to the pipeline risk picture, as less than 1% of 1986-2001 recorded incidents were attributable to the OPS category "subsidence".
Slope instability	DNV was unable to quantify this risk with the conceptual level of design currently available for the pipeline.
Vehicle impact	This is defined as a truck-pipe collision with sufficient momentum to break the pipe. The probability of a belowground portion of pipe being affected by a vehicle impact results in a frequency less than 1×10^{-7} , which is not a credible scenario.
Train derailment	DNV was unable to quantify this very low level of risk in the timeframe required with the conceptual level of design currently available for the pipeline. It is unlikely that this risk factor would contribute significantly to the pipeline risk picture.
Aircraft impact	Since the Keystone Mainline is belowground, aircraft impact risk is estimated at less than 1×10^{-6} . This could be further refined and quantified based on sizes of aircraft and activity levels, if desired; however, it is unlikely to contribute to the Keystone Pipeline risk picture.
Fire or explosion	Since the majority of the pipeline is belowground, this is a credible scenario only at the pump stations. The primary sources of ignition might be station equipment fire, agricultural burns, and wildfires.

Distribution of Hole Sizes for Each Cause

A specific distribution of small, medium, and large sized holes was developed and applied for each spill cause (described further in Section 4.0). Note that hole size is not the same as spill volume. Some leaks from small holes could occur for a long period of time and result in a large spill volume because they would not be detected as quickly as some leaks from larger holes.

The estimation of frequency for a given spill volume is linked to hole size, because for any failure cause, one hole size is more or less likely than another. In assessing the distribution of hole sizes

for each cause, the failure mechanism and pipe material properties were considered. The size of the hole is a function of many factors including stress levels and material properties such as ductility. For instance, corrosion is characterized by a failure mechanism of slow removal of metal, and therefore is generally prone to result in pinhole-type leaks rather than full bore failures. In contrast, outside forces such as vehicle impact on aboveground pipeline are more likely to cause larger holes.

Three sizes of hole were assessed for each cause:

- Small, equivalent to 0.06 inch diameter hole
- Medium, equivalent to 2 inch diameter hole
- Large, equivalent to 10 inch diameter hole and larger

The representative hole sizes were chosen to allow use of the best statistically significant set of data for pipelines. Further detail regarding the generic data sets used in this analysis is provided in Appendix I.

3.2 Segmentation

The pipeline was segmented for this assessment based on several factors, all related to the physical and environmental characteristics that would create unique failure mechanisms or consequence for various lengths of pipe. These segments were used as the basis for calculating frequency of spill volumes. DNV defined each segment as the length of pipe over which none of the risk characterization parameters changes significantly.

An alternative approach would have been to define each segment by a static geographic distance; however, the current approach was deemed more suitable for any future spill risk studies incorporating consequence of a spill.

Table 3-3 lists the characterization parameters used as inputs to segmentation.

Table 3-3 Segmentation Parameters

Parameter	Related cause or consequence	Discussion
Above versus belowground location of pipeline	Excavation damage Corrosion (external or internal)	The majority of Keystone Pipeline is belowground, with transitions to aboveground only within secure areas at pump stations.
Pipe wall thickness	Excavation damage Corrosion (external or internal)	Wall thickness is a risk factor for both excavation damage and corrosion caused leaks.

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Parameter	Related cause or consequence	Discussion
Excavation activity level	Excavation damage	This input factor characterizes segments by the potential for excavation activity. <i>Road crossings per mile</i> was the best available data for estimation of excavation activity (because of the potential for impact to the pipe from activities related to roadside drainage ditches and culverts).
Hydraulic event susceptibility	Hydraulic (pressure surge) event	The sections of Keystone Pipeline operating closer to MAOP are assigned greater susceptibility to hydraulic damage in the event of human or mechanical error.
Washout event susceptibility	Washout	The washout event susceptibility is used to identify segments that cross rivers with a potential to remove sediments surrounding the pipe. This will be combined with flood risk levels along the Keystone Pipeline.
Pipeline patrol frequency	NA (related to leak detection time)	The patrol frequency contributes to both the likelihood of finding unauthorized excavation and the timeliness of detection for small hole leaks.
Direct impact on High Consequence Areas (HCA).	Pipelines crossing High Consequence Areas.	Sets of direct impacted HCA as specified by DOT/OPS for Drinking Water (DW), Ecological (ECO) and High Populated Areas (HPO)
Seismic Event susceptibility	Seismic (earth quake) events	Keystone Pipeline is in a very low risk area for seismic activity according to DOT/NPMS.
Flood risk	(Washout)	Combined with washout susceptibility.

A new segment was created at each point where a change in any of the risk characterization parameters occurred. This approach minimized the number of segments necessary to analyze the entire pipeline at the full resolution of the input data. **Figure 3-1** provides a visual representation of the segmentation process.

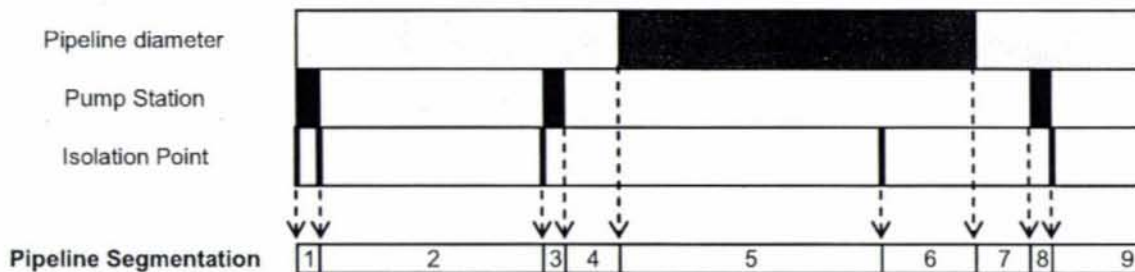


Figure 3-1 Segmentation Process Diagram

Non-discrete (or nearly continuous) risk characterization parameters are not suitable inputs to a segmentation process. These parameters have either a continuously varying value or a large number of values along the length of the pipeline, and would result in a very large number of

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segments. Instead of using these as inputs to the process, a single value for each parameter was established for each segment after segmentation is complete. The segment value was assigned by analyzing the range of values for a given parameter within a given segment, and assigning either the maximum, minimum, count, or average to the entire segment. This resulted in a representative but conservative value being applied to each segment.

The values for such non-segmentation parameters were assigned as follows (**Table 3-4**):

Table 3-4 Non-Segmentation Parameter Values

Parameter	Related cause	Discussion
Depth of cover	Excavation damage Washout Vehicle impact Aircraft impact Train derailment	Depth of cover is currently assigned a constant value of 4 ft for the entire pipeline. When additional detailed data are available, the minimum depth of cover between the start and end mileposts of each segment will be applied to the entire segment, since this will provide the best reasonable conservative estimate as an input to excavation leak frequency.
Pipeline internal pressure	NA (volume related)	The maximum pipeline internal pressure between the start and end mileposts of each segment will be applied to the entire segment, since this will give the most conservative estimate of before isolation release rate.
Pipeline elevation	NA (volume related)	The minimum pipeline elevation between the start and end mileposts of each segment will be applied to the entire segment, since this will give the most conservative estimates of before isolation and after isolation release rates.

4.0 Base Frequencies and Modification Factors

The frequency of an event is the expected number of times per length of pipe that an event will occur in a year. As an illustration, the excavation damage frequency for a given segment might be 1.4×10^{-6} based on historical incident data. That frequency represents the number of times that excavation is expected to cause a leak in that segment of the pipe in a year.

For each segment of the pipeline, the frequency of events (and thus possible leaks) was determined by first assessing the frequency of each spill cause individually, distributed among the three hole sizes. These were summed to give the total leak frequency.

$$f = f_{co} + f_{ex} + f_{md} + f_{hy} + f_{fl} + f_{wo} \quad (4.1) \quad (4.1)$$

Where:

f = the total leak frequency for a section

f_{co} = leak frequency from corrosion

f_{ex} = leak frequency from excavation

f_{md} = leak frequency from material defects or construction deficiency

f_{hy} = leak frequency from hydraulic event

f_{fl} = leak frequency from flange(s)

f_{wo} = leak frequency from washout event

The individual frequencies were determined by applying modification factors to a base leak frequency for each spill cause. The specific modification factors and hole size distributions are discussed for each of the relevant causes in the following subsections.

4.1.1 Corrosion

This event is defined as the failure of mainline pipe to contain the fluid because of external or internal corrosion-degraded (thinned) pipe. The reliability of the pressure relief system is directly accounted for in the analysis.

DNV proprietary analysis of pipeline leaks suggests a base frequency for corrosion leaks of 6.0×10^{-5} per mile of pipeline per year. DNV considers that because of the expected frequency of smart pigging (at least every seven years, 49 CFR 192.937), the material selection and the comprehensive use of active cathodic protection along the pipeline, engineering judgment warrants a reduction of the base frequency (also see generic analyses in Appendix I). A 50% reduction was applied, resulting in a Keystone Pipeline base frequency for corrosion leaks of

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3.0×10^{-5} per mile of pipeline per year. Corrosion is the only spill cause for which the base frequency was changed prior to application of specific modification factors.

Modification factors were applied to the base frequency to represent the following issues:

- Whether the segment was above or belowground
- Initial wall thickness of the segment

f_{co} , the leak frequency from corrosion, was therefore calculated as follows:

$$f_{co} = f_{co}^* (M_{Location} M_{Thickness}) \quad (4.2)$$

Where:

f_{co}^* = the base frequency of corrosion resulting in a leak (3×10^{-5} per mile year)

$M_{Location}$ = modification factor whether the segment was above or belowground

$M_{Thickness}$ = modification factor for initial wall thickness (set to 1 for Keystone Pipeline)

Above or Belowground Location

The Keystone Pipeline is being designed to consist entirely of belowground pipe except within pump station fence lines. Segments of the pipeline belowground were considered to be more likely to incur external corrosion than aboveground sections.

Based on proprietary analysis of CSFM (1993), CONCAWE (1998), and EGIG (2005) data for external corrosion, DNV developed modification factors for belowground versus aboveground piping. (These datasets were used because as of the date of this report, the more current data sets have not yet been fully analyzed.) The modifying factors shown in **Table 4-1** were used to account for the effect of the location of the pipeline on corrosion leak frequencies.

Table 4-1 Corrosion Location Modifying Factor

Location	Factor
Aboveground	0.2
Belowground	1

Engineering judgment was used to develop the hole size distribution shown in **Table 4-2**, which were applied to leaks resulting from corrosion.

Table 4-2 Hole Size Distribution for Corrosion Leaks

Hole Size	Distribution
Small	87%
Medium	10%
Large	3%

4.1.2 Excavation Damage

This event is defined as a leak resulting from digging equipment striking the pipeline. The base frequency of excavation resulting in a leak is 8.4×10^{-5} per mile of pipeline per year. This value was based on DOT data for "external force" type incidents for natural gas transmission lines. Natural gas pipeline data is appropriate for excavation damage because the product being carried in the pipe has almost no effect on whether excavation damage will occur, or how severe it will be. The frequency is essentially the same for gas and for oil pipelines.

Leaks caused by excavation damage are considered only for belowground sections of the pipeline. Modification factors were applied to the base frequency to represent the following features:

- Depth of cover – assigned as a nominal 4 ft.
- Wall thickness of the pipeline – assumed to be 0.375 in for the 30-inch sections, 0.343 in for the 24-inch, and 0.45 for 36-inch sections of pipe.
- Patrol frequency for the pipeline – assumed to be every two weeks.
- Level of excavation activity – estimated based on the number of road crossings in a given segment, with the numbers of crossings summed for each mile. The values were then compared to the criteria in **Table 4-4** to assign an excavation activity level for the segment. A new segment was created at each milepost where the excavation activity level changed, resulting in a constant activity level for each segment.

f_{ex} , the leak frequency from excavation activity, was therefore calculated as follows:

$$f_{ex} = f_{ex}^* (M_{Activity} M_{Depth} M_{Thickness} M_{Patrol}) \quad (4.3)$$

Where:

f_{ex}^* = the base frequency of excavation resulting in a leak (8.4×10^{-5} / mile year)

$M_{Activity}$ = modification factor for activity level

M_{Depth} = modification factor for depth of cover

$M_{Thickness}$ = modification factor for wall thickness

M_{Patrol} = modification factor for patrol frequency

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The hole size distribution shown in **Table 4-3** was applied for excavation damage leaks. The distribution was based on EGIG (2005) data, details of which can be found in Appendix I.

Table 4-3 Hole Size Distribution for Excavation Damage Leaks

Hole Size	Distribution
Small	25%
Medium	55%
Large	20%

Activity Level

Data for the activity levels along the pipeline were assessed using a system suggested by Muhlbauer (1992). This presented three levels of activity: high, medium and low. DNV also identified areas of no expected activity (Very Low).

Table 4-4 Excavation Activity Categorization

Level	One or more of the following
High	Frequent construction activities High volume of on-call or reconnaissance reports (> 2 / week) Significant roadway culvert risk – summed road crossing value greater than 30 per mile Many other buried utilities nearby
Medium	No routine construction activities that could pose a threat Moderate roadway culvert risk – summed road crossing value greater than 10 to 30 per mile Few on-call or reconnaissance reports (> 2 / week) Few other buried utilities nearby
Low	Virtually no activity reports (< 10 / year) No routine harmless activities in area. Agricultural activities that cannot penetrate to within 1 ft of the pipeline depth may be considered harmless. Very low roadway culvert risk – summed road crossing value greater than 0 to 10 per mile
Very Low	No expected excavation activity, except from maintenance activities Trivial roadway culvert risk – summed road crossing value of 0

The modifying factors shown in **Table 4-5** were used for excavation activity level.

Table 4-5 Excavation Activity Level Modifying Factor

Level of Activity	Factor
High	1.5
Medium	1
Low	0.5
None	0.01

Depth of Cover

Modifying factors shown in **Table 4-6** were used for depth of cover, and a factor of 0.7 was applied to Keystone Pipeline as it will be buried to a minimum of four (4) feet. The modifying factors in the table were based on detailed analysis of the UK Health & Safety Executive (HSE) data (ADL, 1999) and DNV engineering judgment for interpolation. They are discussed further in Appendix I.

Table 4-6 Depth of Cover Modifying Factor

Depth of Cover	Factor
0-3 ft	1
3-6 ft	0.7
6-9 ft	0.5
> 9 ft	0.01

4.1.3 Material Defect or Construction Deficiency

- This event was defined as a break in the mainline pipe caused by material or manufacturing defects, improper welding, or installation errors. Empirical data was used to quantify this value.
- For the period 1988-2000, DOT data shows the base frequency of mechanical or material defects causing leak as 3.81×10^{-5} leaks per mile of pipeline per year (DOT, 2001). This is based upon 34 reported leaks for 893,061 miles of pipeline, utilizing a population of pipelines constructed over a wide range of years. Pipelines built more recently will have been designed and built using more modern codes and standards, and inspected using more advanced techniques. These pipelines, such as Keystone Pipeline, are less likely to suffer leaks as a result of mechanical or material defects in the pipeline.
- Data provided by Kiefner and Trench (2001) supports the conclusion that pipelines constructed after 1970 have a reduced likelihood of construction related defects than those built prior to 1970. This decrease is most significant for longitudinal welds, which are typically performed during manufacturing. A lesser decrease is seen for girth welds, which are typically performed during installation. The following are key inputs to the assessment of material defects or construction deficiencies:
- A 50% reduction in the DOT leak frequency was applied to the entire pipeline because the U.S. portion of the Keystone Pipeline will consist of entirely new materials and be constructed to meet current standards and requirements.
- Material defect or construction deficiencies were considered equally likely to occur anywhere along the pipeline, and no modification factors were applied based on location.
- The hole size distribution is based on European Gas Pipeline Incident Data Group (EGIG) (1993) data, details of which can be found in Appendix I. DNV's analysis of the data resulted in the a hole size distribution (**Table 4-7**) applicable to leaks caused by material defects or construction deficiencies.

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Table 4-7 Hole Size Distribution for Material Defect or Construction Deficiency Leaks

Hole Size	Distribution
Small	65%
Medium	25%
Large	10%

Wall Thickness

The modifying factors are normally used for wall thickness. These factors are based on a baseline wall thickness of approximately 0.3 in, and the calculation of the modifying factor for thickness relative to the baseline value from EGIG (2005) data, as detailed in Appendix I. The Keystone Pipeline does not significantly deviate from the baseline thickness, therefore no reduction factor is applied (a significant deviation would be a difference in wall thickness greater than 0.5 inches).

Table 4-8 Wall Thickness Modifying Factor

Keystone Pipeline Diameter	Minimum Wall Thickness	Factor
30 inches	0.375 inches	1
24 inches	0.343 inches	1
36 inches	0.450 inches	1

Patrol Frequency

Regular patrols of the pipeline result in earlier identification of excavation activities and improved advance management of such activities. Patrols reduce the likelihood of excavation damage to the pipeline.

Patrol frequency is required by pipeline safety regulations as at least 26 times a year (averaging at two week intervals), but not exceeding intervals of three weeks (49 CFR 195.412). The modifying factors shown in **Table 4-9** were used for patrol frequency. The more frequent the patrols, the more likely the patrol is to observe excavation and assure it is being conducted in a appropriate manner, and the greater benefit the patrolling has in reducing spill risk from excavation. Patrol frequency is expected to be every two weeks for Keystone, with a resultant modifying factor of 1.3.

Table 4-9 Patrol Frequency Modifying Factor

Frequency	Factor
Monthly – Weekly	1.3
Weekly	1
2 times per week	0.8
4 times per week	0.65
Daily	0.5

4.1.4 Hydraulic Event

This event is defined as an overpressure of the pipeline severe enough to cause a leak or rupture of the line. This scenario involves a series of concurrent hardware or human errors and can occur at a limited number of locations.

Overpressure pipe failures can occur through two distinctly different means. Pipe can fail due to overpressurization if the internal pressure surpasses the maximum strength of the pipeline; however, corroded or fatigued pipe will have a reduced strength and may fail at lower pressures. The following scenarios could result in overpressurization:

- Failure of pressure relief system combined with failure of pressure control
- Uncommanded closure of battery limit or block valves
- Failure of RGVs downstream of high elevation areas to fully close during line shutdown. Hydraulic head will create a high pressure at first sealed valve
- Weakening of pipeline at point where slack and tight line meet, due to the impact of pigs, will reduce bursting strength
- Corrosion damage may reduce the bursting strength of the pipeline

The base frequency for hydraulic event leaks is 9.3×10^{-5} per mile of pipeline per year, based on analysis by DNV proprietary analysis of pipeline leaks. A modification factor was applied to the base frequency to represent susceptibility to hydraulic events. f_{hy} , the leak frequency from hydraulic events, was therefore calculated as follows:

$$f_{hy} = f_{co} M_{Hyd} \quad (4.4)$$

Where:

f_{co} = the base frequency of hydraulic events resulting in a leak (9.3×10^{-5} per mile year)

M_{Hyd} = modification factor for susceptibility to hydraulic events

The hole size distribution shown in **Table 4-10** was applied for hydraulic event leaks. This is based on engineering judgment concerning the types of leaks represented.

Table 4-10 Hole Size Distribution for Hydraulic Event Leaks

Hole Size	Distribution
Small	20%
Medium	50%
Large	30%

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Hydraulic Event Susceptibility

The modifying factors shown in **Table 4-11** were used for Hydraulic Event Susceptibility. Given the current design phase of the pipeline and the design criteria, it appears that the pipeline warrants a hydraulic susceptibility level of "low", resulting in a modifying factor of 1.

Table 4-11 Hydraulic Event Susceptibility Modifying Factor

Susceptibility		Factor
High	Expected operating pressure >1440 psi	3
Medium	Expected operating pressure between 1040 psi and 1440 psi	1
Low	Expected operating pressure between 520 psi and 1040 psi	0.1
None	Expected operating pressure <520 psi	0

4.1.5 Seismic Events

Keystone is in a very low risk area for seismic activity. It is therefore assumed that leaks caused by seismic events are insignificant.

4.1.6 Washout

This event is defined as failure of the mainline pipe below a river bottom due to severe water erosion. Under severe runoff conditions, pipelines have been known to leak due to the forces applied during pipe displacement. The base frequency of failure (**Table 4-12**) was estimated using proprietary pipeline washout data and engineering judgment.

Table 4-12 Frequency Estimate for Washout Failures

Basis	Source
0.1 pipe exposures / yr assuming 1000 river crossings	Proprietary Data
0.1 failure probability on exposure	Engineering Judgment
= 1×10^{-5} failures / per crossing	

The total pipeline frequency was applied to a stream crossing segment by ratioing the number of stream crossings for the segment to the number for the entire system (806). Each mile of pipeline was assigned a river crossing "value" based on the river type (**Table 4-13**). This was used to segment the pipeline where the density of river crossing varied. Each segment's frequency was then calculated by applying three modification factors to the base frequency:

- River type - National Hydrological Dataset (2006) (F Code) in **Table 4-13**.
- Depth of cover in **Table 4-14**
- Flood risk

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Table 4-13 River Crossing Modification Factors

River Type	Modification Factor
River	1
Intermittent/ephemeral stream	0.5
Canal/ditch	0.2
Artificial path or none	0

Table 4-14 Depth of Cover Modifying Factor for Washout Leaks

Depth	Factor
0-10 ft	1
>10 ft	0.5

Table 4-15 Flood Risk Modifying Factor for Washout Leaks

Flood Risk	Factor
0-69	0.5
70-84	0.8
85-100	1

Engineering judgment was used to develop the hole size distribution shown in **Table 4-16**, which were applied to leaks resulting from washout.

Table 4-16 Hole Size Distribution for Washout Leaks

Hole Size	Distribution
Small	90%
Medium	9.9%
Large	0.1%

5.0 Realistic Maximum Spill Volume

The second phase of this assessment calculated the quantity of crude oil that could be lost from each segment of the pipeline. The quantity of material released during a spill is dependent upon the following parameters:

1. Time until leak is detected, verified and pipeline isolated
2. Initial leak rate, under pipeline pressure
3. Quantity of material in isolated section of pipeline
4. Quantity of trapped volume due to changes in pipeline elevation, as described in section 5.3.
5. Leak rate after isolation, driven by hydrostatic head in the pipeline

And, depending on whether containment of the leak source is being considered:

6. Time to effectively contain the leak source (via clamping or some other method)

Detection time is the time required for a potential leak to be identified as such. Verification time is the time required for an operator to confirm that a leak is occurring and decide to take action. Isolation time is the time required from completed leak verification to closure of the remote block valve(s) (RBV) and a relevant downstream check valve, if applicable. Effective valve closure limits the spill volume to the amount trapped between the valves.

A remote block valve is a block valve that stops oil flow in both directions when given a command from a remote location, such as an operations center (or locally if such an option is provided in the design). RBV are located at every pump station and at every major river crossing.

A check valve allows one-way flow only and prevents the reverse flow of oil. Check valves are designed to be held open by flowing oil and to drop closed automatically and nearly effective immediately when oil flow stops or is reversed. Check valves are located on the downstream side of major river crossing along the pipeline. Co-located with each check valve at river crossings, there is also a manual valve.

Prior to valve closure, the leak rate from the pipe ("initial leak rate") is estimated to be the rate that oil would flow out of the hole size being evaluated assuming that the mainline pumps continue to operate. After valve closure, the volume trapped between the upstream RBV and the downstream checkvalve ("isolated section volume") is the maximum that could practically be released. For every potential leak location, the relevant RBV are identified and valve closure times applied based on the values in the tables presented in following subsections.

Actual spill volumes are expected to be significantly less than the potential drain down volume. Accounting for procedures to reduce spill volume, such as depressurization and drain down, may significantly reduce the predicted spill volumes estimated for the Keystone Pipeline.

5.1 Detection, Verification, Response and Isolation

The time required to detect and verify a spill is dependent on the leak detection mechanism that would alert an operator, related to leak rate. The type of cause affects the estimate of times to detect and verify. If the spill cause is such that an individual would be expected to be present and report the leak immediately, the detection/verification times would be different than if the leak detection system was the only means of identifying a spill.

For the purpose of discussion, a cause is called, "reported" if a person is expected to be present at the scene, and very likely to observe the leak and call it in within a short timeframe (regardless of whether the leak is detectable by the leak detection system). An example is excavation damage. Such an event would likely be observed at the time of the incident, and a phone call would be placed to report that a pipeline had been hit during excavation activities. The two reported causes are:

- Excavation damage
- Hydraulic (pressure surge) event

For reported causes, it is assumed that the leak is observed, reported, verified, and valves instructed to close in the times indicated in **Table 5-1**. The listed response times are based on operational and engineering experience, while the valve closure time is manufacturer data. Very small hole leaks may require a few minutes before a leak is apparent, hence the longer observation, reporting, and verification time. Medium hole leaks would be immediately apparent, and would require effective communication to the control center to initiate valve closure. Large hole leaks would be detected in the control center within 9 minutes, regardless of additional reporting avenues.

Table 5-1 Time from Leak Start to Closure of RGVs for Reported Causes

Hole size	Response Time	Valve Closure
Small	30 minutes	3 minutes
Medium	15 minutes	3 minutes
Large	9 minutes	3 minutes

Non-reported causes are expected to occur without any person present to witness and report the event; thus, the leak detection system and surveillance is assumed to be the only means of leak detection for these causes. For example, a corrosion leak is not normally visible to any individuals who pass by, and would have to be detected via the Keystone systems designed for that purpose. The non-reported causes are:

- Material defect or construction deficiency
- Corrosion (external or internal)
- Flange, seal, and fitting leak
- Washout

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The estimated times to detect, verify, initiate valve closure, and complete valve closure (isolation) for non-reported causes are provided in **Table 5-2**. The listed times are based on the current leak detection system model design and leak detection system response time. For large leaks, the time for detection system response is independent of whether the leak is above or belowground. Small leaks belowground (necessarily detected by surveillance) may take significantly longer to detect than small leaks aboveground.

Table 5-2 Time from Leak Start to Closure of RGVs for Non-Reported Causes

Leak Rate (as percentage of throughput)	Detection and Verification	Isolation
	Belowground Pipe	Time for RBV to Close
Less than 1.5%	90 days	3 minutes
5%	90 minutes	3 minutes
53%	5 minutes	3 minutes

For leak rates between those presented in the above tables, times were interpolated using a logarithmic straight line fit. This gave the profile in **Figure 5-1** for detection time versus leak rate.

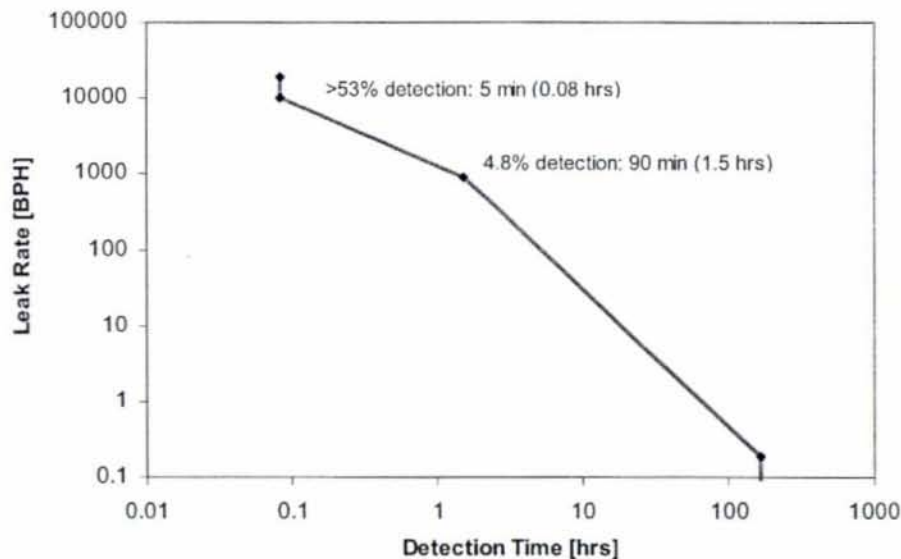


Figure 5-1 Leak Detection & Verification Times

This study assumes that all valves close on demand (zero percent failure rate). The zero failure rate is assumed because of the very low likelihood of a leak concurrent with a valve failure at a critical relevant location. However, a relevant valve failure concurrent with a leak could result in a spill volume greater than estimated in this study; any failure resulting in a delay in leak isolation would increase the spill volume. Such possible complications in leak isolation are:

- RBV fails to close on command
- Check valve fails to drop on loss of flow
- Controller for pump station isolation valves is damaged

5.2 Initial Leak Rate

Standard hole discharge rates were used based on the representative hole size and the operating pressure of the given segment of the pipeline. This formula is given by:

$$Q_D = C_d A \sqrt{\frac{2\Delta P}{\rho}}$$

where:

- Q_D = liquid discharge rate (m³/s)
- C_d = discharge coefficient, set to 0.61
- A = hole cross-sectional area (m²)
- ΔP = driving pressure for the leak (Pa)
- ρ = density (kg/m³), 938 kg/m³ for Keystone

During the initial phase of the leak before the valves close, the driving pressure is based on line pressure at the point of the leak.

5.3 Isolated Section Volumes

Once flow through the pipeline is stopped by shut down of pump stations and closure of RBV, material can still leak from the pipeline via gravitational effects. RBV will stop material flowing in from sections upstream and downstream of the isolation valves, and check valves will stop material flowing back from sections downstream. However, material upstream will be able to flow through check valves, since this is the normal direction of flow.

It was assumed that gravitational effects were the sole mechanism for release after isolation. Siphoning effects, draindown procedures, and line depressurization were not considered. Therefore, the sections of the pipeline that were able to contribute to the spill quantity were those satisfying the following criteria (**Figure 5-2**):

1. Located between the same two remote block valves as the leak point
2. No further downstream of the leak point than the first downstream check valve
3. At a higher elevation than the leak point
4. At a higher elevation than any other point located on the same side of the leak, and closer the leak point

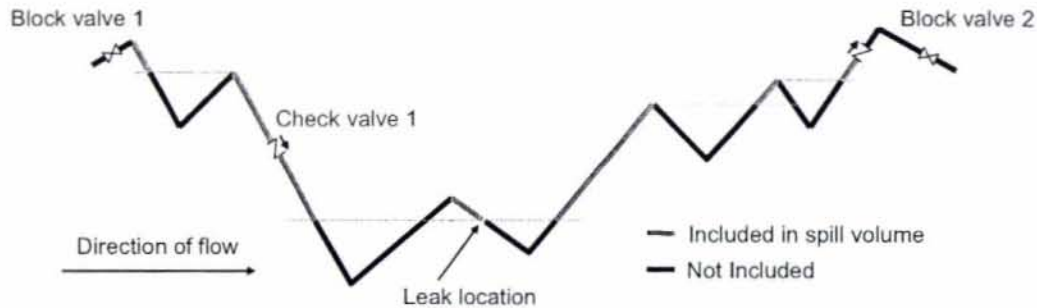


Figure 5-2 Isolated Section Volumes

5.4 Leak Rate After Isolation

In the static phase of the leak, the driving pressure is based on the highest point above the leak, as in isolated volumes, accounting for a closed valve or a peak in the line. For the static phase, the height differential was used to calculate the discharge rate. This formula is given by:

$$Q_s = C_d A \sqrt{2g\Delta h}$$

where:

- C_d = discharge coefficient, set to 0.61
- A = hole cross-sectional area (m^2)
- g = gravitational constant $9.81 (m/s^2)$
- Δh = differential height of crude in line (m)

5.5 Source Control Time

It is assumed that following leak detection, the pipeline will be shut down by means of stopping the pumps and closing the RBV. For small leaks it is also possible to limit the drainage by various source control measures (clamping, gel block). As an initial assumption, these means have been assumed to be in place within four hours throughout the pipeline. Therefore the maximum gravity assisted leak is limited to four hours for medium and small hole sizes.

5.6 Calculation of Spill Volumes

Spill volumes were calculated based on the leak rate and time to isolate. It is important to note that this assessment adopts a conservative approach to estimating spill volumes. The method does not take credit for any reduction in spill volume due to additional actions to control the source aside from shutdown, RBV closure, and plugging. Thus, procedures to reduce spill volume involving depressurization and draindown are not estimated or included. Such procedures would likely be effective for only small and perhaps medium holes.

6.0 Summary and Conclusions

6.1 Calculated Likelihood of Leaks

The risk analysis of the Keystone Pipeline focused on the likelihood of leaks over the entire pipeline during its lifetime. The base frequencies discussed in Section 4.0 were adapted to each segment via application of modification factors. The resulting leak frequencies were summed to provide an average annual leak frequency for the pipeline lifetime.

For the four cases studied, only one case incorporated both the Keystone Mainline and the Cushing Extension, the 591,000 bpd Diluted Bitumen Case. For this case, the likelihood of a leak greater than 50 barrels anywhere along the pipeline is predicted to be about 0.15 per year, or once every 7 years. In the three other cases, where only the Keystone Mainline is included, the likelihood of a leak greater than 50 bbl anywhere along the pipeline is predicted to be about 0.09 per year, or once every 11 years.

The calculated likelihood of spills less than 50 bbl is considerably less than practical experience would dictate. This is primarily the result of historical reporting requirements, as spills of less than 50 bbl were not required to be reported to the DOT within the historical data set. The current requirement of reporting all spills above 5 bbl is therefore not represented in the dataset used in this analysis.

The overall contribution of various causes (as discussed in Section 4.0) to leaks along the pipeline is shown in **Table 6-1**, **Table 6-2**, and **Figure 6-1**. For each cause, the percent contribution is the total frequency for that cause divided by the total leak frequency for all causes.

Table 6-1 Predicted Pipeline Average Leak Frequency, Synthetic Crude

Cause	435,000 bpd Mainline Only		591,000 bpd Mainline Only	
	Percent Contribution	Frequency (per year)	Percent Contribution	Frequency (per year)
Excavation	39%	0.035	37%	0.035
Corrosion	35%	0.032	34%	0.032
Hydraulic Event	0%	0.000	4%	0.004
Mechanical Defect	23%	0.021	22%	0.021
Washout	2%	0.002	2%	0.002
Total	100%	0.090	100%	0.093

Table 6-2 Predicted Pipeline Average Leak Frequency, Diluted Bitumen

Cause	435,000 bpd Mainline Only		591,000 bpd Mainline and Cushing Extension	
	Percent Contribution	Frequency (per year)	Percent Contribution	Frequency (per year)
Excavation	37%	0.035	30%	0.045
Corrosion	34%	0.032	27%	0.040
Hydraulic Event	5%	0.005	24%	0.036
Mechanical Defect	22%	0.021	17%	0.026
Washout	2%	0.002	2%	0.003
Total	100%	0.094	100%	0.151

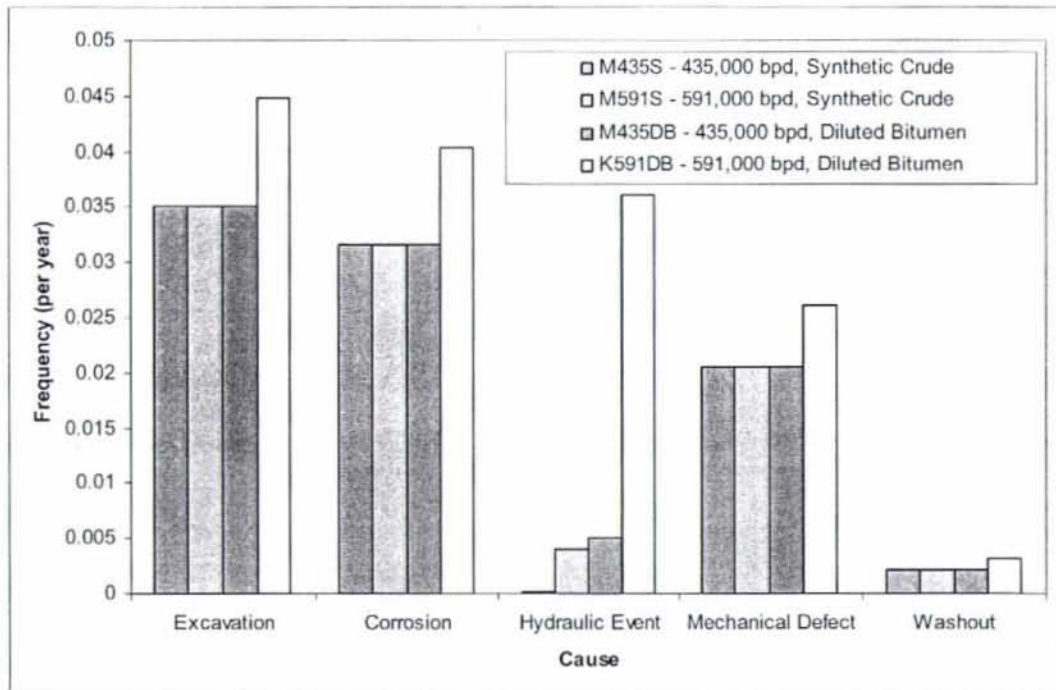


Figure 6-1 Distribution of Pipeline Leak Causes

For all cases, the greatest contributing cause is excavation and the second greatest is corrosion. For the 591,000 bpd Diluted Bitumen case, the next greatest contributing cause is hydraulic events, followed by mechanical defects. For the other cases, the next greatest contributing cause is mechanical defects, followed by hydraulic events. The differences in hydraulic event contribution from the cases are a direct effect of the hydraulic profile and the method used to differentiate higher risk segments regarding hydraulic risk. The 591,000 bpd Diluted Bitumen (K591DB) case is assumed to operate under higher pressure than the 435,000 bpd Keystone Mainline (M435S) case. As a result, the K591DB case is in general closer to the MAOP, which from a risk perspective increases susceptibility to over pressure events.

6.2 Hole Size Distribution

Considering both the Keystone Mainline and the Cushing Extension, approximately 49% of the spills would be from small holes (pinholes), 36% would be from medium sized holes (2 in), and 16% would be from large holes (10 in or greater). When only considering the Keystone Mainline, approximately 57% of the spills would be from small holes (pinholes), 32% would be from medium sized holes (2 in), and 12% would be from large holes (10 in or greater).

Table 6-3 Hole Size Distribution

Case	Small (0.06 inches)	Medium (2 inches)	Large (>10 inches)
M435S	58%	31%	11%
M591S	56%	32%	12%
M435DB	56%	32%	12%
K591DB	49%	36%	16%

6.3 Summary of Frequency-Volume Results

In general, reported incidents over decades provide a good basis for estimating spill volumes and frequencies for new pipelines. However, there are some key weaknesses in this use of such data:

1. Small volume spills are significantly underreported, particularly those less than the reportable quantity.
2. Extremely infrequent events may not have occurred during the period of data collection of incidents.

Figure 6-2 to Figure 6-5 provide a view of the total frequency of spill volumes.

The necessary assumptions and the current design phase of the pipeline required conservative assumptions to be applied, with the result no identified spill volumes between 200 bbl and 1000 bbl for some of the cases. The results should not be interpreted to mean that no spills are likely to occur in that category, but rather, several input assumptions were of a nature that detail in resolution (such as the difference between categories of lesser volume spills and detection time) is unavailable in the output. The category likely falls within the uncertainty of the analysis for a pipeline in the design phase.

The spill volume risk analysis shows the highest frequency for the 50 to 200 bbl category of spill volumes. Spill volumes in this category are driven by leaks that take a long time to detect, as well as medium leaks. Spill volumes between 1000 bbl and 10,000 bbl consist nearly entirely of medium hole leaks, and spills greater than 10,000 bbl consist of large hole size leaks.

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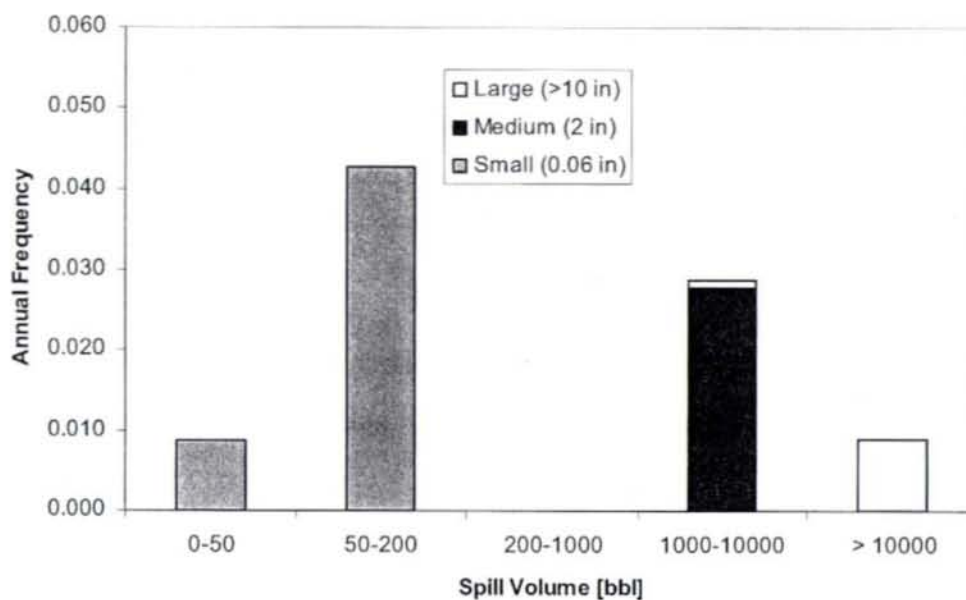


Figure 6-2 Frequency of Spill Volumes by Category (435,000 bpd, Synthetic Crude)

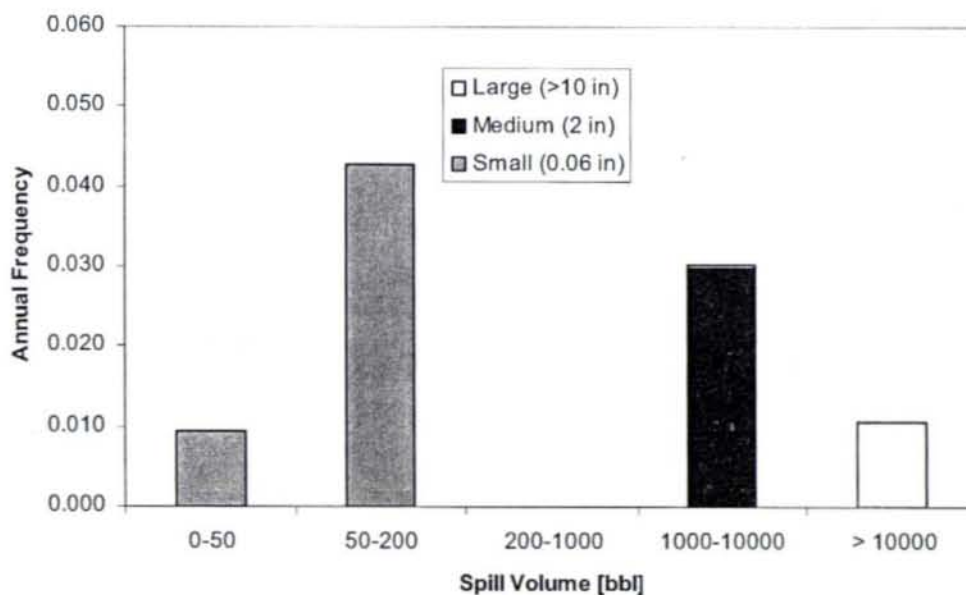


Figure 6-3 Frequency of Spill Volumes by Category (591,000 bpd, Synthetic Crude)

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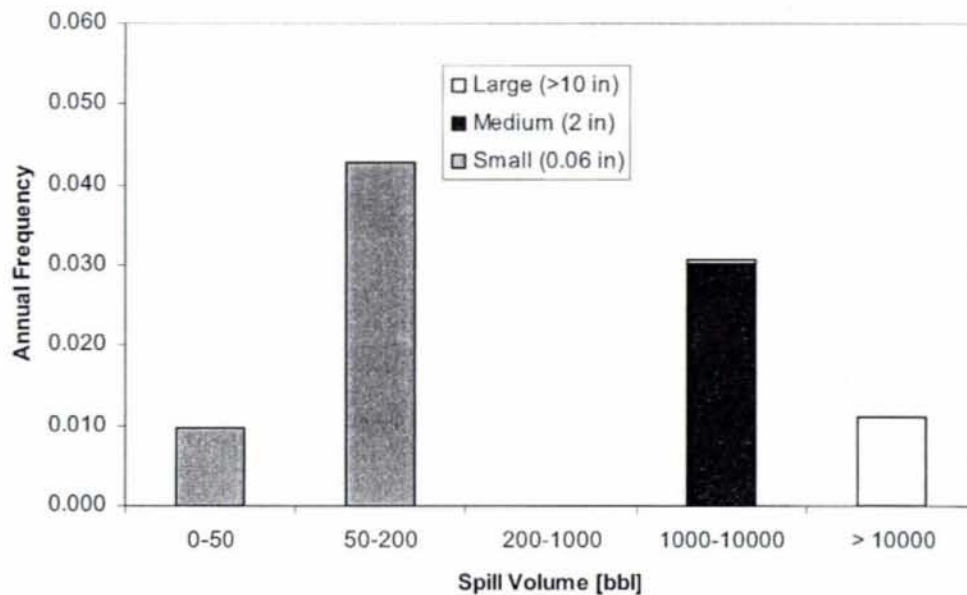


Figure 6-4 Frequency of Spill Volumes by Category (435,000 bpd, Diluted Bitumen)

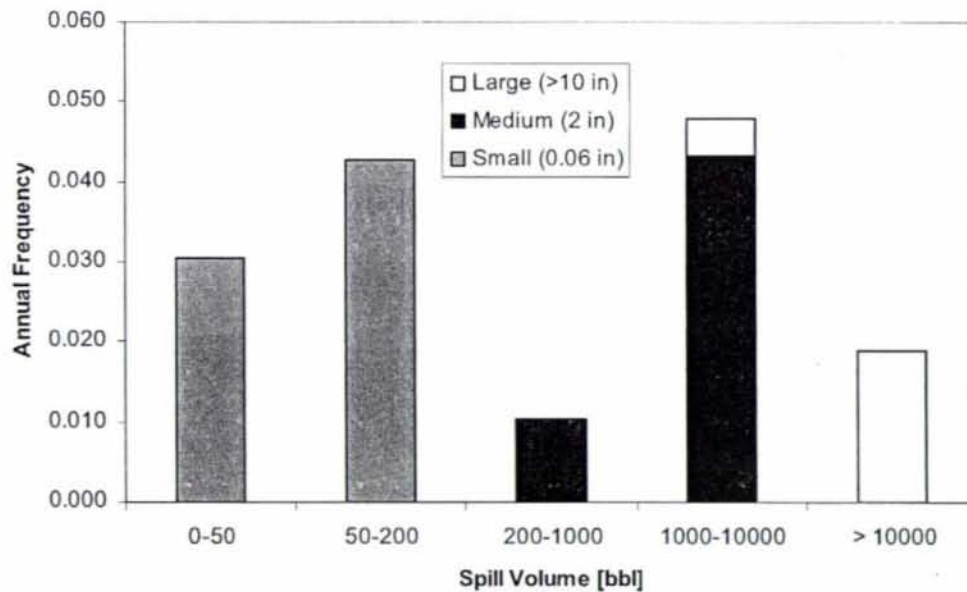


Figure 6-5 Frequency of Spill Volumes by Category (591,000 bpd, Diluted Bitumen)

Figure 6-6 provides a view of the spill size distribution. The cases are described in three categories:

1. Greater throughput, greater pressure, represented by the K591DB case
2. Medium pressure, represented by the M591S and M435DB cases
3. Lesser throughput, lesser pressure, represented by the M435S case

For category 1, 9% of leaks result in spills greater than 20,000 bbl and only 0.7% of the leaks estimated in this study result in spills greater than 30,000 bbl.

For category 2, 4.5% of leaks result in spills greater than 20,000 bbl and only 0.25% of the leaks estimated in this study result in spills greater than 30,000 bbl.

For category 3, 1.5% of leaks result in spills greater than 20,000 bbl and only 0.15% of the leaks estimated in this study result in spills greater than 30,000 bbl.

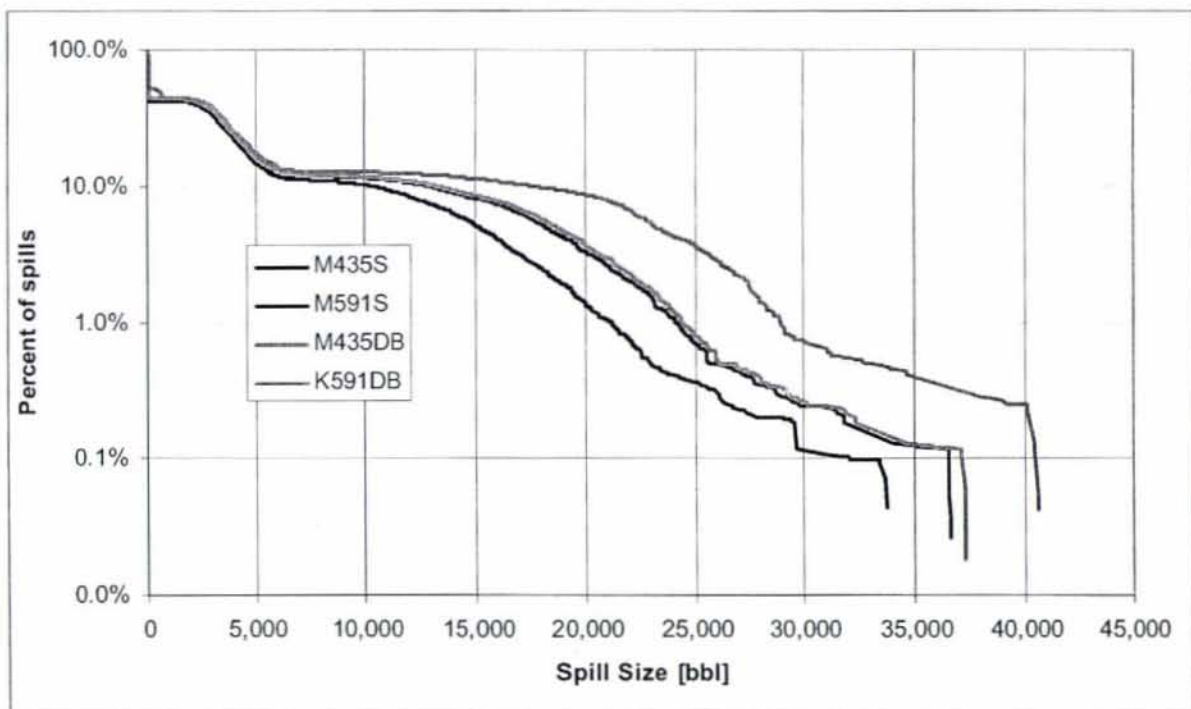


Figure 6-6 Cumulative Spill Volume

The four cases represent the range of expected spills from Keystone Pipeline. However, spill frequency alone does not provide an accurate picture of risk from Keystone. Evaluation of risk requires assessing frequency and consequence together rather than separately, because the

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worst risk scenario is often not the greatest volume release -- a large volume release often is associated with a small frequencies.

To identify the worst-case pairing on frequency and volume (a screening level indicator of risk), the frequency and volume were multiplied and summed per segment for the K591DB case, providing a "risk" number with which to compare the segments of Keystone.

Table 6-4 Largest Spill Volume Segments

Section of Pipeline	Segment Length [mi]	Annual Volume [bbl]	% of Total Annual Volume	Case
Mainline	6.71	11.542	1.9%	K591DB
Mainline	5.16	10.201	1.6%	K591DB
Mainline	6.00	8.700	1.4%	K591DB
Mainline	7.49	8.318	1.3%	K591DB
Mainline	7.00	7.910	1.3%	K591DB
Mainline	5.98	7.779	1.3%	K591DB
Mainline	3.25	6.471	1.0%	K591DB
Mainline	4.29	5.766	0.9%	K591DB
Mainline	4.00	5.311	0.9%	K591DB
Mainline	3.82	5.297	0.9%	K591DB

Keystone has prepared a consequence study that estimates the severity of potential spills from Keystone (paired with their respective frequencies) and identifies those segments posing the greatest risk to the environment. Potential preventive measures will then be evaluated to determine which are the most effective in reducing environmental risk.

This frequency-volume study provides Keystone with a detailed database of failure causes, corresponding likelihood and consequence (in terms of volume released) for the Keystone Pipeline, divided into the smallest relevant subdivisions. Keystone is using the associated database to identify pipeline segments posing the greatest risk (in terms of frequency and volume). This information, taken with fate and transport modeling, is being used to determine where and which additional mitigation measures are appropriate.

6.4 Uncertainties

The data used in this analysis is based on crude transportation pipeline and on gas pipeline data where applicable (external causes). The Diluted Bitumen case has been estimated assuming the failure causes are identical to crude oil. The diluent used, potential presence of oxygen in the diluent, presence of particles in the product, and flow velocity in the pipeline are important factors affecting whether corrosion will be increased or decreased compared to the average pipeline.

The above can be mitigated if necessary, but this study does not assess the effect of diluted bitumen on failure frequencies.

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6.5 Comparison with Generic Pipeline Leak Frequency

Table 6-5 Leak Volume Summary

Case	Leak Volume (per mile per year)
M435S	0.24
M591S	0.29
M435DB	0.30
K591DB	0.45

In summary, the average leak volume per mile for the Keystone Pipeline is estimated in the range of 0.24 bbl to 0.45 bbl per mile per year (**Table 6-5**). For purposes of comparison, pipelines in the U.S. had an average leak frequency of 0.49 bbl per pipeline mile per year during the period 1992 to 2003 (OPS 2006). Thus, the Keystone Pipeline is estimated as better than average regarding oil spill frequency.

7.0 References

DNV 2006 Frequency-Volume Study of Keystone Pipeline, Report no. 70015849-2,
Rev 2, 01 June 2006

OPS 2006 <http://ops.dot.gov/stats/IA98.htm>

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Appendix I:
Generic Failure Rate Data

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I GENERIC FAILURE RATE DATA

I.1 Introduction

Generic failure rates are used in this study to assess spill frequencies for the Keystone Pipeline. This is most specific to the cross-country pipeline portion. The generic failure rate data is separated into cross-country pipeline data and pump station equipment data.

I.2 Cross-Country Pipelines

I.2.1 Introduction

In performing a risk assessment, it is useful to compare the failure history of the system at hand to other sources of information. First, one can gauge whether the pipeline operator is performing up to industry standards. Second, external data sources provide a more statistically significant basis for predicting pipeline failure rates, since most individual pipelines do not have a sufficient operating history to develop statistical significance. However, it is important to select the source of data that is most relevant to the operating conditions and leak reporting standards of the pipeline under review.

There are many sources of pipeline failure rate data. The only source of leak frequencies that clearly defines hole sizes was collected by the European Gas Pipeline Incident Data Group (EGIG, 1993), which covered gas transmission pipelines in Western Europe from 1970 to 1992. This data set also provides good information regarding incident causes.

Probably the largest and best known source of U.S. data is from the U.S. Department of Transportation (DOT) Office of Pipeline Safety, which collects data for both hazardous liquids pipelines and natural gas transmission pipelines. Another good source of U.S. data is the California Pipeline Study published by the California State Fire Marshal (CSFM, 1993). This study had no lower threshold for reporting and collected data regarding several design and operating variables.

Based on comparisons of different sources, the uncertainty in these values is estimated to be up to a factor of three higher for liquid pipelines and a factor of three lower for gas pipelines.

I.2.2 Failure Experience

Major accidents involving cross-country pipelines included:

I.2.2.1 Natural Gas & LPG Spills

- NGL pipeline leak and fire, Austin, Texas, USA, 22 February 1973. A 900-tonne leak of NGL occurred from a 10 inch pipeline. Vehicles stalled inside the cloud and eventually ignited it, killing eight people (Lees 2005 case history A62).
- LPG pipeline leak and fire, Donnellson, Iowa, USA, 4 August 1978. A leak of 435 tonnes occurred from a 16-year-old 8 inch propane pipeline in a rural area. A dent while the pipeline was being constructed and stresses while it was being lowered three months prior to the incident resulted in a 33 inch long split forming. The gas ignited, forming a fireball of 1,000 foot radius, killing three people (Lees 2005 case history A91).
- LPG pipeline leak and fire, Ufa, USSR, 4 June 1989. A leak occurred in an LPG pipeline in a wooded valley, two kilometers from the Trans-Siberian Railway. The operator responded by increasing the pressure. This created a vapor cloud 8 kilometers long. Some hours later, two

trains traveling in opposite directions entered the cloud and ignited it, causing explosions and a fire and derailling the trains, causing an estimated 462 fatalities (Lees 2005 case history A127).

- Natural gas pipeline leak and fire, Caracas, Venezuela, 28 September 1993. An excavator laying telephone cables beside a highway ruptured a gas pipeline, which ignited killing 51 motorists, injuring 41 and destroying 20 vehicles (DNV Technica 1995c K5429).
- Natural gas pipeline leak and fire, Carlsbad, New Mexico, 19 August 2000. The probable cause of this accident was a significant reduction in pipe wall thickness due to severe internal corrosion which had occurred because EPNG's corrosion control program failed to prevent, detect, or control internal corrosion within the company's pipeline. The released gas ignited and burned for 55 minutes. Twelve persons who were camping under a concrete-decked steel bridge that supported the pipeline across the river were killed and their three vehicles destroyed. Two nearby steel suspension bridges for gas pipelines crossing the river were extensively damaged (National Transportation Safety Board, 2003).

I.2.2.2 Gasoline Spills

- Gasoline pipeline leak and fire, Los Angeles, California, USA, 16 June 1976. An 8 inch pipeline in an urban area was punctured by road excavation equipment, causing a 120 x 60 mm hole. The explosion and fire caused eight fatalities, 14 injuries and damaged 16 buildings (Mather and Lines, 1999).
- Gasoline pipeline leak and fire, Bayamon, Puerto Rico, 30 January 1980. A leak of 270 tonnes occurred from a 250 x 150 millimeter hole in a gasoline pipeline caused by a bulldozer during maintenance work on a nearby water pipe. After one and one-half hours, the leak ignited, killing a person who was collecting petrol for personal use and causing damage up to three kilometers away (Mather and Lines, 1999).
- Gasoline pipeline leak and fire, Cubatao, Brazil, 24 February 1984. A leak of 700 tonnes occurred from a 30-year old gasoline pipeline, around which a shanty town had been built. The spill spread along the ground and ignited after two minutes. It was 45 minutes before fire fighters arrived, and by then most of the 2,500 dwellings in the shanty town had been destroyed, killing 508 people (Lees 2005 case history A108).
- Gasoline pipeline leak and fire, San Bernardino, California, USA, 25 May 1989. A 14 inch gasoline pipeline ruptured two weeks after being struck by a derailed freight train. The wreck removal operations may have caused an undetected crack in the pipeline. The rupture was 28 inches long (2x diameter) and 4 inches wide, and sprayed gasoline into a residential area, which ignited causing two fatalities and 31 injuries. A total of 1000 tonnes was spilled due to failure of untested check valves (Mather and Lines, 1999).
- Gasoline pipeline leak and explosion, Guadalajara, Mexico, 22 April 1992. Gasoline leaking through a corrosion hole over several weeks migrated into the sewer system under an urban area. This caused a series of explosions that caused 252 fatalities and destroyed a 20 block area of the city (Mather and Lines, 1999).
- Gasoline pipeline leak and fire, Uong Bi, Vietnam, 2 November 1993. Gasoline leaking from a pipeline in a rural area was ignited, causing 47 fatalities among people collecting it for personal use (Mather and Lines, 1999).
- Gasoline pipeline rupture and fire, Bellingham, Washington, 10 June 1999. A 16-inch-diameter steel pipeline owned by Olympic Pipe Line Company ruptured and released about 237,000 gallons of gasoline into a creek that flowed through Whatcom Falls Park. About 1 1/2

hours after the rupture, the gasoline ignited and burned approximately 1 1/2 miles along the creek. Two 10-year-old boys and an 18-year-old young man died as a result of the accident. Eight additional injuries were documented. A single-family residence and the city of Bellingham's water treatment plant were severely damaged (National Transportation Safety Board, 1999).

- Gasoline pipeline leak, El Paso, Texas, 28 May 2005. An unknown failure of a 12-inch gasoline pipeline resulted in a release of an undetermined volume of gasoline. A respondent discovered a 25-square foot area saturated with gasoline. No fires, injuries, or fatalities were reported in connection with the accident. (Office of Pipeline Safety, 2005)

I.2.2.3 Crude Oil Spills

- Crude oil pipeline punctured, Near Fairbanks Alaska, February 1978. An unknown party bombed the pipeline with plastic explosives at Steel Creek near Fairbanks. As a result, 16,000-barrels (672,000-gallons) were spilled (Rocky Mountain Institute, 2001).
- Crude oil pipeline punctured, Near Fairbanks Alaska, 4 October 2001. An intoxicated 37-year-old local resident, Daniel Lewis, shut down TAPS near its midpoint with a single 0.338-caliber rifle bullet. It punctured the half-inch wall of the 48" pipe (and the surrounding insulation and galvanized sleeve). Approximately 6,800 barrels (285,600 gallons) of crude oil spewed out in a 75-foot, up to 140-gallon-a-minute stream into several acres of forest from the roughly 20,000 barrels (840,000 gallons) of 525-psi oil in the affected section (Rocky Mountain Institute, 2001).
- Crude oil pipeline leak, North Slope, Alaska, 2 March 2006. A leak occurred in a section of pipe built in the late 1970's, depositing up to 267,000 gallons over two acres in the Prudhoe Bay production facilities. Corrosion is initially thought to be the cause of the hole in the pipeline. This spill is still under investigation.

I.2.3 Analysis of EGIG Gas Pipeline Data

I.2.3.1 Data Source

EGIG collected pipeline incident data from a group of eight major pipeline operators in Western Europe for the period 1970-92. The database covers onshore gas transmission lines with a design pressure over 15 bar. In 1992, the pipeline network was 93,000 kilometers, with exposure during 1970-92 of 1.5×10^6 kilometer-years.

The analysis included incidents involving unintentional release of gas occurring outside the fences of installations, and excluding valves or parts other than the pipeline itself. These criteria make it ideal for pipeline Quantitative Risk Assessment (QRA).

The available report does not give numbers of incidents, and only gives frequency graphs; the following summary may include errors from scaling off the graphs.

I.2.3.2 Incident Frequency

The overall incident frequency from 1970-92 was 5.8×10^{-4} per kilometer-year. A declining trend was apparent, particularly during the 1970s. The frequency for 1988-92 was 3.8×10^{-4} per kilometer-year. A coarse analysis of a newer revision of the EGIG (2005) suggests that the frequency is lower.

However, a full analysis has not been performed and the frequency of 3.8×10^{-4} is considered the best estimate for this report.

I.2.3.3 Hole Sizes

EGIG categorizes the incidents as:

- Pinhole/cracks - diameter of defect of 20 millimeter or less
- Holes - diameter of defect between 20 millimeter and pipe diameter
- Ruptures - diameter of defect more than pipe diameter

Table I-1 shows the distribution of hole sizes derived from the data.

Table I-1 EGIG Gas Pipeline Hole Type Distribution, 1970-92

Hole Type	Percent
Pinhole/crack	48
Hole	38
Rupture	14
TOTAL	100

In order to obtain frequencies for different hole sizes, DNV assumed that the "pinhole/crack" category includes all leaks over three millimeter equivalent diameter, while the "rupture" category includes leaks over 300 millimeter equivalent diameter. The following hole size function then gives a good fit to the probability distribution, as shown in **Figure I-1**:

$$F(d) = 3.8 \times 10^{-4} \times 1.55 d^{-0.4} \text{ for } 3 \text{ mm} \leq d \leq D$$

where:

- $F(d)$ = frequency of leaks exceeding diameter d (per km-year)
 d = equivalent diameter of leak (mm)
 D = diameter of pipeline (mm)

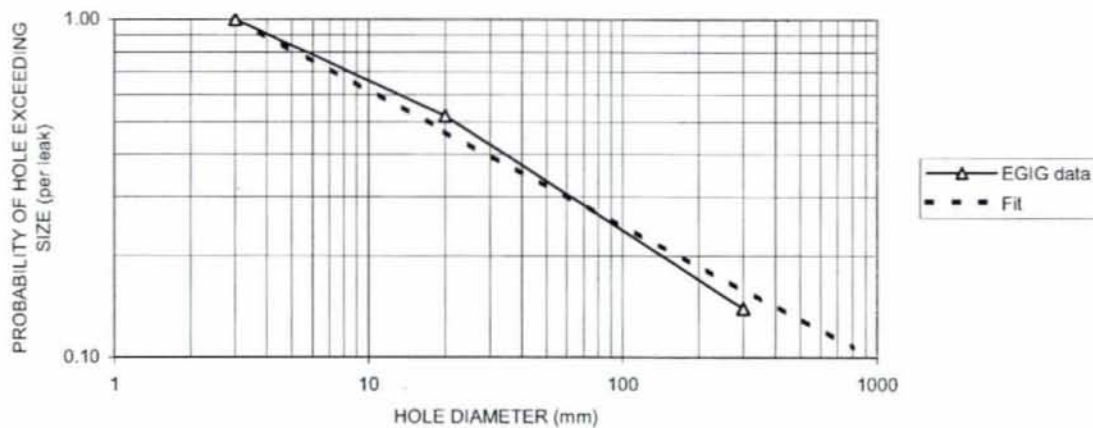


Figure I-1 EGIG Gas Pipeline Hole Size Distribution

I.2.3.4 Incident Causes

Table I-2 summarizes the causes of the incidents in the EGIG data from 1970 to 1996. External interference dominates for both ruptures and medium-sized holes.

Table I-2 Causes of Gas Pipeline Incidents, 1970-96

Cause	% of Pinholes	% of Holes	% of Ruptures	% of Total
External interference	26	77	71	51
Construction/material defect	26	12	12	19
Corrosion	29	0	0	14
Ground movement	3	5	18	6
Hot-tap by error	6	4	0	4
Other/unknown	10	2	0	6
TOTAL	100	100	100	100

I.2.4 Analysis of US Hazardous Liquid Pipeline Data

I.2.4.1 Data Source

The DOT Office of Pipeline Safety collects records of incidents involving hazardous liquid pipelines (crude oil, liquid products and liquefied gases) in the US. The pipeline network amounts to approximately 250,000 kilometer, making it the largest available liquid pipeline incident database. It covers pipeline diameters of 8 inch to 48 inch.

Reportable incidents in the data used for this analysis involved any of the following:

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- Explosion or fire
- Loss of more than 50 barrels of hazardous liquid (previous reporting threshold)
- Escape to atmosphere of more than five barrels per day of highly volatile liquid (i.e. liquefied gas)
- Death or injury
- Property damage exceeding \$50,000 including cost of clean-up and recovery, value of lost product and damage to property.

There is no information on hole sizes in the incident database. The associated population data gives only the total pipeline length, with no breakdown by diameter or any other attribute. This limits the value of the data for QRA.

I.2.4.2 Spill Frequency

The numbers of incidents and exposure during 1986-98 (DOT, 2005a) are given in **Table I-3**. There is a slight declining trend in incident frequency, but this may be influenced by late reporting at the end of the period. The overall experience of 2,595 incidents in 2 million mile-years is a frequency of 8.1×10^{-4} per kilometer-year.

Table I-3 US Hazardous Liquid Pipeline Spills, 1986-96

Year	No. of Incidents	Fatalities	Injuries	Property Damage (\$)	Net Loss (Bbl)	Population (Miles)
1986	209	4	32	16,027,846	219,413	153,462
1987	237	3	20	13,140,434	312,654	152,859
1988	193	2	19	32,414,912	114,251	152,547
1989	163	3	38	8,813,604	121,179	150,488
1990	180	3	7	15,720,422	54,663	149,008
1991	216	0	9	37,788,944	55,774	150,425
1992	212	5	38	38,651,062	68,742	152,595
1993	230	0	10	28,873,651	58,108	165,781
1994	243	1	7	56,453,604	112,348	155,208
1995	188	3	11	32,518,689	53,113	153,566
1996	195	5	13	49,704,731	96,141	154,863
1997	175	0	5	36,565,295	105,952	155,140
1998	154	1	2	57,211,497	51,730	156,753
Totals	2595	30	211	423,884,691	1,424,068	2,002,695

I.2.4.3 Spill Sizes

The gross quantity spilled during 1986-98 of 384,000 m³ is equivalent to 148 m³ per spill. **Table I-4** shows the probabilities of spills by range of standard size bands (DOT).

Table I-4 Hazardous Liquid Pipeline Spill Size Probabilities, 1986-98

Spill Size Range (M ³)	Nominal Spill Size (M ³)	Spill Probability
<1	0.3	0.15
1 - 10	3	0.19
11 - 100	30	0.41
101 - 1000	300	0.22
1001 - 10000	3000	0.03
>10000	30000	0.0004
TOTAL		1.00

An average of 41% was recovered, giving a net spill of 87 m³ per spill. This is sensitive to the materials included, as recovery is not usually relevant for liquefied gases. Kiefner et al (1999) give a breakdown of spills according to whether or not the material was a highly volatile liquid (HVL) for the period 1986-96, from which the average spill sizes in **Table I-5** have been derived.

Table I-5 Hazardous Liquid Pipeline Average Spill Sizes, 1986-96

Pipeline Content	Spills	Average Gross Spill (M ³ Per Spill)	% Recovered	Average Net Spill (M ³ Per Spill)
Non-HVL (crude oil, gasoline, fuel oil etc)	1930	144	53%	68
HVL (liquefied gas)	332	176	0.07%	176
TOTAL	2262	151	43%	86

There is a slight declining trend in quantity spilled. From **Table I-3**, the average net spill for 1996-98 is 77 m³ per spill, which is 12% lower than the average for 1986-98.

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I.2.4.4 Spill Causes

The causes of spills during the period 1986-98 are summarized in **Table I-6**. The large proportion of "other" causes makes this information difficult to use.

Table I-6 Causes of Hazardous Liquid Pipeline Spills, 1986-98

Cause	% of Incidents	% of Gross Spill	Average Gross Spill (M ³ Per Spill)
Corrosion	26	17	101
Failed pipe	6	10	250
Failed weld	5	5	159
Incorrect operation	6	5	116
Malfunction of equipment	5	3	89
Other	26	25	142
Outside force damage	26	35	194
TOTAL	100	100	148

Kiefner et al (1999) give a detailed analysis of causes, as shown in **Table I-7**. Causes are broken down into incidents associated with the pipeline itself, and incidents associated with other facilities such as breakout tanks, pump stations or metering facilities. Non-pipe related incidents accounted for 40% of the total. The DOT data contain a small portion of offshore data (less than 2.5%); the data is therefore assumed to be representative for onshore application.

Table I-7 Causes of Onshore* Hazardous Liquid Pipeline Spills, 1986-96

Cause	% of Incidents
Pipe-related	
Defective girth weld	2.3
Defective pipe	1.8
Defective pipe seam	3.5
Defective repair weld	1.6
External corrosion	19.4
Internal corrosion	9.5
Heavy rains/floods	2.0
Rupture of previously damaged pipe	5.0
Third party	19.9
Total pipe-related	60.5
Non-pipe-related	
Cold weather	1.1
Defective fabrication weld	0.6
Incorrect operation	8.6
Lightning	0.8
Malfunction of control/relief equipment	5.0
Miscellaneous/other	10.8
Ruptured or leaking gasket	5.4
Ruptured or leaking seal or pump packing	2.9
Threads stripped, broken pipe coupling	3.1
Vandalism	1.1
Total non-pipe-related	39.5
Total	100.0

* Offshore population is less than 2.5%

I.2.5 Analysis of US Natural Gas Pipeline Data

I.2.5.1 Data Source

The DOT Office of Pipeline Safety collects records of incidents involving natural gas pipelines (including LNG) in the US. The pipeline network amounts to approximately 525,000 kilometers, making it the largest pipeline incident database.

Reportable incidents involve any of the following:

- Death or injury
- Property damage of \$50,000 or more

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I.2.5.2 Incident Frequency

The numbers of incidents on transmission lines during 1986-98 (DOT, 2005b) are given in **Table I-8**. The pipeline exposure has been extracted from the DOT annual pipeline population databases where available. The total exposure has been estimated by using the average of the available data for the missing years. The overall experience of 1,068 incidents in 4.2 million mile-years is a frequency of 1.6×10^{-4} per kilometer-year.

Table I-8 US Natural Gas Transmission Pipeline Incidents, 1986-96

Year	No. Of Incidents	Fatalities	Injuries	Property Damage (\$M)	Population (Miles)
1986	83	6	20	11.2	
1987	70	0	15	4.7	
1988	89	2	11	9.3	319,811
1989	103	22	28	20.4	324,306
1990	89	0	17	11.3	309,157
1991	71	0	12	11.9	303,171
1992	74	3	15	24.6	312,800
1993	96	1	18	23.0	330,355
1994	81	0	22	45.2	327,799
1995	64	2	10	10.0	327,646
1996	77	1	5	13.1	
1997	73	1	5	12.1	
1998	98	1	11	29.7	326,389
Totals	1068	39	189	226.4	4,162,071

The incidents are broken down according to the part of the system involved, as shown in **Table I-9**. The category "Other" includes offshore risers, storage fields, pig launchers, branch connections and others.

Table I-9 Part of System Involved in Gas Transmission Pipeline Incidents, 1986-96

Part Of System	Incidents	%
Pipeline	831	78
Compressor station	89	8
Regulator metering station	50	5
Other	90	8
Unknown	8	1
TOTAL	1068	100

I.2.5.3 Hole Sizes

The DOT pipeline incident database divides incidents into the following types (**Table I-10**):

- Leaks
- Ruptures, for which a rupture length is given
- Others, such as injury or damage events not involving leaks

The database includes ten incidents with no type allocated. DNV has assumed that the three incidents with a rupture length were ruptures, the four incidents from the body of the pipe without rupture lengths were leaks, and the three incidents from other sources were "Other", i.e. not leaks or ruptures.

The database also divides incidents according to the point where the failure occurred. The category "Other" includes pipeline drips, pig launchers, compressors and appears to include various incorrectly classified valves and fittings.

Table I-10 Incident Type in Gas Transmission Pipeline Incidents, 1986-96

Failure Location	Ruptures	Leaks	Other	Total
Body of pipe	249	231	114	594
Weld	33	51	11	95
Mechanical joint	7	14	19	40
Valve	2	24	13	39
Fitting	5	40	20	65
Other	28	44	140	212
Unknown	1	9	13	23
TOTAL	325	413	330	1068

Figure I-2 gives the distribution of the rupture lengths, expressed as a frequency per pipeline kilometer-year. The rupture length was only recorded for 272 of the 325 ruptures in the database, so the distribution may be a slight underestimate.

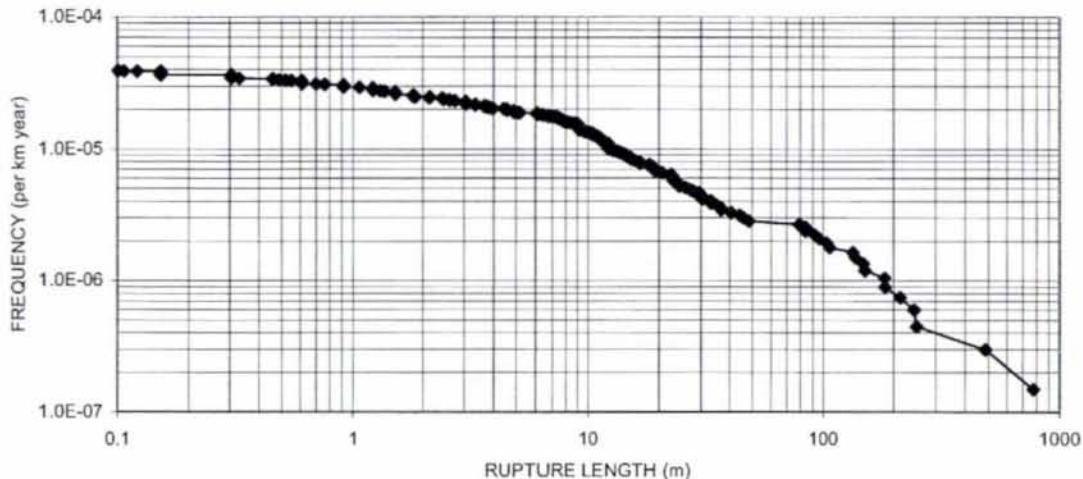


Figure I-2 Gas Transmission Pipeline Rupture Length Distribution, 1986-96

In order to convert the rupture lengths into hole sizes, DNV assumed that the ruptures are diamond-shaped, with a maximum width of 50% of pipeline diameter. Then the hole area is:

$$A = LD/4$$

where:

- A = hole area (m²)
- L = rupture length (m)
- D = pipeline diameter (m)

Using this approach, approximately 60% of ruptures had areas greater than twice the pipe cross-sectional area. When calculating the release rate in a risk analysis, this is the maximum effective hole size, assuming fluid is able to flow towards the hole from both sides of the rupture. The hole area is therefore limited to a maximum of $2\pi D^2/4$.

The equivalent hole diameter is:

$$d = (4A/\pi)^{0.5}$$

The results are shown in **Figure I-3**, together with the frequency of all leaks and ruptures, assumed to have a diameter of at least three millimeters. Most of the curvature in the results is due to the truncation of hole size at twice the pipe cross-sectional area on different pipe diameters, which are mainly in the range 400 to 1000 millimeters.

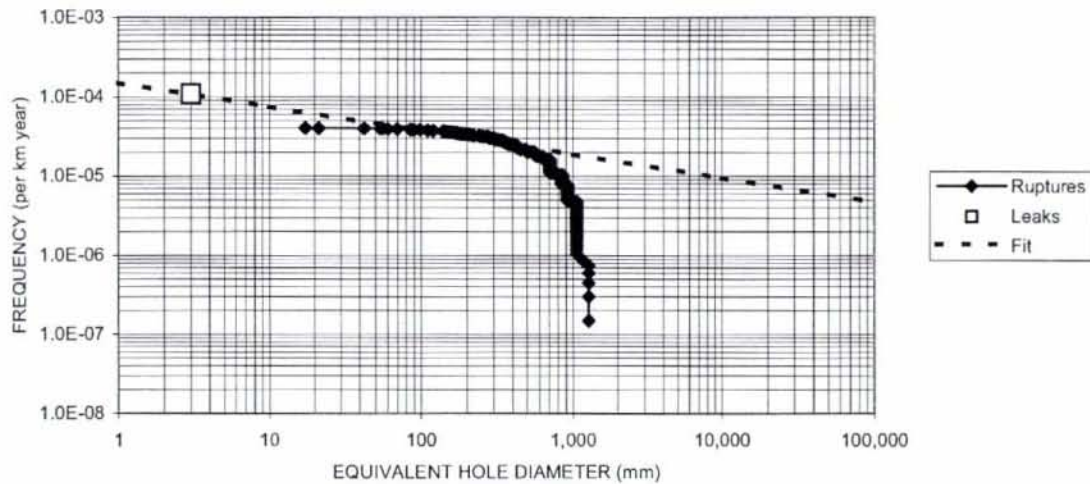


Figure I-3 Gas Transmission Pipeline Hole Size Distribution, 1986-96

The following hole size distribution provides a good fit to the leak frequency and rupture data below 400 millimeter equivalent diameter, as shown in the figure. Using a maximum hole diameter of 1.4D is a convenient representation of the truncation at twice the pipe cross-sectional area:

$$F(d) = 1.5 \times 10^{-4} d^{-0.3} \text{ for } 3 \text{ mm} \leq d \leq 1.4D \text{ mm}$$

where:

- $F(d)$ = frequency of leaks exceeding diameter d (per km-year)
- d = equivalent diameter of leak (mm)
- D = diameter of pipeline (mm)

I.2.5.4 Incident Causes

Table I-11 summarizes the causes of the incidents in the DOT database. Third party impacts are dominant for both ruptures and non-leak incidents.

Table I-11 Causes of Gas Transmission Pipeline Incidents, 1986-96

Cause	% of Ruptures	% of Leaks	% of Other	% of Total
Construction/operating error	14	19	8	14
Corrosion	31	33	2	23
Damage by outside force	41	31	53	41
Other	14	16	38	22
TOTAL	100	100	100	100

I.2.5.5 Effect of Pipeline Diameter

Figure I-4 shows the effect of pipeline diameter on the incident frequency, calculated from the DOT incident and population databases for gas transmission pipelines. The results are plotted on a base of mean pipeline size in the incident data, since the mean sizes in the population data are unknown. The results are sensitive to the treatment of the 15% of incidents for which no pipeline size was recorded. If these incidents are all allocated to the smallest size category (less than four inches), then this appears to have the highest frequency. This was the conclusion from previous analyses. However, the incidents with no pipeline size were not leaks from the pipeline. It would be preferable to neglect these incidents. Then the middle size category (ten to twenty inches) appears to have the highest frequency. It is concluded that there is no clear effect of pipeline diameter on the leak frequencies.

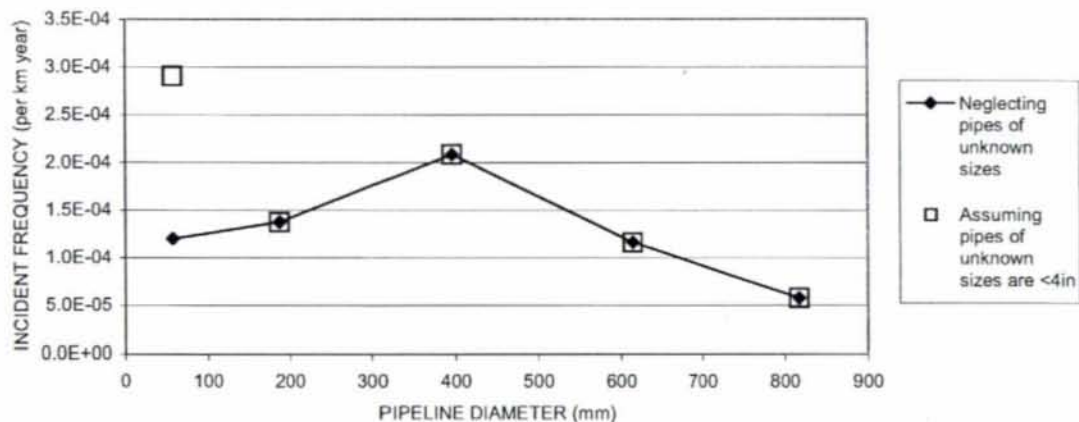


Figure I-4 Effect of Diameter on Gas Pipeline Incident Frequency, 1986-96

I.2.5.6 Effect of Service Type

The DOT incident and population data are divided into transmission and distribution lines, offshore and onshore. The two databases do not fully match, and the following assumptions have been made:

- Offshore pipelines are those recorded as Class 0 in the incident data.
- Transmission pipelines include those recorded as "transmission line of distribution system" in the incident data.

Table I-12 shows the frequencies for the different types of line, expressed as fractions of the overall frequency per kilometer-year. These can be multiplied by the overall frequencies above to estimate the frequency for a specific service type.

Table I-12 Frequency Ratio for Gas Transmission Pipeline Service, 1986-96

Service Type	Ruptures	Leaks + Ruptures	All Incidents
Onshore transmission	1.0	0.8	0.9
Onshore gathering	0.5	0.7	0.6
Onshore total	1.0	0.8	0.8
Offshore transmission	2.0	7.1	6.0
Offshore gathering	2.5	4.5	3.8
Offshore total	2.2	6.4	5.4
TOTAL	1.0	1.0	1.0

This shows that offshore pipelines have higher frequencies, but there are relatively few of these in the database; this has little effect on the overall frequency. The leak frequency shows the effect of associated offshore equipment (i.e. risers, topside processing equipment, pig launchers, etc), and the factor of 2.2 for ruptures is considered to be the best indicator of relative leak frequency. Onshore gathering pipelines have lower than average frequencies by approximately a factor of two. The frequencies for offshore gathering lines are uncertain due to the high proportion of offshore lines for which the type is not specified in the database.

I.2.6 California Pipelines Leak Frequency Data

I.2.6.1 Introduction

In 1993, the CSFM published an analysis of leak rates from regulated pipelines in the state during the 1980s (CSFM, 1993). What is fairly unique about this study compared to other US data sources is the following:

- There was no lower threshold for reporting – that is, in principle, leaks of any size were reported.
- The data were sorted by several design and operating variables of interest.

The impact of these variables on expected pipeline reliability is reviewed next.

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I.2.6.2 Key Design and Operating Variables

Among the key variables identified in this and other analyses of pipeline data are: (1) operating temperature, (2) pipeline age, and (3) pipe diameter. For the conditions of the pipeline, the California data suggest the following:

Variable	Conditions	California Leak Rate (per 1000 mile- years)	Selected Subset of California Data	Trend
Operating temperature	50-60 F	2.38	Pipelines operating at less than 70 F	Failure rates increase with increasing temperature
Pipeline age	30 years, 38 years (currently)	4.17, 8.08	Pipelines 26-35 years old, and 36-45 years old, respectively.	Failure rates increase with increasing age
Pipeline diameter	16", 20"	3.49	Pipelines 16-20" in diameter	Failure rates decrease with increasing pipe diameter

These trends are consistent with what can be deduced from other pipeline databases, although the absolute leak rates are much higher in the California database (presumably because of the low reporting threshold).

A closer analysis of these three variables in the California database reveals that pipeline diameter may not have the impact on failure rates that it appears to have; specifically, the fact that failure rates decline with increasing pipeline diameter appears to result primarily from the fact that larger diameter pipelines tend to be much newer than smaller lines.

In fact, a very good correlation can be developed for the California data based on age and temperature:

$$\text{Leak Rate (per 1000 mile-years)} = [0.0027 \times (\text{age}) \times (\text{temperature})] - 0.80$$

where age is expressed in years, and temperature in degrees Fahrenheit.

I.2.6.3 Other Variables

The California study considers several other variables. Some of these are not discussed below - not because they are not important, but because it is too difficult to isolate the impact of the variable from the influence of temperature and age. Others of common interest to people are briefly assessed next, but were not used as modifiers for the various reasons described. The net effect of not including these other variables, if any, is to make the resulting failure rate conservatively high.

The California data are sorted by three grades of pipe: (1) X-Grade, (2) A53 and Grade B, and (3) Other. A53/Grade B and Other pipe had failure rates 2.7 and 14 times that of X-Grade, respectively, in spite of average operating temperatures that were lower than that used on the X-Grade pipe.

However, the average X-Grade pipe in the California database was installed in 1960 and the others in 1950 on average. The preponderance of data overall is from X-Grade pipe.

I.2.7 Modification of Frequencies for Specific Pipelines

I.2.7.1 Effect of Pipeline Wall Thickness

Increasing the wall thickness of a pipeline, all other parameters being constant, gives greater resistance to external impacts, corrosion and material defects. It should therefore reduce the leak frequency. However, if thickness has been increased to counteract additional hazards, such as high pressure or corrosive environments, this may not change the leak frequency compared to standard conditions.

Figure I-5 shows the effect of wall thickness on external interference and corrosion leak frequencies from the EGIG data for 1970-92 (EGIG, 1993). The results are plotted on a base of the mid-point in each thickness category, which makes the lateral positions on the plots uncertain. It is generally considered that corrosion cannot cause leaks for pipes with over 15 millimeter wall thickness (Hill and Catmur, 1994), as there has been no experience of such events. Extrapolation of this plot suggests that such leaks may occur, but at an extremely low frequency.

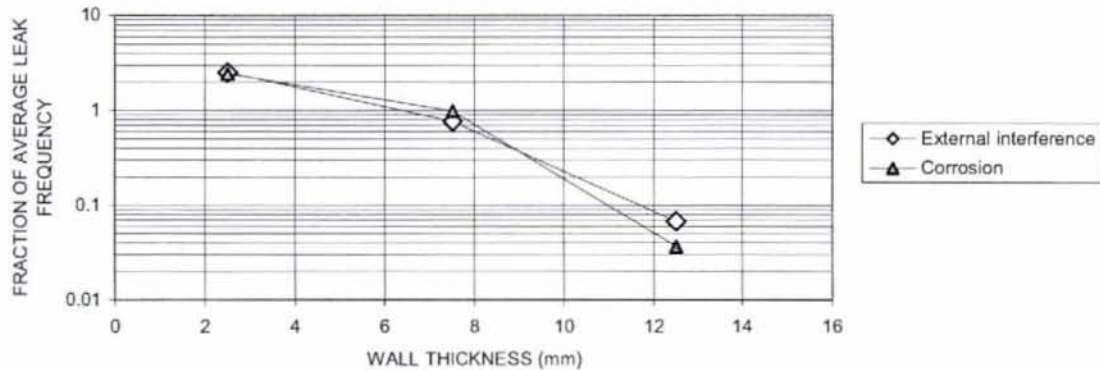


Figure I-5 Effect of Wall Thickness on Third Party and Corrosion Leak Frequencies

The shape of the plot partly reflects the fact that greater wall thickness is usually specified for large diameter pipelines, and hence it cannot be considered additional to any diameter effect. The best available attempt to consider the effects of wall thickness in isolation, at a constant diameter, suggests that leak frequency is inversely proportional to the diameter squared. Hence, the leak frequency for a pipe of non-standard thickness can be estimated as:

$$F(D, t) = F(D) \times (t_s/t)^2$$

where:

- $F(D, t)$ = frequency of any leak (per km-year) for pipeline diameter D and thickness t
- $F(D)$ = frequency of any leak (per km-year) for pipeline diameter D and standard thickness
- T = pipeline wall thickness (mm)
- t_s = nominal pipeline wall thickness (mm)

These are based on a judgmental model, in the absence of any data showing how leak frequency varies with independent changes in diameter and wall thickness.

I.2.7.2 Effect of Design Factor

Pipeline operating conditions are often expressed in terms of a design factor, which is the circumferential stress in the pipe wall at the operating conditions, expressed as a fraction of the specified minimum yield stress of the pipe material. For pipelines with design factors 0.5 to 0.7, the maximum stable hole sizes are usually in the region of 100 millimeter equivalent diameter. There is no need to model leaks between this size and rupture, since any such holes would rapidly grow into ruptures.

This limit is obtained by considering the growth of small flaws in the pipe. Such flaws may be caused by impacts, corrosion or inherent defects. Under normal operating stresses, these flaws grow through the thickness of the pipe until they form a leak. If the flaw is in the form of a crack, and the crack is above a certain critical length, it will then grow rapidly until complete rupture of the pipe occurs.

Ruptures due to crack growth are theoretically virtually impossible if the design factor is less than 0.3, or if the wall thickness is over 19 millimeter and the design factor is less than 0.5 (Townsend and Fearnough, 1986). Ruptures may still occur from natural hazards and massive impacts, but the probability of these is low. Some analyses have neglected the probability of ruptures altogether in these conditions.

I.2.7.3 Effect of Depth of Cover

The leak frequencies are based on combined experience of buried and surface pipelines, but most are buried.

The United Kingdom Health and Safety Executive judgments on the effect of depth of cover on the external impact frequency are (ADL, 1999):

- 0% reduction for 0.9 meter depth
- 25% reduction for 1.5 meter depth
- 50% reduction for 2.0 meter depth
- 99% reduction for 3.0 meter depth

Figure I-6 compares these to data from EGIG for 1970-92, showing some consistency. The EGIG data shows a factor of 3.5 increase in third party damage frequency for cover of 0 to 0.8 meters.

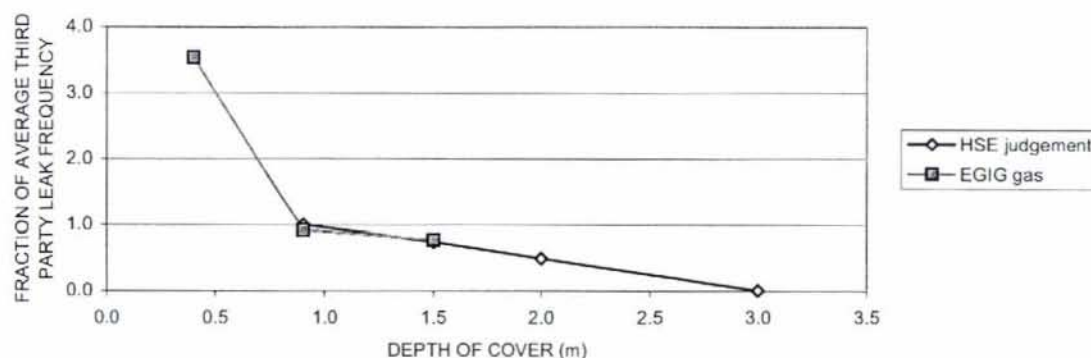


Figure I-6 Effect of Depth of Cover on Third Party Leak Frequencies

I.2.7.4 Effect of Corrosion Protection

Corrosion protection (anti-corrosion coating or cathodic protection) would be expected to reduce the corrosion frequency. Their effects on corrosion incident frequencies in the US gas pipeline data are given in **Table I-13**. These can be multiplied by the corrosion frequencies (based on the overall frequency and the proportion due to corrosion given above) to estimate the corrosion frequency for specific protection type.

Table I-13 Corrosion Frequency Ratios for US Gas Pipelines, 1986-96

Protection Type	All Incidents
Pipelines with corrosion coating and cathodic protection	0.09
Pipelines with corrosion coating but not cathodic protection	12.4
Pipelines with cathodic protection but not corrosion coating	17.4
Pipelines with neither cathodic protection nor corrosion coating	1.5
All pipelines with corrosion coating	0.14
All pipelines with cathodic protection	0.9
All pipelines without corrosion coating	12.0
All pipelines without cathodic protection	2.7
TOTAL	1.0

These results show a very large effect of corrosion protection on corrosion incident frequencies. Some anomalies arise because of the significant number of incidents where the corrosion protection is not recorded in the database. The low corrosion frequency for pipelines with no corrosion protection may result from these being in less corrosive environments.

CSFM (1993) shows a factor of five difference between liquid pipelines with and without cathodic protection, which is slightly greater than the overall factor of three for gas lines in the DOT data. There

was no significant difference between impressed current and sacrificial anode types. The study also quantified the effects of various external pipe coating types.

I.2.7.5 Effect of Pipeline Route

Urban locations will increase the frequencies in various ways. The following assumptions have been used in previous studies:

- Location along the edge of a main road (DNV Technica 1992b, C3006):
 - No Change if barriers in place
 - Material defect increased by a factor of 2
 - Construction defect increased by a factor of 3 due to difficulty of access.
- Location along the central reservation of a main road (DNV Technica 1992b, C3006):
 - External impact frequency increased by a factor of 1.5 due to road maintenance activities.

I.2.7.6 Effect of Intelligent Pigging

The effect of intelligent pigging has been represented by (DNV Technica 1992a, C3239) and other sources for frequencies outside the normal range of four to seven years:

Table I-14 Intelligent Pigging Modification Factors

Frequency of Intelligent Pigging	Corrosion Modifying Factor	Defect Modifying Factor
0-3 years	0.5	0.5
4-7 years	1.0	1.0
>7 years	2.0	2.0

CSFM (1993) also presents an analysis of the effects of internal inspection.

I.2.7.7 Effect of Decade of Construction

The effect of the decade of construction of pipelines was examined by Kiefner and Trench (2001) in a report for the API Pipeline Committee. A key finding from the report was that due to materials of construction, welding techniques, and inspection methods that failures due to material/construction defects were significantly less likely for pipelines constructed in the 1970s and later relative to those constructed from the 1930s through the 1960s. Pipelines constructed prior to the 1930s fared much worse. Combining the effects of longitudinal welds (much greater differential) and girth welds, DNV has estimated the following adjustment factors for the decade of construction:

- Construction prior to 1930s – 2.0
- Construction 1930s through 1960s - 1.0
- Construction 1970s and Later - 0.5

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Overview of the Valve and Pump Station Relocation Rationale

March 2007

Keystone is continually evaluating its pipeline system to identify methods that can reduce potential impacts to the environment. As part of that ongoing analysis, Keystone has relocated some valves and pump stations and has added additional valves in key locations. This submittal identifies these modifications and provides the rationale for the changes.

Pump Stations

Since Keystone initially sited the pump stations, supplemental information has been gathered from electrical power utilities. As a result, seven pump stations have been relocated. Keystone discussed the pump stations' specific electric power requirements with local utility providers. Based on the information obtained from these providers, Keystone has moved pump stations #31 and #36 so that they will now be located adjacent to substations. Minor adjustments were made to the locations of pump stations #27, #30, #34, and #35 to reduce the length of transmission power lines required. Relocation of pump station #27 also moved the site out of native grasslands and into pasture lands. Similarly, relocation of pump station #30 moved the site out of a creek bed. Additionally, pump station #21 was relocated across the road, from Clark and into Beadle County, in an effort to equitable distribute the tax benefits among the affected counties.

Valves

Keystone has evaluated the location of valves through an iterative process involving regulatory, environmental, and HCA considerations. While U.S. Department of Transportation (USDOT) regulations stipulate the minimum number of valves required to protect environmental resources, Keystone has elected to add additional valves to further segment the pipeline, increasing the ability of Keystone to isolate the pipeline in the unlikely event of a pipeline spill.

Initially, valves were placed in locations as required by federal regulations (49 CFR 195), including on either sides of large rivers and in areas to protect drinking water reservoirs. Further analysis has been subsequently conducted to determine if other sensitive resources could be protected by shifting these initial valve sites (while still complying with federal regulations) or by the addition of new valves. Keystone evaluated valve locations in relation to environmental resources, including HCAs and shallow aquifers.

After initial valve locations were identified, a preliminary evaluation of USDOT-defined HCAs was conducted by Keystone (Appendix B of the Keystone Risk Assessment). This evaluation identified and ranked HCAs that could be potentially affected by a pipeline spill. Upon completion of the HCA evaluation, valve locations were re-assessed to determine where relocation (while still complying with federal regulations) or the addition of new valves could mitigate potential risk to HCAs.

These revised locations were then compared to the location of shallow groundwater aquifers (as identified in Data Request #1). Valve locations were again re-assessed to determine where relocation (while still complying with federal regulations and providing protection of HCAs) or the addition of new valves could mitigate potential risk to shallow aquifers.

Finally, additional valves were added to reduce the length of pipe between isolating valves, particularly in those areas where spill volumes and frequencies were predicted to be higher than other areas. Appendix A of the Risk Assessment discusses the process used to identify those areas. However, these sites are not specifically identified due to Homeland security issues.

The results of this iterative process are provided in **Table 1**, Valve and Pump Station Relocation Rationale.

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Valve and Pump Station Relocation Rationale Keystone Pipeline Project March 22, 2007

LINE	Old MP - mi -	New MP - mi -	COUNTY	STATE	OBJECT	OBJECT ID	RATIONALE FOR RELOCATION
KEYSTONE MAINLINE							
ML	5.592	5.592	Cavalier	ND	VALVE	V-01	
ML	8.220	8.220	Pembina	ND	VALVE	V-02	
ML	16.756	16.756	Pembina	ND	VALVE	V-03	
ML	19.518	19.518	Pembina	ND	VALVE	V-04	
ML	33.032	33.032	Walsh	ND	PUMP STATION	PS-15	
ML	-	49.450	Walsh	ND	VALVE	V-47	New Valve: Check valve which protects Linkin PA and surface water HCA on South Park River below Hammel Reservoir
ML	75.916	75.916	Nelson	ND	PUMP STATION	PS-16	
ML	123.411	123.411	Steele	ND	PUMP STATION	PS-17	
ML	167.219	167.219	Barnes	ND	VALVE	V-05	
ML	170.222	170.222	Ransom	ND	PUMP STATION/ PIGGING FACILITY	PS-18	
ML	179.601	179.601	Ransom	ND	VALVE	V-06	
ML	184.696	184.696	Ransom	ND	VALVE	V-07	
ML	-	201.879	Sargent	ND	VALVE	V-51	New Valve: Valve will protect downstream aquifer located between MP 203-217
ML	216.820	216.820	Dickey	ND	PUMP STATION	PS-19	
ML	-	239.939	Marshall	SD	VALVE	V-48	New Valve: Valve reduces distance between facilities to reduce overall maximum spill volumes
ML	262.161	262.161	Day	SD	PUMP STATION	PS-20	
ML	-	276.398	Clark	SD	VALVE	V-52	New Valve: valve will protect downstream aquifer located between MP 278-290
ML	292.908	292.908	Clark	SD	VALVE	V-08	
ML	300.932	300.932	Clark	SD	VALVE	V-09	
ML	308.950	309.038	Clark	SD	PUMP STATION	PS-21	Pump station was moved across street out of Clark County and into Beadle County
ML	-	330.761	Kingsbury	SD	VALVE	V-49	New Valve: Valve reduces distance between facilities to reduce overall maximum spill volumes
ML	353.501	353.501	Miner	SD	VALVE	V-10	
ML	356.820	356.820	Miner	SD	PUMP STATION	PS-22	
ML	365.864	372.225	Hanson	SD	VALVE	V-11	Moves V-11 to protect aquifer located between MP 358-371
ML	391.765	387.673	McCook	SD	VALVE	V-12	Moves V-12 to north side of Wolf Creek ESA
ML	404.853	404.853	Hutchinson	SD	PUMP STATION/ PIGGING FACILITY	PS-23	
ML	420.790	417.485	Yankton	SD	VALVE	V-13	Moves V-13 further north from James River ESA to capture tributary of James River
ML	422.548	-	Yankton	SD	VALVE	V-14	Eliminated V-14, V-15 will serve as valve on the north side of the Missouri River, protecting James River, Beaver Creek, and HCAs associated with the James and Missouri rivers area
ML	434.066	429.912	Yankton	SD	VALVE	V-15	Moves V-15 further north of Yankton PA, protecting James River, Beaver Creek, and HCAs associated with the James and Missouri rivers area
ML	438.754	444.093	Cedar	NE	VALVE	V-16	Move V-16 further downstream to protect Yankton, Surface DW USA and multiple Missouri River ESAs
ML	452.691	452.691	Cedar	NE	PUMP STATION	PS-24	
ML	499.099	499.099	Stanton	NE	PUMP STATION	PS-25	
ML	505.375	505.375	Stanton	NE	VALVE	V-17	
ML	532.146	532.146	Colfax	NE	VALVE	V-18	
ML	533.131	537.311	Colfax	NE	VALVE	V-19	Moves V-19 south, closer to Platte River and its ESAs
ML	540.926	-	Colfax	NE	VALVE	V-20	Remove V-20, V-19 will serve as valve for Platte River ESAs
ML	542.845	546.361	Butler	NE	VALVE	V-21	Move V-21 outside of Deer Creek which flows into Platte River ESAs
ML	549.536	549.536	Butler	NE	PUMP STATION	PS-26	
ML	572.026	572.026	Seward	NE	VALVE	V-22	
ML	576.086	576.086	Seward	NE	VALVE	V-23	
ML	587.284	587.284	Seward	NE	VALVE	V-24	
ML	591.748	591.748	Saline	NE	VALVE	V-25	
ML	601.802	601.802	Saline	NE	PUMP STATION	PS-27	It avoids the need for longer new overhead transmission lines and lowers the cost of the power infrastructure for the project.
ML	-	611.819	Saline	NE	VALVE	V-53	New Valve to decrease spacing between PS-27 and PS-28 and the Ogallala Aquifer
ML	625.800	625.800	Jefferson	NE	DENSITOMETER	D-1	
ML	637.301	637.301	Jefferson	NE	PUMP STATION/ PIGGING FACILITY	PS-28	
ML	658.030	654.954	Marshall	KS	VALVE	V-26	Move V-26 further east to protect Deer Creek as well as North Elm Creek ESA

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Valve and Pump Station Relocation Rationale Keystone Pipeline Project March 22, 2007

LINE	Old MP - mi -	New MP - mi -	COUNTY	STATE	OBJECT	OBJECT ID	RATIONALE FOR RELOCATION
ML	660.157	667.520	Marshall	KS	VALVE	V-27	Move V-27 further west to protect North Elm Creek ESA and its tributaries
ML	681.925	681.925	Nemaha	KS	VALVE	V-28	
ML	688.198	688.198	Nemaha	KS	PUMP STATION	PS-29	
ML	690.271	698.876	Nemaha	KS	VALVE	V-29	Move V-29 (check valve) to the east of multiple surface and ground water USA buffers and also protects downstream transport along South Fork Big Nemaha River or Harris Creek
ML	-	718.343	Brown	KS	VALVE	V-54	New Valve: Valve will help isolate multiple aquifers upstream and downstream
ML	736.837	736.837	Doniphan	KS	PUMP STATION/ PIGGING FACILITY	PS-30	It avoids the need for longer new overhead transmission lines and lowers the cost of the power infrastructure for the project.
ML	747.475	741.502	Doniphan	KS	VALVE	V-30	Move V-30 further east of tributaries that flow into Missouri River ESAs
ML	749.834	749.834	Buchanan	MO	VALVE	V-31	
ML	760.962	756.000	Buchanan	MO	VALVE	V-32	Move V-32 further east to help protect tributaries that flow into Missouri River ESAs and also move east of Agency PA
ML	763.841	763.841	Buchanan	MO	VALVE	V-33	
ML	782.330	784.057	Clinton	MO	PUMP STATION	PS-31	It avoids the need for longer new overhead transmission lines and lowers the cost of the power infrastructure for the project.
ML	829.799	829.799	Carroll	MO	PUMP STATION	PS-32	
ML	839.502	839.502	Carroll	MO	VALVE	V-34	
ML	843.546	847.080	Chariton	MO	VALVE	V-35	Move V-35 to isolate aquifer and incorporate Salt Creek into isolation area
ML	859.748	859.748	Chariton	MO	VALVE	V-36	
ML	864.679	864.679	Chariton	MO	PUMP STATION	PS-33	
ML	-	883.644	Randolph	MO	VALVE	V-50	New Valve: Valve reduces distance between facilities to reduce overall maximum spill volumes
ML	903.804	898.923	Audrain	MO	PUMP STATION	PS-34	It avoids the need for longer new overhead transmission lines and lowers the cost of the power infrastructure for the project.
ML	918.380	918.380	Audrain	MO	VALVE	V-37	
ML	919.965	919.965	Audrain	MO	VALVE	V-38	
ML	947.536	944.581	Montgomery	MO	PUMP STATION	PS-35	It avoids the need for longer new overhead transmission lines and lowers the cost of the power infrastructure for the project.
ML	970.398	968.192	Lincoln	MO	VALVE	V-39	Move V-39 east of Troy PA
ML	972.803	972.803	Lincoln	MO	VALVE	V-40	
ML	980.898	980.898	Lincoln	MO	VALVE	V-41	
ML	984.865	984.865	St. Charles	MO	PUMP STATION	PS-36	Pump station will be co-located with Central Electric substation, eliminating the need for transmission power lines
ML	-	999.770	St. Charles	MO	VALVE	V-46	New Valve: Valve to protect east side of multiple ESAs (Missouri and Mississippi rivers) and surface and ground water drinking water USAs near Mississippi River
ML	1012.078	1012.078	St. Charles	MO	DENSITOMETER	D-2	
ML	1019.876	1015.119	St. Charles	MO	VALVE	V-42	Move V-42 next to Highway 67 to provide better access to valve in case of flooding
ML	1022.756	1022.756	Madison	IL	PUMP STATION/ PIGGING FACILITY	PS-37/ WOOD RIVER TERMINAL	
ML	1044.945	1044.945	Madison	IL	VALVE	V-43	
ML	1049.814	1049.814	Bond	IL	PUMP STATION	PS-38	
ML	1065.465	1065.465	Bond	IL	VALVE	V-44	
ML	1074.951	1074.951	Fayette	IL	VALVE	V-45	
ML	1077.925	1077.925	Marion	IL	PUMP STATION/ PIGGING FACILITY	PATOKA TERMINAL	

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Valve and Pump Station Relocation Rationale Keystone Pipeline Project March 22, 2007

LINE	Old MP - mi -	New MP - mi -	COUNTY	STATE	OBJECT	OBJECT ID	RATIONALE FOR RELOCATION
CUSHING EXTENSION							
CE	15.581	15.581	Washington	KS	VALVE	V-01	
CE	-	36.664	Clay	KS	VALVE	V-14	New Valve: Valve would isolate multiple aquifers
CE	49.971	49.971	Clay	KS	VALVE	V-02	
CE	53.867	53.866	Clay	KS	VALVE	V-03	
CE	74.043	67.445	Dickinson	KS	VALVE	V-04	Move V-04 north of multiple groundwater USAs and Chapman PA also moved upstream of Chapman Creek
CE	77.087	77.090	Dickinson	KS	VALVE	V-05	
CE	94.398	94.398	Dickinson	KS	PUMP STATION	CE30	
CE	113.443	102.466	Marion	KS	VALVE	V-06	Move V-06 to protect downstream side of multiple ESAs of Lyon Creek and upstream side of Mud Creek ESA, also multiple DW USAs
CE	117.453	121.507	Marion	KS	VALVE	V-07	Move V-07 downstream to protect Marion PA and Clear and Cottonwood Creeks surface water USA
CE	-	145.862	Butler	KS	VALVE	V-15	New Valve: Valve will reduce gap between V-07 and PS-CE32
CE	183.470	183.470	Cowley	KS	PUMP STATION	CE32	
CE	194.537	194.537	Cowley	KS	VALVE	V-08	
CE	10210.580	10210.580	Cowley	KS	VALVE	V-09	
CE	10224.554	10224.554	Kay	OK	DENSITOMETER	D-1-CE	
CE	228.389	228.389	Kay	OK	PUMP STATION	CE33	
CE	235.934	235.934	Kay	OK	PIGGING FACILITY	PONCA CITY TERMINAL	
CE	244.763	244.763	Noble	OK	VALVE	V-10	
CE	-	256.571	Noble	OK	VALVE	V-13	New Valve: valve protects south side of surface water USA and terrestrial ESAs at Sooner Lake and HCAs associated with Arkansas River
CE	284.333	278.242	Payne	OK	VALVE	V-11	Move V-11 further north of Cimarron River ESA and associated surface water USA
CE	279.442	279.442	Payne	OK	PAD CENTROID	D-2-CE	
CE	285.462	285.462	Payne	OK	VALVE	V-12	
CE	291.770	291.770	Payne	OK	PIGGING FACILITY	CUSHING TERMINAL	

LINE	MP - mi -	New MP - mi -	COUNTY	STATE	OBJECT	OBJECT ID	RATIONALE FOR RELOCATION
HCS	10217.579	10217.579	Sargent	SD	PUMP STATION	PS-19-ALT	
BCR	10981.245	10981.245	St. Charles	MO	PUMP STATION	PS-36-ALT	
BCR	10986.029	10986.029	St. Charles	MO	VALVE	V-41-ALT	
WR	11025.437	11025.437	Madison	IL	PUMP STATION/ PIGGING FACILITY	PS-37-ALT/ WOOD RIVER TERMINAL	



Overview – Keystone Pipeline Project Biological Survey Reports

March 2007

Biological Surveys and Reports

Construction and operation of the Keystone Pipeline Project may affect habitats and populations of species protected under the federal Endangered Species Act and by individual State legislation. During 2006, TransCanada Keystone Pipeline, L.P. (Keystone) initiated contact with the U.S. Fish and Wildlife Service (USFWS), and state natural heritage programs and wildlife agencies to identify species and habitats of concern. After receiving lists of species and habitats, Keystone developed field survey protocols, target survey areas, and survey schedules. These protocols were submitted to the USFWS and state agencies for review. No agencies objected to the proposed protocols; agency comments received on the protocols were incorporated into survey protocols. Agency coordination documentation and survey protocols were filed by Keystone with the Department of State (DOS) on September 15, 2006, and in January 2007. Further Agency coordination that has taken place since the January filing date is included in this March 2007 supplemental filing.

Biological field surveys along the proposed Keystone Mainline pipeline right-of-way were initiated in late summer and fall of 2006. Additional field surveys will be conducted in 2007 where necessary to determine species occurrence in the appropriate season, to survey pipeline reroutes, pump stations, pipe storage yards, and contractor yards, as well as pipeline segments where access was not previously available. Field surveys also will be conducted along the Cushing Extension and its pump station sites, pipe storage yards, and contractor yards during 2007.

The biological survey reports included in this filing will be used for: 1) preparation of a Biological Assessment as part of the USFWS Section 7 consultation; 2) documentation for the Environmental Impact Statement; and 3) preparation of state agency permit applications.

The reports filed herein include the results of field work completed in the winter, 2007. In addition, desktop analysis reports were prepared based on agency correspondence (e.g., USFWS, Missouri Department of Conservation, and Natural Heritage Program/NatureServe), and species habitat association, in combination with aerial habitat surveys and wetland/waterbody field surveys, U.S. Geological Survey Land Use Land Cover data, and aerial photography, and are included in this filing.

Wetlands Report

Construction and operation of the Keystone Pipeline Project may also affect wetlands and Waters of the U.S. (WUS). During 2006, Keystone initiated contact with the U.S. Army Corps of Engineers (USACE) and USFWS regarding wetlands survey protocols and potential impacts. Wetland survey protocols were submitted to the individual USACE Districts along the proposed right-of-way (ROW) for review. These include the Omaha, Kansas City, St. Louis, and Tulsa Districts. Agency comments received were incorporated into wetland survey protocols. Agency coordination documentation and survey protocols were filed by Keystone with the DOS on September 15, 2006. Further Agency coordination that has taken place since the September filing date is included in this March 2007 supplemental filing.

Wetlands and WUS surveys along the proposed Keystone Mainline pipeline ROW were initiated in summer 2006. Wetlands and WUS surveys along the proposed Cushing Extension pipeline ROW were initiated in the spring of 2007. These surveys were conducted along the pipeline ROW that was filed with the DOS on September 15, 2006. Additional field surveys will be conducted in 2007 where necessary to complete survey requirements in each District, including reroutes and pipeline segments where access was not previously available.

The report filed herein includes the results of all wetlands survey work completed along the Cushing Extension to-date.

Biological and Wetlands Survey Progress

The attached table outlines Keystone's process for the collection and submission of biological and wetlands/WUS data.

Keystone Pipeline Project – Biological Survey Report Completion Plan – March 2007

Survey Objective	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Future DOS Filing Dates
Rare Plants (western fringed orchid, eastern fringed orchid, small white ladies slipper orchid, decurrent false aster, running buffalo clover, prairie spiderwort, royal catchfly, spring ladies tresses)	Survey completion status: Western prairie fringed orchid: Habitat surveys – 90% Occurrence surveys – 0% Other rare plants: Habitat surveys – 0% Occurrence Surveys – 0% 2007 spring /summer – Occurrence surveys (Keystone Mainline and Cushing Extension).	Agency consultation records and species lists. Preliminary survey areas.	Documentation of potential suitable orchid habitats in North and South Dakota, and Nebraska (including photographs and habitat suitability for western fringed orchid is provided in the Native Prairie Survey Report above discussed below).	Agency consultation records.	Agency consultation records.	August 2007 Summary of surveys completed; occurrence data.
Wetlands and Waters of the U.S.	2006 delineation surveys Keystone Mainline survey completion status as of December 2006 ND – 95% SD – 83% NE – 100% KS – 98% MO – 83% IL – 89% Overall – 85% Spring 2007-Cushing delineation surveys. Cushing survey completion status as of February 23, 2007 NE – 100% (L)	Consultation records with USACE. Preliminary survey areas.	Summary of survey progress. List of wetland crossings by type, and distances crossed.		Wetlands Survey Status Report – Cushing Extension.	April 2007 - Cushing Extension – additional survey reports and wetland crossing list. September 2007 404 Applications filed with USACE Districts.

Keystone Pipeline Project – Biological Survey Report Completion Plan – March 2007

Survey Objective	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Future DOS Filing Dates
	KS – 84% (L) OK – 50% (M) Overall – 85% (L) Overall – 50% (M)					
Native Prairie	Survey completion status: SD, ND -90% (Keystone Mainline) NE– 0% (Keystone Mainline) KS, OK – 0% (Cushing) Fall 2006 – Preliminary Spring 2007 – Supplemental surveys (Keystone Mainline, Cushing Extension).	Agency consultation records and species lists. Preliminary survey areas.	Habitat Assessment for ND and SD	Agency consultation records.	Agency consultation records.	May 2007 - Keystone Mainline - Supplemental surveys with site descriptions (reroutes). April or May 2007 - Cushing Extension habitat descriptions.
Mussels	Survey completion status - SD (James River) - 100% KS (Cottonwood River, Doyle Creek) – 0% 2007 late summer/fall – habitat/occurrence surveys completed along Cushing Extension	Agency consultation records and species lists. Preliminary survey areas.	Survey methods and results, habitat descriptions. No listed mussels were found.	Agency consultation records.	Agency consultation records.	Fall 2007 KS (Cushing) survey reports based on spring/summer field reconnaissance

Keystone Pipeline Project – Biological Survey Report Completion Plan – March 2007

Survey Objective	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Future DOS Filing Dates
Dakota Skipper butterfly	Survey completion status: Habitat – 90% Occurrence – 0% Summer 2007 (Occurrence Surveys -Keystone Mainline in ND and SD).	Agency consultation records Preliminary survey areas.	Documentation of potential suitable habitats in North and South Dakota (including photographs and habitat suitability for Dakota skipper is provided in the Native Prairie Survey Report above discussed above).	Agency consultation records.	Agency consultation records.	July 2007 • Occurrence surveys with site descriptions.
Topeka Shiner	Survey completion status: Habitat Surveys SD, KS, MO – 94% (Keystone Mainline) KS – 0% (Cushing) Occurrence Surveys KS, MO – 100% (Keystone Mainline) SD, KS – 0% Spring 2007 Keystone Mainline and Cushing occurrence surveys – SD, KS (Cushing)	Agency consultation records. Preliminary survey areas.	Survey methods and results, habitat descriptions.	Updated KS/MO Topeka shiner survey report. Agency consultation records.	Agency consultation records.	July 2007 • Survey reports based on spring/summer field reconnaissance in SD and KS (Keystone Mainline and Cushing).
Fish (Arkansas River shiner, Arkansas darter, silver chub, speckled chub, Neosho madtom)	Survey completion status: Habitat surveys: KS – 0% (Cushing) Occurrence surveys: KS – 0% (Cushing) Spring 2007 habitat and occurrence surveys – KS (Cushing)	No information filed.	No information filed.	Agency consultation records.	Agency consultation records.	Fall 2007 • Survey reports based on spring/summer field reconnaissance in KS (Cushing).

Keystone Pipeline Project – Biological Survey Report Completion Plan – March 2007

Survey Objective	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Future DOS Filing Dates
Reptiles and Amphibians (Massasauga, Kirtland's snake, Western fox snake)	Survey completion status: Habitat Surveys: MO, IL – 100% of accessible sites IL – 0% Occurrence Surveys: MO, IL– 0% Spring 2007 – Complete habitat surveys – MO, IL. Spring/summer 2007 – Occurrence surveys.	Agency consultation records. Preliminary survey areas and protocols.	No information filed.	Habitat survey reports based on surveys completed in fall/winter 2006. Report letters detailing further survey work to be completed. Agency consultation records.	Habitat survey reports based on winter 2007 field reconnaissance.	May 2007 • Habitat Survey Reports based on spring 2007 field reconnaissance and updated agency consultation records. August 2007 • Snake Survey Reports.
Least tern and piping plover	No 2006 Surveys were conducted. Occurrence Surveys – 2007 (Keystone Mainline and Cushing Extension).	Agency consultation records. Preliminary survey areas.	Documentation of potential suitable habitats.	No information filed.	Agency consultation records.	August 2007 • Results of 2007 surveys (Keystone Mainline and Cushing)
Raptor Nests (including bald eagle)	Spring 2006 – • Preliminary Survey 2006 Survey Completion Status – 70% Spring 2007 – • Aerial Surveys – 2007 Conducted Keystone Mainline and Cushing Extension Raptor Surveys within construction ROW. • Potential Preconstruction	Agency consultation records.	List of raptor nests and locations encountered during spring 2006 helicopter surveys.	Agency consultation records.	Results of 2007 aerial raptor/bald eagle surveys (Keystone Mainline and Cushing Extension).	

Keystone Pipeline Project – Biological Survey Report Completion Plan – March 2007

Survey Objective	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Future DOS Filing Dates
	Surveys – 2008 (Keystone Mainline and Cushing Extension).					
Greater Prairie Chicken	Winter 2007 – Phone surveys with landowners to determine potential presence. Completion status – 100%. Spring 2007 – breeding surveys, depending on phone survey results.	Agency consultation records. Preliminary survey areas and protocols.	No information filed.	Agency consultation records.	Phone survey report detailing results of phone surveys with landowners in MO and agency coordination regarding further survey requirements.	August 2007 Results of breeding surveys, if surveys are required by the Missouri Department of Conservation.
King rail	Spring 2007 MO - Surveys may be conducted in large complex wetlands.	Agency consultation records Preliminary survey areas and protocols.	No information filed.	Agency consultation records.	Desktop habitat analysis report based on wetland delineations.	April 2007 - Further agency coordination regarding survey requirements, and survey protocols. August 2007 - Habitat survey report, if surveys are necessary based on wetland habitat assessment.

Keystone Pipeline Project – Biological Survey Report Completion Plan – March 2007

Survey Objective	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Future DOS Filing Dates
Barn owl	To date, no structures will be destroyed during construction, therefore; no surveys planned. However, 2008 preconstruction surveys in MO, IL would be conducted if structures (old barns or homes) would be affected by construction activities.	Agency consultation records Preliminary survey areas and protocols.	No information filed.	Agency consultation records.	No information filed.	Spring 2008 • Report filed only if habitat is present.
Bats (Indiana bat, gray bat)	Survey completion status: Fall 2006 habitat surveys: MO – 84% of accessible sites, IL – 100% of accessible sites Completions status - 84% Spring 2007 – Complete habitat surveys Spring/summer 2007 – Potential Mist net surveys – MO, IL.	Agency consultation records Preliminary survey areas and protocols.	No information filed.	Habitat survey reports (MO, IL) based on surveys completed in fall/winter 2006. Report letters detailing further survey work to be completed.	Habitat survey reports based on spring 2007 field reconnaissance and updated agency consultation records.	Fall 2007 • Mist Net/Occurrence survey reports – MO, IL (if required).
River otter denning	2007 – Occurrence surveys in NE, IL	Agency consultation records	No information filed.	No information filed.	Agency consultation records.	August 2007 • Results of surveys conducted in NE and IL.

Note on Migratory Birds: Keystone will discuss options for complying with the Migratory Bird Treaty Act with the USFWS. Future surveys will depend on the outcome of these discussions.

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Prepared for:
Keystone Pipeline Project



A Phone Survey for Potentially Suitable Greater Prairie Chicken Habitat within the Proposed Keystone Mainline Project Right-Of-Way in Audrain County, Missouri

ENSR Corporation
March 2007
Document No.: 10623-004

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1.0 Executive Summary

Seventeen landowners and 21 land tracts were identified as having potentially suitable greater prairie chicken (*Tympanuchus cupido*) habitat along the proposed Keystone Mainline right-of-way in Audrain County, Missouri. Private landowners were contacted during January 2007 to determine if greater prairie chickens have been observed on private lands within the past 5 years. Fifteen of the landowners were available for comment. A telephone questionnaire (Appendix A), developed by ENSR Corporation (ENSR), in cooperation with Missouri Department of Conservation (MDC), was used to contact landowners. No greater prairie chickens or greater prairie chicken signs were identified by landowners within the past 5 years. The results of the telephone surveys are provided in **Table 2**. Based on the outcome of this survey, it is unlikely that the proposed Keystone Pipeline Project will impact the greater prairie chicken.

2.0 Purpose

As requested by the MDC during a meeting on July 19, 2006, ENSR conducted a desktop habitat assessment and contacted landowners to determine the potential for occurrence of greater prairie chickens along the proposed Keystone Mainline Project route in Audrain County, Missouri.

2.1 Relevant Life History

Prime habitat for greater prairie chickens consists of large, unbroken expanses of native tallgrass prairie and other grassland habitats with few trees taller than 15 feet. In Missouri, habitat available for greater prairie chickens is typically limited to grassland/prairie fragments interspersed with cropland, woodland, and forest (MDC 2006).

The breeding season begins in early spring and extends until June. Cocks occupy the "booming grounds" or "leks" in the early morning and late afternoon where males display to establish territories. Lek sites tend to remain at the same location from year to year. At the height of the breeding season, hens visit the booming grounds and mating occurs.

Greater prairie chickens are ground nesters. Nests are simple, saucer-shaped structures, about 7 inches in diameter and 2 to 3 inches deep. Nests are usually located in high, arching clumps of grass but sometimes are built in weedy areas. The average clutch contains about a dozen eggs. Incubation requires about 3 weeks. The peak of the hatching period comes in late May to early June, depending on weather conditions. The chicks remain with the hen for 8 to 10 weeks, and then the brood disperses (MDC 2004).

3.0 Methods

Potential habitat locations for greater prairie chickens were determined based on species habitat association and agency correspondence (e.g., U.S. Fish and Wildlife Service, MDC, and Natural Heritage Program/NatureServe), in combination with aerial habitat surveys, wetland/waterbody field surveys, U.S. Geological Survey Land Use Land Cover data, and aerial photography. The MDC documented that Audrain County, Missouri, was the only Missouri county along the proposed Keystone Mainline route that had any historic occurrence records of greater prairie chickens.

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For the Keystone Mainline, ENSR originally identified 22 properties and 17 landowners in Audrain County, Missouri with potentially suitable greater prairie chicken habitat. ENSR submitted the list of these properties to the MDC for approval (Appendix B). Due to small deviations from the originally identified route, twenty of these properties and one later identified property are currently identified as properties with potentially suitable habitat for the greater prairie chicken along the Keystone mainline. These properties are shown in **Table 1**.

Table 1 Potential Greater Prairie Chicken Habitat Locations

Approximate Keystone MP	Keystone Tract ID
904.3	ML-MO-AU-4512
908.3 – 908.8	ML-MO-AU-4539
908.9 – 909.2	ML-MO-AU-4541
913.9 – 914.6	ML-MO-AU-4553, ML-MO-AU-4554, ML-MO-AU-4555
914.7	ML-MO-AU-4558
914.8	ML-MO-AU-4557
914.9 – 915.2	ML-MO-AU-4559
915.2 – 915.5	ML-MO-AU-4560
915.8 – 916.1	ML-MO-AU-4561
917.0 – 917.3	ML-MO-AU-4566
917.6 – 917.8	ML-MO-AU-4569
917.6 – 917.8	ML-MO-AU-4571
917.8 – 918.4	ML-MO-AU-4570
917.8 – 918.4	ML-MO-AU-4571
918.6	ML-MO-AU-4572
918.8 – 919.1	ML-MO-AU-4573
919.1 – 919.4	ML-MO-AU-4574
919.6	ML-MO-AU-4576
928.6	ML-MO-AU-4607

ENSR attempted to contact landowners by telephone using the questionnaire template found in Appendix A. This template also was approved by the MDC. All telephone conversations were documented.

4.0 Results

ENSR was able to make contact with 15 landowners for the telephone questionnaire. The results of the telephone questionnaire are listed in **Table 2**. No greater prairie chickens or signs of greater prairie chickens were identified by landowners within the last 5 years.

One of the landowners did observe three individual greater prairie chickens and one nest on his property approximately 6 to 7 years ago, but has not seen or heard any prairie chickens since that time.

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5.0 Discussion

Greater prairie chickens were not observed in the last 5 years by any of the private landowners as documented in **Table 2**. Therefore, based on the accumulated information from the telephone questionnaires, it is unlikely that pipeline construction would have any foreseeable negative affect on the greater prairie chicken in Audrain County, Missouri. ENSR will consult with the MDC to confirm that no additional surveys are required.

6.0 References

Missouri Department of Conservation (MDC). 2006. Email correspondence with Andrew Forbes (MDC Ornithologist) with Patti Lorenz (ENSR) on 10/18/06.

_____. 2004. Missouri Department of Conservation Website. 2004.
<http://www.mdc.mo.gov/nathis/birds/chickens/>. Accessed by ENSR on 10/13/06.

Table 2 Greater Prairie Chicken Telephone Questionnaire Responses

MP	Tract ID	Date Called	Greater Prairie Chickens Observed		Comments
			Yes	No	
904.3	ML-MO-AU-4512	1/2/2007			No answer – ENSR left a voicemail message.
				X	The landowner called ENSR back at 2:50 p.m. The landowner has never observed a greater prairie chicken or signs on his property but was aware of what they looked like.
908.3-908.8	ML-MO-AU-4539	1/2/2007		X	The landowner was not aware of what a greater prairie chicken looked like. After describing greater prairie chicken's the landowner said that he had never seen anything like that on his land. No signs of greater prairie chickens had been seen either.
908.92-909.19	ML-MO-AU-4541	1/2/2007			No answer – ENSR left a voicemail message.
		1/3/2007		X	The landowner called back at 2:30 p.m. He said that he had a nest on the property 6 to 7 years ago near the proposed pipeline route. He had seen three individual greater prairie chickens the spring before he found the nest. The nest was predated and the eggs were destroyed. At the time he also had seen greater prairie chickens about 5 miles north of his property. He used to be able to hear them booming. He hasn't seen or heard any since. He keeps cattle on his property and they have grazed down all of the native tallgrass prairie. He wished he still had them around but said that there were too many owls and no habitat left.
913.95-914.65	ML-MO-AU-4553 ML-MO-AU-4554 ML-MO-AU-4555	1/3/2007		X	The landowner has owned the land since 1991. The property has deer and turkey. She stated that Audrain County is not known to have had greater prairie chicken in over 40 years. The landowner is 85 years old. More than 80 years ago there used to be a booming ground about 3 miles from where she grew up in eastern Audrain County. The farm crossed by the proposed route of the pipeline is in western Audrain County. The farm is slight rolling hillsides whereas eastern Audrain County was flat prairie. She has never seen a greater prairie chicken on her land.
914.75	ML-MO-AU-4556	1/2/2007			No answer – ENSR left a voicemail message.
		1/3/2007			The landowner called back and left a message to return his call. No answer – ENSR left a voicemail message.
		1/5/2007		X	The landowner called back and said that he had never seen any greater prairie chickens on his property. He was not aware of what they looked liked but after ENSR described their appearance, he responded by saying that he had never seen anything like that. The landowner has had the property for approximately 1.5 years and has never seen a greater prairie chicken.

Table 2 Greater Prairie Chicken Telephone Questionnaire Responses

MP	Tract ID	Date Called	Greater Prairie Chickens Observed		Comments
			Yes	No	
914.85	ML-MO-AU-4571	1/2/2007		X	The landowner has never seen a greater prairie chicken or its sign on his property. He was aware of what they look like from pictures in magazines. His neighbor hit one on the road a few years ago about 10 miles south of Mexico, Missouri.
914.95-915.2	ML-MO-AU-4559	1/2/2007		X	The landowner has never seen a greater prairie chicken or its sign on his property. He was aware of what they look like. He said they used to be observed in fields just east of Mexico, Missouri. He has seen their breeding behaviors. He would like to see them come back to the area and asked if it would be possible for the MDC to stock them.
915.2-915.5	ML-MO-AU-4560	1/2/2007			ENSR talked with the respondent. The landowner is deceased and the respondent handles the management of that land. He can be reached at (phone number withheld). ENSR left a voice message for the respondent.
		1/3/2007		X	The landowner called back and left a message to call him. ENSR called him at 11:15 a.m. and he stated that he was aware of what a greater prairie chicken looked like and that he had never seen one on the property. He has walked a lot of his land and has kicked up a bunch of different birds but has never seen a greater prairie chicken.
915.75-916.1	ML-MO-AU-4561	1/2/2007			No answer – ENSR left a voicemail message.
		1/3/2007		X	ENSR spoke with the landowner at 5:12 pm. He stated that there haven't been greater prairie chickens in his area in 50 years. He stated there were some 10 to 15 miles east of his property in Rafael.
917.0-917.3	ML-MO-AU-4566	1/2/2007		X	The landowner has never seen a greater prairie chicken or signs of greater prairie chickens on his property. He was aware of what they look like.
917.6-917.85-917.85-918.4	ML-MO-AU-4569 ML-MO-AU-4570	1/2/2007			The respondent (receptionist for the landowner) is answering all calls regarding the pipeline projects. She will contact the farm manager and the landowner to see if they have ever seen a greater prairie chicken on the land. She has never seen a greater prairie chicken and doesn't think anyone else on the property has either. She is familiar with what they look like. She will call ENSR back with a response.
		1/3/2007		X	The respondent (receptionist for the landowner) called back and left a voicemail message saying that no one has ever seen a greater prairie chicken on Yellowstone Farms, LLC.
918.4-918.45	ML-MO-AU-4571	1/2/2007			No answer – ENSR left a voicemail message.
		1/3/2007			ENSR left a message.
		1/8/2007		X	The landowner was not aware of what a greater prairie chicken looked like. After greater prairie chickens were described, he stated that he had never seen anything like that on

Table 2 Greater Prairie Chicken Telephone Questionnaire Responses

MP	Tract ID	Date Called	Greater Prairie Chickens Observed		Comments
			Yes	No	
					the property or in his life. He has owned the land for 6 years and has been planting a warm season mix for 3 years to reestablish native habitat. In those 3 years, he has seen an increase in quail but no greater prairie chickens.
918.8-919.1	ML-MO-AU-4573	1/2/2007		X	The landowner indicated that she doesn't have any greater prairie chickens on her land. She has never observed the prairie chicken or its sign on her property. She was aware of what greater prairie chicken looked like. She is from South Dakota and is familiar with quail and pheasant. Her family hunts deer on the property and no one has ever seen a greater prairie chicken or its sign.
919.1-919.4	ML-MO-AU-4574	1/2/2007			ENSR spoke with respondent (granddaughter of property owner). Her grandparents are failing and she would prefer any pipeline representatives to contact her or another respondent with any questions or concerns. The respondent will look into the greater prairie chicken issue. She will ask those who hunt on the land, friends, and family members if they have ever seen greater prairie chicken's on the land. She will call back with a reply.
				X	ENSR spoke with the respondent. She spoke with everyone on and around the property and asked if they have ever seen a greater prairie chicken. No one has ever seen a prairie chicken on the property.
919.42-919.55	ML-MO-AU-4576	1/2/2007			No answer – ENSR left a voicemail message.
		1/3/2007			ENSR left a message.
		1/4/2007			The landowner called back and left a message. ENSR returned call at 3:25 p.m. There was no answer.
		1/11/2007		X	Although the landowner has never seen a greater prairie chicken on the land, he is aware of what they look like. He does not live on the land but has owned the land for 4 to 5 years and is confident that there are no greater prairie chicken on that property. He has spoken with many of the farmers in the area, and they have never seen a greater prairie chicken.

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Appendix A

Telephone Questionnaire for the Greater Prairie Chicken

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Telephone Questionnaire for the Greater Prairie Chicken

Hello Sir or Madam:

On behalf of the Rockies Express Pipeline-West (REX-West) Project, I am conducting a telephone questionnaire to address impacts to the greater prairie chicken. Could you please help us by taking a few minutes to answer some questions?

The reason for this telephone questionnaire is that the greater prairie chicken is endangered in the state of Missouri. Eighty percent of Missouri's remaining prairie chickens live on and around remnant native prairies. If prairie habitat and populations continue to decline at the present rate, the prairie chicken may disappear from Missouri in as little as 10 years. The population may fall so low that it cannot recover. If that happens, the species will be extirpated from the state (MDC 2004). REX-West would like to minimize impacts to this species. The questions are as follows:

1. Do you know what a greater prairie chicken looks like?

The prairie chicken is strongly barred brown and tan to white, especially on the under parts. The tail is short and square, dark brown in males, barred brown and tan in females. The legs are feathered down to the toes; nostrils are hidden by feathers. Orange-colored air sacs and eyebrows are conspicuous on males in the spring. Individuals are about 18 inches long and weigh about 2 pounds (MDC 2004).

Greater Prairie-Chickens may sometimes be confused with female Ring-necked Pheasants (an introduced game bird). Both are brown overall, have similar body sizes, and occur in similar habitats. However, Pheasants have a long, pointed tail as opposed to the Prairie-Chickens' short, rounded tail. Also, Prairie-Chickens are heavily barred above and below, whereas Pheasants have no barring underneath, and are more buffy brown overall with only some bars and spots on their upperparts.

2. Have you seen a prairie chicken on your property in the past 5 years?

3. Have you observed prairie chicken feathers or droppings on your property?

Prime habitat for Greater Prairie-Chickens consists of large, unbroken expanses of native tallgrass prairie and other grassland habitats with minimal trees above 15 feet. In Missouri, habitat available for Prairie-Chickens is typically limited to grassland/prairie fragments interspersed with cropland, woodland, and forest.

4. Have you observed or heard breeding prairie chickens or young on your property?

a. If yes, how many and when?

The breeding season begins in early spring and extends until June. Cocks make early morning and late afternoon visits to certain areas called "booming grounds" or "leks," which are used traditionally. Here the males dance, call and fight among themselves as they establish territories. At the height of the breeding season, hens visit the booming grounds and mating occurs (MDC 2004).

Greater prairie chicken are ground nesters. Nests are simple, flimsy structures of dead grass; they are saucer-shaped, about 7 inches in diameter and perhaps 2 to 3 inches deep. Nests are usually located in high, arching clumps of grass but sometimes are built in weedy areas (MDC 2004).

The average clutch contains about a dozen eggs. The eggs, only a little smaller than domestic chicken eggs, are dark olive-buff to grayish-olive with fine spots and occasional red flecks. Incubation requires about 3 weeks. The peak of the hatching period comes in late May to early June depending on weather conditions. The chicks remain with the hen for 8 to 10 weeks, and then the brood breaks up (MDC 2004).

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Reference

Missouri Department of Conservation Website. 2004. <http://www.mdc.mo.gov/nathis/birds/chickens/>. Accessed by ENSR on 10/13/06.

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Appendix B

Correspondence with the Missouri Department of Conservation

Stribley, Sara

Subject: FW: Greater Prairie Chicken

Attachments: GPC.jpg

>>> "Lorenz, Patricia" <plorenz@ensr.aecom.com> 10/18/06 9:54 AM >>>

Great, thanks Andrew. The MDC website has a great link with GPC information. Could we distribute that information to landowners if they request additional information?

Patti

-----Original Message-----

From: Andrew Forbes [<mailto:Andrew.Forbes@mdc.mo.gov>]

Sent: Wednesday, October 18, 2006 8:44 AM

To: Lorenz, Patricia

Cc: Barnes, Chad; Johnson, Charlie; Tillquist, Heidi; Ellis, Scott;

Patti, Scott; Stribley, Sara; Doyle Brown

Subject: Re: REX-West and Keystone Greater Prairie Chicken Information

Patti,

I've reviewed the questionnaires. They look fine to me overall. I would suggest the following changes to both versions-

1. Add "Do you know what a Prairie-Chicken looks like", ADD to supplemental information:

Greater Prairie-Chickens may sometimes be confused with female Ring-necked Pheasants (an introduced game bird). Both are brown overall, have similar body sizes, and occur in similar habitats. However, Pheasants have a long, pointed tail as opposed to the Prairie-Chickens' short, rounded tail. Also, Prairie-Chickens are heavily barred above and below, whereas Pheasants have no barring underneath, and are more buffy brown overall with only some bars and spots on their upperparts.

Under "Have you observed prairie-chicken feathers or droppings on your property", CHANGE supplemental information to:

"Prime habitat for Greater Prairie-Chickens consists of large, unbroken expanses of native tallgrass prairie and other grassland habitats with minimal trees above 15'. In Missouri, habitat available for Prairie-Chickens is typically limited to grassland/prairie fragments interspersed with cropland, woodland, and forest."

Andrew Forbes

Ornithologist

Missouri Dept. of Conservation/Audubon Missouri

phone: 573-447-2249

573-447-2428

> "Lorenz, Patricia" <plorenz@ensr.aecom.com> 10/16/06 5:40 PM >>>

Andrew,

3/8/2007

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Page 2 of 2

Attached is the information regarding greater prairie chicken telephone
veys that we spoke of on Friday 10/13/06. The attached document
contains two sets of letters and telephone questionnaires in order to
keep the projects separate. If you have any questions, please feel free
to contact me at the number below. Again, thank you for your help.

Sincerely,

Patti Lorenz
ENSR
1601 Prospect Parkway
Fort Collins, CO 80525
T: (970) 493-8878 x179
F: (970) 493-0213

3/8/2007

Stribley, Sara

From: Lorenz, Patricia
Sent: Monday, October 16, 2006 4:40 PM
To: Andrew.Forbes@mdc.mo.gov
Cc: Doyle Brown; Johnson, Charlie; Stribley, Sara; Patti, Scott; Barnes, Chad; Tillquist, Heidi; Ellis, Scott
Subject: REX-West and Keystone Greater Prairie Chicken Information
Attachments: Greater Prairie Chicken Information for MDC.PDF

Andrew,

Attached is the information regarding greater prairie chicken telephone surveys that we spoke of on Friday 10/13/06. The attached document contains two sets of letters and telephone questionnaires in order to keep the projects separate. If you have any questions, please feel free to contact me at the number below. Again, thank you for your help.

Sincerely,

Patti Lorenz
ENSR
1601 Prospect Parkway
Fort Collins, CO 80525
T: (970) 493-8878 x179
F: (970) 493-0213
p.lorenz@ensr.aecom.com

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ENSR

1601 Prospect Parkway, Fort Collins, Colorado 80525
T 970.493.8878 F 970.493.0213 www.ensr.aecom.com

October 16, 2006

Andrew Forbes

Missouri Department of Conservation/Audubon Missouri
P.O. Box 180
Jefferson City, MO 65102

**RE: Rockies Express Pipeline-West (REX-West) Project
Greater Prairie Chicken Telephone Questionnaire**

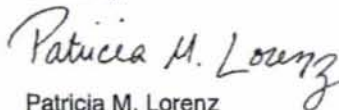
Dear Mr. Forbes:

Thank you for agreeing to review the material prepared by ENSR Corporation (ENSR) regarding a telephone questionnaire to determine the occurrence of greater prairie chickens (GPC) along the Rockies Express Pipeline-West (REX-West) Project in Audrain County, Missouri. As discussed during our phone conversation, the Missouri Department of Conservation (MDC) is requesting that ENSR conduct a telephone questionnaire with private land owners whose property could provide potential habitat for GPC in Audrain County.

Attached for your review is a preliminary table with potential GPC habitat locations along the REX-West route. Potential habitat locations for GPC were determined based on species habitat association and agency correspondence (e.g., U.S. Fish and Wildlife Service, Missouri Department of Conservation, and Natural Heritage Program/ NatureServe), in combination with aerial habitat surveys, wetland/waterbody field surveys, U.S. Geological Survey Land Use Land Cover data, and aerial photography. Also enclosed is a draft telephone questionnaire that will be used during phone surveys with private land owners for the REX-West Project. ENSR would appreciate any input regarding the questions that will be asked during these surveys.

Doyle Brown has been identified as the point of contact for the MDC for the project. He has been given maps of the proposed route through Missouri. If you have any questions regarding the enclosed materials or need any additional information, please contact me at (970) 493-8878 ext. 179 or email plorenz@ensr.aecom.com.

Sincerely,



Patricia M. Lorenz
Biologist

PL

Enc: GPC Habitat Table
GPC Telephone Questionnaire

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Potential Greater Prairie Chicken (GPC) Habitat Locations

Milepost (MP)	Tract ID
707.8	MO-AU-100
707.4-707.8	MO-AU-097
707.2-707.4	MO-AU-096
706.8	MO-AU-094
706.5-706.7	MO-AU-093
706.4	MO-AU-093.S14
706.3	MO-AU-093.S08
706.2-706.3	MO-AU-093
706.0-706.2	MO-AU-092
705.4-705.6	MO-AU-090
704.1-704.4	MO-AU-084
703.6-703.8	MO-AU-083
703.2-703.6	MO-AU-082
703.2	MO-AU-081
703.1	MO-AU-077
702.3-703.0	MO-AU-074, MO-AU-075, MO-AU-076
697.3-697.4	MO-AU-059
696.6-697.1	MO-AU-056
692.6	MO-AU-028.S01

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Phone Questionnaire for Contract Land Staff (CLS) Agent:

Hello Sir or Madam:

On behalf of the Rockies Express Pipeline-West (REX-West) Project, I am conducting a telephone questionnaire to address impacts to the greater prairie chicken. Could you please help us by taking a few minutes to answer some questions?

The reason for this telephone questionnaire is that the greater prairie chicken is endangered in the state of Missouri. Eighty percent of Missouri's remaining prairie chickens live on and around remnant native prairies. If prairie habitat and populations continue to decline at the present rate, the prairie chicken may disappear from Missouri in as little as 10 years. The population may fall so low that it cannot recover. If that happens, the species will be extirpated from the state (MDC 2004). REX-West would like to minimize impacts to this species. The questions are as follows:

1. Do you know what a greater prairie chicken looks like?

The prairie chicken is strongly barred brown and tan to white, especially on the underparts. The tail is short and square, dark brown in males, barred brown and tan in females. The legs are feathered down to the toes; nostrils are hidden by feathers. Orange-colored air sacs and eyebrows are conspicuous on males in the spring. Individuals are about 18 inches long and weigh about 2 pounds (MDC 2004).

2. Have you seen a prairie chicken on your property in the past five years?

3. Have you observed prairie chicken feathers or droppings on your property?

Prime habitat for this species includes mid-grass and tall-grass prairies bordered by open oak woodlands, oak forests, and cropland. In Missouri, nesting habitat is limited to cropland and nearby prairies.

4. Have you observed or heard breeding prairie chickens or young on your property?

a. If yes, how many and when?

The breeding season begins in early spring and extends until June. Cocks make early morning and late afternoon visits to certain areas called "booming grounds" or "leks", which are used traditionally. Here the males dance, call and fight among themselves as they establish territories. At the height of the breeding season, hens visit the booming grounds and mating occurs (MDC 2004).

GPC are ground nesters. Nests are simple, flimsy structures of dead grass; they are saucer-shaped, about 7 inches in diameter and perhaps 2 to 3 inches deep. Nests are usually located in high, arching clumps of grass but sometimes are built in weedy areas (MDC 2004).

The average clutch contains about a dozen eggs. The eggs, only a little smaller than domestic chicken eggs, are dark olive-buff to grayish-olive with fine spots and occasional red flecks. Incubation requires about three weeks. The peak of the hatching period comes in late May to early June depending on weather conditions. The chicks remain with the hen for 8-10 weeks, then the brood breaks up (MDC 2004).

Reference:

Missouri Department of Conservation Website. 2004. <http://www.mdc.mo.gov/nathis/birds/chickens/>. Accessed by ENSR on 10/13/06.

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ENSR

1601 Prospect Parkway, Fort Collins, Colorado 80525
T 970.493.8878 F 970.493.0213 www.ensr.aecom.com

October 16, 2006

Andrew Forbes
Missouri Department of Conservation/Audubon Missouri
P.O. Box 180
Jefferson City, MO 65102

RE: Keystone Pipeline Project Greater Prairie Chicken Telephone Questionnaire

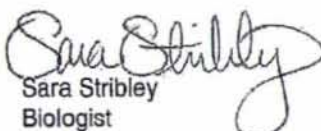
Dear Mr. Forbes:

Thank you for agreeing to review the material prepared by ENSR Corporation (ENSR) regarding a telephone questionnaire to determine the occurrence of greater prairie chickens (GPC) along the Keystone Pipeline Project (Keystone) in Audrain County, Missouri. As requested by the Missouri Department of Conservation (MDC), ENSR is conducting a telephone questionnaire with private land owners whose property could provide potential habitat for GPC in Audrain County.

A total of 22 areas have been identified as having potential GPC habitat along the project route in Audrain County. Of the 22 areas, 21 of the areas are co-located with the REX-West Pipeline. As a result, these 21 GPC areas will be covered under the REX-West Pipeline Project (contacted by a REX-West land agent). The remaining potential GPC habitat area that is not co-located with the REX-West pipeline occurs between mileposts 928.0-928.2 (Tract Number: ML-MO-AU-4607; Property Owner: William Deimke). This land owner will be contacted separately by a Keystone land agent. Potential habitat locations for GPC were determined based on species habitat association and agency correspondence (e.g., U.S. Fish and Wildlife Service, Missouri Department of Conservation, and Natural Heritage Program/ NatureServe), in combination with aerial habitat surveys, wetland/waterbody field surveys, U.S. Geological Survey Land Use Land Cover data, and aerial photography. Also enclosed is a draft telephone questionnaire that will be used during the phone survey with the private land owner for the Keystone Project. ENSR would appreciate any input regarding the questions that will be asked during these surveys.

Doyle Brown has been identified as the point of contact for the MDC for the project. He has been given maps of the proposed route through Missouri. If you have any questions regarding the enclosed materials or need any additional information, please contact me at (970) 493-8878 ext. 168 or email sstribley@ensr.aecom.com.

Sincerely,


Sara Stribley
Biologist

SS

Enc: GPC Telephone Questionnaire

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Phone Questionnaire for Ellis & Associates Land Staff Agent:

Hello Sir or Madam:

On behalf of the Keystone Pipeline Project, I am conducting a telephone questionnaire to address impacts to the greater prairie chicken. Could you please help us by taking a few minutes to answer some questions?

The reason for this telephone questionnaire is that the greater prairie chicken is endangered in the state of Missouri. Eighty percent of Missouri's remaining prairie chickens live on and around remnant native prairies. If prairie habitat and populations continue to decline at the present rate, the prairie chicken may disappear from Missouri in as little as 10 years. The population may fall so low that it cannot recover. If that happens, the species will be extirpated from the state (MDC 2004). Keystone would like to minimize impacts to this species. The questions are as follows:

1. Do you know what a greater prairie chicken looks like?

The prairie chicken is strongly barred brown and tan to white, especially on the underparts. The tail is short and square, dark brown in males, barred brown and tan in females. The legs are feathered down to the toes; nostrils are hidden by feathers. Orange-colored air sacs and eyebrows are conspicuous on males in the spring. Individuals are about 18 inches long and weigh about 2 pounds (MDC 2004).

2. Have you seen a prairie chicken on your property in the past five years?

3. Have you observed prairie chicken feathers or droppings on your property?

Prime habitat for this species includes mid-grass and tall-grass prairies bordered by open oak woodlands, oak forests, and cropland. In Missouri, nesting habitat is limited to cropland and nearby prairies.

4. Have you observed or heard breeding prairie chickens or young on your property?

a. If yes, how many and when?

The breeding season begins in early spring and extends until June. Cocks make early morning and late afternoon visits to certain areas called "booming grounds" or "leks", which are used traditionally. Here the males dance, call and fight among themselves as they establish territories. At the height of the breeding season, hens visit the booming grounds and mating occurs (MDC 2004).

GPC are ground nesters. Nests are simple, flimsy structures of dead grass; they are saucer-shaped, about 7 inches in diameter and perhaps 2 to 3 inches deep. Nests are usually located in high, arching clumps of grass but sometimes are built in weedy areas (MDC 2004).

The average clutch contains about a dozen eggs. The eggs, only a little smaller than domestic chicken eggs, are dark olive-buff to grayish-olive with fine spots and occasional red flecks. Incubation requires about three weeks. The peak of the hatching period comes in late May to early June depending on weather conditions. The chicks remain with the hen for 8-10 weeks, then the brood breaks up (MDC 2004).

Reference:

Missouri Department of Conservation Website. 2004. <http://www.mdc.mo.gov/nathis/birds/chickens/>. Accessed by ENSR on 10/13/06.

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Potential Greater Prairie Chicken (GPC) Habitat Locations

MP		Tract ID	
REX-West	Keystone	REX-West	Keystone
707.8	919.6	MO-AU-100	ML-MO-AU-4576
707.4-707.8	919.1-919.3	MO-AU-097	ML-MO-AU-4574
707.2-707.4	918.9-919.1	MO-AU-096	ML-MO-AU-4573
706.8	918.6	MO-AU-094	ML-MO-AU-4572.1
706.5-706.7	918.2-918.04	MO-AU-093	ML-MO-AU-4571
706.4	N/A	MO-AU-093.S14	N/A
706.3	917.8	MO-AU-093.S08	ML-MO-AU-4570
706.2-706.3	917.7-917.8	MO-AU-093	ML-MO-AU-4571
706.0-706.2	917.5-917.7	MO-AU-092	ML-MO-AU-4569
705.4-705.6	917.0-917.2	MO-AU-090	ML-MO-AU-4566
704.1-704.4	915.4-916.0	MO-AU-084	ML-MO-AU-4561
703.6-703.8	915.2-915.4	MO-AU-083	ML-MO-AU-4560
703.2-703.6	915.0-915.2	MO-AU-082	ML-MO-AU-4559
703.2	914.8	MO-AU-081	ML-MO-AU-4557
703.1	914.7	MO-AU-077	ML-MO-AU-4558
702.3-703.0	913.9-914.6	MO-AU-074, MO-AU-075, MO-AU-076	ML-MO-AU-4553, ML-MO-AU-4554, ML-MO-AU-4555
697.3-697.4	909.0-909.1	MO-AU-059	ML-MO-AU-4541
696.6-697.1	908.2-908.7	MO-AU-056	ML-MO-AU-4539
692.6	904.2	MO-AU-028.S01	ML-MO-AU-4512

**CONTENTS OF ENVIRONMENTAL SURVEYS
KEYSTONE SUPPLEMENTAL FILING, MARCH 2007**

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- SNAKE SURVEY STATUS
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 - King Rail desk top habitat assessment
- RAPTOR AND BALD EAGLE
 - Raptor and Bald Eagle aerial nest survey and location report

WETLANDS

- Wetland Surveys - Cushing Extension

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Prepared for:
Keystone Pipeline Project



**A Summary Report of the January-
February 2007 Aerial Raptor Nest / Bald
Eagle Nest and Winter Roost Survey
Completed for the Keystone Mainline
and Cushing Extension Rights-of-Way**

ENSR Corporation
March 2007
Document No.: 10623-004

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Executive Summary

Two aerial surveys were previously completed to collect raptor nest occurrence information along portions of the proposed Keystone Pipeline right-of-way (ROW) from March 28 through April 1, 2006, in Kansas and Missouri and from April 26 through May 2, 2006, in North Dakota, South Dakota, and Nebraska (ENSR 2006). This report covers a third additional raptor nest aerial survey conducted along the entire Keystone ROW (Illinois, Missouri, Kansas, Nebraska, South Dakota, and North Dakota) and the Cushing Extension ROW (Nebraska, Kansas, and Oklahoma) from January 30 through February 4, 2007. All aerial surveys were conducted in a helicopter with a pilot and a two-person survey team. The 2006 surveys covered an area of at least 0.25-mile on each side of the proposed ROW alignment, while the 2007 survey addressed only an approximate 150-foot ROW corridor along each side of the proposed pipeline centerline (300-foot-wide survey path). At major river crossings, survey coverage was expanded to 1 mile on each side of the ROW to search for bald eagle nests and their winter roost sites.

The 2007 survey documented 112 raptor nests within the proposed Keystone Pipeline Project construction ROW. These included 93 nests along the Mainline ROW (2-Illinois, 44-Missouri, 19-Kansas, 15-Nebraska, 4-South Dakota, 9-North Dakota) and 19 nests along the Cushing Extension (16-Kansas, 3-Oklahoma).

Additionally, two osprey hack sites have been identified within the immediate vicinity of the proposed Missouri River crossing near Yankton, South Dakota. Discussion with the South Dakota Game, Fish, and Parks Department (SDGFP) indicates that the two hack sites may be used again in 2007, 2008, and 2009.

Surveys for wintering bald eagles identified transitory or communal roosts and winter concentration areas within 1 mile of the Mainline ROW at the Mississippi River crossing, the Missouri River near its confluence with the Mississippi, the Cuivre River, the West Fork of the Cuivre River, the Missouri River at the Kansas/Missouri state line, and the Big Blue River. Roosts and wintering concentrations of bald eagles within 1 mile of the Cushing Extension ROW were identified at the Little Blue River, Mill Creek, Republican River, Smoky Hill River, Arkansas River, and Salt Fork of the Arkansas River.

A total of 7 bald eagle nests were located within 1 mile of the Mainline ROW. These included two bald eagle nests at the Mississippi River crossing near Confluence Park, three nests in the Cuivre and Missouri River floodplain in Missouri, one nest at the Big Blue River in Kansas, and one at the Pembina River in North Dakota. Two nests were observed within 1 mile of the Cushing Extension ROW, one on the Smoky Hill River in Kansas and one nest in poor shape at the Arkansas River in Oklahoma.

1.0 Introduction

Keystone is planning to construct, operate, and maintain an approximately 1,845-mile-long interstate crude oil transmission system from an oil supply hub near Hardisty, Alberta, Canada to destinations in the Midwestern United States (U.S.) (Figure 1). ENSR Corporation (ENSR) has been retained by Keystone to assist with environmental permitting for the proposed Keystone Pipeline Project (Project) within the U.S. In the U.S., the proposed Project consists of approximately 1,078 miles of new pipeline constructed from the U.S.-Canada border in Pembina County, North Dakota, to terminals and refineries in Salisbury (Chariton County), Missouri; Wood River (Madison County); and Patoka (Marion County), Illinois. This route is identified as the Mainline. Based on interest expressed by crude oil shippers, Keystone also is considering the construction of a 294-mile pipeline extension, which would extend the Keystone Pipeline south from the Nebraska/Kansas border (Jefferson County) to Cushing, Oklahoma. The primary delivery point would be in the Cushing area, with potential connections to refineries or pipelines in Kansas and North Texas as well as Oklahoma. This portion

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of the Keystone Pipeline system is named the Cushing Extension. Keystone proposes to begin construction of the new pipeline in the spring of 2008, with the Keystone Mainline in-service by the end of 2009.



Figure 1 Proposed Keystone Pipeline Route (Cushing Extension represented by the dotted line)

The Project also will require the construction of pump stations, valves, meters, and other ancillary facilities. Location data for these facilities was not available at the time of this survey; therefore, surveys required for these project features need to be completed prior to construction.

Background Information

A variety of raptor species are known to nest in the region of the proposed Project. These species include eagles, hawks, falcons, owls, harriers, osprey, and other birds of prey. Breeding and nest building/tending activities can begin as early as February for some raptor species, and the rearing of young and fledgling dependency can last into early August for some of the later nesting species. Protected raptor species occurring along the proposed Keystone Pipeline Project route include the bald eagle, northern harrier, peregrine falcon, and barn owl. Other raptors identified as species of special concern include the Cooper's hawk, red-shouldered hawk, broad-winged hawk, and short-eared owl.

Information obtained by Keystone on historic raptor nest sites in the vicinity of the proposed ROW was primarily limited to listed species, including bald eagles. The principal methods for locating nest sites along the proposed pipeline route were the aerial surveys conducted by helicopter in late March through early May 2006 and the January-February 2007 survey.

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2.0 Methods

Aerial survey methods for the 2007 followed those outlined by Call (1978). Two surveyors (seated in left- and right-hand positions of the helicopter) examined the area within the 300-foot-wide construction corridor along the entire Mainline and Cushing Extension ROW to locate existing raptor nest sites. In addition, a 1-mile survey area on each side of the ROW was employed to locate potential bald eagle nest and winter roost sites where the ROW intercepted major river crossings, such as the Platte and Missouri rivers. Aircraft navigation along the proposed pipeline ROW and maintenance of appropriate aircraft position in relation to the ROW was then facilitated using a pilot operated and monitored GPS unit and real time GPS tracking on an on-board computer. Aircraft position and location along the ROW was further monitored by the front, right-hand observer using a separate GPS unit that displayed real time position and the ROW centerline on DRG (digital raster graphic) 7.5-minute USGS topographic maps exhibited on the observer's laptop computer screen.

The 2007 aerial raptor survey focused on locating raptor stick nests constructed in trees in riparian zones, shelterbelts, and other wooded areas, and on locating bald eagle winter roost sites along the major river crossings. Winter timing of the survey facilitated locating nests in deciduous trees prior to leaf-out. No areas of cliffs, rock outcrop, knolls, and topographic features suitable for raptor nesting use were located within the Keystone Mainline or Cushing Extension ROW. In addition to recording raptor nest sites, heron rookeries (communal nest areas) were also recorded by the survey since herons are migratory along most portions of the Keystone Pipeline ROW. Herons are protected under the Migratory Bird Treaty Act (MBTA). Nesting herons are susceptible to disturbance and pipeline construction near a rookery during the nesting season and could result in nest abandonment and a potential "take" or loss of young of these bird species.

The January-February 2007 survey started at the eastern terminus (Patoka) of the Keystone Mainline on January 30, and proceeded westward to the junction of the Keystone Mainline and Cushing Extension. The Cushing Extension segment was surveyed on February 1, and the remainder of the Keystone Mainline, north of the Keystone Mainline/Cushing Extension junction, was surveyed from February 2 through 4.

Surveys were conducted between sunrise and sunset (approximately 0800 to 1730 Central Time). The date, temperature, wind, and cloud cover were recorded at the beginning of each survey day and at the end of each survey day; changes in overall weather conditions during the survey were also recorded.

Temperatures during the survey ranged from highs of approximately 20 degrees Fahrenheit (°F) to lows of minus 25°F. Skies were generally clear to partly cloudy with little to no precipitation. Sporadic, light snowfall events were encountered the morning of January 30 in western Illinois and the afternoon of January 31 in western Missouri and eastern Kansas along the Mainline ROW, but visibility of the ROW was not compromised. West/northwest winds were fairly consistent, ranging from 5 to 15 miles per hour (mph) during most of the survey period.

Complete coverage of the entire ROW was obtained by traveling down the ROW centerline and visually scanning all areas of potential nesting habitat. This typically involved slowing aircraft speed to 25 to 40 mph when woodlands, shelterbelts, riparian areas, and isolated trees were encountered. Once a possible nest site was located, a second pass-over was made to confirm nest type and condition and to obtain accurate GPS location coordinates using the front observer's GPS unit. The rear observer recorded notes on nest configuration, condition, possible species, habitat, and nearest pipeline milepost.

All major rivers crossed by the Keystone Mainline and Cushing Extension ROW were initially selected as potential areas to be searched for bald eagle winter roosting activity (**Table 1**). However, during the January-February 2007 aerial survey a number of these crossings were determined not to support suitable bald eagle winter roosting habitat, either because the river was completely frozen over and there was no open water for bald eagle foraging and/or there were no suitably sized roost trees along the river within 1 mile of the ROW

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(Table 1). At major river crossings where suitable bald eagle winter roosting habitat (large trees and open water) was present, a 2-mile survey corridor centered on the ROW was obtained by flying 1 mile from the ROW centerline along one side of the river and returning along the opposite side of the river to the ROW centerline. The same process was then repeated on the opposite side of the ROW. Only raptor nests large enough to support eagle nesting activity were recorded outside of the 300-foot ROW but within 1 mile of the ROW centerline. The observers were also alert to noting and recording perched bald eagles in trees as well as bald eagles flying along the river corridor. GPS location coordinates were recorded for all bald eagle nest and roost sites observed. In addition, general GPS coordinates were recorded for areas along the river where bald eagles were observed in flight. General observations on bald eagle behavior and numbers were also recorded where birds were observed.

Initially, the focus of the bald eagle roosting portion of the surveys was to survey major river crossings either early in the morning (within an hour after sunrise) or late in the afternoon (1 hour before sunset) when eagles were most likely to found using nighttime roost sites. However, as the survey progressed, it was noted that bald eagles appeared to be remaining in or near roost sites along the major rivers during most of the day as a result of the cold temperatures (less than 20°F down to subzero temperatures) that were encountered throughout the survey period. In addition, it also was noted that bald eagles often flushed from perch sites as the helicopter flew into the vicinity making accurate identification of specific roosts difficult. As a result, survey emphasis shifted to recording bald eagle presence rather than specific roost trees although eagle perch site locations were still recorded. It was assumed that if bald eagles were located within 1 mile of the ROW then nighttime roost sites were also likely to be present within 1 mile of the ROW.

3.0 Results

3.1 Bald Eagle Winter Roost and Nest Sites

The U.S. Fish and Wildlife Service (USFWS) defines two types of bald eagle winter roost sites. Transitory roosts are described as sites with three or more eagles within 100 meters of each other for at least two nights in an area with no previous history of winter communal roosting. Communal roosts are defined as six or more eagles in a small area for extended periods of time or used for multiple years. Since a one-time winter aerial survey cannot distinguish between transitory roosts versus communal roosts, it was assumed that if bald eagles were observed perching along a river within 1 mile of the ROW then at least some type of roosting activity occurs within 1 mile of the ROW. Follow-up ground surveys would be required to determine if identified roosting areas represent transitory or communal roost sites.

3.1.1 Mainline ROW

Out of the 24 major river crossings initially selected as potential bald eagle winter roost areas on the Keystone Mainline ROW, 14 were found to be frozen solid and/or supported no suitable-sized perch trees near the ROW. These river crossings were not surveyed for bald eagle winter roosting use (Table 1). The Pembina River in North Dakota was frozen solid making it unsuitable for winter roosting use, but one historic bald eagle nest was located on the south side of the river. Four additional river crossings (Missouri River at South Dakota/Nebraska border, Platte River in Nebraska, Grand River in Missouri, and Kaskaskia River in Missouri) were surveyed for bald eagle use, but no eagles were observed within 1 mile of the ROW. The Missouri River ROW crossing at the South Dakota/Nebraska border exhibited suitable stretches of open water for bald eagle foraging, but the south bank had few large perch trees. The north bank crossing is close to Yankton and other human activities rendering this area unsuitable for bald eagle roosting use. One historic eagle nest was located approximately 1.5 miles downstream of the ROW on the north side of the river, and two adults were seen nearby. In addition, at least 10 adult and immature bald eagles were observed along the river corridor near the Lewis and Clark Lake dam (Gavins Point Dam) approximately 5 miles upstream of the ROW. The area of the Platte River ROW crossing in Nebraska exhibited only one very narrow, short stretch of open water making this reach of the river unsuitable for bald eagle foraging. Suitable roost trees and open water were

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determined to be present at the Grand River ROW crossing in Missouri, but no eagles or eagle nests were found within 1 mile of the ROW. The ROW crossing at the Kaskaskia River and adjacent wetland complexes was found to exhibit only limited areas of open water with few potential perch trees within 1 mile of the ROW, and no eagles were noted using this area.

Bald eagles and bald eagle perch/roost trees were recorded at the five remaining major rivers either crossed or approached by the Keystone Mainline ROW. These were the Big Blue River in Kansas, the Missouri River at the Kansas/Missouri state line, West Fork of the Cuivre and the Cuivre River (two locations) in Missouri, and the Mississippi River at the Missouri/Illinois state line (**Tables 1 and 2**). Two adult eagles were noted roosting on the Big Blue River within 1 mile of the ROW. In addition, one possible eagle nest was located in a heron rookery within 1 mile of the ROW on the Big Blue River. Several eagles and perch/roost locations were observed within 1 mile of the ROW on the Missouri River at the Kansas/Missouri state line. Eagle roosting use was documented for both the West Fork of the Cuivre River and the Cuivre River within 1 mile of the ROW, and two eagle nests were found on the Cuivre River within 1 mile of the ROW (**Table 2**).

3.1.2 Cushing Extension

Bald eagle presence and roosting use was documented within 1 mile of the ROW along six of the seven major rivers crossed by the Cushing Extension ROW (**Tables 1 and 2**). Observations within 1 mile of the ROW included two adults and one immature eagle on the Little Blue River, two adult eagles on Mill Creek, several adult eagles on the Republican River, one adult and one eagle nest on the Smoky Hill River, three adult and two immature eagles on the Arkansas River, and three adults and one immature eagle on the Salt Fork Arkansas River at its confluence with the Bois'd Arc River. The confluence of the Salt Fork Arkansas River and Bois'd Arc River is a documented historic eagle concentration area. The Cimarron River was the only major river crossed by the Cushing Extension where eagle presence was not documented within 1 mile of the ROW. This segment of the river also supported few suitable roost sized trees. Three perched eagles, however, were located along a segment of the Cimarron River approximately 1.5 to 4 miles downstream of the ROW, and one nest in poor condition was found approximately 1 mile downstream of the ROW.

3.2 Other Raptor Nest Sites

Table 3 provides a listing of all raptor nest locations (including great blue heron rookeries) identified by January-February 2007 aerial survey along the Keystone Mainline ROW and Cushing Extension ROW. A total of 112 nest sites were documented within the survey area. Of these, seven were heron nest sites representing three separate rookery areas (two on the Keystone Mainline ROW and one on the Cushing Extension). The remaining 105 nests were potential raptor nest sites with 90 on the Keystone Mainline ROW (2 in Illinois, 43 in Missouri, 17 in Kansas, 15 in Nebraska, 4 in South Dakota, and 9 in North Dakota) and 15 nests along the Cushing Extension (12 in Kansas, 3 in Oklahoma). The listing includes bald eagle nests within 1 mile of the ROW centerline and all other possible raptor and heron nests within a 150-foot construction corridor on each side of the ROW centerline. **Table 3** also includes GPS coordinates for each nest location as well as information on species ownership, nest condition, and habitat. All nests located were tree nests, and no other types of potential nesting habitat, such as cliffs or rock outcrops, were located within the survey corridor.

Twenty-six of the 2007 survey nests had been identified during the 2006 surveys of the Keystone Mainline ROW. Nine other previously identified raptor nest locations within the Keystone Mainline ROW were either not found (site #75, 86, 98, 111, and 133), were located just outside of the proposed ROW corridor (site #190 and 191), or were determined not to be raptor nests (site #83 and 184). The remainder of the nests documented by the 2006 surveys were well outside of the 300-foot ROW corridor. It is quite possible that nests not relocated by the 2007 survey had been lost to the severe winter ice storms that had plagued the region prior to the survey. Considerable ice storm damage to trees in the form of broken limbs and trunks was clearly evident along many portions of the ROW during the January-February 2007 survey.

Because of the winter timing of the survey, information on activity status of nests was limited to a few bald eagle, great horned owl, and red-tailed hawk nests that showed evidence of early season nesting use. Active

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nests included three bald eagle nests that either had an adult on a nest or adults nearby that were assumed to be establishing a nesting territory, one red-tailed hawk nest with a pair of adults nearby, one red-tailed hawk nest with an adult incubating a single egg, and a great horned owl nest with an adult in incubation posture. The one red-tailed hawk nest with an adult incubating an egg was a very early nesting attempt for this species.

Species ownership determinations for remaining nests were based on nest size, configuration, and location. Beyond the few nests where species ownership was determined by presence of adults, the majority were classified as red-tailed hawk or accipiter (either Cooper's hawk or sharp-shinned hawk) (**Table 3**). Great horned owl, long-eared owl, and American crow could also use nests classified as accipiter.

In addition to the raptor nest sites identified above, two osprey hack sites were identified during field reconnaissance efforts in 2006 near the Missouri River crossing near Yankton, South Dakota. The hack sites are artificial nesting towers approximately 15 feet aboveground, located in the Paddlewheel Point Natural Area. The nearest hack site is located approximately 450 feet east from the Project ROW. The second hack site is located approximately 750 feet east from the Project ROW. The hack sites were used to hack osprey in 2006. The birds were placed in the hack site on July 26 and were considered fledged by August 12. The SDGFP indicated that this site could possibly be used again in 2008 and 2009, if appropriate funding was available.

4.0 Discussion

Based on the findings of the 2006 and 2007 aerial surveys, a number of raptor species breed and forage in and near the Project ROW. The most common species include red-tailed hawks and great-horned owls, with scattered breeding records for the Swainson's hawk, northern harrier, American kestrel, red-shouldered hawk, osprey, and bald eagle. Given the aerial survey method employed for the project, nests of some species such as cavity nesters (American kestrel and eastern screech owl) ground nesters (short-eared owl, burrowing owl, turkey vulture, and northern harrier), and woodland nesters in evergreens (accipiters, long-eared owl, and great horned owl) could not be effectively located. Survey emphasis was placed on locating nests of eagles, buteos (broad-winged hawks), and accipiters and owls that nest in deciduous trees. These are the most common species that could be affected by project construction, particularly if it were to occur within the breeding season (February through August).

The intent of these surveys was to identify as many raptor nests as possible within the immediate vicinity of the proposed pipeline ROW. The surveys were conducted in 2006 and 2007, in anticipation of construction in 2008. Nest data will aid in project planning in two ways: 1) provide information to avoid the disturbance of nest sites located within the construction ROW during the breeding season, or if necessary, identify nests that may need to be removed outside of the nesting season; and 2) provide historic nest location information for specific follow-up surveys that may need to be completed to determine activity status immediately prior to construction. For the purposes of avoiding adverse impacts to wintering bald eagles, follow-up surveys would need to be employed at major river crossings with documented eagle use to confirm the location of transitory or communal winter roost sites, if pipeline construction will occur at any of these crossings between October 1 and January 31. Winter roost surveys need to be conducted at least one day prior to the first date of construction.

Use of GPS

GPS provides an advanced, practical method for precise navigation and to obtain accurate location data, particularly in areas with little to no topographic relief or prominent landmarks; however, use of GPS can occasionally have limitations. Due to wind movement and positioning of the helicopter, GPS coordinate locations could be up to 100 to 200 feet in error from the actual nest location. All efforts were made to obtain

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the most accurate GPS coordinate locations possible during the aerial surveys. However, two principal factors are believed to affect the overall accuracy of GPS recorded raptor nest locations during aerial surveys.

First, it was often difficult to maintain aircraft position directly over a nest site long enough to obtain GPS accuracy because of nest location, topography, wind, and other factors affecting flight conditions. Second, the GPS units used during the aerial surveys required several seconds of acquiring and averaging satellite position data to compute the most accurate location coordinates for each waypoint recorded. This factor in combination with difficulties in maintaining aircraft position exactly over the nest site were believed to be the greatest contributing factors to errors in obtaining the most accurate GPS coordinates for nest sites. Another complication related to obtaining accurate GPS coordinates, especially for active nest sites, was the aerial survey crew's concern for potential disturbance of active nests, particularly when an incubating adult bird was present on the nest. In order to avoid undue disturbance of these nests, the extent of aircraft time near the nest was kept to a minimum, and these nests were only approached close enough to obtain accurate information regarding nest type and species presence.

The accuracy of the majority of the nest location coordinates obtained during the January-February 2007 survey was believed to be very high (± 15 meters or less) during this survey period for two reasons: 1) relatively calm or steady winds and 2) inactive status of most nests because of winter timing of survey. The combination of these two factors permitted the pilot to maintain aircraft position directly over each nest site until the observer's GPS had locked in on the location coordinates thereby obtaining as accurate a GPS reading as possible. During the 2007 survey, there were only a small number of nests (**Table 3**) with early season activity (presence of adults on nest or in incubation posture). At these nests the GPS location was taken as quickly as possible and not immediately over the nest, and location accuracy was slightly compromised to avoid undue disturbance of the nest.

Even with less than optimal accuracy for some nest location coordinates, ENSR is confident that the data provided in this report and for the 2006 survey will be sufficient for future nest identification, project planning, and application of appropriate mitigation measures, if warranted. The next important step in the protection of breeding raptors from project construction and operation will be consultation with the USFWS, as well as applicable state game and fish departments, and the development of an agency approved mitigation plan and implementation process.

5.0 Mitigation Planning

The data from these surveys will allow Keystone and appropriate wildlife agencies to plan construction along the ROW and temporary use areas to avoid the removal of existing raptor nests, where possible. Raptor nest surveys were conducted during the 2006 breeding season and late winter 2007 to obtain complete coverage for the Keystone Mainline ROW and Cushing Extension ROW. However, pipeline construction is currently proposed to commence in 2008. It is highly likely that activity status of nests will change, some existing nests may be lost, and new nests constructed in the interim between survey completion and pipeline construction in 2008. It is Keystone's intent to minimize impacts to wildlife species, including breeding raptors, and it is anticipated that additional raptor surveys would be completed immediately prior to construction to confirm nest locations and activity status. All attempts would be made to construct during periods with the most minimal impacts to breeding birds. In the event that construction occurs during the breeding season, it may be necessary to provide a biological monitor or clearance surveys along certain portions of the route that would be scheduled for construction between February 1 and August 31 to prevent disturbance to nesting raptor species. However, these measures would depend on a number of site-specific factors and would be determined on a case-by-case basis with the applicable agencies.

It is anticipated that areas that would be disturbed by project construction and reclamation would be resurveyed prior to commencement of construction activities, or a biological monitor would be present to

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determine whether birds were moving into the area and could be affected by project activities. Based on these survey results, Keystone would coordinate with the applicable agencies to determine whether additional protection measures may be warranted. It is possible that construction could proceed in certain areas near known nests depending on the activity status of a given nest, the distance between construction and the nest site, line-of-sight implications between the nest site and construction activities, duration and type of construction activity, and/or the presence of a qualified biologist to monitor bird behavior and response to construction activity. However, it is also likely under certain conditions that the agencies would require a buffer area around an active site and a construction constraint period within this buffer area until breeding is complete and the young had fledged.

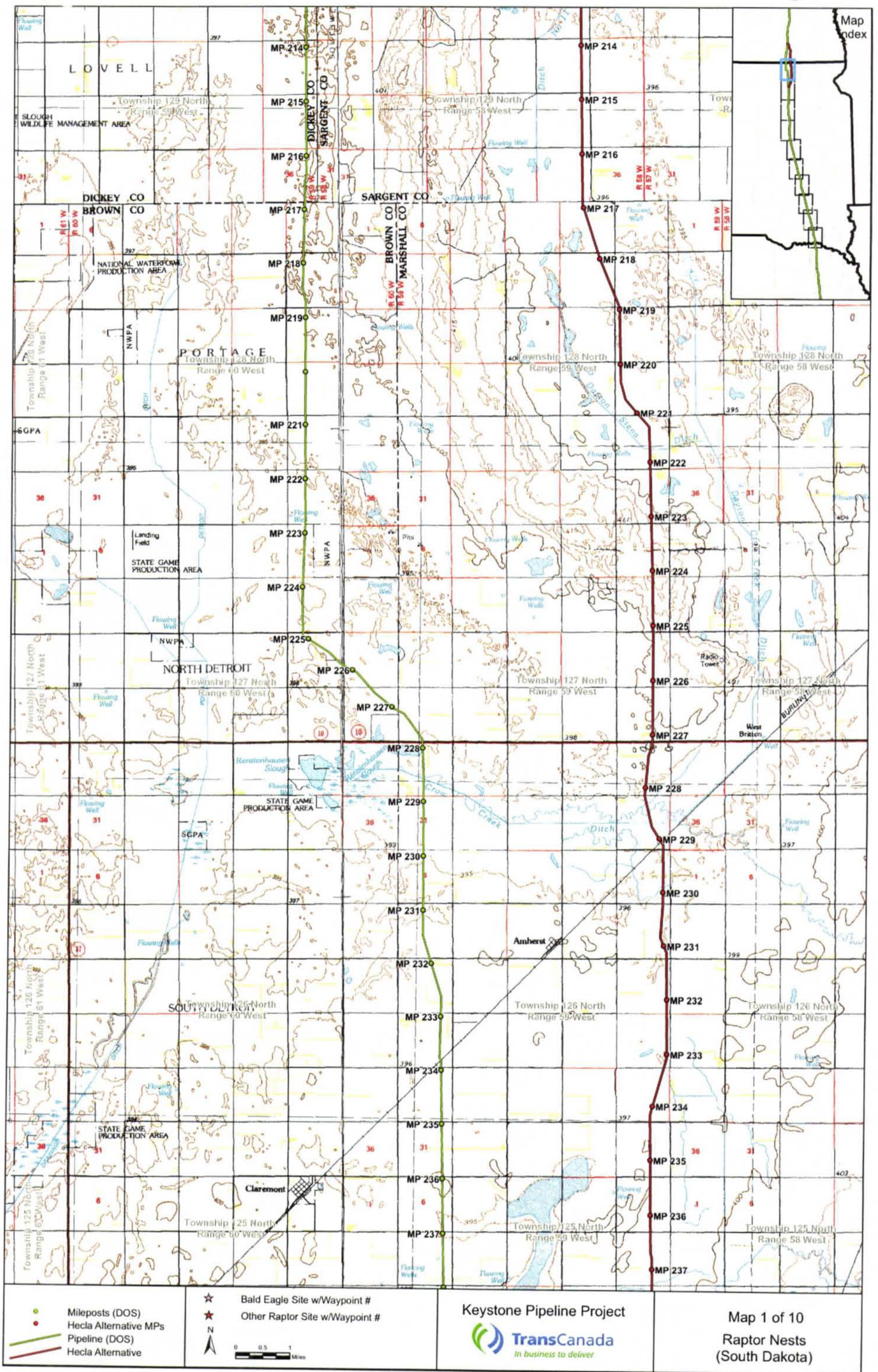
The development and implementation of potential mitigation measures would depend on a number of factors, including species involved, its relative sensitivity to disturbance, the time of year, the type of activity proposed (e.g., trenching versus reclamation), the duration and timing of this activity, and possible topographical shielding. The use of a biological monitor may be warranted to allow construction to proceed in certain areas to ensure that nest sites are not disturbed and/or abandoned. These decisions would be made by the applicable agencies in consultation with Keystone.

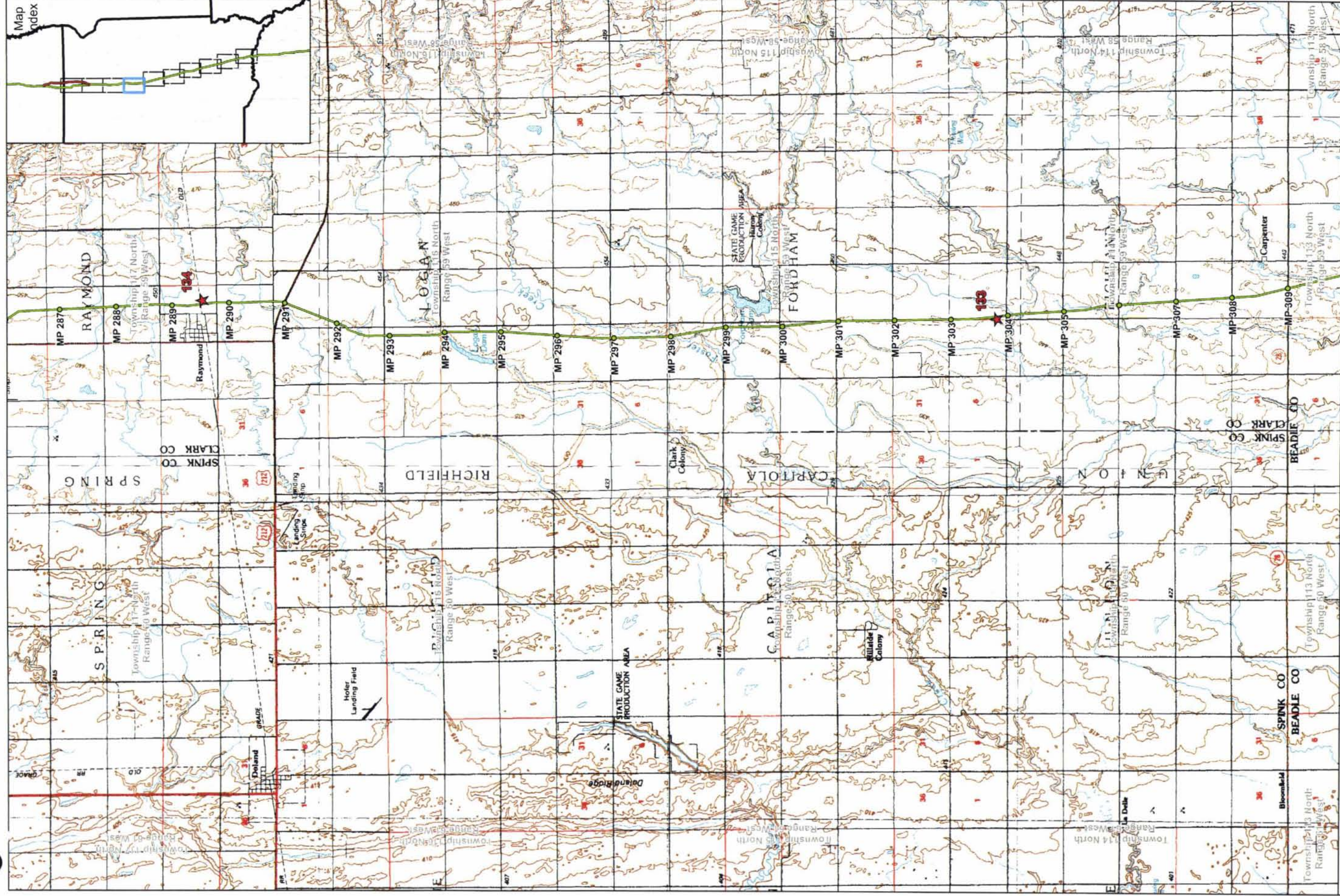
Literature Cited

Call, M. W. 1978. Nesting Habitat and Surveying Techniques for Common Raptors. Bureau of Land Management, Denver, Colorado. 115 pp.

ENSR. 2006. A summary report of aerial surveys conducted for raptor nests along the Keystone Pipeline Project right-of-way in Missouri, Kansas, Nebraska, South Dakota, and North Dakota. ENSR, Fort Collins, Colorado. 23 pp.

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Map 4 of 10
Raptor Nests
(South Dakota)

Raptor Nests (South Dakota)

(South Dakota)

	Bald Eagle Site w/Waypoint #	Other Raptor Site w/Waypoint #
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Other Raptor Site w/Waypoint #

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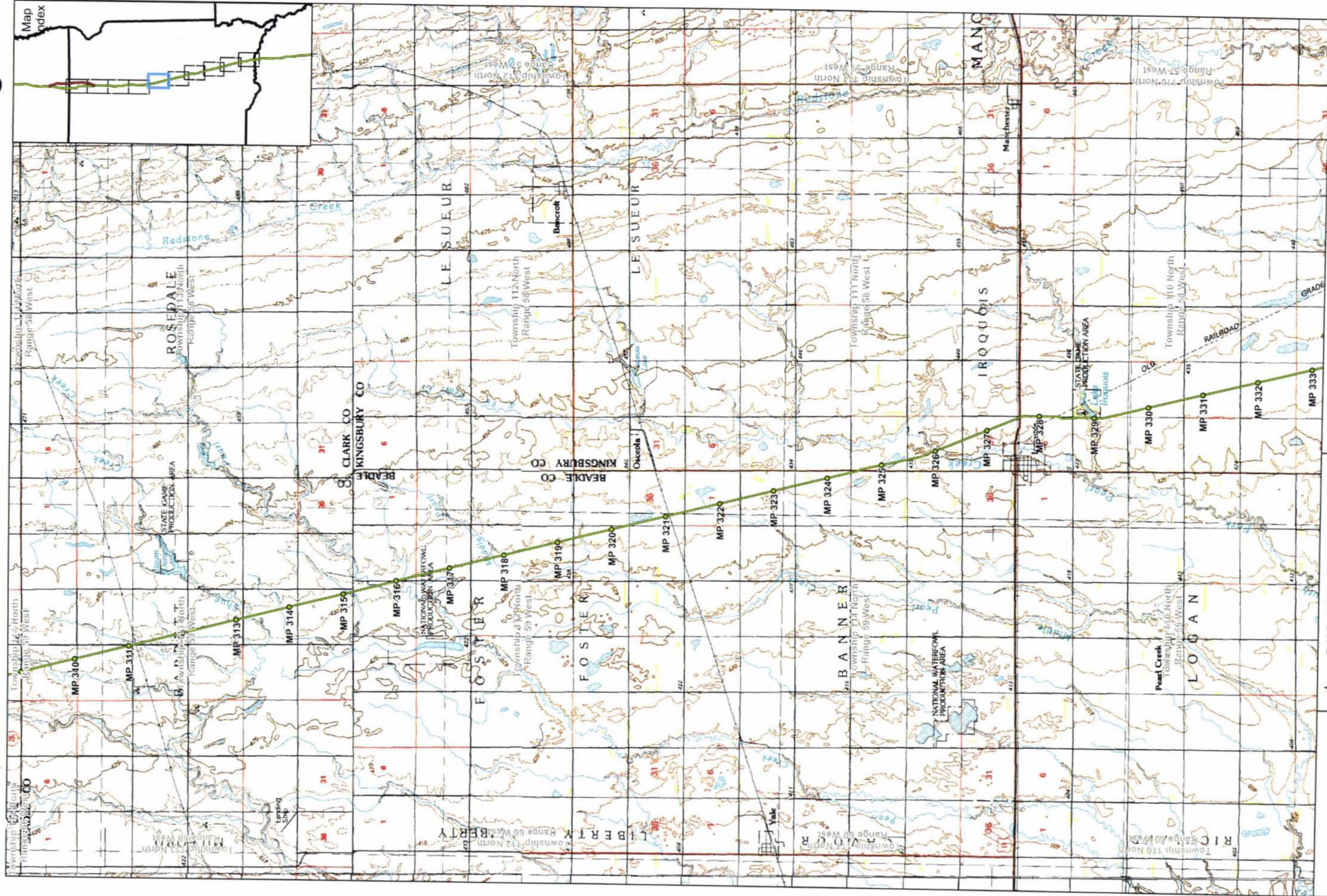
★

Mileposts (DOS)

Mileposts (DOS)

Mileposts (DOS)

Mileposts (DOS)



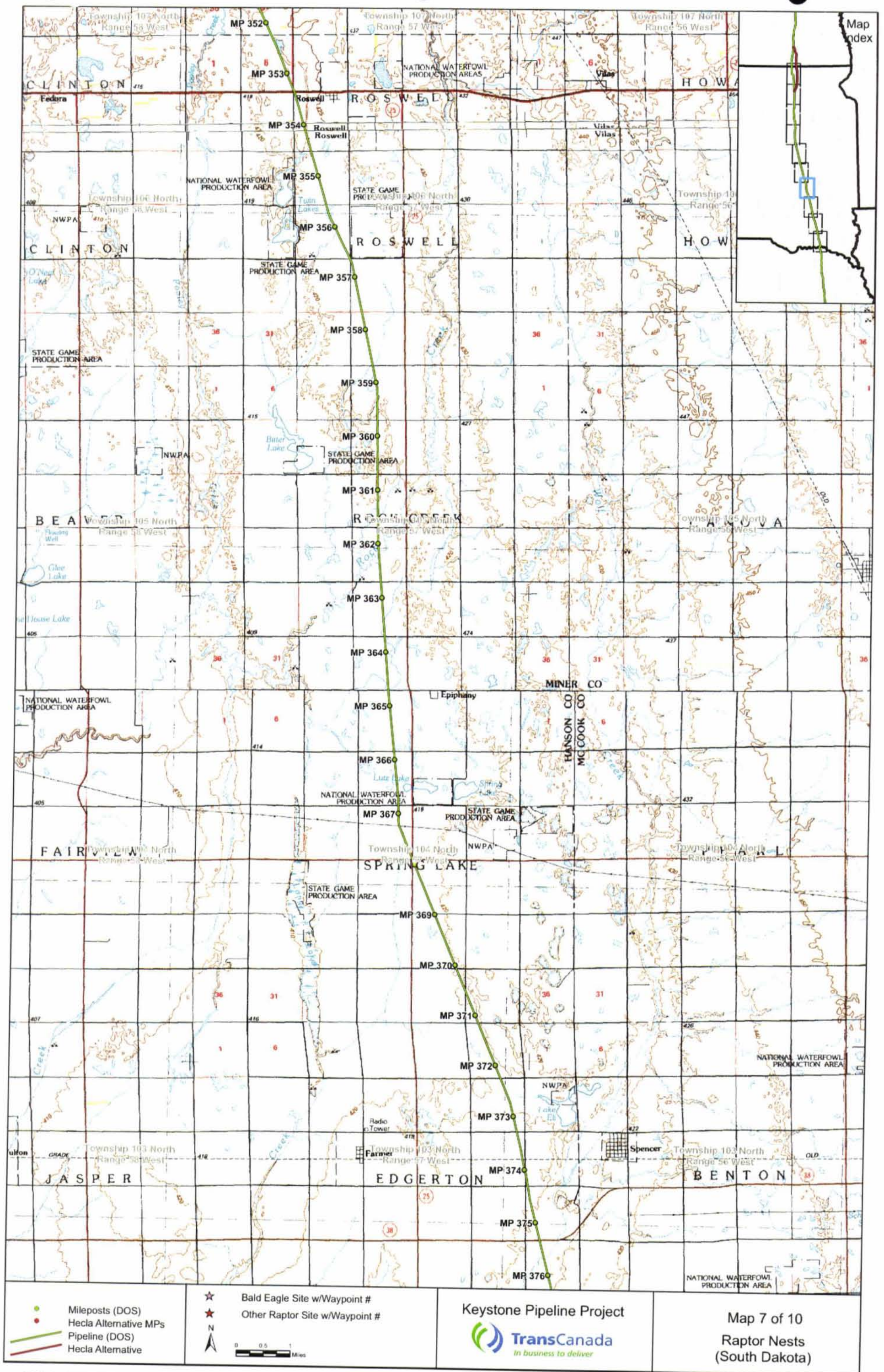
Keystone Pipeline Project

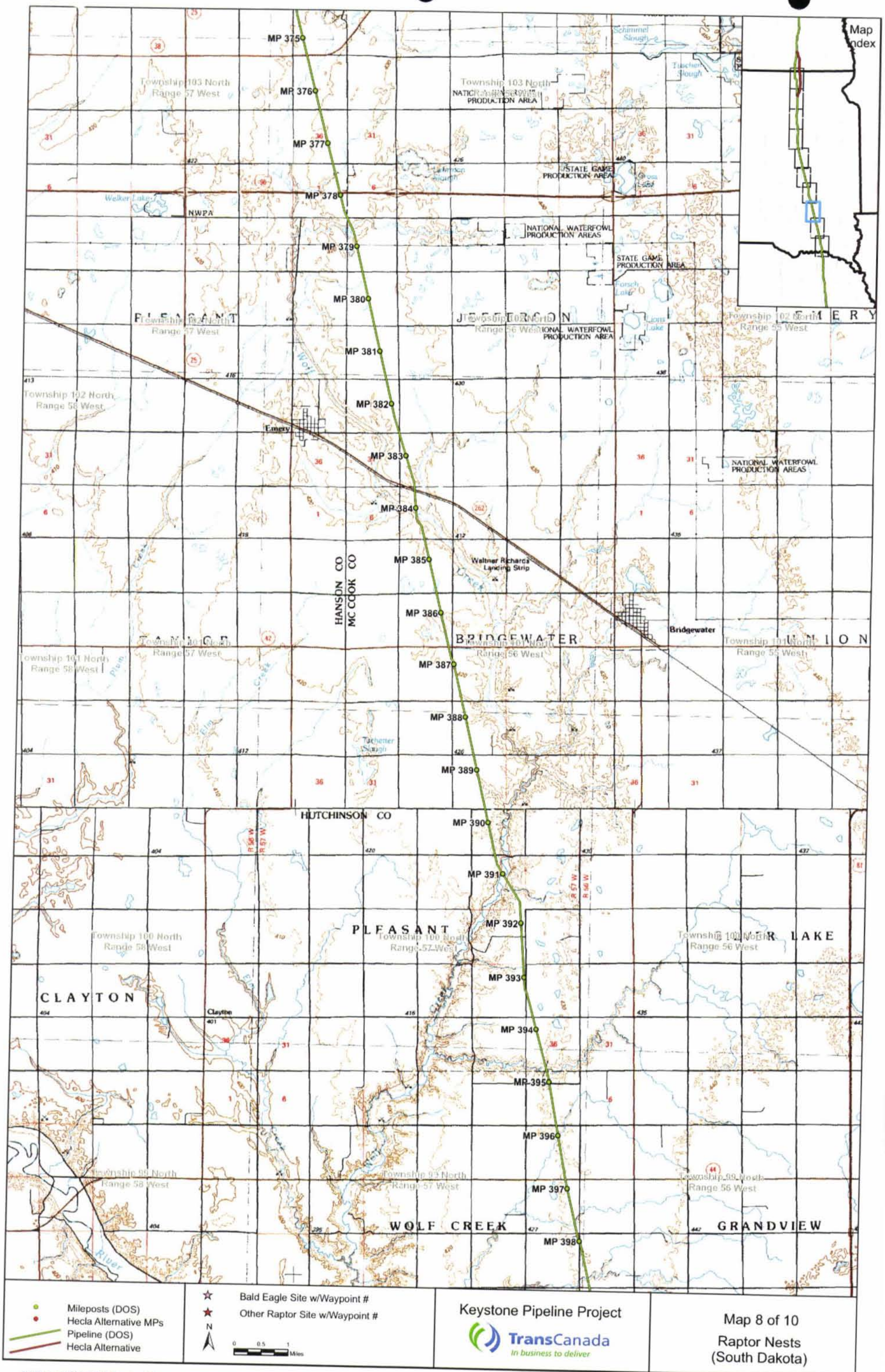


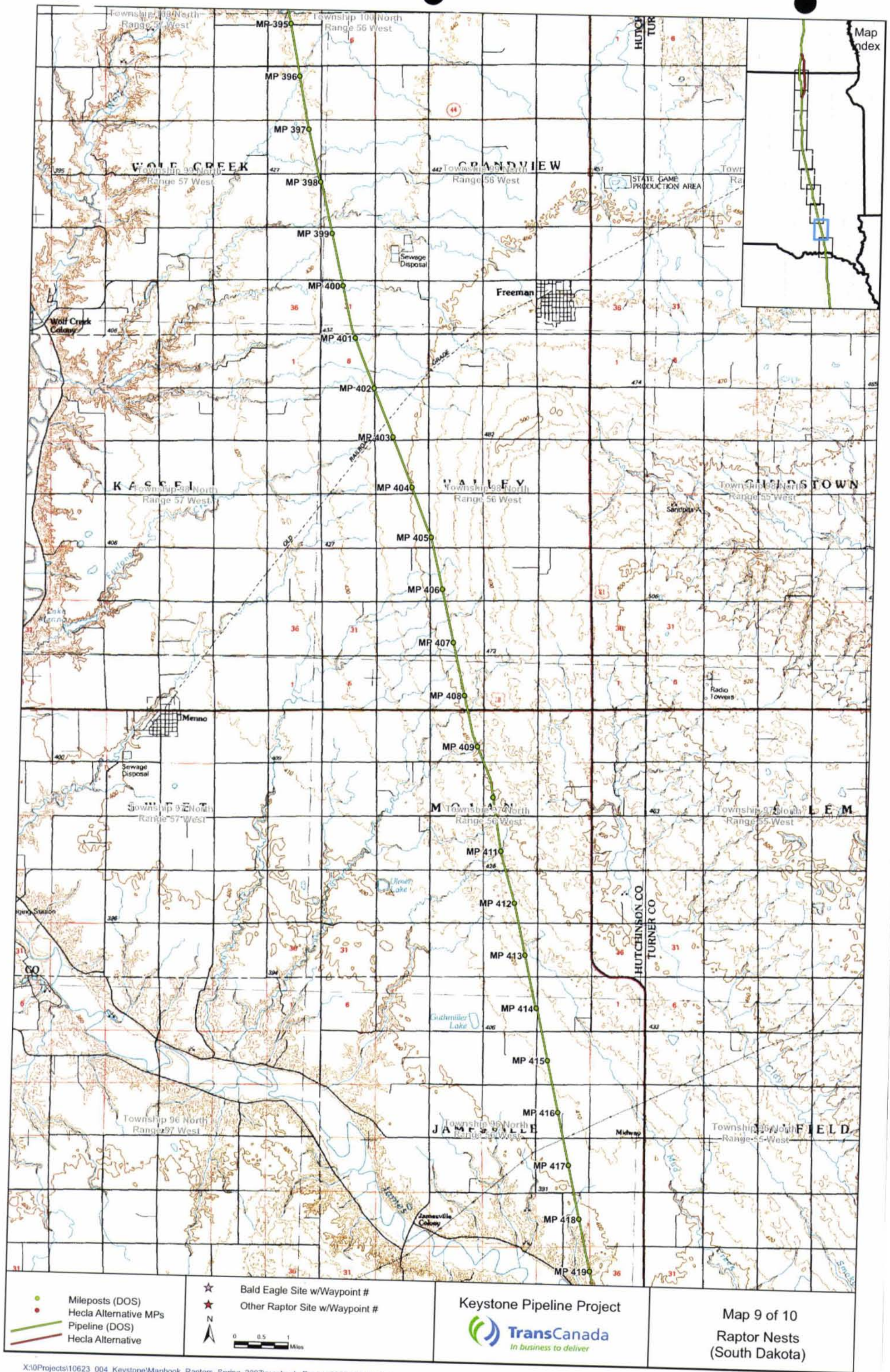
Map 5 of 10
Raptor Nests
(South Dakota)

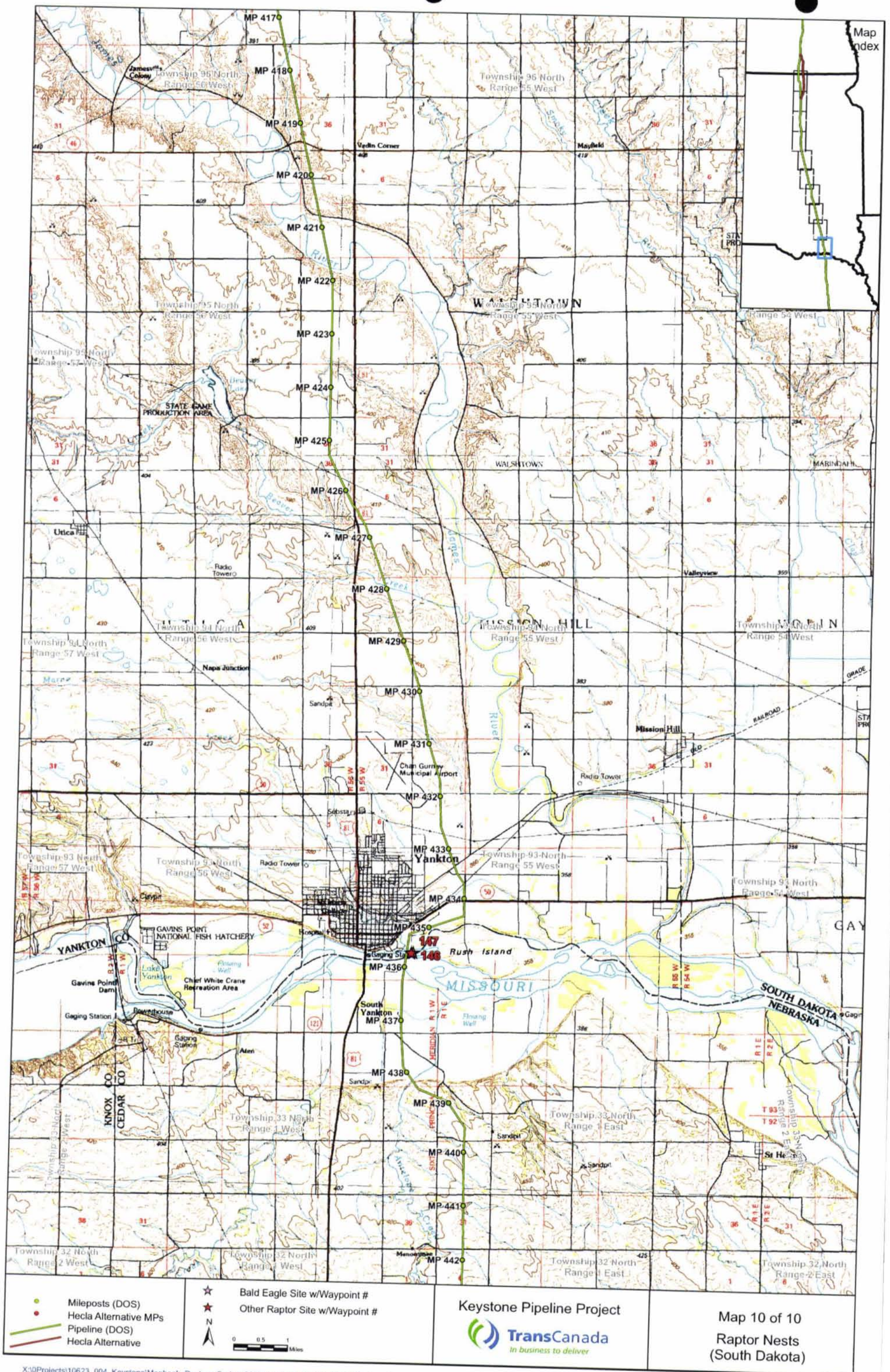
★ Bald Eagle Site w/Waypoint #
★ Other Raptor Site w/Waypoint #

Mileposts (DOS)
Hecla Alternative MP's
Pipeline (DOS)
Hecla Alternative



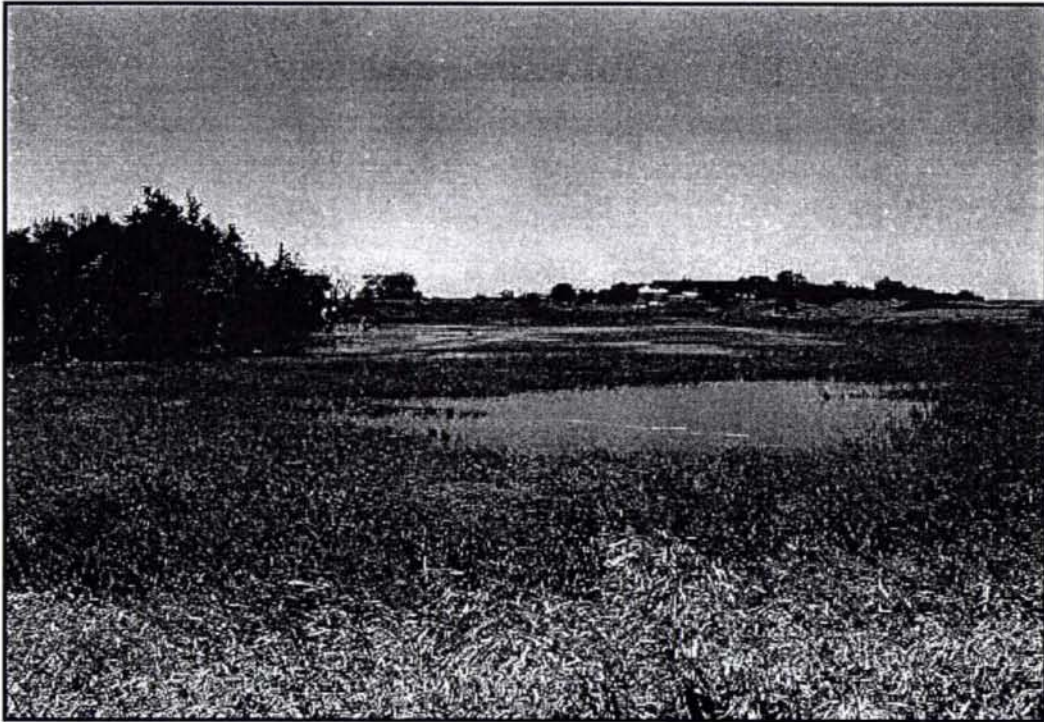






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Prepared for:
Keystone Pipeline Project



Keystone Pipeline Project Progress Report for Wetland Surveys on the Cushing Extension

ENSR Corporation
March 2007
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Prepared for:
Keystone Pipeline Project

Keystone Pipeline Project Progress Report for Wetland Surveys on the Cushing Extension

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March 2007
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- Appendix B - Wetlands Identified and Delineated To-Date Along the Cushing Extension (Nebraska, Kansas, Oklahoma)

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Executive Summary

Wetlands, waterbodies (including rivers, streams, lakes, and ponds), and riparian areas have been identified along the proposed Cushing Extension of the Keystone Pipeline Project right-of-way (ROW) through ongoing field surveys and the review of aerial photographs for areas where reroutes have been developed. The purpose of this report is to review the methodologies being used to collect wetland and waterbody data, summarize the data that was collected for wetlands during the spring 2007 field effort and discuss projected wetland survey needs for summer 2007.

1.0 Introduction

As part of federal regulatory requirements under the Clean Water Act (CWA), wetland and other waters of the U.S. (WUS) inventories involving field surveys are required to evaluate the potential for adverse effects to WUS along the proposed pipeline right-of-way (ROW) and other associated areas of disturbance related to project construction. Information gathered during the inventories will be used to complete notification and permitting requirements under Section 401 and 404 of the CWA, as managed by the U.S. Army Corps of Engineers (USACE) and applicable state agencies. The Cushing Extension of the Keystone Pipeline Project crosses three USACE districts including the Omaha, Kansas City, and Tulsa districts. Each of these districts has slightly different surveying and permitting requirements. Meetings were held in 2006 with the Omaha (February 6, March 29), Tulsa (March 13), and Kansas City (March 27) districts to discuss surveying, permitting, and construction requirements.

Consultation with the various USACE districts resulted in the following general survey requirements:

- Omaha District (Nebraska): Field surveys along the Cushing Extension ROW route through Nebraska will be required only at specific locations. Information will be provided to the USACE on other crossings, such as ephemeral streams and farmed wetlands, using remote sensing and GIS.
- Kansas City District (Kansas): All wetland and drainage crossings along the Cushing Extension in Kansas will require ground surveys
- Tulsa District (Oklahoma): All wetland and drainage crossings along the Cushing Extension in Oklahoma will require ground surveys.

More specific information regarding discussions with the USACE districts' personnel, level of effort, wetland and other WUS delineation methodology and permitting requirements has been provided in a submittal to the Department of State (September 15, 2006). In partial fulfillment of USACE requirements, field surveys commenced in the spring of 2007 and will be completed by summer 2007. The remainder of this report provides a summary of data collection efforts for wetlands through March 2007 and discusses projected wetland survey needs for the summer of 2007.

2.0 Data Collection Methods for Wetlands and Other WUS

To initiate this project, ENSR completed a review of U.S. Geological Survey (USGS) topographic maps, National Wetland Inventory (NWI) maps, available soil surveys, and 2005 aerial photographs pertaining to the proposed ROW. The objectives of this data review were to identify wetlands and other WUS intercepted by the proposed pipeline route, including intermittent and ephemeral streams, and to identify specific wetlands and other WUS that will require field evaluation to confirm their status. Areas identified for field verification

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included: 1) NWI-mapped wetlands intercepted by the pipeline route that are not farmed; 2) areas that appear to meet the wetlands three-parameter criteria (discussed below), but are not mapped on NWI maps; and 3) forested areas where wetland boundaries could not be estimated from aerial photographs. Additional areas to be field verified were included if recommended by the various USACE districts. Areas identified on the NWI maps as farmed wetlands or agricultural or roadway drainage ditches were eliminated from field delineations.

ENSR coordinated with USACE representatives regarding features requiring field verification and delineation. Preliminary survey areas were identified on maps of the proposed ROW previously provided by the district offices. For each site surveyed, a decision was made by the field team regarding the presence of wetlands and other WUS. For drainages with no wetland characteristics (e.g., unvegetated channel, defined bed and bank), a Stream Data Form developed by ENSR was completed to evaluate stream crossing characteristics. This form applied to stream crossings whether or not it supported adjunct wetland plant communities. If both wetlands and other WUS were present, a Stream Data Form and a Routine Wetland Determination Form was completed for the survey site.

The methods and techniques used to evaluate and delineate wetlands and other WUS on the maps of the proposed route corresponded to those specified for "routine on-site delineations" in the USACE Wetlands Delineation Manual (Manual; USACE 1987). The Manual identifies a "three-parameter" approach used for defining wetlands which requires that all three of the conditions listed below be met under normal circumstances for an area to be defined and delineated as wetland.

1. The prevalent vegetation consists of hydrophytic plants that have the ability to grow in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content and depleted soil oxygen levels.
2. Soils are present and are classified as hydric or possessing characteristics that are associated with reducing soil conditions. Hydric soils are poorly drained and have a seasonal high water table within 6 inches of the surface.
3. The area is inundated either permanently or periodically at mean water depths less than or equal to 6.6 feet or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation (usually 12.5 percent of the growing season) (USACE 1987).

Vegetation, soil, and hydrology data was collected at each sample point within the wetlands and immediately adjacent uplands and was entered onto a standardized wetland delineation field data form. The form also included a field sketch, which illustrated the wetlands and uplands. Wetland/upland boundaries were delineated using a handheld Global Positioning System (GPS) receiver. Photographs showing a representative view of each wetland visited also were taken. In addition to collecting sufficient data for "routine on-site delineations" and channel characteristics data for drainage crossings, wetland survey teams collected sufficient data (e.g., defined bed and bank and connectivity to navigable waters) for the USACE to make jurisdictional determinations for all wetlands and drainage crossings surveyed in the field.

Wetlands and other WUS along the proposed route were delineated in accordance with the direction provided by the USACE – Omaha, Kansas City, and Tulsa districts. The requirements and level of effort to complete wetland other WUS delineations differed within each district. The level of effort completed within each of the respective states has been provided below.

Cushing Extension

- Nebraska: Preliminary identification of wetlands and other WUS was based on the review of aerial photographs. Delineations of wetlands and other WUS will be initiated and completed in the spring/summer of 2007.

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- Kansas: Preliminary identification of wetlands and other WUS was based on the review of aerial photographs. Delineations of wetlands and other WUS will be initiated and completed in the spring/summer of 2007.
- Oklahoma: Preliminary identification of wetlands and other WUS was based on the review of aerial photographs. Delineations of all wetlands and other WUS will be initiated and completed in the spring/summer of 2007.

A table of all potential wetlands identified which require ground-verification/field delineation in Nebraska and Kansas may be found in Appendix A.

3.0 Results of Spring 2007 Wetland Surveys

Maps of the proposed route, including USGS topographic maps and high resolution aerial photography overlaid with NWI wetland polygons, were evaluated for wetland crossings. Based on this evaluation, priority wetland survey areas were identified along the Cushing Extension ROW. Based on surveys conducted to date, a total of 145 wetlands have been field delineated along the Cushing Extension ROW in Nebraska, Kansas, and Oklahoma.

Of the 145 wetlands identified to date, the vast majority are classified as palustrine emergent (PEM) wetlands (**Figure 1**), representing 64 percent of all identified. PEM wetlands are dominated by persistent and nonpersistent grasses, rushes, sedges, forbs and other herbaceous or grass-like plants. The second most common wetland type identified is palustrine forested (PFO) wetlands, comprising 29 percent of the total. PFO wetlands are dominated by woody vegetation, generally greater than ten feet in height. One percent of wetlands identified are classified as palustrine scrub-shrub (PSS) wetlands (dominated by shrubs), while 6 percent are classified as wetlands dominated by open water (OW). A complete list of wetlands identified to date for the Cushing Extension may be found in Appendix B.

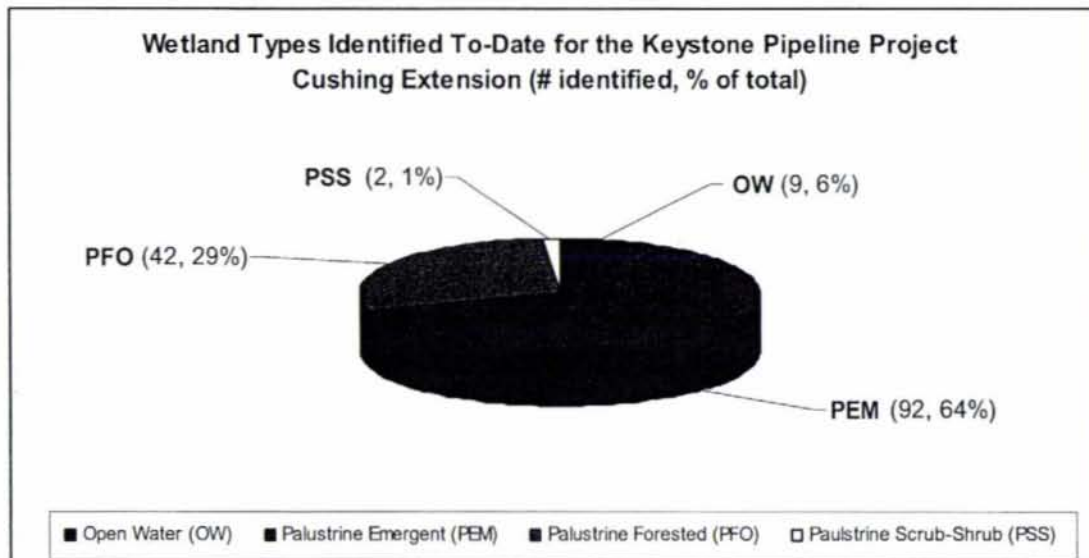


Figure 1 Wetland Types Identified To-Date on the Cushing Extension

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Currently, wetland survey status for the Cushing Extension of the Keystone Pipeline Project is variable by state. Nebraska is currently complete, with further surveys necessary in Kansas and Oklahoma (**Table 1**). The current wetland survey status by state is provided in detail below:

- Nebraska: Wetland delineations are 100 percent complete. Of 10 total locations requiring survey, all 10 have been completed.
- Kansas: Wetland delineations are approximately 84 percent complete, based on pre-survey location estimates. Delineations have been completed for 190 of the 226 locations identified prior to survey initiation. Based on mileage, wetland and WUS surveys in Kansas are approximately 80 percent complete. Further wetland surveys will be conducted in spring/summer 2007 on tracts where permission was recently obtained and for any potential reroutes.
- Oklahoma: Wetland delineations are approximately 50 percent complete. Of the 80 total miles requiring wetland survey from the Kansas border to the Cushing Terminal, 40 miles have been successfully completed. Further wetland surveys will be conducted in spring/summer 2007 on tracts where permission was recently obtained and for any potential reroutes.

Table 1 Cushing Wetlands Survey Progress as of February 24, 2007

State	Locations (L) Requiring Pedestrian Survey ¹	Miles (M) Requiring Pedestrian Survey ¹	Total Locations (L) Surveyed ¹	Total Miles (M) Surveyed ¹	Percent Complete
Nebraska	10 (L)	---	10(L)	---	100
Kansas	226 (L)	210 (M)	190 (L) ²	170 (M)	84
Oklahoma	---	80 (M)	---	40(M)	50
Total locations	236 (L)	---	200 (L)	---	---
Total miles	---	290 (M)	---	210 (M)	---

¹Numbers of wetlands for survey subject to verification.

²Kansas requires 100 percent pedestrian survey. Location records have been kept to track survey progress. Mileage numbers reflect areas void of features, in addition to areas where survey crews have found and delineated wetlands.

4.0 Projected Survey Needs (Spring/Summer 2007)

Cushing Extension

Remaining wetland survey work on the Keystone Pipeline Project Cushing Extension includes:

- Nebraska: Complete. No further surveys on the Cushing Extension required.
- Kansas and Oklahoma: Further wetland surveys will be conducted in spring/summer 2007 on tracts where permission was recently obtained and for any potential reroutes.

5.0 References

U.S. Army Corps of Engineers (USACE). 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Available online at: <http://www.wes.army.mil/el/wetlands/pdfs/wlman87.pdf>.

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Appendix A

Potential Wetlands Identified for Field Verification/Delineation in Nebraska and Kansas along the Cushing Extension

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation In Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
0.239	0.247	0.008	OW		NE	1
0.431	0.435	0.004	OW		NE	2
0.568	0.570	0.002	OW		NE	3
0.636	0.638	0.002	OW		NE	4
0.745	0.747	0.002	OW		NE	5
1.717	1.719	0.002	OW		NE	6
1.840	1.843	0.003	OW		NE	7
1.851	1.857	0.006	OW		NE	8
1.890	1.892	0.002	OW		NE	9
2.823	2.824	0.002	OW		KS	10
3.570	3.572	0.002	OW		KS	11
4.113	4.156	0.042	OW	Little Blue River	KS	12
4.822	4.847	0.026	PEM		KS	13
5.652	5.669	0.018	PEM		KS	14
7.452	7.467	0.015	PEM		KS	15
7.601	7.613	0.012	PEM		KS	16
7.758	7.771	0.013	PEM		KS	17
7.793	7.808	0.015	PEM		KS	18
7.985	8.029	0.043	PEM		KS	19
8.924	8.958	0.034	PEM		KS	20
9.071	9.089	0.018	PFO		KS	21
9.089	9.091	0.002	OW		KS	
9.091	9.098	0.008	PFO		KS	
9.631	9.640	0.009	PFO		KS	22
9.640	9.642	0.002	OW		KS	
9.642	9.657	0.015	PFO		KS	
10.888	10.929	0.041	PFO		KS	23
11.661	11.677	0.016	PFO		KS	24
12.046	12.056	0.010	PFO		KS	25
12.056	12.058	0.002	OW	Mill Creek	KS	
12.058	12.073	0.015	PFO		KS	
13.484	13.505	0.021	PFO		KS	26
13.505	13.507	0.002	OW	Mill Creek	KS	
13.507	13.520	0.012	PFO		KS	
15.793	15.807	0.013	PFO		KS	27
16.469	16.478	0.009	PEM		KS	28
16.773	16.783	0.010	PEM		KS	29
16.854	16.866	0.011	PEM		KS	30
17.050	17.062	0.011	PEM		KS	31
17.397	17.430	0.033	PEM		KS	32
18.353	18.384	0.031	PEM		KS	33
18.518	18.536	0.018	PEM		KS	34
20.004	20.036	0.032	PEM		KS	35

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation in Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
20.570	20.576	0.006	PEM		KS	36
21.703	21.710	0.007	PEM		KS	37
21.718	21.726	0.008	PEM		KS	38
21.737	21.743	0.006	PEM		KS	39
21.918	21.983	0.065	PEM		KS	40
22.625	22.635	0.010	PFO		KS	41
22.635	22.637	0.003	OW		KS	
22.637	22.655	0.018	PFO		KS	
23.620	23.636	0.016	PEM		KS	42
23.847	23.877	0.030	PFO		KS	43
24.088	24.155	0.067	PEM		KS	44
25.954	26.010	0.056	PFO		KS	45
28.697	28.699	0.002	OW		KS	46
29.649	29.651	0.002	OW		KS	47
30.263	30.283	0.020	PFO		KS	48
30.283	30.285	0.002	OW		KS	
30.285	30.297	0.011	PFO		KS	
30.475	30.477	0.002	OW		KS	49
31.315	31.317	0.002	OW		KS	50
32.135	32.137	0.002	OW		KS	51
33.251	33.253	0.002	OW		KS	52
34.699	34.701	0.002	OW		KS	53
36.284	36.297	0.013	PFO		KS	54
36.297	36.299	0.002	OW	West Fancy Creek	KS	
36.299	36.310	0.011	PFO		KS	
43.876	43.878	0.002	OW		KS	55
45.475	45.477	0.002	OW		KS	56
46.209	46.317	0.108	PEM		KS	57
46.357	46.390	0.033	PEM		KS	58
46.391	46.475	0.084	PEM		KS	59
50.288	51.130	0.842	PFO		KS	60
51.142	51.182	0.039	OW	Republican River	KS	
51.182	51.233	0.051	PFO		KS	
51.247	51.293	0.046	PEM		KS	61
52.514	52.516	0.002	OW		KS	62
53.989	54.028	0.038	PEM		KS	63
54.028	54.030	0.002	OW		KS	
54.030	54.050	0.020	PEM		KS	
54.114	54.253	0.139	PEM		KS	64
59.294	59.296	0.003	OW		KS	65
60.063	60.067	0.005	OW		KS	66
68.781	68.813	0.032	PFO		KS	67
68.813	68.815	0.002	OW	Chapman Creek	KS	
68.815	68.836	0.021	PFO		KS	
69.921	69.943	0.022	PFO		KS	68
69.950	69.981	0.031	PFO		KS	69

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation In Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
70.234	70.246	0.012	PFO		KS	70
70.246	70.248	0.002	OW		KS	
70.248	70.261	0.013	PFO		KS	
70.627	70.643	0.016	PFO		KS	71
70.643	70.645	0.002	OW		KS	
70.645	70.652	0.007	PFO		KS	
71.899	71.903	0.003	PFO		KS	72
71.903	71.905	0.002	OW		KS	
71.905	71.908	0.004	PFO		KS	
72.024	72.027	0.002	OW		KS	73
72.052	72.055	0.003	OW		KS	74
72.100	72.105	0.005	OW		KS	75
76.080	76.253	0.174	PFO		KS	76
76.533	76.552	0.019	PFO		KS	77
76.552	76.582	0.030	OW	Smoky Hill River	KS	
76.582	76.604	0.022	PFO		KS	
78.920	78.944	0.024	PEM		KS	78
79.373	79.426	0.053	PFO		KS	79
80.022	80.037	0.015	PEM		KS	80
80.037	80.039	0.002	OW		KS	
80.039	80.052	0.013	PEM		KS	
81.427	81.429	0.002	OW		KS	81
81.429	81.438	0.009	PEM		KS	
81.899	81.904	0.006	PEM		KS	82
83.571	83.580	0.009	PEM		KS	83
83.580	83.582	0.002	OW		KS	
83.582	83.593	0.011	PEM		KS	
85.079	85.087	0.008	PEM		KS	84
85.087	85.088	0.002	OW		KS	
85.088	85.101	0.012	PEM		KS	
85.816	85.836	0.020	PEM		KS	85
86.206	86.217	0.012	PEM		KS	86
86.217	86.219	0.002	OW		KS	
86.219	86.233	0.014	PEM		KS	
86.919	86.932	0.012	PFO		KS	87
87.002	87.019	0.017	PFO		KS	88
87.053	87.068	0.015	PFO		KS	89
87.068	87.070	0.002	OW		KS	
87.070	87.073	0.003	PFO		KS	
87.622	87.635	0.013	PEM		KS	90
87.635	87.637	0.002	OW		KS	
87.637	87.652	0.015	PEM		KS	
89.604	89.616	0.012	PEM		KS	91
89.616	89.618	0.002	OW		KS	
89.618	89.634	0.016	PEM		KS	
90.990	91.028	0.038	PFO		KS	92

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation In Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
91.028	91.032	0.004	OW		KS	
91.032	91.065	0.033	PFO		KS	
92.032	92.039	0.007	PFO		KS	
92.039	92.040	0.002	OW		KS	93
92.040	92.049	0.008	PFO		KS	
92.649	92.660	0.011	PEM		KS	
95.169	95.234	0.065	PFO		KS	94
95.234	95.239	0.005	OW		KS	
95.239	95.246	0.007	PFO		KS	
95.841	95.848	0.007	PEM		KS	95
95.848	95.850	0.002	OW		KS	
95.850	95.866	0.016	PEM		KS	
96.294	96.320	0.026	PFO		KS	96
96.320	96.323	0.003	OW		KS	
96.323	96.337	0.014	PFO		KS	
97.013	97.068	0.056	PFO		KS	97
97.082	97.127	0.045	PFO		KS	
97.163	97.174	0.011	PFO		KS	
97.174	97.175	0.002	OW		KS	98
97.175	97.195	0.020	PFO		KS	
98.759	98.772	0.012	PEM		KS	
98.772	98.775	0.003	OW		KS	99
98.775	98.780	0.005	PEM		KS	
99.967	99.979	0.012	PFO		KS	
99.979	99.981	0.002	OW		KS	100
99.981	99.986	0.005	PFO		KS	
101.615	101.652	0.037	PEM		KS	
101.652	101.655	0.003	OW		KS	101
101.655	101.673	0.018	PEM		KS	
105.113	105.121	0.008	PEM		KS	
105.121	105.123	0.003	OW		KS	102
105.123	105.127	0.004	PEM		KS	
105.127	105.130	0.002	OW		KS	
105.130	105.137	0.007	PEM		KS	103
105.151	105.157	0.007	PEM		KS	
105.157	105.160	0.003	OW		KS	
105.160	105.173	0.012	PEM		KS	104
105.189	105.197	0.008	PEM		KS	
105.197	105.201	0.004	OW		KS	
105.201	105.233	0.032	PEM		KS	105
105.233	105.238	0.005	OW		KS	
105.238	105.272	0.034	PEM		KS	
106.301	106.311	0.010	PFO		KS	106
106.311	106.313	0.002	OW		KS	
106.313	106.384	0.071	PFO		KS	
108.685	108.700	0.016	PEM		KS	107
						108

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation In Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
108.700	108.702	0.002	OW		KS	
108.702	108.709	0.007	PEM		KS	
109.386	109.394	0.008	OW		KS	109
111.599	111.605	0.007	OW		KS	110
111.632	111.637	0.005	OW		KS	111
111.921	111.924	0.002	OW		KS	112
112.704	112.712	0.009	PEM		KS	
112.712	112.714	0.002	OW		KS	113
112.714	112.730	0.016	PEM		KS	
114.106	114.128	0.022	PFO		KS	
114.128	114.141	0.013	OW		KS	114
114.141	114.175	0.034	PFO		KS	
116.928	116.930	0.002	OW		KS	115
117.104	117.127	0.023	PFO		KS	
117.127	117.134	0.007	OW	Cottonwood River	KS	116
118.852	118.854	0.003	OW		KS	117
119.833	119.864	0.031	OW		KS	118
120.590	120.592	0.002	OW		KS	119
122.577	122.582	0.005	PEM		KS	
122.582	122.585	0.003	OW		KS	120
122.585	122.592	0.007	PEM		KS	
123.385	123.426	0.041	PFO		KS	
123.438	123.442	0.003	OW		KS	121
124.211	124.216	0.005	OW		KS	122
124.265	124.267	0.002	OW		KS	123
126.606	126.615	0.008	PEM		KS	124
128.217	128.219	0.002	OW		KS	125
128.950	128.952	0.002	OW	Doyle Creek	KS	126
129.488	129.491	0.003	PEM		KS	
129.491	129.493	0.002	OW		KS	127
129.493	129.496	0.003	PEM		KS	
130.187	130.196	0.008	PEM		KS	
130.196	130.200	0.005	OW		KS	128
130.200	130.203	0.003	PEM		KS	
130.203	130.208	0.005	OW		KS	
130.208	130.216	0.008	PEM		KS	
130.253	130.258	0.005	PEM		KS	
130.258	130.260	0.002	OW		KS	129
130.260	130.264	0.004	PEM		KS	
130.275	130.283	0.008	PEM		KS	
130.283	130.286	0.003	OW		KS	130
130.286	130.288	0.002	PEM		KS	
130.359	130.361	0.002	PEM		KS	131
131.026	131.034	0.007	PEM		KS	132
133.040	133.043	0.003	OW		KS	133
133.044	133.046	0.002	OW		KS	134

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation In Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
133.063	133.066	0.002	OW		KS	135
133.402	133.408	0.006	OW		KS	136
134.420	134.436	0.015	PEM		KS	137
134.436	134.438	0.002	OW		KS	
134.438	134.458	0.021	PEM		KS	
134.494	134.511	0.016	PEM		KS	138
136.180	136.186	0.006	PEM		KS	139
136.186	136.188	0.002	OW		KS	
136.188	136.196	0.008	PEM		KS	
136.263	136.267	0.004	PEM		KS	140
136.267	136.269	0.002	OW		KS	
136.269	136.285	0.015	PEM		KS	
136.285	136.288	0.004	OW		KS	
136.288	136.300	0.012	PEM		KS	
136.313	136.328	0.015	PEM		KS	141
136.328	136.330	0.002	OW		KS	
136.330	136.338	0.008	PEM		KS	
136.777	136.782	0.005	PEM		KS	142
137.579	137.605	0.027	PEM		KS	143
140.116	140.117	0.002	OW		KS	144
140.203	140.219	0.016	OW		KS	145
142.530	142.532	0.002	OW		KS	146
144.043	144.055	0.012	OW		KS	147
144.964	144.966	0.002	OW		KS	148
147.481	147.545	0.064	PEM		KS	149
148.481	148.490	0.010	PEM		KS	150
148.717	148.720	0.002	OW		KS	151
148.897	148.907	0.011	PEM		KS	152
148.997	149.004	0.006	PEM		KS	153
149.004	149.006	0.002	OW		KS	
149.006	149.041	0.035	PEM		KS	
151.581	151.596	0.015	PSS		KS	154
151.596	151.598	0.002	OW		KS	
151.598	151.619	0.022	PSS		KS	
152.337	152.406	0.069	PEM		KS	155
153.524	153.550	0.026	PEM		KS	156
154.824	154.955	0.131	PFO		KS	157
154.955	154.957	0.002	OW		KS	
154.957	154.982	0.024	PFO		KS	
155.885	155.891	0.006	OW		KS	158
155.912	155.923	0.011	OW		KS	159
155.930	155.934	0.004	OW		KS	160
156.010	156.034	0.024	PFO		KS	161
156.034	156.042	0.008	OW		KS	
156.042	156.091	0.049	PFO		KS	
156.312	156.324	0.011	PEM		KS	162

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation In Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
158.226	158.235	0.009	PFO	Whitewater River	KS	163
158.235	158.250	0.015	OW		KS	
158.250	158.265	0.015	PFO		KS	
159.066	159.090	0.024	PFO		KS	164
159.090	159.092	0.002	OW		KS	
159.092	159.109	0.018	PFO		KS	
159.928	159.939	0.011	PFO		KS	165
159.939	159.941	0.002	OW		KS	
159.941	159.978	0.037	PFO		KS	
160.600	160.603	0.003	OW		KS	166
164.050	164.063	0.013	PFO		KS	167
164.063	164.065	0.002	OW		KS	
167.295	167.367	0.072	PEM		KS	168
167.614	167.619	0.005	OW		KS	169
167.987	168.001	0.014	PFO		KS	170
168.001	168.004	0.003	OW	Fourmile Creek	KS	
168.004	168.019	0.015	PFO		KS	
169.524	169.589	0.066	PFO		KS	171
170.873	170.892	0.019	PEM		KS	172
170.892	170.894	0.002	OW		KS	
170.894	170.950	0.057	PEM		KS	
171.100	171.114	0.013	PEM		KS	173
171.469	171.497	0.029	PEM		KS	174
172.465	172.594	0.129	PFO		KS	175
173.135	173.170	0.034	PEM		KS	176
173.232	173.235	0.003	PEM		KS	177
174.827	174.842	0.015	PFO		KS	178
174.842	174.844	0.002	OW		KS	
174.844	174.879	0.035	PFO		KS	
175.744	175.752	0.009	PFO		KS	179
175.752	175.754	0.002	OW		KS	
175.754	175.762	0.008	PFO		KS	
176.421	176.433	0.013	PEM		KS	180
177.506	177.514	0.009	PFO		KS	181
177.522	177.524	0.002	PFO		KS	182
177.524	177.528	0.004	OW		KS	
177.528	177.545	0.018	PFO		KS	
178.120	178.122	0.002	OW		KS	183
178.782	178.785	0.003	PEM		KS	184
178.848	178.862	0.014	PFO		KS	185
178.862	178.865	0.003	OW		KS	
178.865	178.888	0.023	PFO		KS	
180.903	180.917	0.014	PFO		KS	186
180.917	180.919	0.002	OW		KS	
180.919	180.941	0.022	PFO		KS	
185.377	185.386	0.009	PFO	Polecat Creek	KS	187

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Table A-1 Potential Wetlands Identified for Field Verification/ Delineation In Nebraska and Kansas Along the Cushing Extension¹

Enter MP	Exit MP	Miles Crossed	WL Type	Name	State	Survey Site Count
185.386	185.388	0.002	OW		KS	188
185.388	185.407	0.019	PFO		KS	
185.465	185.470	0.005	PFO		KS	
185.470	185.472	0.002	OW		KS	
185.472	185.566	0.094	PFO		KS	
185.566	185.568	0.002	OW		KS	
185.568	185.588	0.021	PFO		KS	
186.961	186.966	0.005	OW		KS	189
186.976	186.980	0.003	OW		KS	190
186.990	186.992	0.002	OW		KS	191
187.007	187.010	0.003	OW		KS	192
187.021	187.023	0.002	OW		KS	193
188.116	188.136	0.019	PFO		KS	194
188.136	188.141	0.005	OW		KS	
188.141	188.181	0.041	PFO		KS	
188.269	188.273	0.004	PFO		KS	195
188.273	188.275	0.002	OW		KS	
188.275	188.304	0.029	PFO		KS	
188.399	188.415	0.015	PFO		KS	196
188.415	188.417	0.002	OW		KS	
188.417	188.434	0.017	PFO		KS	
188.461	188.465	0.004	PFO		KS	197
190.211	190.228	0.017	PEM		KS	198
191.603	191.640	0.037	PEM		KS	199
192.277	192.338	0.061	PEM		KS	200
192.947	192.981	0.034	PFO		KS	201
193.288	193.319	0.030	PEM		KS	202
195.163	195.185	0.022	PEM		KS	203
196.122	196.152	0.030	PEM		KS	204
198.268	198.291	0.023	PEM		KS	205
202.951	202.967	0.016	PEM		KS	206
203.188	203.207	0.019	PEM		KS	207
205.059	205.104	0.045	PFO		KS	208
205.590	205.630	0.040	PFO		KS	209
205.630	205.740	0.110	OW	Arkansas River	KS	
205.740	205.818	0.078	PFO		KS	
206.897	206.911	0.015	PEM		KS	210
207.086	207.099	0.013	PEM		KS	211
209.666	209.689	0.023	PEM		KS	212
209.769	209.820	0.051	PEM		KS	213
210.197	210.265	0.067	PEM		KS	214

¹Analysis based on review of high resolution photography, topographic maps, and NWI polygons.

Locations requiring on-site verification/delineation were grouped for the purpose of tracking field survey progress.

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Appendix B

Wetlands Identified and Delineated To-Date Along the Cushing Extension (Nebraska, Kansas, Oklahoma)

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Table B-1 Wetlands Identified and Field Delineated To-Date along the Cushing Extension (Nebraska, Kansas, Oklahoma)

Enter MP	Exit MP	Distance Crossed (miles)	Wetland Type	State
1.166	1.176	0.011	OW	NE
7.452	7.467	0.015	PEM	KS
7.601	7.613	0.012	PEM	KS
7.758	7.771	0.013	PEM	KS
7.793	7.808	0.015	PEM	KS
7.985	8.029	0.043	PEM	KS
16.855	16.858	0.003	PEM	KS
17.408	17.426	0.018	PEM	KS
18.353	18.384	0.031	PEM	KS
18.518	18.536	0.018	PEM	KS
23.620	23.636	0.016	PEM	KS
51.130	51.142	0.012	PFO	KS
51.182	51.233	0.051	PFO	KS
51.247	51.293	0.046	PEM	KS
53.989	54.028	0.038	PEM	KS
54.030	54.050	0.020	PEM	KS
54.114	54.253	0.139	PEM	KS
69.921	69.925	0.004	PFO	KS
69.925	69.932	0.007	PEM	KS
69.932	69.943	0.011	PFO	KS
69.950	69.961	0.010	PFO	KS
69.961	69.972	0.011	PEM	KS
69.972	69.981	0.009	PFO	KS
70.234	70.255	0.022	PFO	KS
70.260	70.261	0.002	PFO	KS
76.080	76.253	0.174	PFO	KS
78.920	78.944	0.024	PEM	KS
85.816	85.836	0.020	PEM	KS
86.206	86.217	0.012	PEM	KS
86.219	86.233	0.014	PEM	KS
87.654	87.672	0.018	OW	KS
105.117	105.201	0.084	PEM	KS
105.212	105.227	0.015	PEM	KS
105.234	105.260	0.026	PEM	KS
105.262	105.272	0.010	PEM	KS
108.704	108.718	0.013	PEM	KS
116.919	116.930	0.011	PEM	KS
136.777	136.782	0.005	PEM	KS
140.148	140.151	0.003	PEM	KS
140.184	140.186	0.003	PEM	KS

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Table B-1 Wetlands Identified and Field Delineated To-Date along the Cushing Extension (Nebraska, Kansas, Oklahoma)

Enter MP	Exit MP	Distance Crossed (miles)	Wetland Type	State
147.509	147.518	0.010	PEM	KS
151.581	151.600	0.019	PSS	KS
151.603	151.619	0.016	PSS	KS
154.824	154.912	0.088	PFO	KS
154.928	154.982	0.053	PFO	KS
156.010	156.034	0.024	PFO	KS
156.042	156.091	0.049	PFO	KS
156.312	156.324	0.011	PEM	KS
158.226	158.235	0.009	PFO	KS
158.250	158.265	0.015	PFO	KS
159.066	159.090	0.024	PFO	KS
159.092	159.109	0.018	PFO	KS
159.928	159.939	0.011	PFO	KS
159.941	159.978	0.037	PFO	KS
167.295	167.367	0.072	PEM	KS
170.912	170.914	0.002	PEM	KS
171.107	171.113	0.006	PEM	KS
171.469	171.497	0.029	PEM	KS
172.495	172.497	0.002	OW	KS
173.135	173.170	0.034	PEM	KS
173.232	173.235	0.003	PEM	KS
174.825	174.847	0.022	PFO	KS
176.401	176.469	0.068	PEM	KS
178.778	178.779	0.001	OW	KS
185.377	185.386	0.009	PFO	KS
185.388	185.407	0.019	PFO	KS
185.465	185.470	0.005	PFO	KS
185.472	185.566	0.094	PFO	KS
185.568	185.588	0.021	PFO	KS
190.211	190.228	0.017	PEM	KS
191.603	191.640	0.037	PEM	KS
192.326	192.333	0.007	PEM	KS
192.947	192.981	0.034	PFO	KS
198.267	198.282	0.015	PEM	KS
202.951	202.967	0.016	PEM	KS
203.188	203.207	0.019	PEM	KS
205.059	205.104	0.045	PFO	KS
205.590	205.630	0.040	PFO	KS
205.740	205.818	0.078	PFO	KS
206.897	206.911	0.015	PEM	KS
207.086	207.099	0.013	PEM	KS
210.197	210.265	0.067	PEM	KS

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Table B-1 Wetlands Identified and Field Delineated To-Date along the Cushing Extension (Nebraska, Kansas, Oklahoma)

Enter MP	Exit MP	Distance Crossed (miles)	Wetland Type	State
215.730	215.758	0.029	PEM	OK
216.503	216.511	0.007	PEM	OK
218.515	218.528	0.013	PEM	OK
218.932	218.941	0.010	PEM	OK
219.236	219.240	0.004	PEM	OK
220.038	220.041	0.003	PEM	OK
220.528	220.534	0.006	PEM	OK
221.285	221.304	0.019	OW	OK
222.997	223.012	0.015	PEM	OK
227.110	227.127	0.017	PEM	OK
228.087	228.110	0.024	PEM	OK
228.207	228.218	0.011	PEM	OK
228.522	228.549	0.027	PEM	OK
228.791	228.802	0.011	PEM	OK
230.650	230.672	0.022	PEM	OK
231.446	231.577	0.130	PEM	OK
232.575	232.578	0.003	PFO	OK
233.350	233.410	0.060	PEM	OK
233.583	233.606	0.023	PEM	OK
233.783	233.795	0.012	PEM	OK
235.645	235.677	0.032	PEM	OK
236.080	236.111	0.031	PEM	OK
236.195	236.228	0.033	PEM	OK
241.950	241.962	0.012	PEM	OK
243.188	243.198	0.010	PEM	OK
243.234	243.240	0.006	PEM	OK
243.813	243.818	0.005	PEM	OK
244.568	244.589	0.021	PEM	OK
245.540	245.661	0.121	PEM	OK
245.894	245.926	0.032	PEM	OK
248.311	248.322	0.011	PFO	OK
248.582	248.671	0.089	PFO	OK
248.744	248.887	0.143	PFO	OK
250.173	250.198	0.025	OW	OK
254.293	254.382	0.090	PEM	OK
254.680	254.709	0.029	PFO	OK
254.716	254.796	0.080	PFO	OK
255.087	255.307	0.220	PFO	OK
255.476	255.481	0.005	PEM	OK
255.913	256.013	0.100	PEM	OK
257.713	257.795	0.082	PEM	OK
257.797	257.861	0.063	PEM	OK

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Table B-1 Wetlands Identified and Field Delineated To-Date along the Cushing Extension (Nebraska, Kansas, Oklahoma)

Enter MP	Exit MP	Distance Crossed (miles)	Wetland Type	State
259.596	259.627	0.030	PEM	OK
260.268	260.296	0.028	PEM	OK
260.298	260.323	0.026	PEM	OK
264.184	264.196	0.012	PFO	OK
264.199	264.219	0.020	PFO	OK
266.392	266.406	0.014	PFO	OK
268.358	268.369	0.011	OW	OK
269.426	269.451	0.025	PEM	OK
270.226	270.234	0.008	PEM	OK
270.304	270.328	0.024	PEM	OK
271.095	271.312	0.217	PFO	OK
271.312	271.323	0.011	PEM	OK
271.323	271.345	0.022	PFO	OK
272.399	272.425	0.026	PFO	OK
275.364	275.365	0.002	PEM	OK
283.450	283.455	0.004	PEM	OK
287.888	287.898	0.010	OW	OK
288.621	288.629	0.008	PEM	OK
288.640	288.664	0.024	PEM	OK
289.201	289.207	0.006	PEM	OK
289.882	289.926	0.045	OW	OK



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MAC

Metcalf Archaeological Consultants, Inc.

January 19, 2006

Ms. Paige Hoskinson, Historical Archaeologist
South Dakota State Historical Society
900 Governors Drive
Pierre, South Dakota 57501-2217

RE: Keystone Pipeline Project Survey Report

Dear Ms. Hoskinson,

Enclosed is a copy of the final survey report for fieldwork conducted during 2006 for the Keystone Pipeline Project.

After you have had the opportunity to review, please contact the MAC Bismarck office, as well as the client, with your comments:

Ms. Kim Munson, Anthropologist
ENSR International
1601 Prospect Parkway
Fort Collins, Colorado 80525

If you should you have any questions please contact the MAC Bismarck office.

Sincerely,

Amy Bleier
Staff Archaeologist

cc: Ms. Kim Munson

enclosure

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MAC

Metcalf Archaeological Consultants, Inc.

January 19, 2006

Ms. Jane Watts
South Dakota Archaeological Research Center
P.O. Box 1257
Rapid City, South Dakota 57709-1257

RE: Keystone Pipeline Project Site Forms

Dear Ms. Watts:

Enclosed are final copies of 15 site forms (five railroad sites, two foundation/depression sites, two rock cairn sites, one farmstead site, one foundation site, one artifact scatter site and two isolated find locales) that were encountered and recorded during fieldwork conducted in 2006 within the corridor surveyed for the proposed Keystone Pipeline.

Should you have any comments or questions in regards to these site forms, please contact the MAC Bismarck office.

Sincerely,

Amy Bleier
Staff Archaeologist

cc: Ms. Kim Munson

enclosure:	39BE2072 (Update)	39YK77
	39CK50	39YK78
	39DA70	39YK79
	39DA71	39YK2003 (Update)
	39DA2000 (Update)	
	39HT133	
	39HT134	
	39KB2003 (Update)	
	39ML2000 (Update)	
	39YK75	
	39YK76	

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Metcalfe Archaeological Consultants, Inc.

March 7, 2007

Mr. Albert M. LeBeau III
Tribal Historic Preservation Officer
Cheyenne River Sioux Tribe Cultural Preservation Office
P.O. Box 590
Eagle Butte, South Dakota 57625

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. LeBeau III,

In response to your request at the February 21, 2007, Corps of Engineers meeting in Pierre, South Dakota, Kim Munson with ENSR International requested that our office send the enclosed copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota and Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalfe Archaeological Consultants, Inc., the subcontractor who conducted the investigations, is sending these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

Elizabeth A. Orlando, Esq.
US Department of State
OES/ENV
Foreign Affairs Officer
Multilateral Team
Telephone: 202-647-4284
Fax: 202-647-1052
Cell: 240-723-3157
orlandoa2@state.gov

Sincerely,

Suzanne Nelsen
Office Manager

cc: Kim Munson

enclosures

(701) 258-1215
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e-mail: macnodak@metcalfarchaeology.com

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Eagle, Colorado 58502
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Metcalfe Archaeological Consultants, Inc.

February 7, 2007

Mr. James Whitted
Tribal Historic Preservation Officer
Sisseton-Wahpeton Oyate Planning and Development
Old Agency
P.O. Box 509
Sisseton, South Dakota 57262-0509

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Whitted,

Upon review we noticed that the cover letter with the reports we sent out January 22, 2007, was inadvertently addressed to Mr. Frankly and Mr. CrowsBreast. We apologize for the oversight and do hope that no harm has been caused by the error. It is our hope that you received the copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota* and *Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalfe Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

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OES/ENV
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Sincerely,

Ed Stine
Staff Archaeologist

cc: Kim Munson
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Metcalf Archaeological Consultants, Inc.

January 22, 2007

Mr. Franky Jackson
Tribal Historic Preservation Officer
Sisseton-Wahpeton Oyate Planning and Development
Old Agency
P.O. Box 509
Sisseton, South Dakota 57262-0509

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Crows Breast,

Enclosed are copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota and Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalf Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

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Foreign Affairs Officer
Multilateral Team
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orlandoa2@state.gov

Sincerely,

Amy Bleier
Staff Archaeologist

cc: Kim Munson

enclosures

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MAC

Metcalf Archaeological Consultants, Inc.

January 22, 2007

Mr. Calvin Grinnell
Tribal Historian
Mandan, Hidatsa, Arikara Nation
220 8th Avenue North
New Town, North Dakota 58673

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Grinnell,

Enclosed are copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota and Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalf Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

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Foreign Affairs Officer
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Sincerely,

Amy Bleier
Staff Archaeologist

cc: Kim Munson

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MAC

Metcalf Archaeological Consultants, Inc.

January 22, 2007

Mr. Elgin Crows Breast
Cultural Resource Program Director
Mandan, Hidatsa, Arikara Nation
P.O. Box 673
New Town, North Dakota 58673

RE: Keystone Pipeline Project Cultural Resource Investigation Survey Reports

Dear Mr. Crows Breast,

Enclosed are copies of the final drafts of the survey reports prepared for TransCanada's Keystone Pipeline Project (*Keystone Pipeline Project: Class I, II, and III Cultural Resource Investigations in Eastern North Dakota* and *Keystone Pipeline Project: Level I and II Cultural Resource Investigations in Eastern South Dakota*).

Metcalfe Archaeological Consultants, Inc., the subcontractor who conducted the investigations, has sent these reports on behalf of the Department of State which is conducting the government-to-government consultation with respect to this matter. If you have any comments or concerns regarding the survey reports please contact the Department of State. The contact information is:

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Sincerely,

Amy Bleier
Staff Archaeologist

cc: Kim Munson

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Overview – Keystone Pipeline Project Cultural Resource Surveys and Reports

March 2007

Cultural Resource Surveys and Reports

Construction and operation of the Keystone Pipeline Project (Keystone) may affect cultural resources protected under the National Historic Preservation Act (NHPA), and by individual State legislation. During 2006, Keystone initiated contact with the State Historic Preservation Officer (SHPO) in each state to identify known cultural resource sites, and to develop survey plans. Keystone submitted records searches and research designs to each state for review and approval. Agency coordination documentation and survey protocols were filed by Keystone with the Department of State (DOS) on September 15, 2006.

Cultural resource field surveys along the proposed Keystone Mainline pipeline right-of-way were initiated in the spring and summer of 2006, and were completed in the fall of 2006. These surveys were conducted along the pipeline route alignment that was filed with the DOS on September 15, 2006. Additional field surveys will be conducted during the spring and summer of 2007 to survey pipeline reroutes, pump stations, certain pipe storage yards and contractor yards, access roads, and pipeline segments where access was not previously available. Field surveys will be conducted along the Cushing Extension and on pump station sites, pipe storage yards and contractor yards associated with the extension in 2007.

Keystone reached an agreement with Kinder Morgan to purchase the cultural resources survey reports for the proposed Rockies Express Pipeline (REX) segment that will be located parallel to the Keystone pipeline route in Nebraska, Kansas, and Missouri. The REX reports and concurrence letters received from the SHPO in each state were included in the November 17, 2006, supplemental filing. Site testing along the REX corridor is ongoing and results will be provided when available.

Keystone initiated discussions with the Nebraska, Kansas, and Missouri SHPOs to define a process for incorporating the REX survey results into the Keystone Pipeline project. Keystone prepared maps of its proposed construction surface disturbance footprint in relation to the REX cultural resources survey corridor. These maps documented the portion of the REX survey corridor that includes the proposed Keystone surface disturbance. The SHPOs reviewed this submittal and provided concurrence letters for the portion of the Keystone Project located within the REX survey corridor. The concurrence letters were included in the January 2007 supplemental filing.

Keystone documented proposed surface disturbance located outside the REX survey corridor and began field surveys of these areas in January 2007. The status of surveys conducted to date along deviations from the REX corridor will be submitted to the SHPOs in a separate Keystone report and are included in this filing.

Results of the pedestrian survey along the Mainline pipeline right-of-way in North/South Dakota, Nebraska, Missouri, and Illinois were submitted to the North/South Dakota, Nebraska, and Missouri SHPOs. As directed by the Illinois SHPO, the survey report will not be submitted to the SHPO until survey is completed along the Illinois segment of the Mainline. The Nebraska and North Dakota SHPOs have concurred with the findings in the cultural resources survey reports. The North Dakota SHPO will not provide NRHP determinations until requested in writing by the DOS. Copies of the letters from the North Dakota and Nebraska SHPOs are included in this filing. Concurrence from the South Dakota and Missouri SHPOs is pending and will be submitted in a supplemental filing.

Site testing to determine National Register eligibility was conducted in North Dakota, Missouri, and Illinois. The results of site testing in Missouri and Illinois can be found in the testing reports included in January 2007 supplemental filing. Two sites were tested in North Dakota, and both sites were recommended as ineligible. Results of testing in North Dakota will be included in this filing. Site testing

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has not yet been conducted at two sites in Missouri due to lack of access. All potentially eligible sites in South Dakota and Nebraska were avoided by reroutes; therefore, no site testing was conducted in these states. With the exception of Illinois, the site testing reports were submitted to SHPOs for review and concurrence. A copy of the North Dakota SHPO letter is included in this filing. Concurrence on the Missouri site testing report is pending and will be included in a supplemental filing.

Cushing Extension

Pedestrian survey along the Cushing Extension in Nebraska, Kansas, and Oklahoma began in January 2007. To date, survey of the Nebraska segment is complete; surveys in Kansas and Oklahoma are ongoing and scheduled for completion in summer 2007. The status reports for survey conducted to date are included in this filing and will be submitted to the Nebraska, Kansas, and Oklahoma SHPOs. Keystone will file cultural resource status reports for remaining segments of the Cushing Extension, as well as addendum reports for Mainline reroutes, ancillary facilities, and any additional site testing (if required) in the next supplemental filing.

Table 1 outlines the process for the collection and submission of cultural resource data.

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Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
North Dakota	Field Survey Completion Status as of March 2007: • Pedestrian Survey – 88% • Site Testing – 100% Spring 2007 – follow up surveys as needed for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms, site testing methodology).	Compilation of 2006 surveys (pedestrian and geomorphological surveys).	SHPO Concurrence, 2 sites. Site testing report, 2 sites, February 2007. SHPO Concurrence on Class I-III report submitted to DOS January 2007. Site Forms Errata submitted to DOS January 2007. Transmittal Letters to Tribes	May or June 2007 Reports will include survey results for pipeline reroutes and ancillary facilities, and site testing (if required).
South Dakota	Completion Status as of March 2007: • Pedestrian Survey – 86% • Site Testing – no sites Spring 2007 – follow up surveys as needed for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms, site testing methodology).	Compilation of 2006 surveys (pedestrian and geomorphological surveys).	Transmittal Letter for 2006 Survey Reports Transmittal Letter - 15 site forms recorded in 2006 survey reports Transmittal Letters to Tribes	May or June 2007 Reports will include survey results for pipeline reroutes and ancillary facilities, and site testing (if required).

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Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
Nebraska	Mainline Completion Status as of March 2007: • Pedestrian Survey – 97% • Site Testing – no sites • Cushing Extension 100% Spring 2007 – Mainline follow up surveys; Cushing Extension.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms). Rockies Express (REX) Cultural Surveys in NE (pedestrian survey results and SHPO concurrence for segments where REX and Keystone are co-located).	Compilation of 2006 surveys (pedestrian and geomorphological surveys). Map documentation of Keystone proposed construction ROW overlap with REX cultural resource survey areas and SHPO concurrence.	Cushing Extension field surveys – status report.	May or June 2007 Reports will include Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required). Cushing Extension – Pedestrian survey results; site testing (if required).
Kansas	Field Survey Completion Status as of March 2007: • Mainline Pedestrian Survey – 99% • Mainline Site Testing – 0% • Cushing Extension – 100% 2007 Spring – Mainline Follow up surveys; Cushing Extension.	Cultural resources record search; Survey protocols and survey areas.	REX Cultural Surveys in KS (pedestrian survey results and SHPO concurrence for segments where REX and Keystone are co-located).	Map documentation of Keystone proposed construction ROW overlap with REX cultural resource survey areas and SHPO concurrence. Cushing Extension Revised research design (maps included) and SHPO concurrence.	Mainline field survey status report for any areas outside REX survey area. Cushing Extension field surveys – status report. Cushing Extension Tribal Letters.	May or June 2007- Reports will include Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required). Cushing Extension – Pedestrian survey results; site testing (if required).

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Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
Missouri	Field Survey Completion Status as of March 2007: • Mainline Pedestrian Survey – 79% • Mainline Site Testing – 44% Spring 2007 – Follow up surveys for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian and geomorphological survey results and site forms) REX Cultural Surveys in MO (pedestrian survey results and SHPO concurrence for segments where REX and Keystone are co-located.	Compilation of 2006 surveys (pedestrian and geomorphological surveys and site testing). Map documentation of Keystone proposed construction ROW overlap with REX cultural resource survey areas and SHPO concurrence.	SHPO Concurrence on 2006 Phase II (11 Sites) Report REX Deviations Phase I Cultural Survey status report.	May or June 2007 Reports will include Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required).
Illinois	Field Survey Completion Status as of March 2007: • Pedestrian Survey – 89% • Site Testing – 33% Spring 2007 – Follow up surveys for reroutes and ancillary sites.	Cultural resources record search; Survey protocols and survey areas.	Keystone Cultural Resources Status Report (pedestrian survey results and site forms).	Compilation of 2006 surveys (pedestrian and geomorphological surveys, and site testing).	Wood River Terminal Pump Station survey status report.	May or June 2007 Keystone Mainline survey results for pipeline reroutes and ancillary facilities, and site testing (if required).

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Table 1. Keystone Pipeline Project - Cultural Resources Field Surveys and Report Completion Plan – March 2007

State	Survey Status	September 2006 DOS Filing	November 2006 DOS Filing	January 2007 DOS Filing	March 2007 DOS Filing	Supplemental Reports
Oklahoma	Spring 2007 Pedestrian and geomorphological surveys; site testing, if required. • Cushing Extension – 81%	Cultural resources record search; Survey protocols and survey areas.	No information filed.	No information filed.	Cushing Extension field surveys – status report. Cushing Extension Revised research design (maps included) and SHPO concurrence. Cushing Extension Tribal Letters	May or June 2007 Cushing Extension survey results for pipeline reroutes, ancillary facilities; site testing, if required.

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SUPPLEMENTAL FILING, MARCH 2007

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- **NORTH DAKOTA**
 - Metcalf report transmittal letter sites 32RM160 and 32RMx89 February 2007
 - Letter from North Dakota SHPO, concurrence on sites 32RM160 and 32RMx89
 - Testing Report for sites 32RM160 and 32RMx89, February 2007
 - SHPO Concurrence on Class I-III Report submitted to DOS January 2007
 - Metcalf letter to SHPO forwarding site form updates on above testing report
 - Metcalf letter to SHPO forwarding reports submitted to DOS January 2007
 - Site Forms Errata from ND Class I, II, III Cultural Resource Investigations in Eastern, North Dakota, submitted to DOS in January 2007
- **SOUTH DAKOTA**
 - Letters (2) from Metcalf to SD SHPO - survey reports (DOS January 2007 submission)
- **NORTH DAKOTA AND SOUTH DAKOTA LETTERS TO TRIBES (5)**
- **MISSOURI**
 - MO SHPO concurrence on Phase II (11 sites) – (January 2007 DOS submission)
 - ARG transmittal letter – Phase II (11 sites) Report

REX DEVIATIONS SURVEYS

- **KANSAS**
 - REX Deviations Phase I Cultural Survey Status Report, March, 2007
- **MISSOURI**
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CUSHING EXTENSION

- **NEBRASKA**

- Cultural Survey Status Report March 2007

- **KANSAS**

- Cultural Survey Status Report March 2007
- Letters to Tribes

- **OKLAHOMA**

- Cultural Survey Status Report March 2007
- Letter to Oklahoma SHPO from ARG requesting concurrence on Phase I Surveys, February, 2007
- Proposed Methods for Phase I Cultural Surveys, Oklahoma, February 2007
- Letter from Oklahoma SHPO – Phase I Concurrence
- Letters to Tribes

Prepared for:
Keystone Pipeline Project



A Field Survey of the Keystone Pipeline
Project Construction Corridor in North
and South Dakota for Dakota Skipper
(*Hesperia dacotae*) Habitat, Western
Prairie Fringed Orchid (*Platanthera
praeclara*) Habitat, and for Native
Grassland

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Executive Summary

A field survey was conducted along the proposed Keystone Pipeline Project construction right-of-way for native grassland habitat and for native grassland species. The target native grassland species were western prairie fringed orchid (*Platanthera praeclara*) and Dakota skipper butterfly (*Hesperia dacotae*). The survey was conducted by a two person team from September 11 to September 16, 2006. Survey sites were determined from aerial photograph and topographic map analysis along the proposed project route, and through consultation with federal and state agencies. A total of 38 sites were visited during the field survey. Of the 38 survey sites, four of the sites were determined not to be grassland. Of the remaining 34 survey areas, 10 were determined to be high quality grasslands, seven were determined to be medium quality grasslands, and 17 were determined to be low quality grasslands. Eight survey sites were identified as potential habitat for the Dakota skipper and eight were identified as potential habitat for the western prairie fringed orchid. It is recommended that these sites be surveyed in 2007 for the presence or absence of the target species. Photographs, detailed survey site summaries, survey location maps, and a species list can be found in the appendices of this report.

1.0 Introduction

The proposed Keystone Mainline enters Cavalier County, North Dakota, from Canada and continues south along the eastern portions of North Dakota, South Dakota, and Nebraska. The proposed pipeline route then turns east crossing Kansas and Missouri, and terminates in Marion County, Illinois. The Mainline objectives of this survey were as follows:

Objective 1. To determine areas along the corridor that are potential habitat for Dakota skipper (*Hesperia dacotae*), a butterfly that is designated as a federal candidate species.

Objective 2. To determine areas along the corridor that are potential habitat for western prairie fringed orchid (*Platanthera praeclara*), a plant that is federally listed as a threatened species.

Objective 3. To identify sections of the corridor with intact or partially intact native grassland.

The western prairie fringed orchid and Dakota skipper butterfly, hereafter referred to as the target species, both occur on native grassland areas. However, they occupy different types of grassland habitat. Therefore, any area designated as potential habitat for either target species also constitutes intact or partially native grassland. In contrast, there may be intact or partially intact native grassland areas that are not potential habitat for either of these two target species. In order to identify which native grassland areas are best suited for the two target species the following, background information on grassland and target species habitats was obtained.

Habitat Requirements for Dakota Skipper (*Hesperia dacotae*)

The literature consulted to determine Dakota skipper habitat included reports or articles by Vaughan and Shepherd (2005), Royer (1996), Schlicht (1997), and Dakota Skipper Conservation Guidelines from the U.S. Fish and Wildlife Service (USFWS 2005) in Bloomington, Minnesota. From these articles the following habitat summary was developed.

Dakota skipper habitat is native tall and mixed-grass prairie or prairie remnants where there are abundant larval and adult food-sources present. The two grassland habitats where this species is known to occur are: 1) low (wet) grassland dominated by bluestem grasses, wood lily, harebell, and smooth camas, and 2) upland (dry) grassland on ridges and hillsides dominated by bluestem grasses, needlegrass, pale purple and upright coneflowers and blanketflower. Since nectar provides the nutrients and carbohydrates for Dakota skippers to meet the energetic demands of flight, one of the best indicators for Dakota skipper habitat is the presence of Dakota skipper food plants for larva and nectar plants for adults. The Dakota skipper larva prefers little blue stem (*Schizachyrium scoparium*) roots as a nutrient source, but the larvae do not use this grass exclusively.

Preferred nectar plants for the adult Dakota skipper are purple coneflowers or black Sampson plants: *Echinacea angustifolia*. Other preferred nectar sources include a vetch (*Astragalus adsurgens*), hoary vervain (*Verbena stricta*), leadplant (*Amorpha canescens*), white prairie clover (*Dalea candida*), fleabane (*Erigeron* spp.), blanketflower (*Gaillardia*), black-eyed Susans (*Rudbeckia* sp.), yellow sundrops (*Calylophus serrulatus*) and purple locoweed (*Oxytropis lambertii*.) The Dakota skipper also is a generalist in regards to pollen collection, and it also is believed that the larvae can live on roots other than those of the little blue stem. Therefore, if a grassland site had both a diverse mix of native forbs, and only one or two of the known larvae or pollen plants, it was considered Dakota skipper habitat. Another important factor in determining suitable habitat is the proximity of other native grassland areas.

Habitat Requirements for Western Prairie fringed Orchid (*Platanthera praeclara*)

The western prairie fringed orchid occurs on tall-grass calcareous silt loam or sub-irrigated sandy grasslands. The largest known population of this orchid occurs on the Sheyenne National Grasslands in Ransom County, North Dakota. Therefore, all grassland wetland areas in Ransom County were considered to be potential habitat for this orchid. To obtain a better search image for the habitat where this orchid occurs, an area on the Sheyenne National Grassland where this orchid was known to occur about two months prior to this survey was visited. The following photos were taken on September 12, 2006, of the habitat where western prairie fringed orchid (*Platanthera praeclara*) was seen in July 2006. Note the mowing and bailing that has occurred since July.



Photo 1: Search image for western prairie fringed orchid habitat obtained at the Sheyenne National Grassland, Ransom County, North Dakota



Photo 2: Sheyenne National Grassland western prairie fringed orchid habitat located along roadside ditch



Photo 3: Bailing had occurred along the roadside ditch where the western prairie fringed orchid had been sighted in July 2006

Native Grassland Habitat in the Dakotas

Ecologists often divide the Great Plains grasslands into short, mid, and tallgrass prairie regions. These three grasslands are named on the basis of the average height of the dominant, native grass cover. The differences among these three grassland types also correspond to both the amount and seasonal distribution of annual precipitation. The shortgrass steppe area usually receives less than 30 centimeters (cm) of precipitation per year, most of which occurs in summer thunderstorm events. The mixed or mid-grass prairie regions usually receive more than 30 cm of precipitation per year (up to 50 or more), but compared to the shortgrass prairie, the mid-grass prairie receives more annual precipitation during the spring. This early season precipitation encourages more of the "cool-season" or C-3 photosynthetic pathway grass species (*Stipa*, *Agropyron*, *Kohleria*). Finally, the tallgrass prairie, sometimes referred to as "true prairie," occurs further east and typically receives over 50 cm of precipitation per year.

The grasslands of interest in this survey are mid-grass prairie and tallgrass prairie areas along the proposed Keystone Pipeline Project construction right-of-way (ROW) in eastern North and South Dakota. The mixed or mid-grass grasslands were once dominated by cool-season grasses such as needle-and-thread (*Stipa*), junegrass (*Kohleria macrantha*), western wheat grass (*Agropyron smithii*) and others. The tallgrass areas have taller species such as Indian grass (*Sorghastrum nutans*), and big blue stem (*Andropogon gerardii*). There is a transition region between mid- and tallgrass prairie that is sometimes evident in the few remaining grasslands in the eastern Dakotas.

The significance of conserving the remaining grassland areas becomes evident when a few statistics are cited regarding the extent to which our native grasslands have been converted to other land uses, especially to cropland and pastures. Sampson and Knoph (1994) reported that over 99 percent of the original tallgrass prairie in Iowa, Minnesota, and North Dakota has been destroyed by settlement and agriculture. It was not indicated how much mixed or mid-grass prairie remains in North Dakota, but it was estimated that in South Dakota, about 85 percent of the original 3 million acres of mixed-grass prairie has been converted to non-grassland uses. Jones and Cushman (2004) site that only 0.3 percent of the original tallgrass prairie and 1.8 percent of the original mixed-grass prairie remains in central North America.

2.0 Methods

Prior to field work, aerial photographs of the entire Keystone Pipeline Project route in North Dakota and South Dakota were studied to identify potential native grassland areas. Survey sites were selected with varying size, geographic location, and hypothesized habitat quality, to capture a wide array of grassland habitat that would be encountered along the pipeline route. Based on the aerial photograph analysis these sites were further categorized as low, medium, or high quality grasslands; categories that were to be verified in the field. Sites identified as high quality grasslands typically were areas that appeared to have native vegetation, steep slopes or hills, or were fairly large, or that were adjacent to larger areas of grassland outside of the pipeline corridor. Sites identified as medium quality grasslands were areas of moderate size, or appeared to be lightly or moderately grazed pastures, or have a mixture of planted and native vegetation. Low quality grasslands were areas of smaller size, or sites that appeared to have a majority of planted grass species, or heavily grazed pastures. This designation helped assure that a large variety of sites would be visited in the field, and that no major grassland areas would be missed during the field survey.

Seventeen sites were pre-selected for ground surveys. A ground survey consisted of walking a majority of the survey site, taking detailed field notes of the site, completing a data sheet outlining the dominant vegetation types, native plant species, invasive plant species, disturbance, and potential threatened and endangered species habitat, taking representative photos of the site, and collecting voucher specimens for further identification. Drive-by reconnaissance was conducted at the remaining grassland sites identified from the aerial photograph exercise. Drive-by reconnaissance also consisted of taking field notes of the site, and completing a data sheet, taking photographs and global positioning system coordinates from the roadside. All sites were analyzed for native grassland habitat quality, and potential target species habitat.

3.0 Results

Field surveys were conducted by Sara Stribley (ENSR biologist) and Don Hazlett (ENSR botanist) from September 11 to September 16, 2006. A total of 38 sites were surveyed during this timeframe. Of the 38 sites visited, detailed documentation was completed for 30 of the sites. A data sheet for each of these 30 sites was completed, which includes a plant species list and other notes that are unique to the site. Photographs were taken of each location that was identified as a "feature" and a unique feature number was assigned to each of 30 these sites. The eight sites that were not recorded as features were either non-grassland areas, or were very low quality grassland sites, similar to previous survey sites visited. Notes were taken on these eight sites, but detailed documentation for these areas was not necessary. Global positioning system (GPS) coordinates also were taken at a majority of the sites to ensure that the surveys were being conducted within the pipeline construction ROW.

A ground survey was conducted at 12 sites. Initially, 17 sites were selected for ground surveys. However, in the field, some of the original 17 sites turned out to be agriculture fields or very low quality pastures, that did not warrant a thorough ground examination.

A summary table was made for the sites that were visited during the field survey (**Table 1**). This table contains information on the feature number, survey date, start and end milepost, county, state, survey type (visit or drive-by), habitat quality designation, target species designation (or not), and a brief description of the site.

Color photographs (one or more for each feature), detailed site summaries, and survey location maps can be found in Appendix I.

A list of over 150 plant species that were identified during this field survey, including several noxious weed species can be found in Appendix II.

For each of the 38 locations, a determination was made if the site consisted of native grassland. If the site contained some or all native grassland, the next determination was made in regards to the quality of the grassland. The following summarizes the determinants used in the field to classify grassland quality at each site:

High Quality Grassland. This category was assigned only to large areas dominated by native grass, with special attention given to corridor areas that were adjacent to large tracts of native grassland. Further criteria required to obtain a high quality status was the presence of a relatively high diversity of native grasses (three or more) and of native forbs (four or more that were relatively common). Also, there must be few exotic, weedy plants to be ranked as high. Only 10 of the 38 sites that were viewed or visited obtained the rank of high quality grassland (**Table 1**).

Medium Quality Grassland. This rank was given to grassland that had a matrix vegetation of native plants, but that also had significant disturbance, such as moderate to high grazing or pockets of exotic weeds or pasture grass invasion. Of the 38 sites that were viewed or visited, 7 obtained the rank of medium quality grassland (**Table 1**).

Low Quality Grassland. Plowed cropland was not considered grassland. In addition, unplowed pastures that have been heavily grazed for a long period of time, or that have been planted with exotic pasture grasses to the extent that no native grasses can be found, were not considered grassland, even though some of these sites contained several weedy, native forbs (ex: *Grindelia*). The low quality grassland rank was given to sites with a few upland or sometimes ridge top areas with recognizable areas of native grasses and forbs. An area could be considered low quality grassland despite the dominance in some areas of the corridor by smooth brome or by other pasture grasses. Of the 38 areas that were viewed, 17 (nearly half) were given a rank of low quality grassland (**Table 1**).

None. In the field it was discovered that 4 of the 38 areas designated from the aerial photographs as grassland were actually grass-filled wetlands or croplands (grazed hayfield, etc.).

Dakota skipper habitat. After an area was categorized as a high, medium, or low quality grassland, it was then determined if this area also was suitable habitat for the Dakota skipper butterfly. Factors that were considered in this determination were: 1) if there was little blue stem present, a known larval food for the Dakota skipper; 2) if at least two of the known pollen source plants for the Dakota skipper were present; 3) if there was a diverse mix of native grasses and forbs; 4) if there was a large area of native prairie adjacent to the pipeline corridor; and 5) if the site was in the range of where this species could potentially occur.

Based on the above criteria 8 of the 34 grassland areas were designated as potential Dakota skipper habitat sites (**Table 2**). Seven of these potential Dakota skipper habitat locations were on areas designated as high quality prairie, and one was on an area designated as medium quality grassland.

Western prairie fringed orchid habitat. After an area was categorized as a high, medium, or low quality grassland, it was then determined if this area also was habitat for the western prairie fringed orchid. Factors that were considered in this determination were: 1) if it was possible for a grassland (of any quality) to be subirrigated, 2) subirrigation meant that there needed to be a wetland area nearby, 3) if the wetland area had upland inclusions, and 4) if the site was in the range of where this orchid could potentially occur.

Based on these criteria, 8 of the 34 grassland areas were potential habitat for this orchid (**Table 2**). Of these selected locations, one was high quality grassland, three were medium quality grassland, and two were low quality grassland.

4.0 Discussion

Dakota skipper (*Hesperia dacotae*)

Most of the locations designated as potential habitat for the Dakota skipper were located on ridges or hilly areas containing native prairie with at least one Dakota skipper pollen plant, and little blue stem, the preferred food for Dakota skipper larvae.

The threats to Dakota skipper habitat identified by the USFWS Guidelines include burning, haying, grazing, pesticide use, and invasion by non-native plants, including exotic pasture grasses. During this survey there were few signs of burning or pesticide use, but grazing and exotic plants were present. The most severe threat to the few remaining sections of high and moderate quality grassland (potential Dakota skipper sites) was grazing coupled with exotic pasture grass invasion and/or planting. On several occasions, especially at the only site in Kingsbury County, there was clear evidence that grazing facilitated the invasion of exotic pasture grasses.

Pipeline construction reduces native grassland areas by destroying the prairie sod. Once disturbed, this sod is extremely slow (over 100 years) at redeveloping. A second threat is that disturbing soil along the construction ROW encourages the establishment of exotic pasture grasses, especially smooth brome (*Bromus inermis*) and the establishment of noxious weeds. The most aggressive weeds in this area are the plumeless thistle (*Carduus ancanthoides*) toward the south, Canadian thistle (*Cirsium arvense*) and wormwood (*Artemisia absinthium*) in wetlands and mesic pastures, and in some areas the invasion of sweet clover (*Melilotus*), bindweed (*Convolvulus arvensis*), and leafy spurge (*Euphorbia esula*).

Table 1 Summary of the 38 Sites Along the Keystone Pipeline Route in North and South Dakota that were Surveyed from September 11 to September 16, 2006 for: 1) Potential Habitat for the Prairie Fringed Orchid (*Platanthera praeclara*), 2) Potential Habitat for the Dakota Skipper Butterfly (*Hesperia dacotae*), and 3) for the Presence of Quality Native Grassland

	Feature Number	Survey Date	Start MP	End MP	County	State	Survey Type	Quality of Grassland Habitat	Suitable Dakota Skipper or Western Prairie Fringed Orchid Habitat?	Site Summary
1	None Designated	9/12/2006	200.4	202.0	Sargent	ND	Drive-by	None	No	Agriculture.
2	TDH1NDSA003	9/12/2006	202.0	202.5	Sargent	ND	Drive-by	Low	No	Wet lowland, few prairie plants, BRIN dominated.
3	None Designated	9/12/2006	202.4	203.6	Sargent	ND	Drive-by	None	No	Agriculture.
4	TDH1NDSA002	9/12/2006	203.6	203.9	Sargent	ND	Drive-by	High	Yes, Dakota skipper	Appears to be high quality native prairie from road.
5	TDH1NDSA001	9/12/2006	204.1	205.0	Sargent	ND	Site Visit	High	Yes, Dakota skipper	Very high quality, Government land.
6	None Designated	9/12/2006	205.0	205.6	Sargent	ND	Drive-by	Low	No	BRIN Pasture and wetland mosaic.
7	TDH1NDDI003	9/12/2006	207.8	208.3	Dickey	ND	Drive-by	Medium	Yes, prairie fringed orchid	Wetland meadow with upland inclusions.
8	TDH1NDDI002	9/12/2006	210.8	211.9	Dickey	ND	Site Visit	High	Yes, prairie fringed orchid	Grazed, wetland meadow with upland inclusions.
9	None Designated	9/12/2006	211.9	212.4	Dickey	ND	Drive-by	None	No	Agriculture.
10	TDH1NDDI001	9/12/2006	212.9	214.0	Dickey	ND	Drive-by	None	Yes, prairie fringed orchid	Large, high quality wetland with few upland areas.
11	TDH1SDMA001	9/13/2006	228.5	228.9	Marshall	SD	Site Visit	None	No	Large, wetland meadow on State land.
12	None Designated	9/11/2006	258.6	258.8	Day	SD	Drive-by	Low	Yes, prairie fringed orchid	Appeared to be heavily grazed from the road.
13	TDHISDDA005	9/11/2006	260.0	260.8	Day	SD	Drive-by	Low	No	Heavily grazed, with only a few native grasses and forbs.
14	TDH1SDDA004	9/11/2006	261.4	262.6	Day	SD	Drive-by	Low	No	Wheatgrass pasture with few native grasses and forbs.
15	TDH1SDDA003	9/11/2006	264.5	264.8	Day	SD	Site Visit	Low	No	Heavily grazed BRIN ridge near a meandering creek.
16	TDH1SDDA002	9/11/2006	265.2	266.2	Day	SD	Site Visit	High	Yes, Dakota skipper	Native prairie adjacent to a hilly, high quality prairie.

Table 1 Summary of the 38 Sites Along the Keystone Pipeline Route in North and South Dakota that were Surveyed from September 11 to September 16, 2006 for: 1) Potential Habitat for the Prairie Fringed Orchid (*Platanthera praeclara*), 2) Potential Habitat for the Dakota Skipper Butterfly (*Hesperia dacotae*), and 3) for the Presence of Quality Native Grassland

	Feature Number	Survey Date	Start MP	End MP	County	State	Survey Type	Quality of Grassland Habitat	Suitable Dakota Skipper or Western Prairie Fringed Orchid Habitat?	Site Summary
17	None Designated	9/11/2006	267.2	267.7	Day	SD	Drive-by	Low	No	Pasture with introduced grasses.
18	TDH1SDDA001	9/11/2006	270.6	271.6	Day	SD	Drive-by	Low	No	Heavily grazed riparian area in corridor.
19	None Designated	9/11/2006	272.3	273.3	Clark	SD	Drive-by	Low	No	Pasture with introduced grasses.
20	TDH1SDCL005	9/13/2006	277.2	277.9	Clark	SD	Drive-by	Medium	Yes, prairie fringed orchid	A mosaic of pasture/wetland and grassland.
21	TDH1SDCL006	9/13/2006	278.4	279.2	Clark	SD	Drive-by	Medium	Yes, prairie fringed orchid	A mosaic of pasture/wetland and grassland.
22	TDH1SDCL004	9/11/2006	280.1	280.5	Clark	SD	Drive-by	Low	No	BRIN dominated alkaline pasture.
23	None Designated	9/11/2006	280.8	281.1	Clark	SD	Drive-by	Low	No	Pasture with introduced grasses.
24	TDH1SDCL003	9/11/2006	285.3	285.7	Clark	SD	Drive-by	Low	No	Heavily grazed, BRIN dominated riparian/meadow.
25	TDH1SDCL002	9/11/2006	293.7	294.1	Clark	SD	Drive-by	Low	No	Heavily grazed, BRIN dominated riparian/meadow.
26	TDH1SDCL001	9/11/2006	296.9	297.9	Clark	SD	Site Visit	Medium	Yes, Dakota skipper	Wetland swale with upland (blue grama) inclusions.
27	TDH1SDKI001	9/16/2006	325.1	326.4	Kingsbury	SD	Drive-by	High/North Medium/ South	No	Road dissects High (N) and Medium (S) quality grasslands.
28	TDH1SDMI001	9/16/2006	342.9	344.0	Miner	SD	Drive-by	Low	No	Redstone Creek with BRIN, <i>Poa</i> and AGCR pasture grasses.
29	TDH1SDMI002	9/16/2006	358.5	359.9	Miner	SD	Drive-by	Low	No	BRIN pasture with wetland spots.
30	TDH1SDMC001	9/16/2006	383.9	384.5	McCook	SD	Drive-by	Medium to High	Yes, prairie fringed orchid	BRIN pasture with wetlands and native grassland on hills.

Table 1 Summary of the 38 Sites Along the Keystone Pipeline Route in North and South Dakota that were Surveyed from September 11 to September 16, 2006 for: 1) Potential Habitat for the Prairie Fringed Orchid (*Platanthera praeclara*), 2) Potential Habitat for the Dakota Skipper Butterfly (*Hesperia dacotae*), and 3) for the Presence of Quality Native Grassland

	Feature Number	Survey Date	Start MP	End MP	County	State	Survey Type	Quality of Grassland Habitat	Suitable Dakota Skipper or Western Prairie Fringed Orchid Habitat?	Site Summary
31	TDH1SDHU001	9/16/2006	389.7	390.6	Hutchinson	SD	Drive-by	Low	No	BRIN / <i>Poa</i> dominated pasture.
32	TDH1SDHU002	9/16/2006	390.9	391.7	Hutchinson	SD	Site Visit	High	Yes, Dakota skipper, prairie fringed orchid	By Wolf Creek, rolling, native prairie hills.
33	TDH1SDYA006	9/15/2006	418.7	419.2	Yankton	SD	Site Visit	Medium	No	Grassland on ridges. BRIN / <i>Poa</i> pasture & weeds in wet spots.
34	TDH1SDYA005	9/15/2006	419.6	420	Yankton	SD	Site Visit	High	Yes, Dakota Skipper	Mosaic of BRIN pasture with quality BOGR prairie spots.
35	TDH1SDYA004	9/15/2006	420.6	420.8	Yankton	SD	Drive-by	High	Yes, Dakota Skipper	Moderately grazed hills with native grassland.
36	TDH1SDYA003	9/15/2006	421.8	422.1	Yankton	SD	Site Visit	High	Yes, Dakota Skipper	By James River, native prairie ridges between cedar/broadleaf tree-filled ravines.
37	TDH1SDYA002	9/15/2006	423.5	423.8	Yankton	SD	Site Visit	Medium	No	Heavily grazed, but BOGR dominated.
38	TDH1SDYA001	9/14/2006	426.7	428.9	Yankton	SD	Site Visit	Low	No	BRIN and <i>Carduus acanthoides</i> in swales: few native plants.

ND – North Dakota

SD – South Dakota

BRIN – *Bromus inermis*

AGCR – *Agropyron cristatum*

BOGR – *Bouteloua gracilis*

Table 2 Summary Sites that Contain Suitable Dakota Skipper and Western Prairie Fringed Orchid Habitat

Feature Number	Start MP	End MP	County	State	Quality of Grassland Habitat	Survey Type	Site Summary
TDH1NDSA002	203.6	203.9	Sargent	ND	High	Dakota skipper	Appears to be high quality native prairie from road.
TDH1NDSA001	204.1	205.0	Sargent	ND	High	Dakota skipper	Very high quality, Government land.
TDH1NDDI003	207.8	208.3	Dickey	ND	Medium	western prairie fringed orchid	Wetland meadow with upland inclusions.
TDH1NDDI002	210.8	211.9	Dickey	ND	High	western prairie fringed orchid	Grazed, wetland meadow with upland inclusions.
TDH1NDDI001	212.9	214.0	Dickey	ND	None	western prairie fringed orchid	Large, high quality wetland with few upland areas.
None Designated	258.6	258.8	Day	SD	Low	western prairie fringed orchid	Appeared to be heavily grazed from the road.
TDH1SDDA002	265.2	266.2	Day	SD	High	Dakota skipper	Native prairie adjacent to a hilly, high quality prairie.
TDH1SDCL005	277.2	277.9	Clark	SD	Medium	western prairie fringed orchid	Mosaic of pasture/wetland and grassland.
TDH1SDCL006	278.4	279.2	Clark	SD	Medium	western prairie fringed orchid	Mosaic of pasture/wetland and grassland.
TDH1SDCL001	296.9	297.9	Clark	SD	Medium	Dakota skipper	Wetland swale with upland (blue grama) inclusions.
TDH1SDMC001	383.9	384.5	McCook	SD	Medium to High	western prairie fringed orchid	BRIN pasture with wetlands and native grassland on hills.
TDH1SDHU002	390.9	391.7	Hutchinson	SD	High	Dakota skipper, western prairie fringed orchid	By Wolf Creek, rolling, native prairie hills.
TDH1SDYA005	419.6	420	Yankton	SD	High	Dakota skipper	Mosaic of BRIN pasture with quality BOGR prairie spots.

Table 2 Summary Sites that Contain Suitable Dakota Skipper and Western Prairie Fringed Orchid Habitat

Feature Number	Start MP	End MP	County	State	Quality of Grassland Habitat	Survey Type	Site Summary
TDH1SDYA004	420.6	420.8	Yankton	SD	High	Dakota skipper	Moderately grazed hills with native grassland.
TDH1SDYA003	421.8	422.1	Yankton	SD	High	Dakota skipper	By James River, native prairie ridges between cedar/broadleaf tree-filled ravines.

ND – North Dakota

SD – South Dakota

BRIN – *Bromus inermis*

AGCR – *Agropyron cristatum*

BOGR – *Bouteloua gracilis*

Western prairie fringed orchid (*Plantanthera praeclara*)

Declines in the western prairie fringed orchid populations, as identified by the USFWS Guidelines, have been caused by the drainage and conversion of its habitats to agricultural production, channelization, siltation, road and bridge construction, grazing, haying, and the application of herbicides. The most apparent threats to the orchid along the proposed Keystone Pipeline Project construction ROW include conversion of its habitat to agriculture, haying, and heavy grazing.

5.0 Grassland Survey Sites in Nebraska

The Nebraska Game and Park Commission (NGPC) indicated that it has identified and mapped remnant native grasslands in Nebraska. To date, Keystone has not received the NGPC data to determine whether any of these remnant grasslands would be crossed by the project.

ENSR identified as potential native grassland or high quality grassland areas from aerial photograph interpretation. These areas are very limited in number, and therefore, all of these areas should be included in the 2007 surveys for native grassland species. **Table 3** details the locality information for these additional survey areas in Nebraska. Aerial photographs of these survey areas are presented in Appendix III.

Table 3 Additional Grassland Survey Sites in Nebraska for the 2007 Grassland Species Surveys

Start MP	End MP	County	Grassland Species
436.0	436.1	Cedar	Western prairie fringed orchid, small white lady's slipper
503.4	503.5	Stanton	Western prairie fringed orchid, small white lady's slipper
540.9	541.2	Colfax	Western prairie fringed orchid, small white lady's slipper
548.1	548.2	Butler	Western prairie fringed orchid, small white lady's slipper
564.4	564.7	Butler	Western prairie fringed orchid, small white lady's slipper
594.8	595.1	Saline	Western prairie fringed orchid, small white lady's slipper
606.4	606.5	Saline	Western prairie fringed orchid, small white lady's slipper
622.2	622.4	Jefferson	Western prairie fringed orchid, small white lady's slipper
635.1	636.8	Jefferson	Western prairie fringed orchid, small white lady's slipper
637.0	637.4	Jefferson	Western prairie fringed orchid, small white lady's slipper

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Appendix I

Photos, Site Summaries, and Survey Location Maps

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Grassland Habitat Quality	Suitable T&E Habitat?
TDH1NDSA003	9/12/2006	202.0	202.5	Sargent	ND	Drive By	Low	No

Site Summary: Over 90% smooth brome (*Bromus inermis*) pasture with weedy wormwood (*Artemisia absinthium*) in spots. A railroad dissects this pasture (to the left of this photograph). This pasture area is not suitable habitat for any of the target species.



Feature TDH1NDSA003: Overview of this smooth brome (*Bromus inermis*) dominated pasture.

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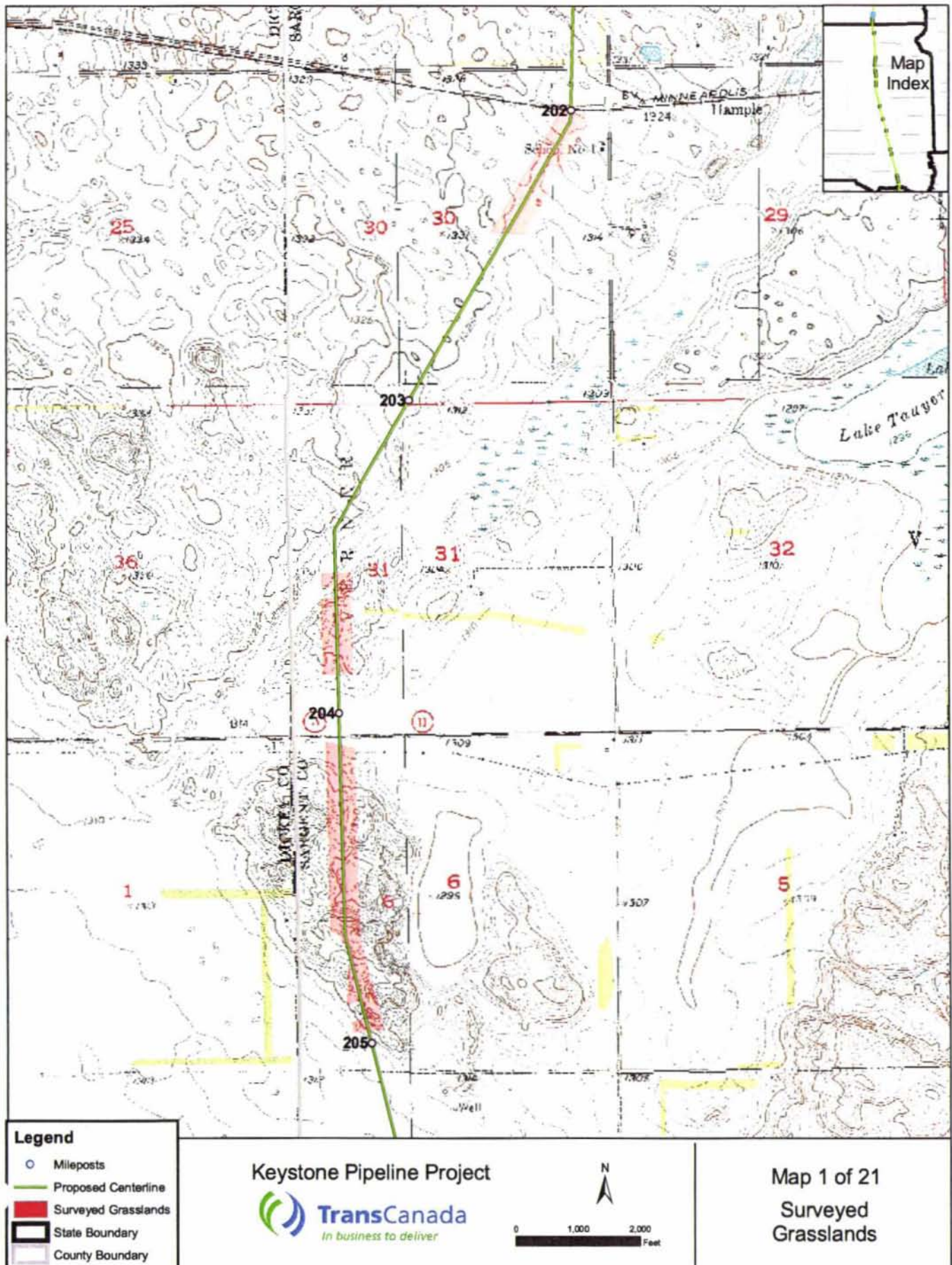
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1NDSA002	9/12/2006	203.6	203.9	Sargent	ND	Drive By	High	Yes, Dakota skipper

Site Summary: This agriculture field is by a paved road. However, on the hills in the background of this photograph is grassland ca. 0.25 mile north that was ranked as high quality (we have no access). This grassland is similar to feature TDH1NDSA001 and is designated as Dakota skipper habitat.

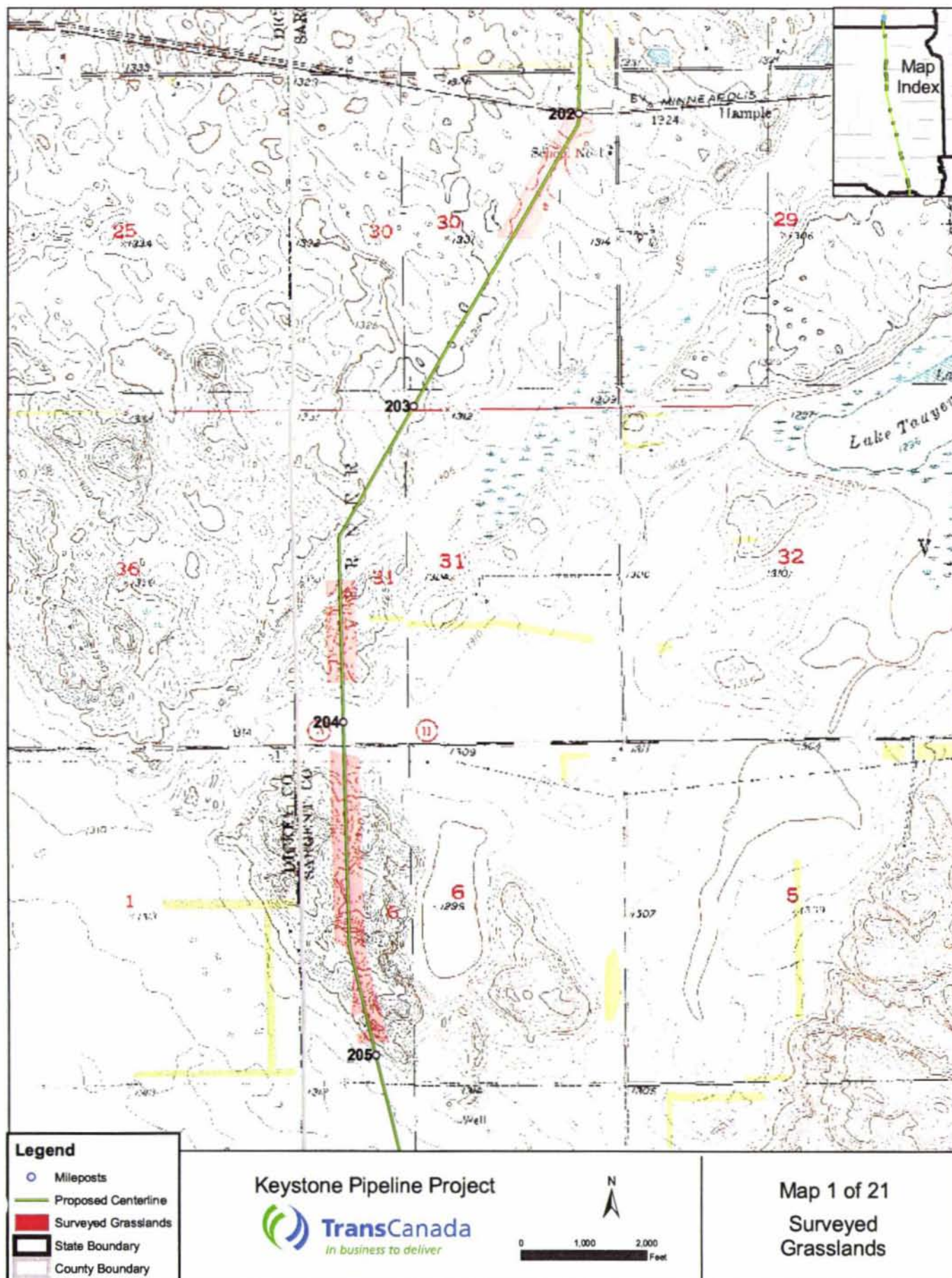


Feature TDH1NDSA002: This high quality grassland is in the distance, past the agriculture field.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1NDSA001	9/12/2006	204.1	205.0	Sargent	ND	Site Visit	High	Yes, Dakota skipper

Site Summary: This is a very high quality grassland site. The site contains rolling hills of rock grass (*Kohleria macrantha*), little blue stem (*Schizachyrium scoparium*), and big blue stem (*Andropogon gerardii*). Native forbs include white sage (*Artemisia ludoviciana*) on rocky hillsides, and Dakota skipper pollen plants such as black Sampson (*Echinacea*) and leadplant (*Amorpha*). Other pollen plants for the Dakota skipper, such as fleabane (*Erigeron*), are likely to be present, but were not seen in mid-September. This site also has animal burrows and access to water for wildlife. A re-route to the west of this high quality area (along a road) deserves consideration.



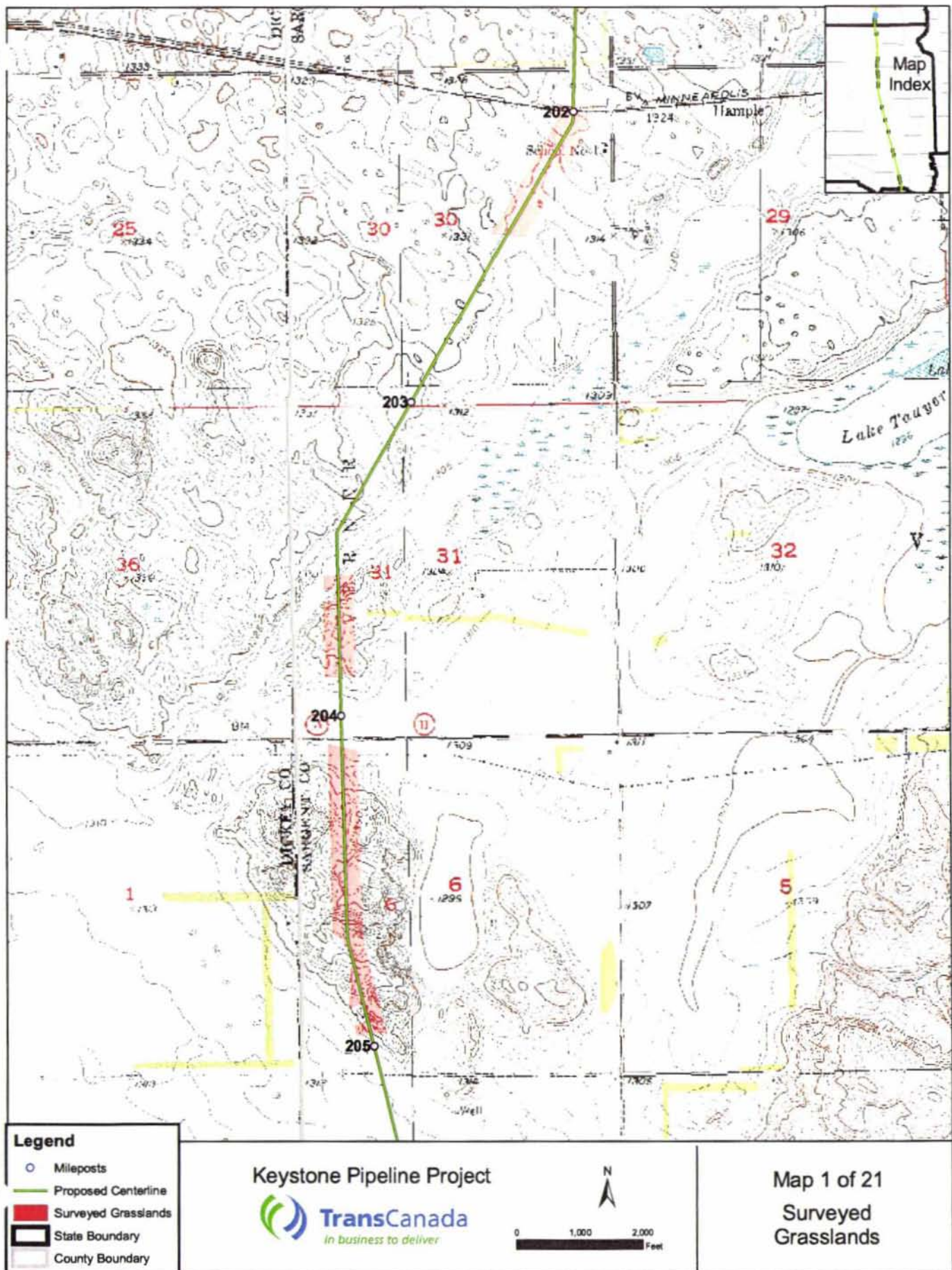
Feature:TDH1NDSA001: View to the east of this high quality grassland area.

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Feature TDH1NDSA001: Overview of this very high quality grassland area. This is the largest tract of native grassland seen during this survey.

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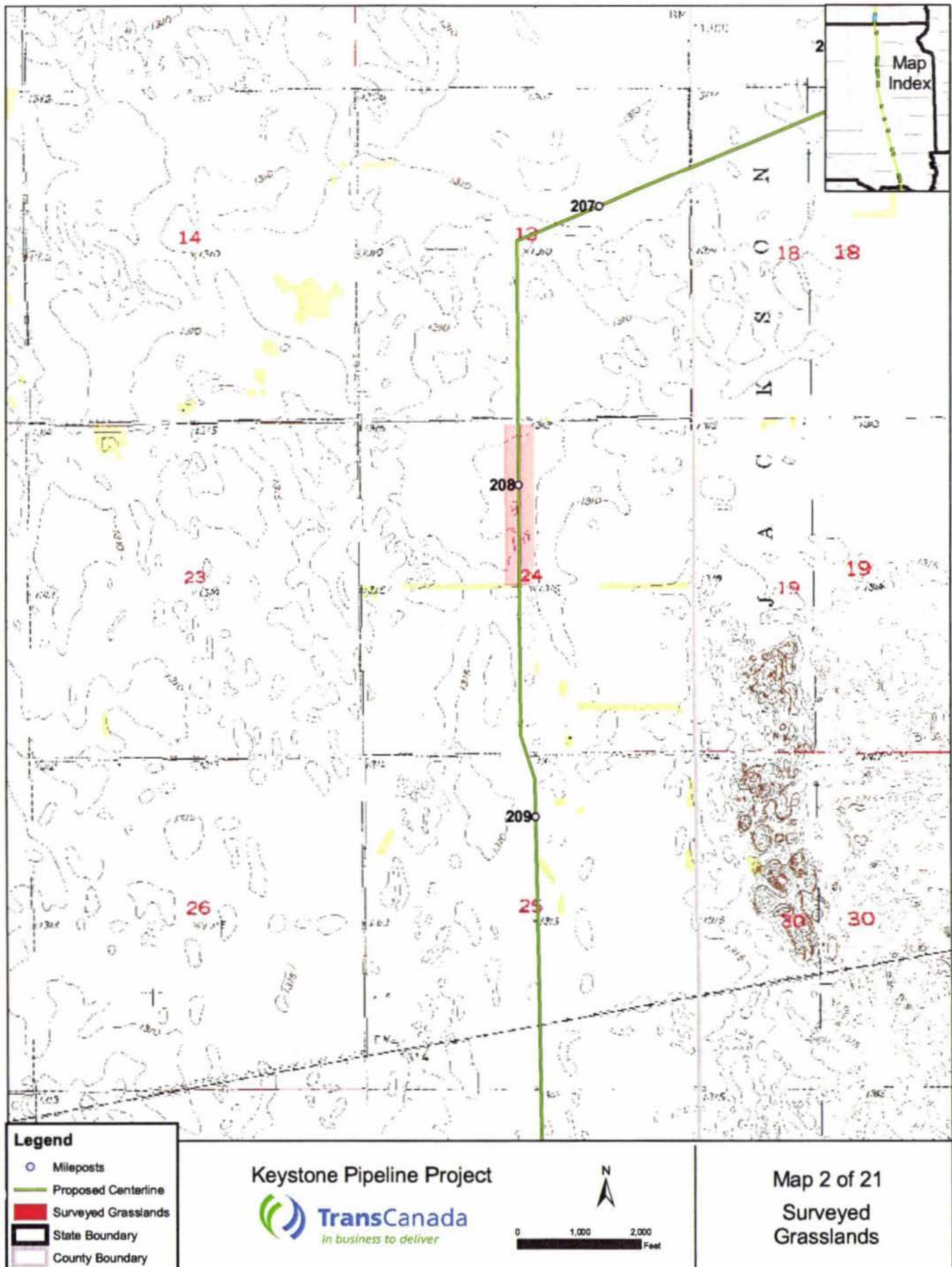
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1NDDI003	9/12/2006	207.8	208.3	Dickey	ND	Drive By	Medium	Yes, prairie fringed orchid

Site Summary: This lowland meadow has a mosaic of wetlands (*Typha*, *Scholenopectus*, *Hordeum jubatum*, *Spartina pectinata*, etc.), with upland inclusions. Despite weeds and grazing this is potential habitat for the prairie fringed orchid. This location is visually similar to TDH1NDDI002.



Feature TDH1NDDI003: Overview of wet meadow with upland inclusions.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1NDDI002	9/12/2006	210.8	211.9	Dickey	ND	Site Visit	High	Yes, prairie fringed orchid

Site Summary: This lowland meadow has a mosaic of wetlands (*Typha*, *Scholenopectus*, *Hordeum jubatum*, *Spartina pectinata*, etc.), with upland inclusions. Despite weeds and grazing this grassland is potential habitat for the prairie fringed orchid. The Great Plains lady's tresses orchid (*Spiranthes cf. magnicamphorum*) occurs at this location (see photo below).



Feature TDH1NDDI002: Overview of mosaic area with uplands and wetlands.

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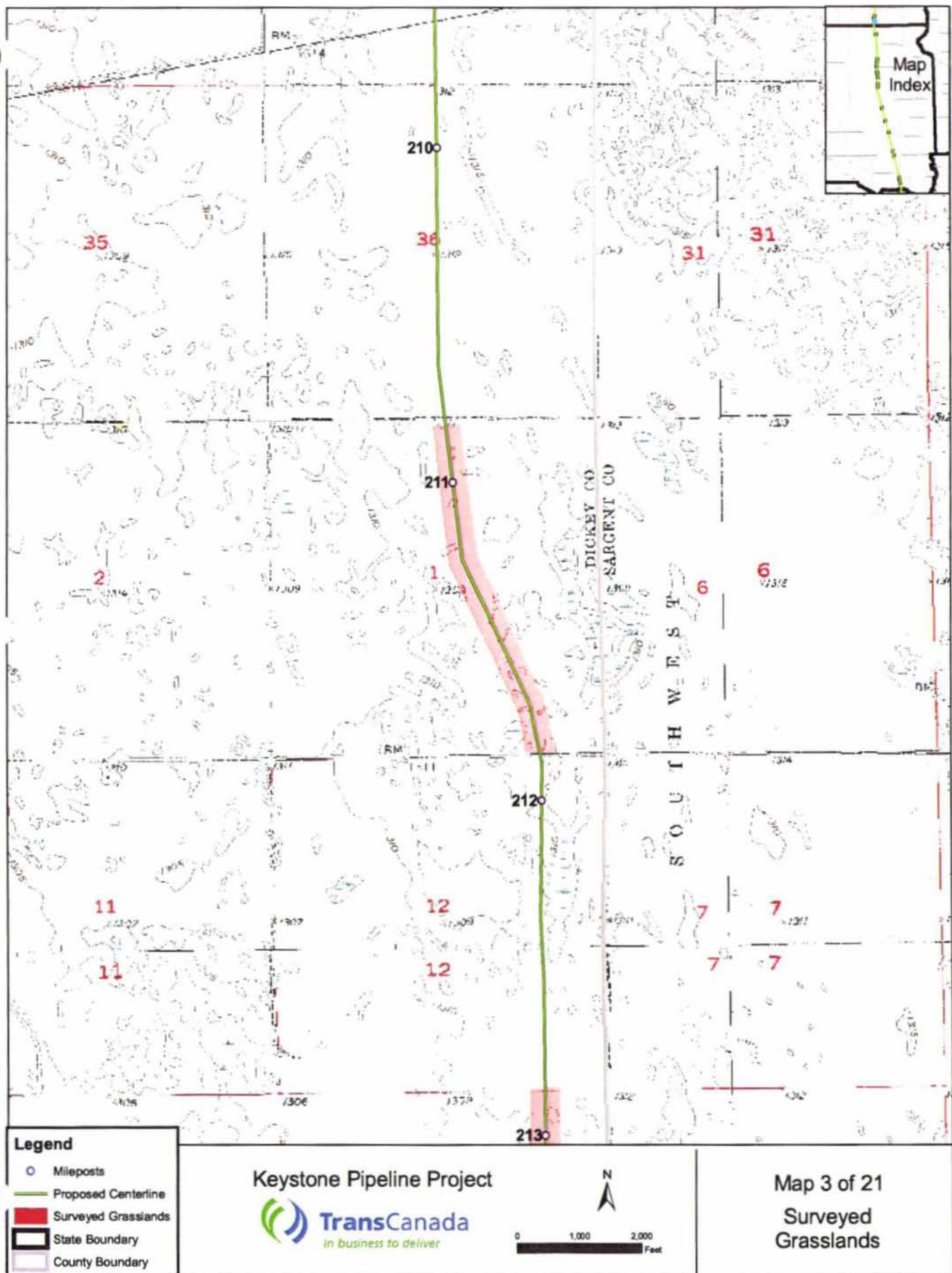


Feature TDH1NDDI002: Great Plains Lady's tresses orchid (*Spiranthes cf. magnicamphorum*)



Feature TDH1NDDI002: Overview of the *Spiranthes* habitat. Note the distance between the white orchid (to the right) and the wetland (to the left).

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1NDDI001	9/12/2006	212.9	214.0	Dickey	ND	Drive By	None	Yes, prairie fringed orchid

Site Summary: This is a large wetland with willow (*Salix spp.*) and cottonwood (*Populus deltoides*) trees scattered among *Typha* (cattails) and prairie cordgrass (*Spartina pectinata*). Some areas are dense with willows while others are 100% cattails. This large wetland meadow also has wooden water-fowl hunting blinds as towers (ca. 15 feet tall) that occur at or near center line (in the distance of the second photograph). This is a high quality wetland with perhaps a few upland, grassy areas where the prairie fringed orchid could occur.



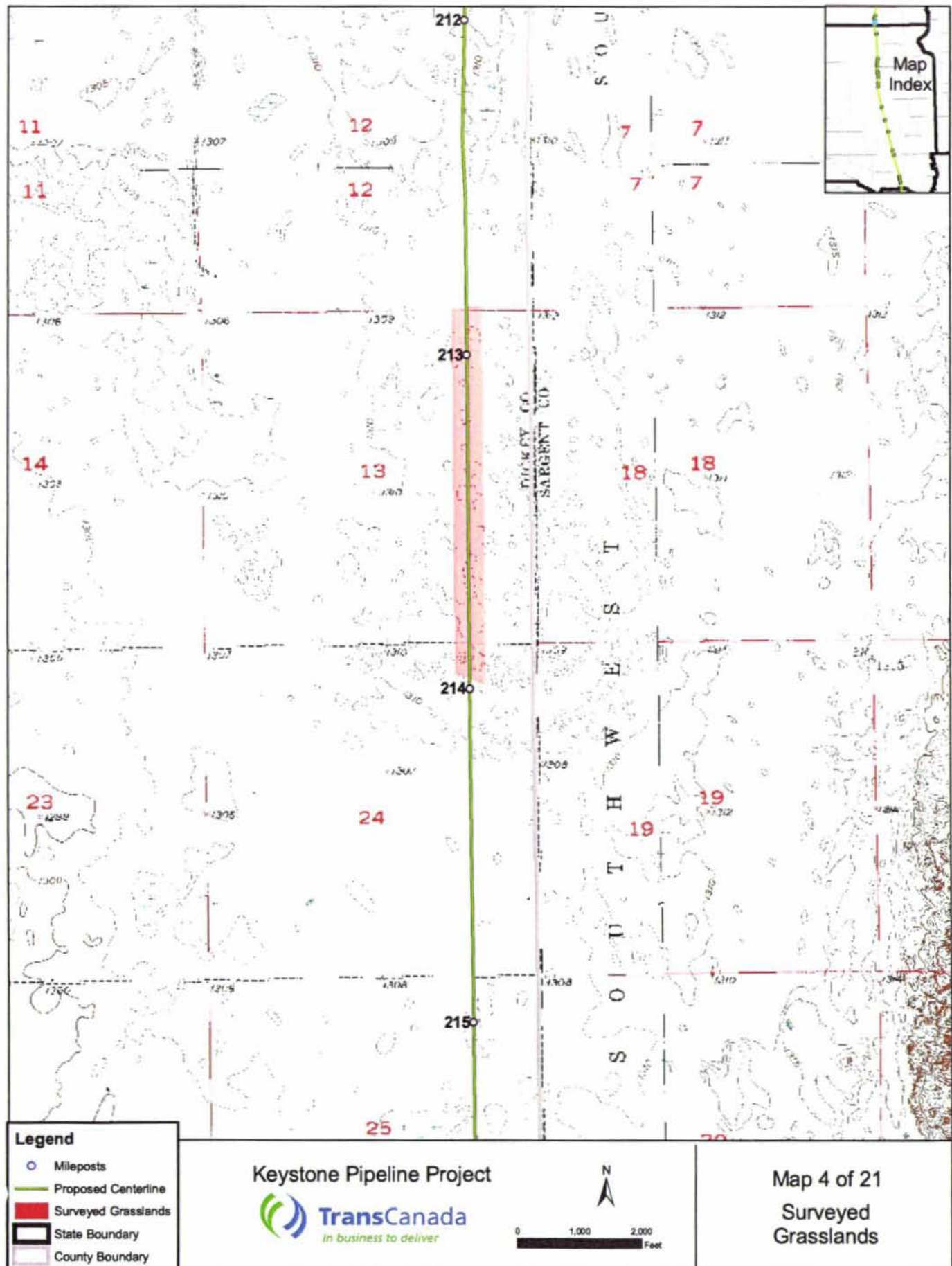
Feature TDH1NDDI001: Large wetland with willows (*Salix sp*), cattails (*Typha sp*) and a few cottonwood trees (*Populus deltoides*).

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Feature TDH1NDDI001: Large wetland with several wooden hunting towers (blinds) near the center.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDMA001	9/13/2006	228.5	228.9	Marshall	SD	Site Visit	None	No

Site Summary: This area appeared as grassland on the aerial photographs. However, it is dominated by reed canary grass (*Phalaris arundinacea*) and a strip of common reed grass (*Phragmites australis*) along the ditch to the north. This is a game production area (note the sign in the third photograph) with patches of smooth brome (*Bromus inermis*). This is a high quality wetland site with minimal grazing, but no grassland inclusions were seen.



Feature TDH1SDMA001: Southern exposure along center line of this large wetland, dominated by reed canary grass (*Phalaris arundinacea*) and common reed grass (*Phragmites australis*).

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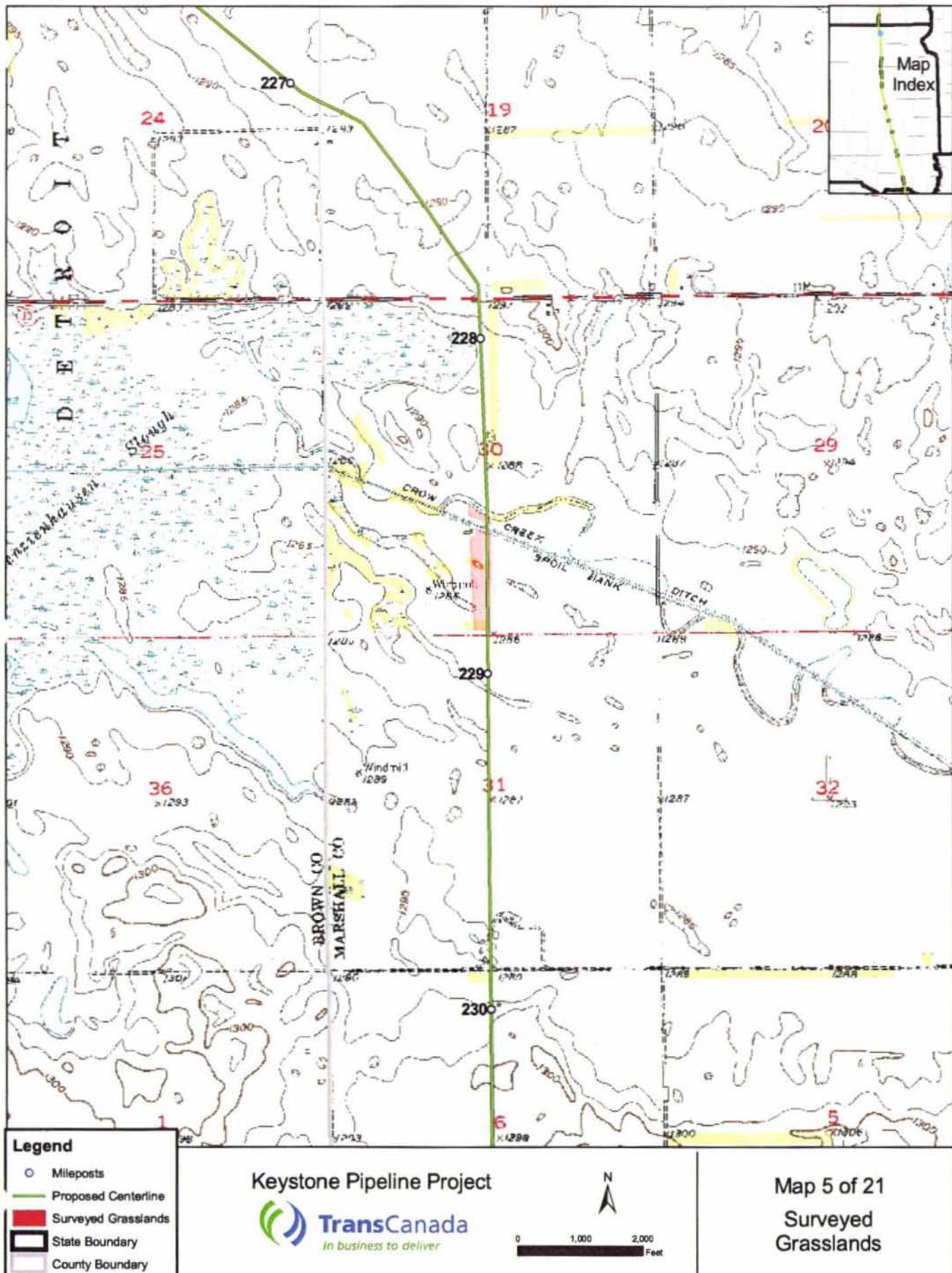


Feature TDH1SDMA001: View along center line that crosses this canal.



Feature TDH1SDMA001: Sign at the border of this large wetland that is on state land.

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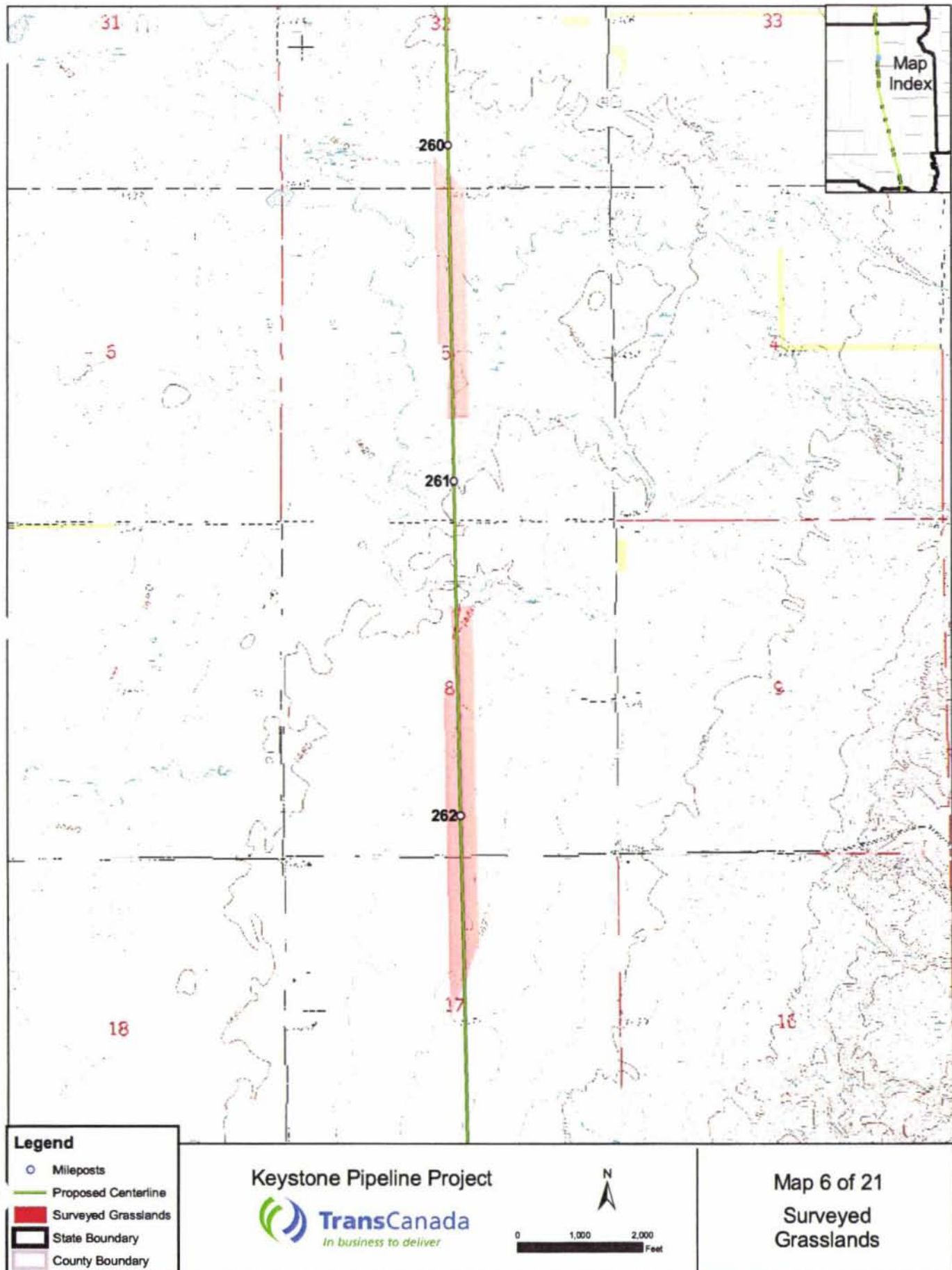
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDHISDDA005	9/11/2006	260.0	260.8	Day	SD	Drive By	Low	No

Site Summary: This site was seen only from a distance (drive-by), but appeared heavily grazed. It is a low quality grassland area.



Feature TDH1SDDA005: Overview of this heavily grazed pasture.

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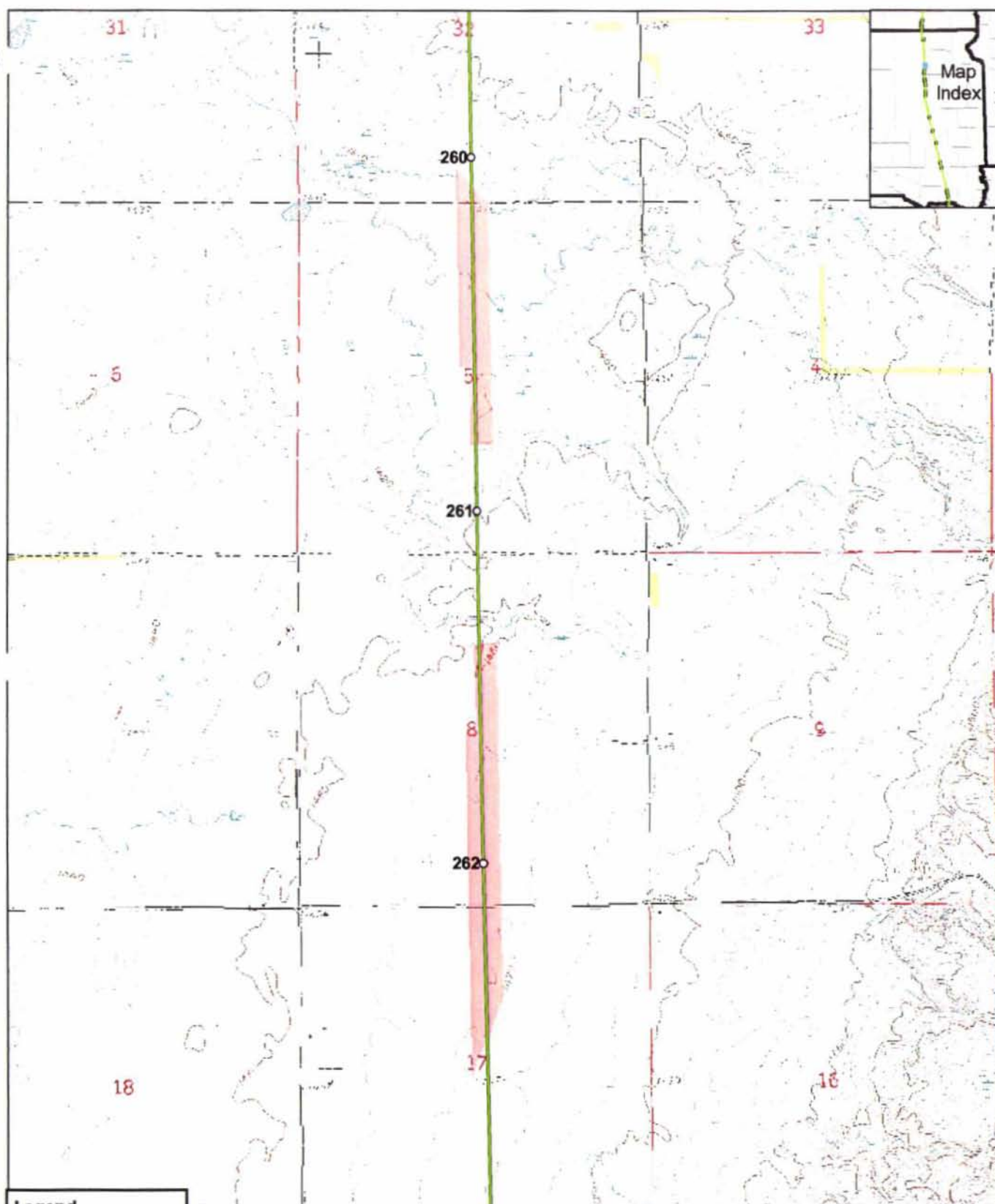
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDDA004	9/11/2006	261.4	262.6	Day	SD	Drive By	Low	No

Site Summary: A pasture dominated by introduced wheat grasses such as tall and intermediate wheat grass (*Agropyron spp.*) and perhaps other *Agropyron* species. There may be a few native grasses and forbs in spots, but the overall grassland quality is low.



Feature TDH1SDDA004: Pasture planted with wheatgrass (*Agropyron spp.*).

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Legend

- Mileposts
- Proposed Centerline
- Surveyed Grasslands
- ▬ State Boundary
- ▬ County Boundary

Keystone Pipeline Project



0 1,000 2,000 Feet

Map 6 of 21
Surveyed
Grasslands

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDDA003	9/11/2006	264.5	264.8	Day	SD	Site Visit	Low	No

Site Summary: This is a heavily grazed hillside with an ox-bow by a stream. It is mostly all smooth brome (*Bromus inermis*), but it also has dense spots of Canadian thistle (*Cirsium arvense*) near the stream, patches of wormwood (*Artemisia absinthium*) on the hillsides, and wet spots with prairie cordgrass (*Spartina pectinata*). A few native forbs such as silver scurf pea (*Pedimelum argophyllum*) also occur, but the grassland quality is low.



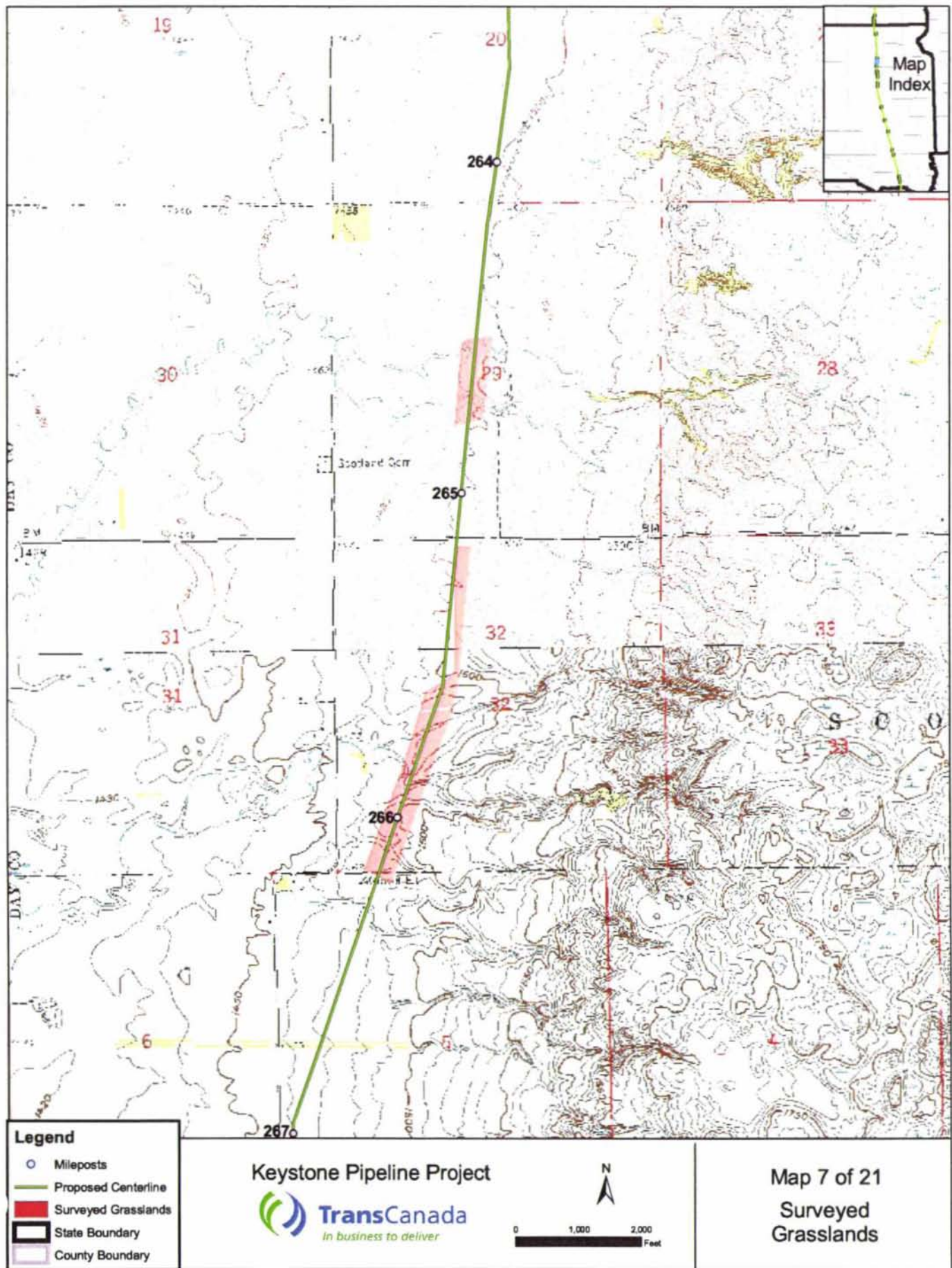
Feature TDH1SDDA003: Overview of large wetland located at site.

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Feature TDH1SDDA003: Close-up of prairie cordgrass (*Spartina pectinata*)

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CONFIDENTIAL

Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDDA002	9/11/2006	265.2	266.2	Day	SD	Site Visit	High	Yes, Dakota skipper

Site Summary : This is high quality prairie area. The northern section is adjacent (toward the east) to a high quality, rolling hill prairie. To the west is a plowed field (photograph 1). In the middle section of this tract the corridor crosses a disturbed area of a farm. However, in the southern portion the center line actually crosses quality rolling hills with high quality prairie. The southern section of the site contained Dakota skipper pollen plants such as black Sampson (*Echinacea*) and leadplant (*Amorpha*). On the rocky slopes were side-oats grama (*Bouteloua curtipendula*), little blue stem (*Schicachyrium scoparium*), and big blue stem (*Andropogon gerardii*). This was the only site where the clonal variety of pincushion cactus (*Coryphantha vivipara*) was seen. Rerouting the pipeline a bit to the west to avoid this high quality prairie should be considered.



Feature TDH1SDDA002: Agricultural field in background.

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Feature TDH1SDDA002: Hills with red-brown little blue stem (*Schizachyrium scoparium*)



Feature TDH1SDDA002: A close-up of leadplant (*Amorpha canescens*)

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Feature TDH1SDDA002: Close-up of Big Blue Stem (*Andropogon gerardii*)

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Feature TDH1SDDA002: Fruiting heads of black Sampson (*Echinacea angustifolia*)



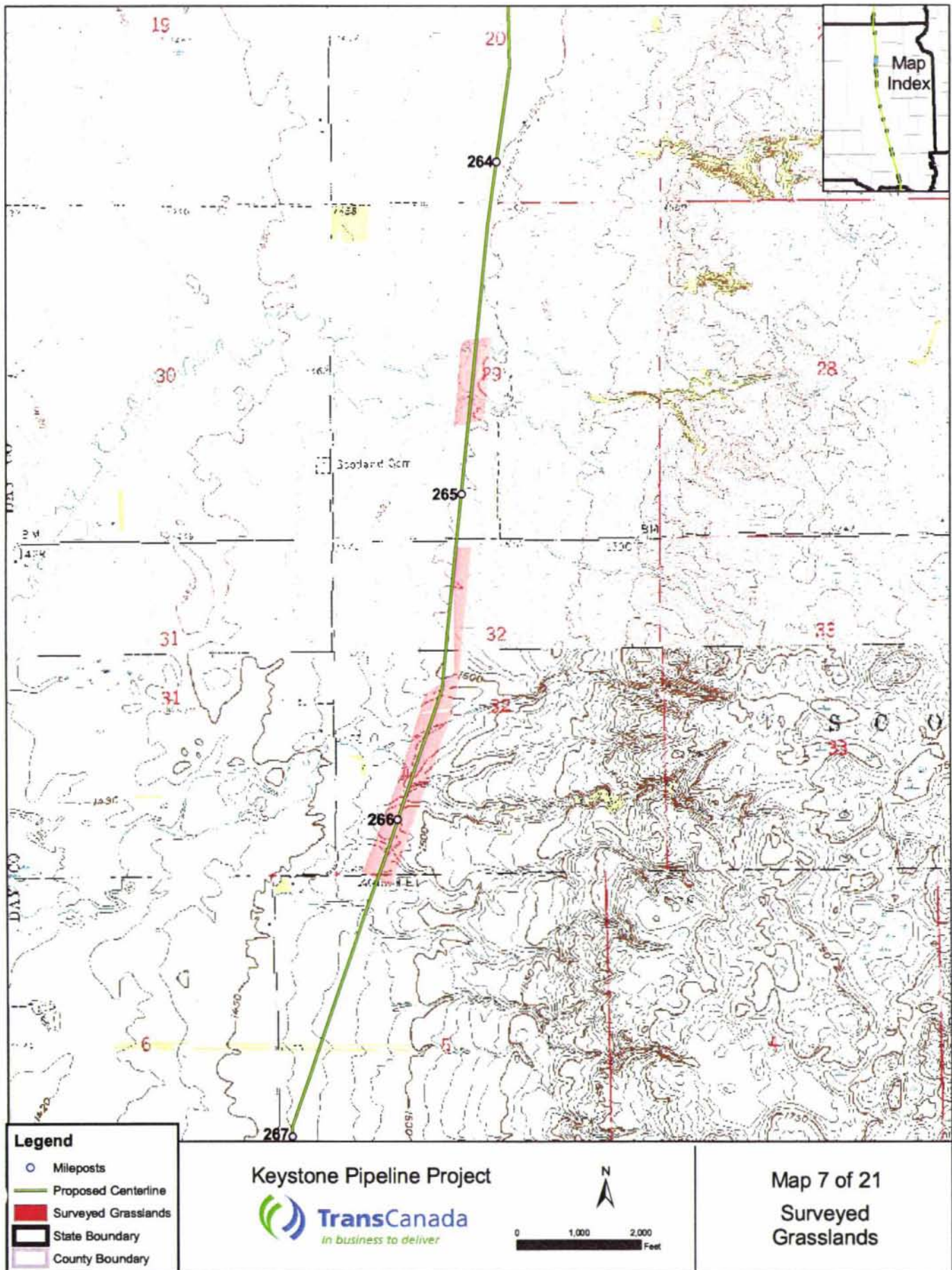
Feature TDH1SDDA002: Close-up of silky aster (*Aster sericeus*)

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Feature TDH1SDDA002: Close-up of the clonal variety of pincushion cactus (*Coryphantha vivipara*).

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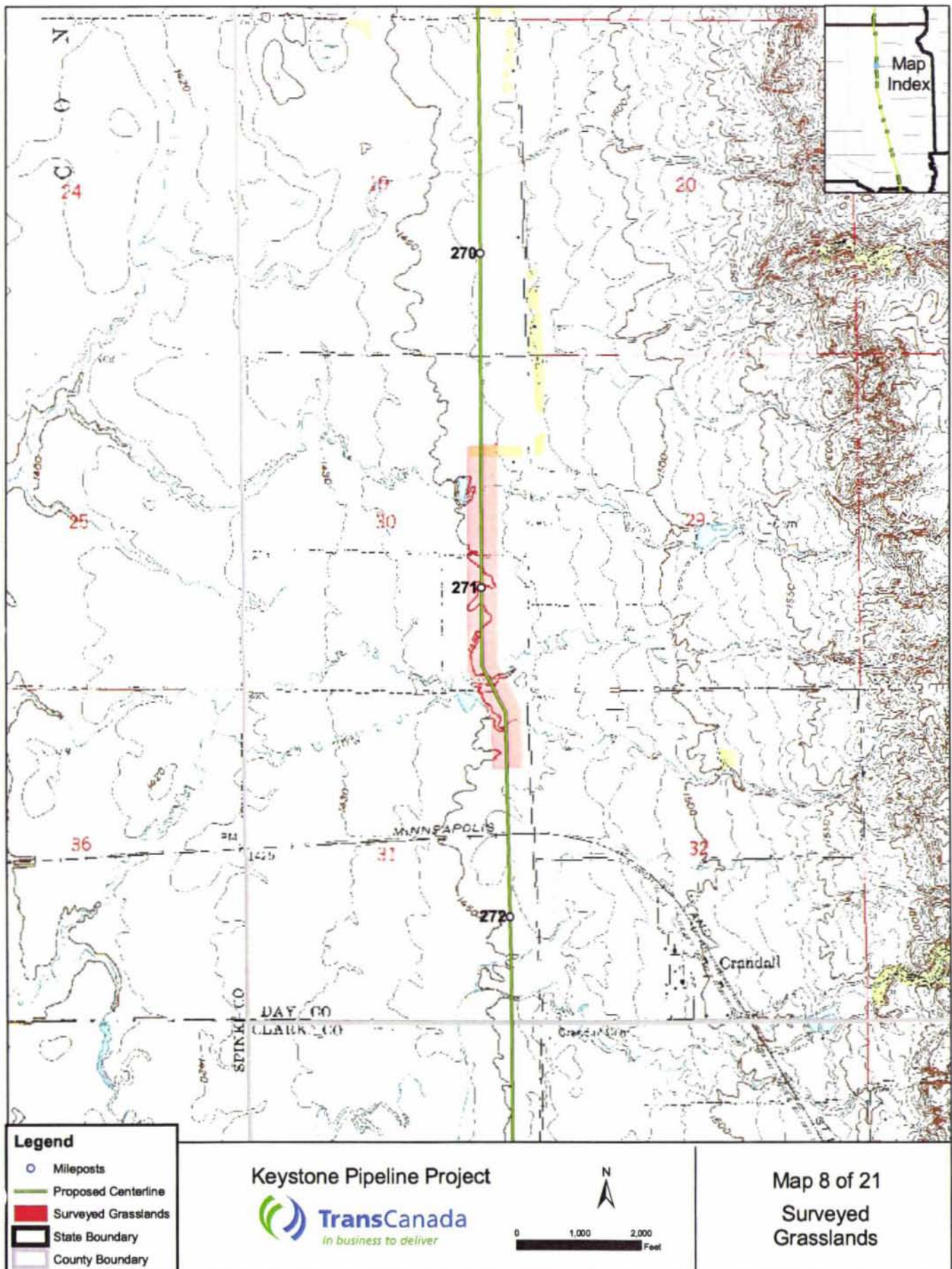
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDDA001	9/11/2006	270.6	271.6	Day	SD	Drive By	Low	No

Site Summary: This is an alkaline pasture / wetland with prairie cordgrass (*Spartina pectinata*) and saltgrass (*Distichlis spicata*). There are a few native forbs here such as blazing star (*Liatris ligulistylis*), but exotic plants such as Russian olive (*Elaeagnus angustifolia*), Canadian thistle (*Cirsium arvense*), and wormwood (*Artemisia absinthium*) are also present at this low quality grassland site.



Feature TDH1SDDA001: A Russian olive tree (*Elaeagnus angustifolia*) by an alkaline, heavily grazed pasture.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDCL005	9/13/2006	277.2	277.9	Clark	SD	Drive By	Medium	Yes, prairie fringed orchid

Site Summary: This is an area with exotic pasture grasses, such as crested wheat grass (*Agropyron cristatum*), and with exotic forage legumes such as alfalfa (*Medicago sativa*), yellow sweet clover (*Melilotus officinalis*), and clover (*Trifolim*). There are upland spots with native plants that include hoary vervain (*Verbena stricta*), prairie cone flower (*Ratibida columnifera*), and silver scurf pea (*Pedimelum argophyllum*). This is potential prairie fringed orchid habitat.



Feature TDH1SDCL005: Close-up of wetland vegetation that is potential prairie orchid habitat.

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Feature TDH1SDCL005: Overview of pasture area included on site.



Feature TDH1SDCL005: Prairie cone flower (*Ratibida columnifera*)

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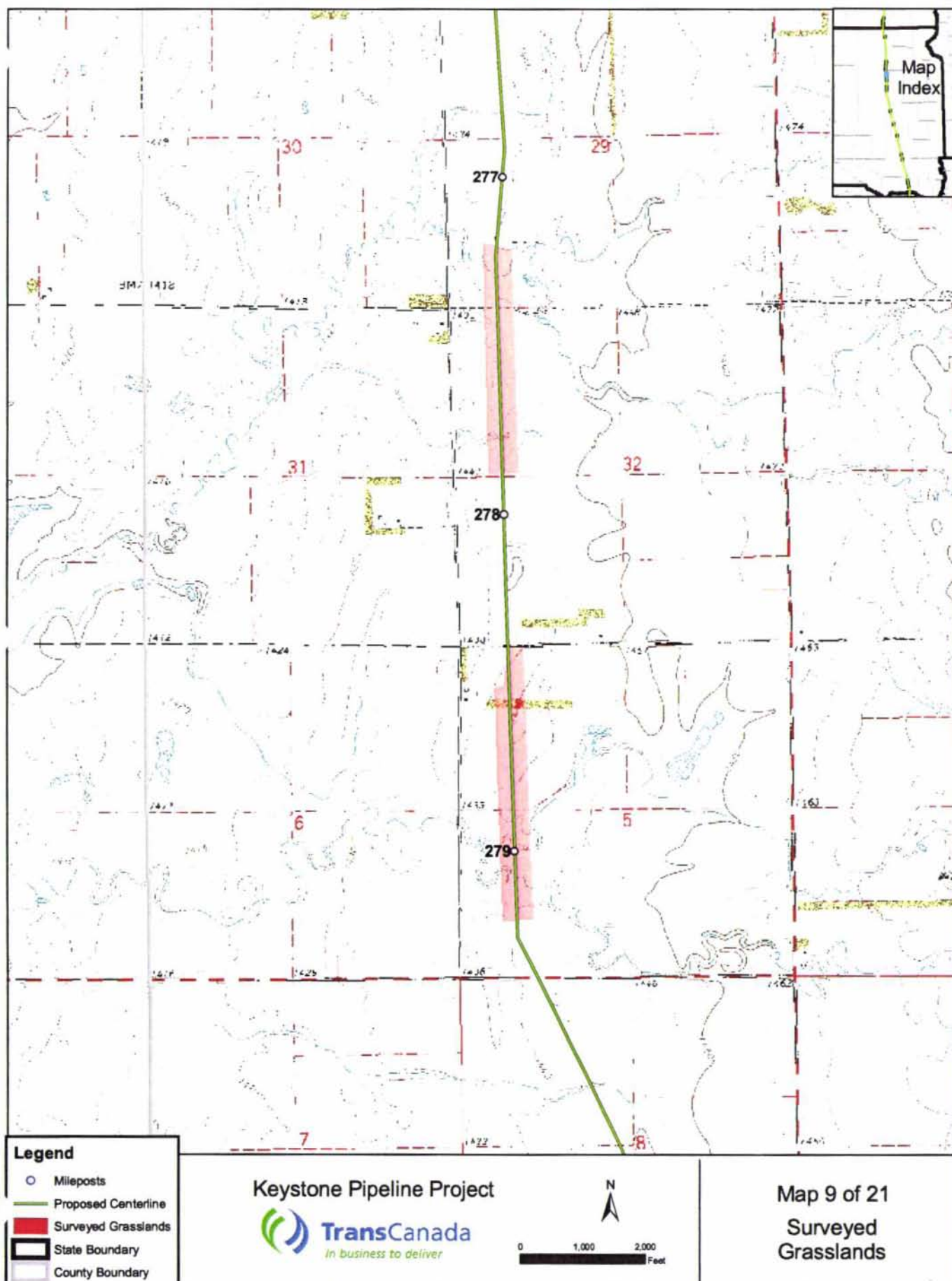


Feature TDH1SDCL005: Butterfly on a white frost flower (*Aster falcatus*)



Feature TDH1SDCL005: Bird nest in wetland vegetation.

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CONFIDENTIAL

Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDCL006	9/13/2006	278.4	279.2	Clark	SD	Drive By	Medium	Yes, prairie fringed orchid

Site Summary: This is an area with exotic pasture grasses, such as crested wheat grass (*Agropyron cristatum*), and with exotic forage legumes such as alfalfa (*Medicago sativa*), yellow sweet clover (*Melilotus officinalis*), and clover (*Trifolium*). In this area of pasture and wetlands are upland spots with native plants that include hoary vervain (*Verbena stricta*), prairie cone flower (*Ratibida columnifera*), and silver scurf pea (*Pedimelum argophyllum*). This is potential prairie fringed orchid habitat.



Feature TDH1SDCL006: View of pasture (with several wetland spots) from the road.

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Feature TDH1SDCL006: Overview of pasture away from the wetland spots.



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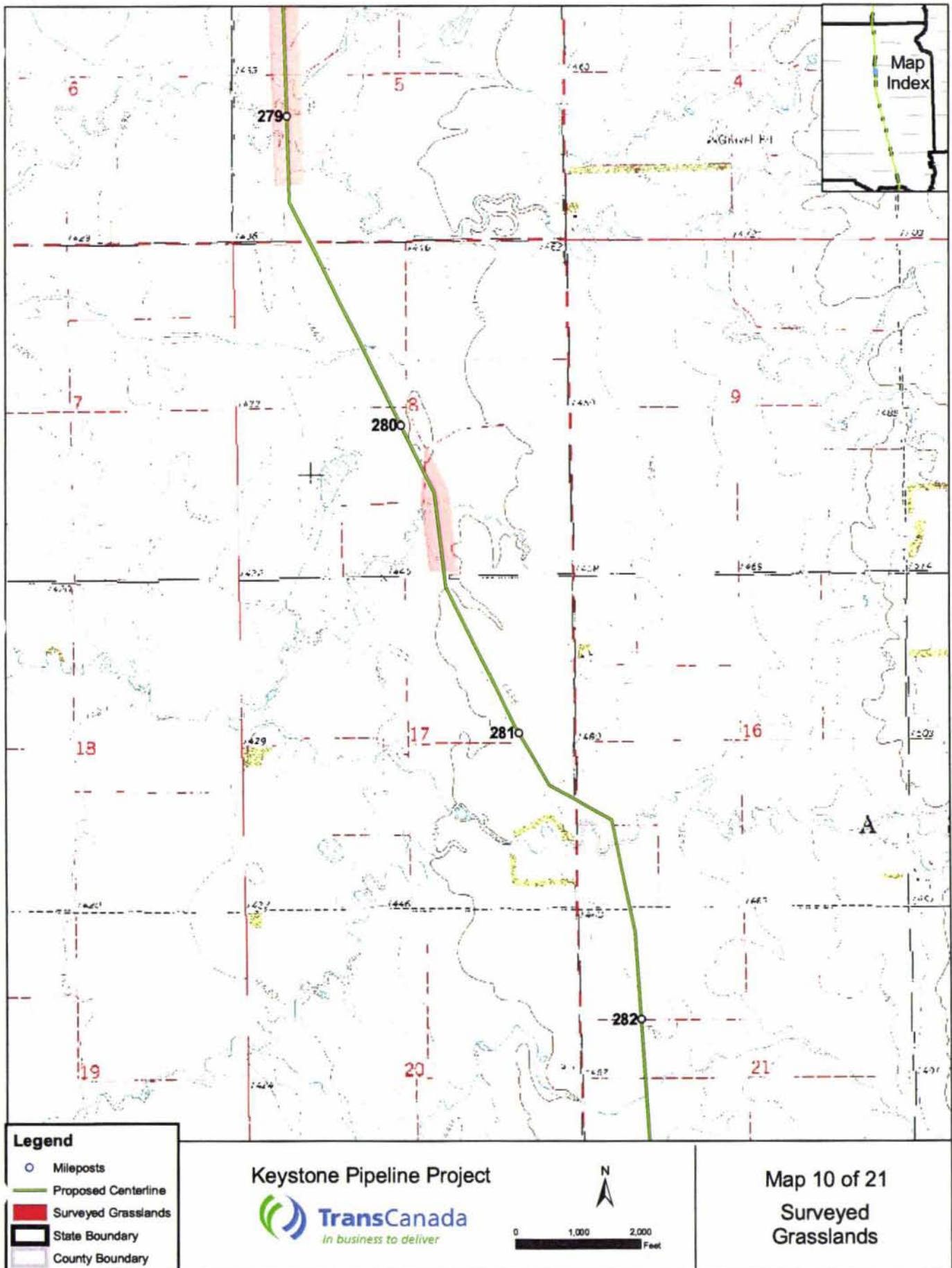
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDCL004	9/11/2006	280.1	280.5	Clark	SD	Drive By	Low	No

Site Summary. This is a smooth brome (*Bromus inermis*) dominated pasture with an abundance of western ragweed (*Ambrosia psilostachya*). This is apparently an alkaline area due to the presence of saltgrass (*Distichlis spicata*) and gumweed (*Grindelia squarrosa*).



Feature TDH1SDCL004: General overview of site.

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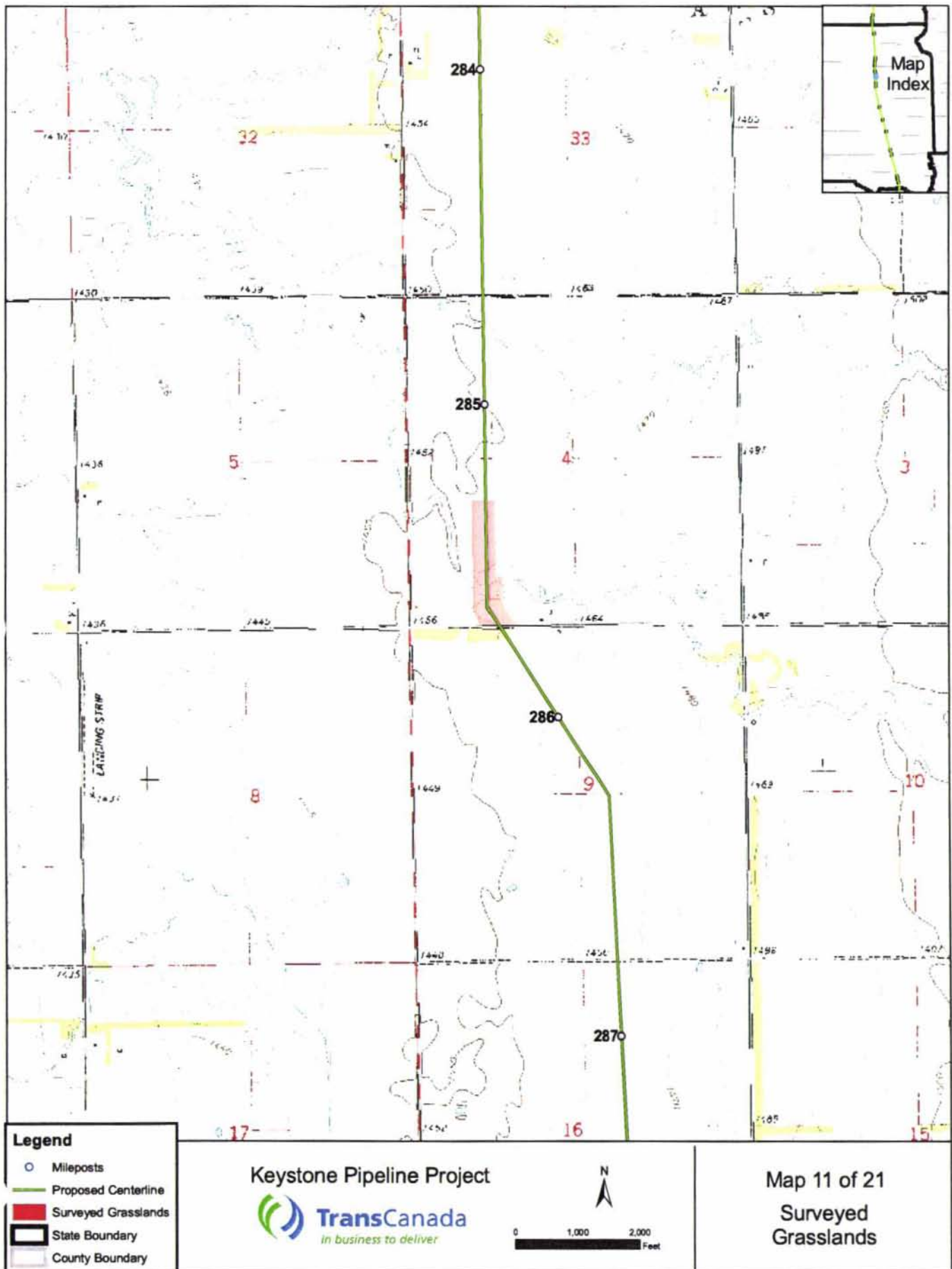
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDCL003	9/11/2006	285.3	285.7	Clark	SD	Drive By	Low	No

Site Summary: This is a smooth brome (*Bromus inermis*) dominated pasture with lots of western ragweed (*Ambrosia psilostachya*). A heavily grazed creek in the corridor has a few peach-leaf willows (*Salix amygdaloides*) and wormwood (*Artemisia absinthium*) is common in the floodplain pasture.



Feature TDH1SDCL003: View of weedy, smooth brome (*Bromus inermis*) pasture from the road.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDCL002	9/11/2006	293.7	294.1	Clark	SD	Drive By	Low	No

Site Summary: This is a heavily grazed wetland/upland inclusion area where ironweed (*Vernonia* spp.) and cocklebur (*Xanthium canadense*) are common. There are a few peach-leaf willows (*Salix amygdaloides*) and wormwood (*Artemisia absinthium*) is common in the floodplain pasture.



Feature TDH1SDCL002: The tree is a peach-leaf willow (*Salix amygdaloides*) that is near center line.

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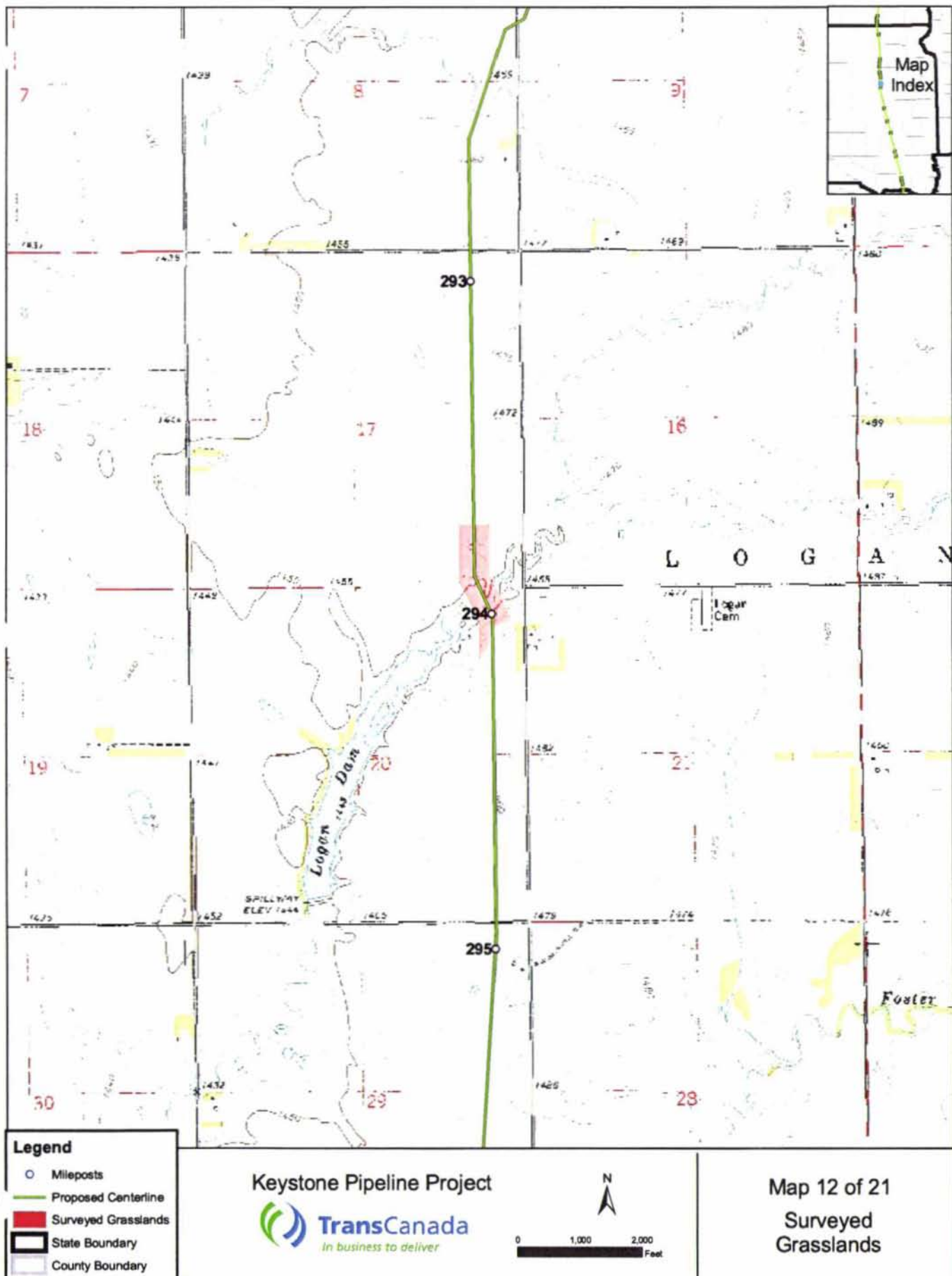


Feature TDH1SDCL002: Just east of the corridor by the road the same stream that also crosses center line has an abundance of Canadian thistle (*Cirsium arvense*).



Feature TDH1SDCL002: Wormwood (*Artemisia absinthium*) in smooth brome (*Bromus inermis*) pasture

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDCL001	9/11/2006	296.9	297.9	Clark	SD	Site Visit	Medium	Yes, Dakota skipper

Site Summary: This is a medium quality grassland. It has a stream with rolling hills with native grasses present to the west of the stream. There are pasture grasses such as crested wheat (*Agropyron cristatum*), but there are also large areas with native grasses such as blue grama (*Bouteloua gracilis*) and little blue stem (*Schizachyrium scoparium*). There are also native forbs, including pollen plants for the Dakota skipper butterfly.



Feature TDH1SDCL001: Overview of site.

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Feature TDH1SDCL001: Over view of this area looking south from the road.



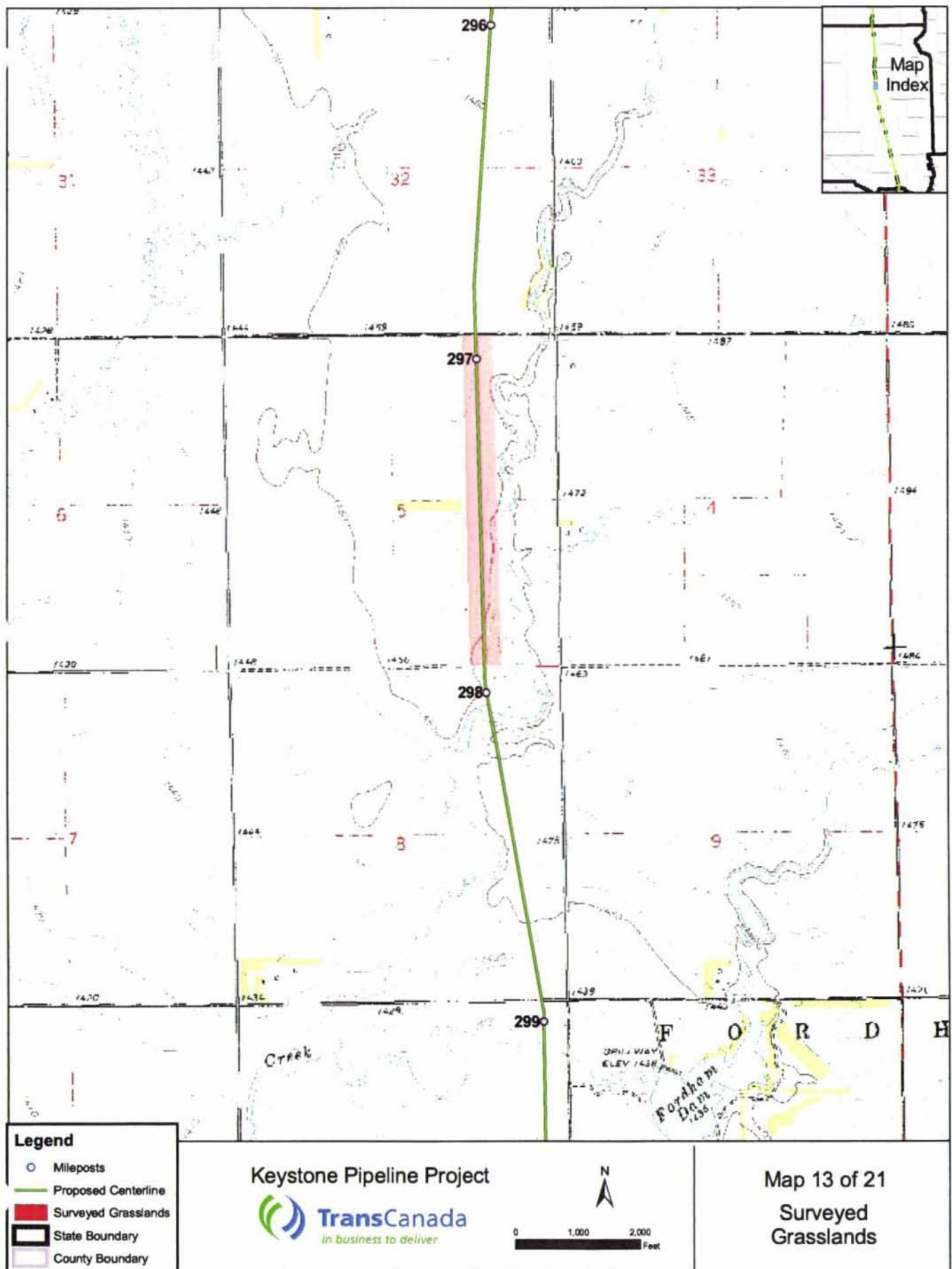
Feature TDH1SDCL001: Hillside with an abundance of glodenrrod (*Solidago* spp.).

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Feature TDH1SDCL001: Yellow flowers of gumweed (*Grindelia squarosa*) and spikes of hoary vervain (*Verbena stricta*).

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDKI001	9/16/2006	325.1	326.4	Kingsbury	SD	Drive By	High/North Medium/South	No

Site Summary: A road dissects a high quality grassland to the north and a medium quality grassland to the south. This is a good example of the impact that grazing can have in terms of allowing exotic plants to invade and to become more common in grazed areas. This is the only area where the noxious leafy spurge (*Euphorbia esula*) was seen. The high quality pasture includes large, flowering stands of blue grama (*Bouteloua gracilis*) and patches of little blue stem (*Schizachyrium scoparium*). Since there was no adjacent prairie, and essentially no pollen plants, this site was not considered to be Dakota skipper habitat.



Feature TDH1SDKI001: High quality prairie to the north of the road.

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Feature TDH1SDKI001: A large stand of flowering blue grama (*Bouteloua gracilis*) north of road.



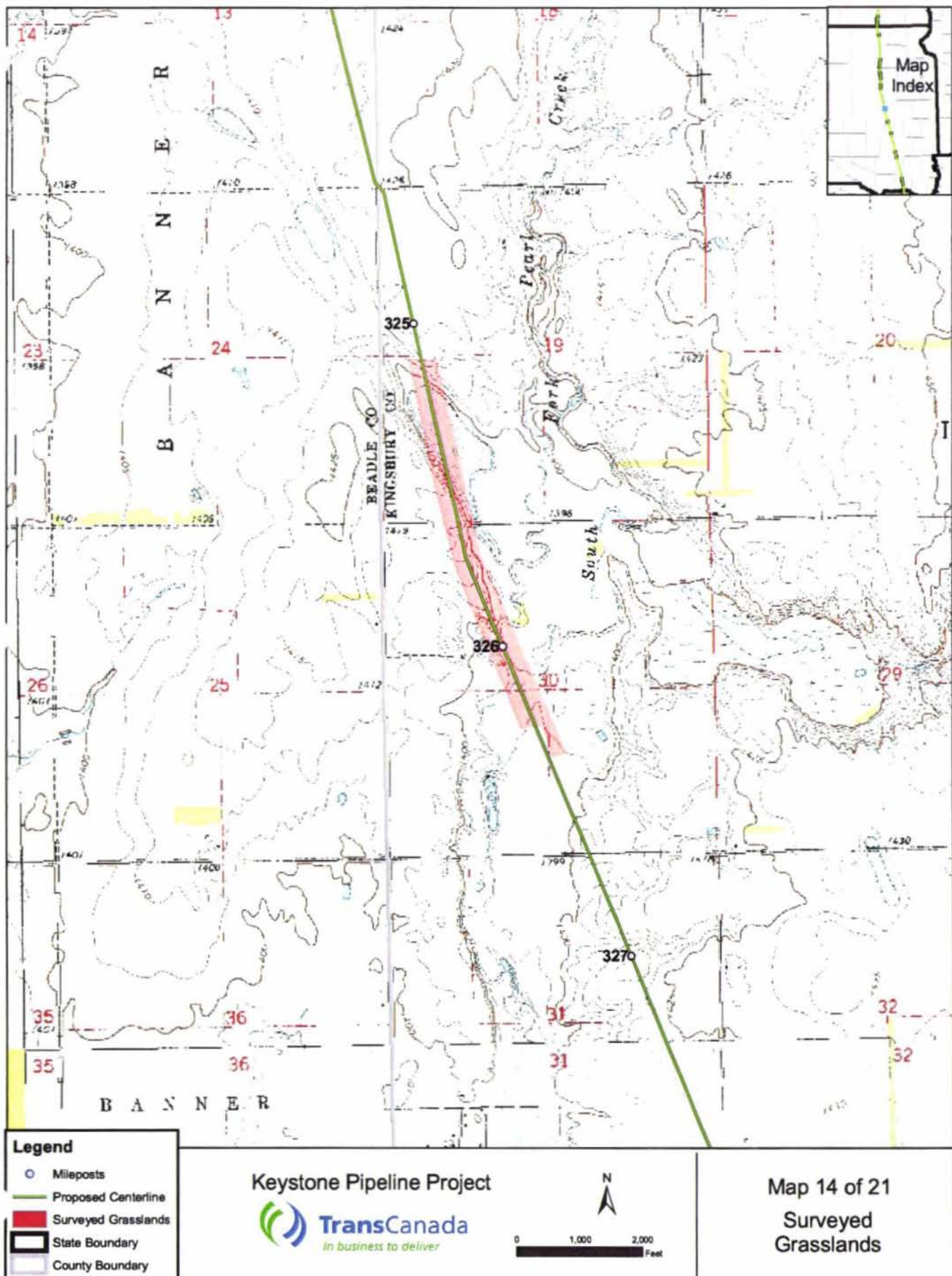
Feature TDH1SDKI001. Medium quality, heavily grazed grassland south of road.

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Feature TDH1SDKI001: Leafy spurge (*Euphorbia esula*) in heavily grazed pasture south of road.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDMI001	9/16/2006	342.9	344.0	Miner	SD	Drive By	Low	No

Site Summary: A pasture of introduced grasses that has nearly all smooth brome (*Bromus inermis*) and some crested wheatgrass (*Agropyron cristatum*). There are cattails (*Typha*) in the wetland spots and blue grama (*Bouteloua gracilis*) on the few upland areas.



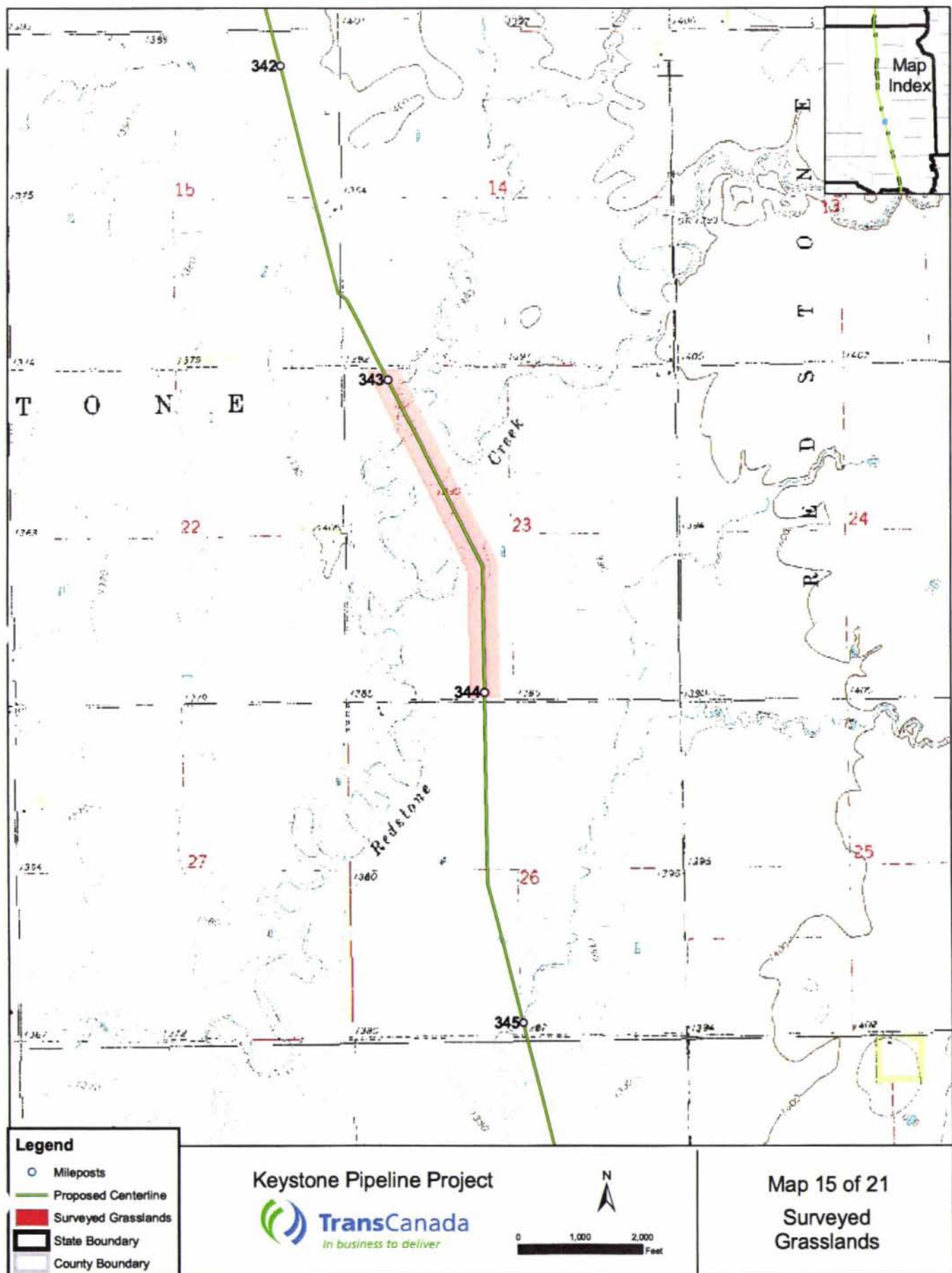
Feature TDH1SDMI001: Overview of this site to the North from the road.

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Feature TDH1SDMI001: Overview of the site south from the road.

CONFIDENTIAL



CONFIDENTIAL

Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDMI002	9/16/2006	358.5	359.9	Miner	SD	Drive By	Low	No

Site Summary: A pasture of introduced grasses that has blue grass (*Poa* spp.) and smooth brome (*Bromus inermis*) as dominants and crested wheatgrass (*Agropyron cristatum*) in spots. Wet areas have prairie cordgrass (*Spartina pectinata*), smartweed (*Polygonum*), and Indian hemp (*Apocynum cannabinum*).

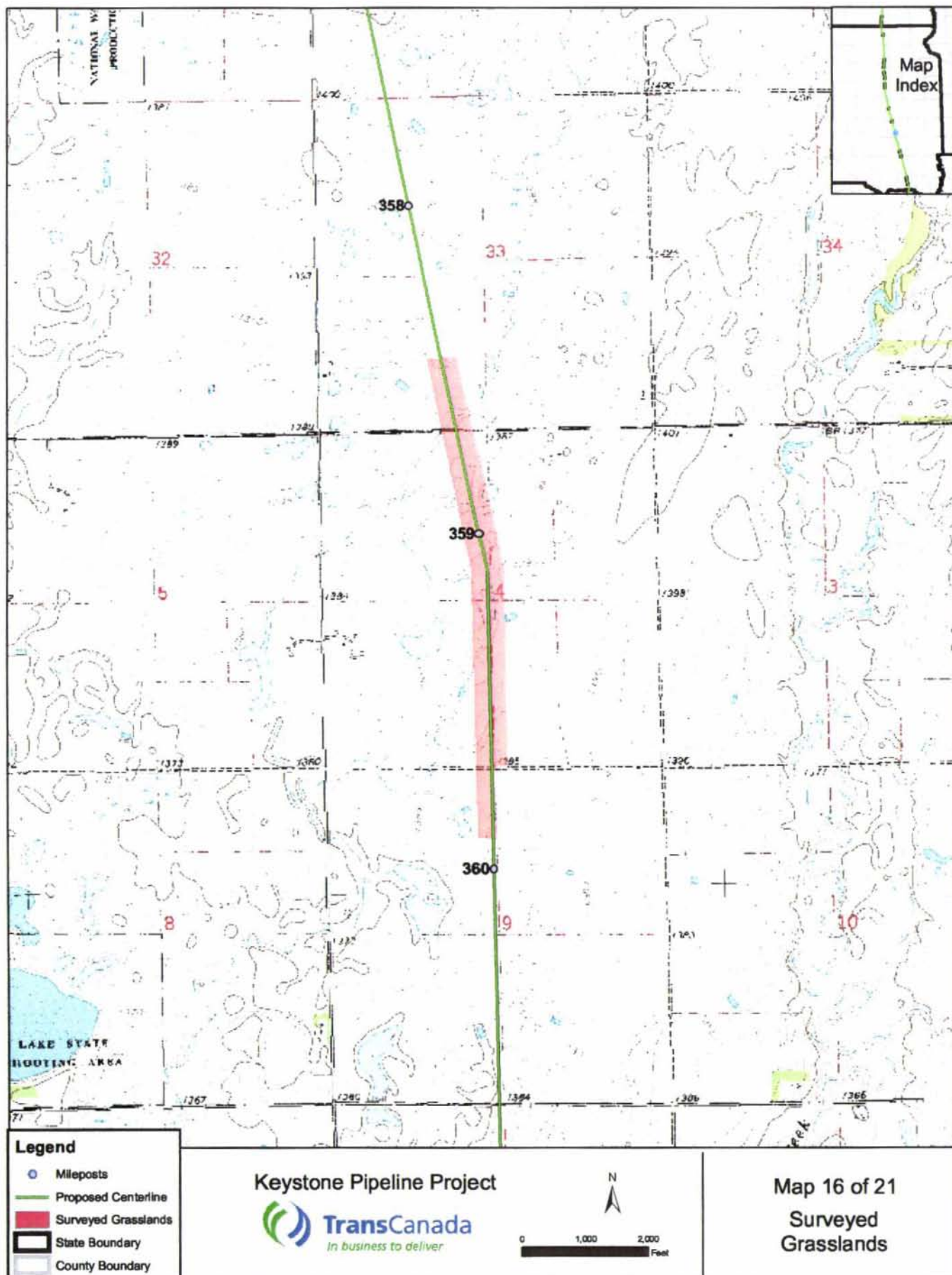


Feature TDH1SDMI002: Overview of pasture north from the road.

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Feature TDH1SDMI002: Overview of the pasture (wetland in foreground) south from the road.



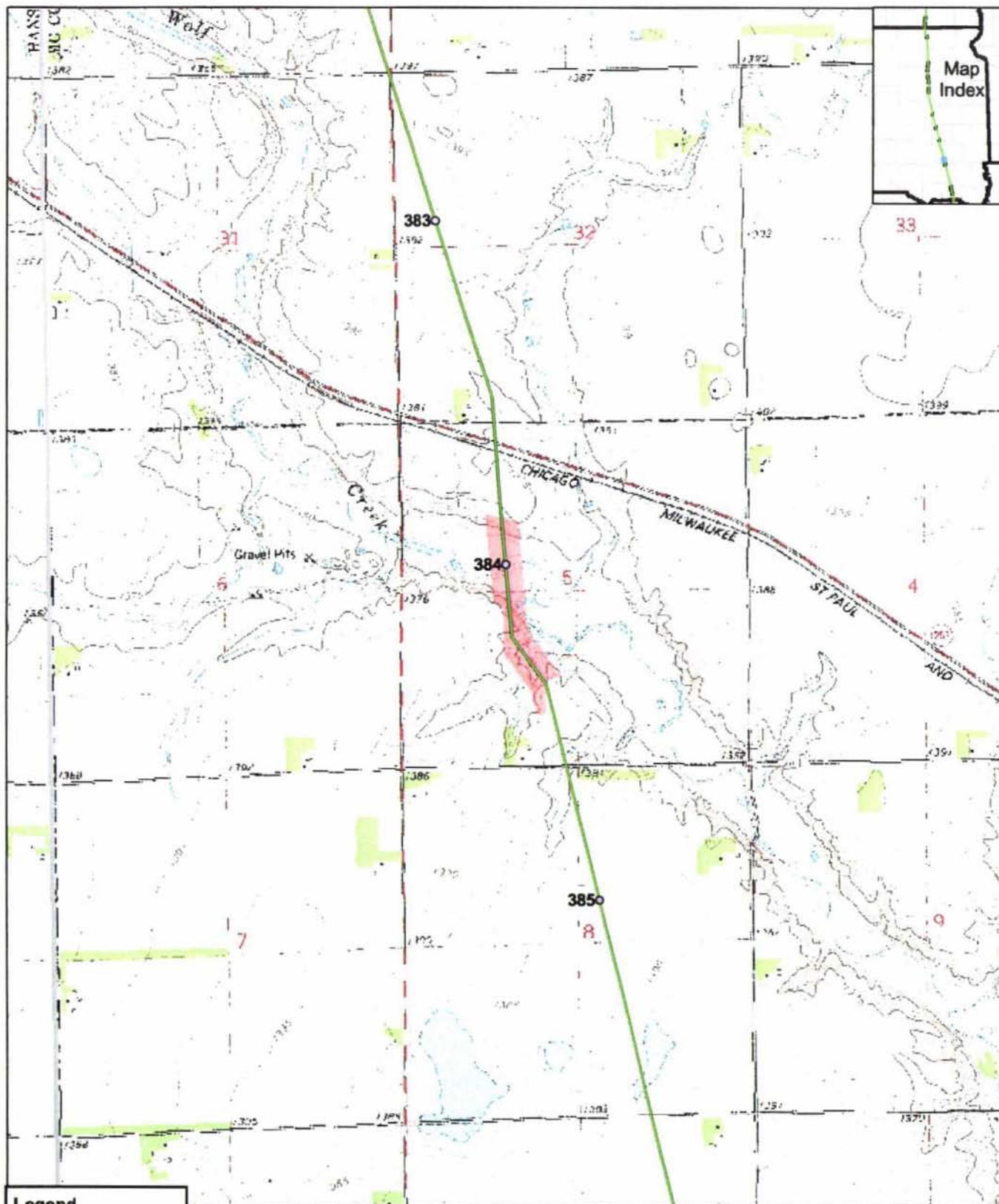
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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat? Yes, prairie fringed orchid
TDH1SDMC001	9/16/2006	383.9	384.5	McCook	SD	Drive By	Medium – High	

Site Summary: A pasture of introduced grasses that has smooth brome (*Bromus inermis*) as the dominant in low spots and cattails (*Typha*) in wet spots. Native grasses such as blue grass (*Bouteloua gracilis*) and prairie dropseed (*Sporobolus heterolepis*) on hillsides. Due to these higher quality grassland slopes it is medium to high quality grassland with possible orchid habitat.



Feature TDH1SDMC001: Overview of area with creek in the distance.



Legend

- Mileposts
- Proposed Centerline
- Surveyed Grasslands
- State Boundary
- County Boundary

Keystone Pipeline Project

0 1,000 2,000 Feet

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Surveyed Grasslands

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDHU001	9/16/2006	389.7	390.6	Hutchinson	SD	Drive By	Low	No

Site Summary: A pasture of introduced grasses that has blue grass (*Poa* spp.) and smooth brome (*Bromus inermis*) as dominants and crested wheatgrass (*Agropyron cristatum*) in spots. Wet areas have prairie cordgrass (*Spartina pectinata*). Site also contained smartweed (*Polygonum* spp.), and Indian hemp (*Apocynum cannabinum*).

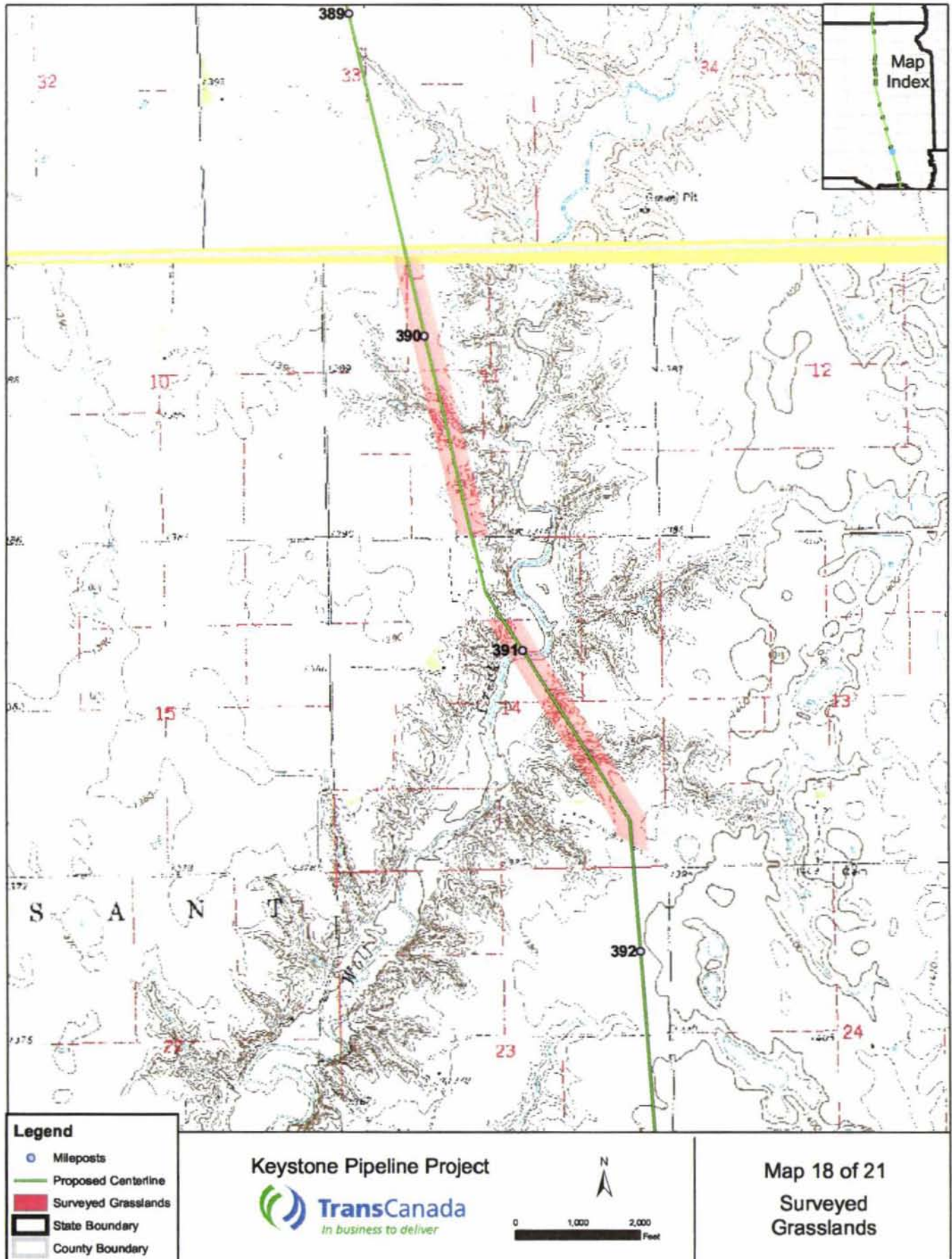


TDH1SDHU001. Overview of pasture.



Feature TDH1SDHU001. Close-up of a dense stand of smooth brome (*Bromus inermis*).

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat? Yes, Dakota skipper, prairie fringed orchid
TDH1SDHU002	9/16/2006	390.9	391.7	Hutchinson	SD	Site Visit	High	

Site Summary. This site is along Wolf Creek. Near the creek, in the ox-bow floodplain is sand dropseed (*Sporobolus* sp.) and prairie cordgrass (*Spartina pectinata*). On the hills are very high quality Dakota skipper habitat with little blue stem (*Schizachyrium scoparium*), black Sampson (*Echinacea angustifolia*), leadplant (*Amorpha canescens*), etc. Other native plants that occur at this site that were not seen elsewhere in South Dakota during the survey were hairy grama (*Bouteloua hirsuta*) and milkwort (*Polygala alba*). Both north and south of Wolf Creek, the hills contain native plants, but as the terrain levels brome grass (*Bromus inermis*) becomes more common. Note the photograph of this area with grazed pasture to the north and a lesser grazed pasture to the south of a fence.



Feature TDH1SDHU002: Overview of high quality grassland around Wolf Creek (in background)

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Feature TDH1SDHU002: Native hillside with little blue stem (*Schizachyrium scoparium*) and blazing star (*Liatris* sp.)



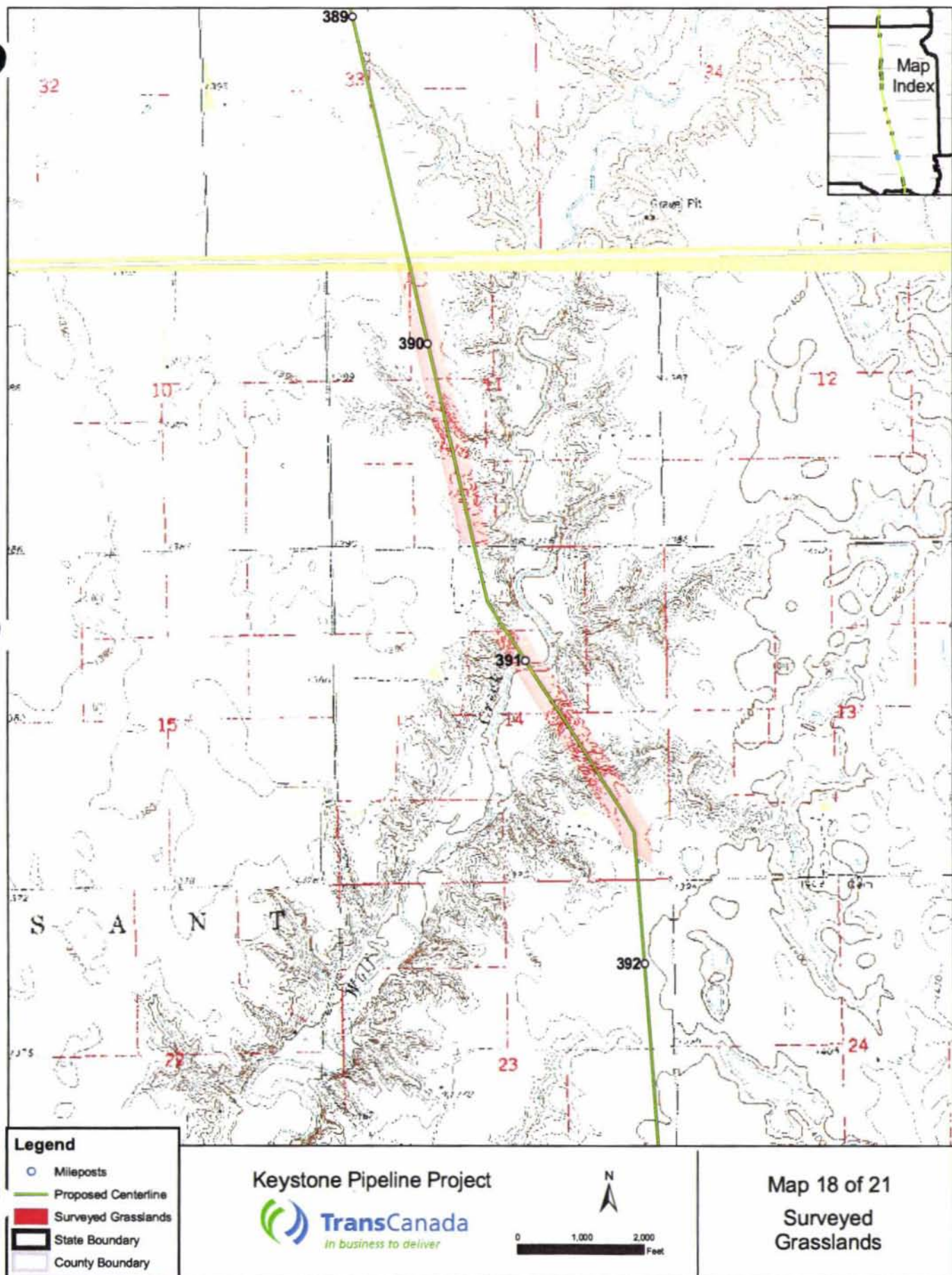
Feature TDH1SDHU002: Little blue stem (*Schizachyrium scoparium*), blazing star (*Liatris* sp.) and Black Sampson (*Echinacea angustifolia*).

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Feature TDH1SDHU002: Effects of grazing on prairie habitat. Note the difference between the moderately grazed pasture to the left, and the nearly ungrazed pasture to the right.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDYA006	9/15/2006	418.7	419.2	Yankton	SD	Site Visit	Medium	No

Site Summary: This is a smooth brome (*Bromus inermis*) and blue grass (*Poa cf. pratensis*) dominated pasture with wet swale areas and upland ridges. Cedar trees (*Juniperus scopulorum*) are common in the ravines. Also common in the more mesic areas are three exotic plants: plumeless thistle (*Carduus acanthoides*), horseweed (*Conyza canadensis*), and yellow sweet clover (*Melilotus officinalis*). However, there are patches of native grassland present on the upland ridges.



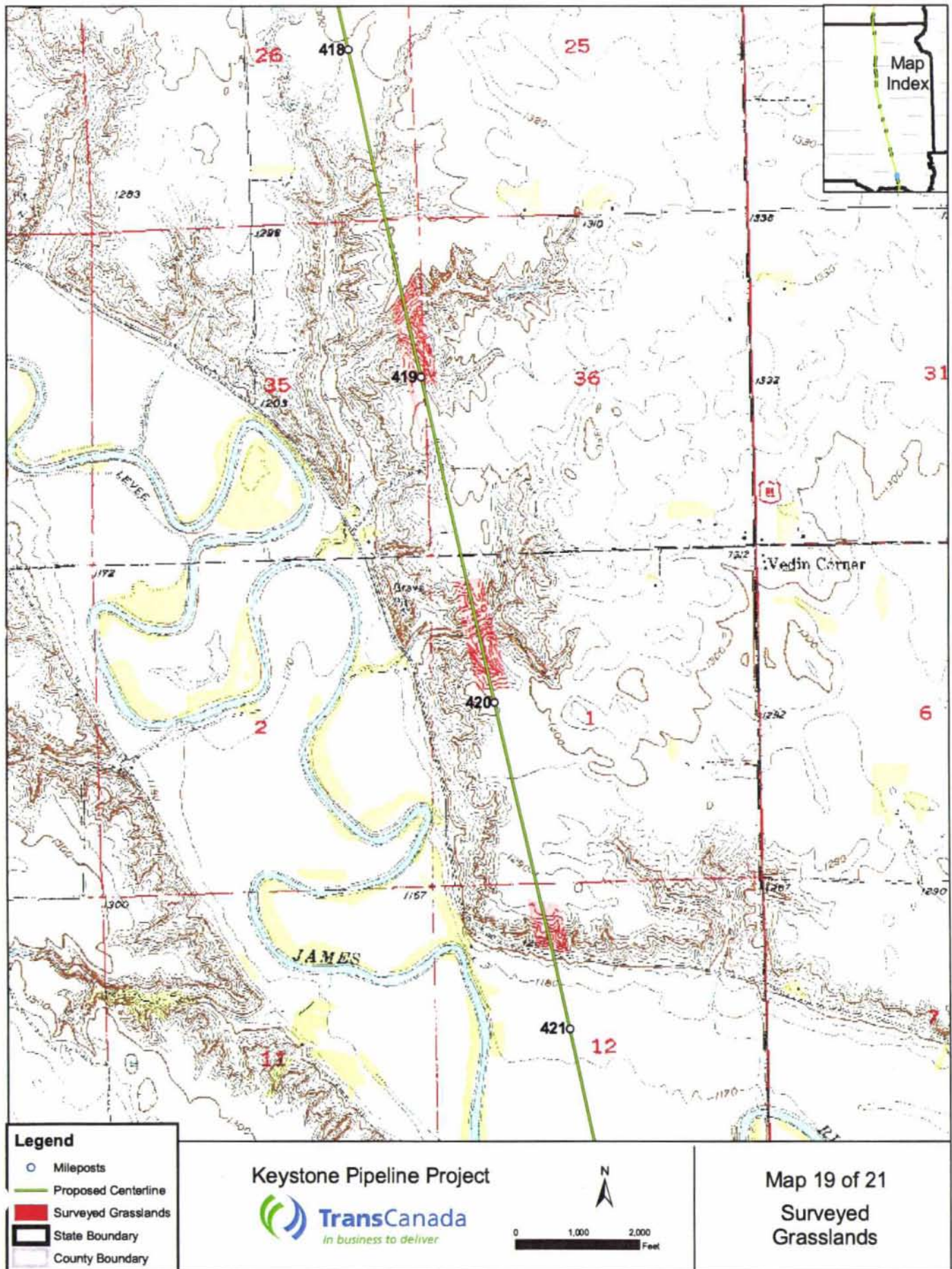
Feature TDH1SDYA006: Overview of site to the north. In the foreground is a plumeless thistle (*Carduus acanthoides*).

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Feature TDH1SDYA006: A smooth brome (*Bromus inermis*) dominated pasture area.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDYA005	9/15/2006	419.6	420	Yankton	SD	Site Visit	High	Yes, Dakota skipper

Site Summary: This site has high quality upland areas with the native black Sampson (*Echinacea angustifolia*), junegrass (*Koeleria micrantha*), blue grass (*Bouteloua gracilis*), prairie dropseed (*Sporobolus heterolepis*), etc. Cedar trees (*Juniperus scopulorum*) are common in the ravines. There are lowland spots with brome grass (*Bromus inermis*) and bindweed (*Convolvulus arvensis*).



Feature TDH1SDYA005: Native grassland ridge with cedar (*Juniperous scopulorum*) in the ravines.

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Feature TDH1SDYA005: Native grassland ridge with cedar (*Juniperous scopulorum*) in the ravines.



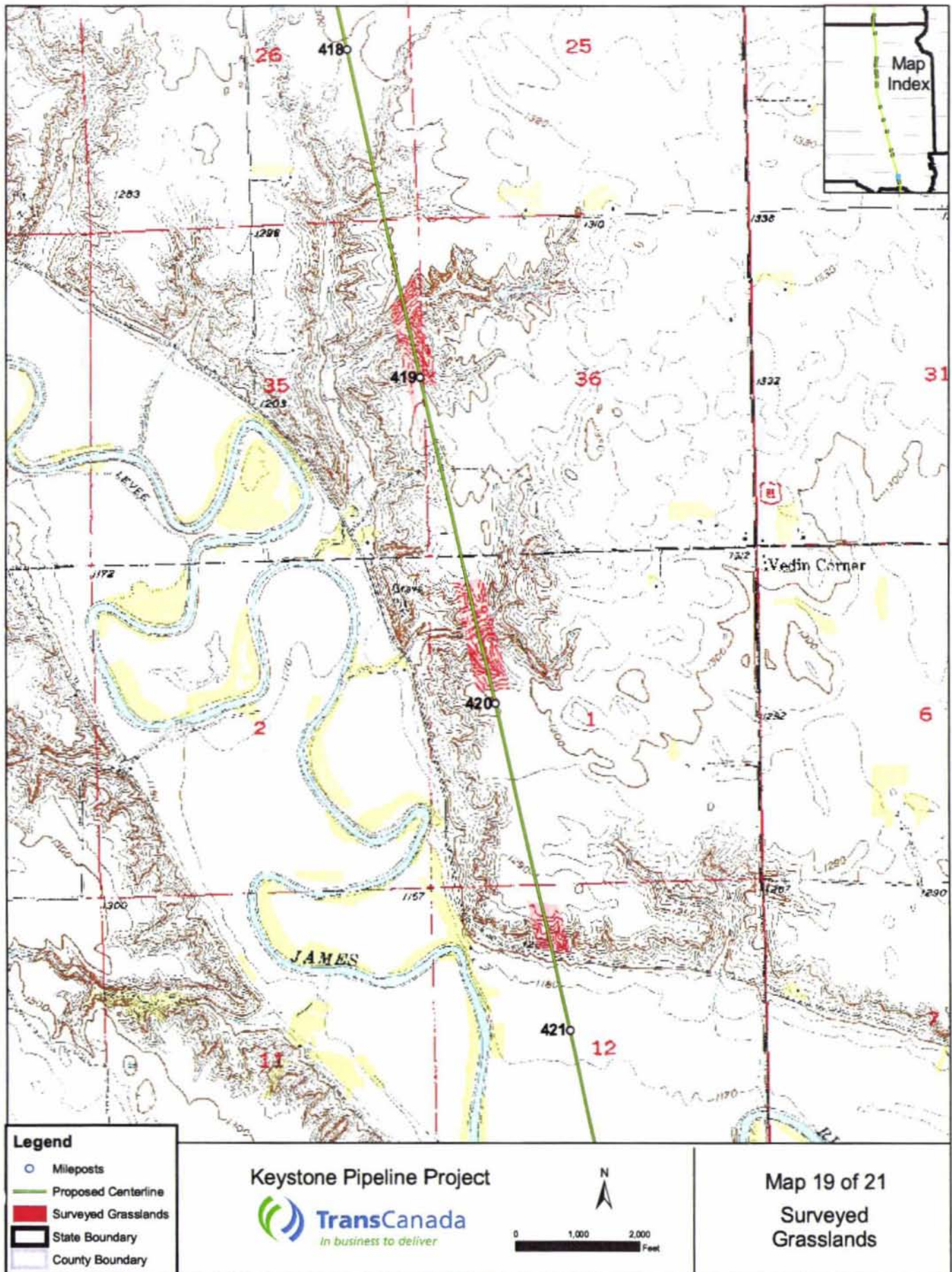
Feature TDH1SDYA005: Cedar (*Juniperous scopulorum*) trees have been cut and left in these ravines

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Feature TDH1SDYA005: This site has the most junegrass (*Koeleria macrantha*) of any site visited.

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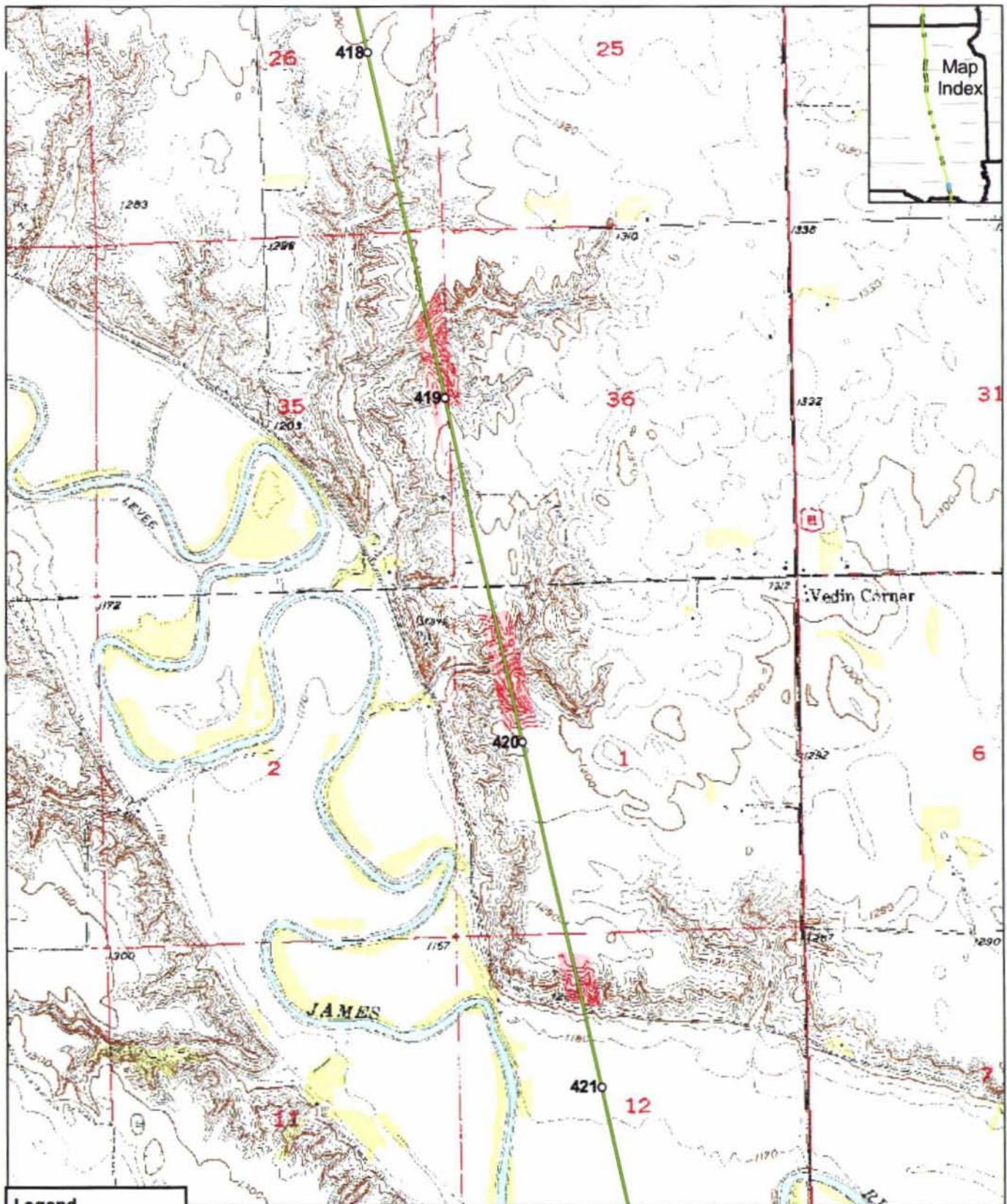
Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDYA004	9/15/2006	420.6	420.8	Yankton	SD	Drive By	High	Yes, Dakota skipper

Site Summary: This is a moderately grazed, high quality grassland site for the Dakota Skipper. It is adjacent to fairly large areas of native grassland. It has unplowed hillsides with a good mix of native plants, including black Sampson (*Echinacea angustifolia*), side-oats grama (*Bouteloua curtipendula*) and blue gram (*Bouteloua gracilis*).



Feature TDH1SDYA004: High quality hillside grassland. View to the north.

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Legend

- Mileposts
- Proposed Centerline
- Surveyed Grasslands
- State Boundary
- County Boundary

Keystone Pipeline Project



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Surveyed
Grasslands

CONFIDENTIAL

Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDYA003	9/15/2006	421.8	422.1	Yankton	SD	Site Visit	High	Yes, Dakota skipper

Site Summary. This grassland is at the Keystone pipeline James River crossing. Although this area has ravines filled with cedar (*Juniperus scopulorum*) and a mix of less common broadleaf trees such as box elder (*Acer negundo*) and hackberry (*Celtis occidentalis*), there are ridges between these wooded ravines that have high quality, well protected native grassland. Grasses on these ravines include prairie dropseed (*Sporobolus heterolepis*), Indian grass (*Sorghastrum nutans*), side-oats grama and blue grama (*Bouteloua gracilis*). Native forbs include black Sampson (*Echinacea angustifolia*), cusp blazing star (*Liatris mucronata*), compass plant (*Silphium laciniatum*), and hoary verbain (*Verbena stricta*). Although this area is moderately grazed and has a few exotic weeds such as burdock (*Arctium minus*), it is quality habitat for the Dakota skipper.



Feature TDH1SDYA003: View to the south of a ridge of native prairie.

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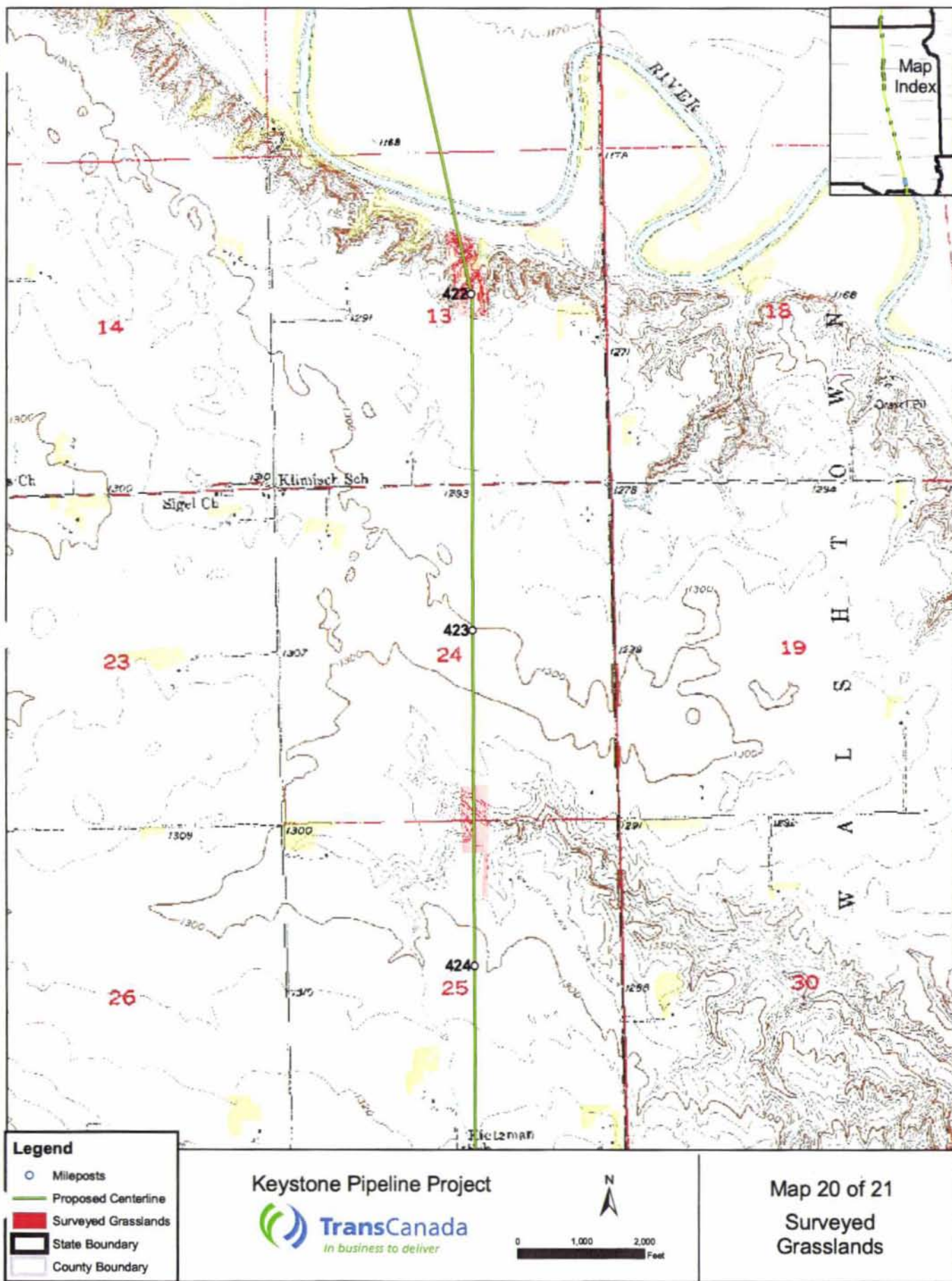


Feature TDH1SDYA003: A ridge of native prairie with trees in the ravines near the James River.



Feature TDH1SDYA003: A close-up of ridge vegetation: black Sampson (*Echinacea angustifolia*) to the right, and a purple cusp blazing star (*Liatris mucronata*) in the center.

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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDYA002	9/15/2006	423.5	423.8	Yankton	SD	Site Visit	Medium	No

Site Summary: The lowland swales are dominated by smooth brome (*Bromus inermis*) with very few native plants. The slopes of these hills have erosion contours due to heavy grazing. The upland area near center line is heavily grazed (few native forbs). The ridges along the construction corridor are dominated by blue grama (*Boutoula gracilis*) with patches of side-oats grama (*Boutoula curtipendula*), and still contain native prairie with few exotic plants. This site would become a higher quality prairie if the grazing intensity were lowered. Due to the absence of native forbs (heavy grazing), it is currently not a high quality site.



Feature TDH1SDYA002: Heavily trampled water tank at center line, along the ridge.

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Feature TDH1SDYA002: Heavily grazed pasture with few forbs, which is dominated by blue grama (*Bouteloua gracilis*).



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Feature ID	Survey Date	Start MP	End MP	County	State	Survey Type	Habitat Quality	Suitable T&E Habitat?
TDH1SDYA001	9/14/2006	426.7	428.9	Yankton	SD	Site Visit	Low	No

Site Summary: This area is very heavily infested with plumeless thistle (*Carduus acanthoides*), especially in the lowland swale areas. The slopes and uplands are dominated by a mix of exotic pasture grasses, especially by smooth brome (*Bromus inermis*) and crested wheat grass (*Agropyron cristatum*). Native grasses and forbs occur in only a few areas.



Feature TDH1SDYA001: Smooth brome (*Bromus inermis*) dominated pasture.

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Feature TDH1SDYA001: Overview of site to the south.



Feature TDH1SDYA001: Plumeless thistle (*Carduus acanthoides*) is abundant in the swales.

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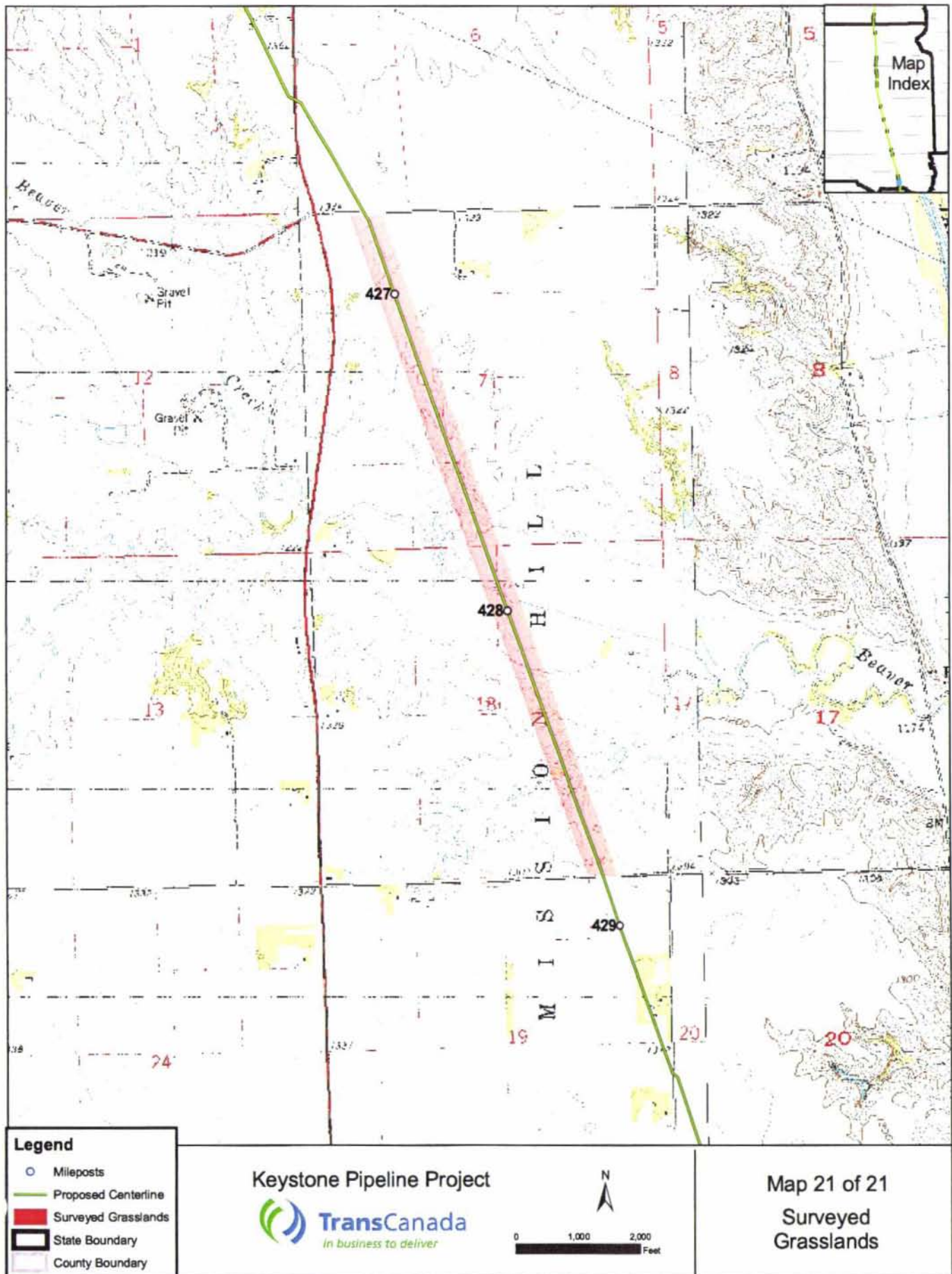


Feature TDH1SDYA001: View of a stock pond to the east of center line



Feature TDH1SDYA001: Smooth brome (*Bromus inermis*) at the southern edge of this site.

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Appendix II

Plant Species List

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Plant species identified in the three southernmost counties in North Dakota (Ransom, Sargent, and Dickey) and in all South Dakota counties between September 11 and September 16, 2006. These are species that occur along the Keystone pipeline corridor. This list could easily be expanded if these areas were visited in the spring or early summer. Plants with an asterisk (*) are not native to this region.

SCIENTIFIC NAME

COMMON NAME

FERNS AND FERN ALLIES

Equisetaceae / Horsetail family

Equisetum laevigatum A. Braun

smooth scouring rush, horsetail

GYMNOSPERMS

Cupressaceae / Juniper or Cedar family

Juniperus scopulorum Sarg.

Sabina, Rocky Mtn juniper, cedar

ANGIOSPERMS: Monocotyledons and Dicotyledons

Aceraceae / Maple family

Acer negundo L.

box elder

Amaranthaceae / Pigweed family

Amaranthus albus L.

**Amaranthus blitoides* Watson

**Amaranthus retroflexus* L.

tumble pigweed
prostrate pigweed
redroot pigweed

Anacardiaceae / Poison Ivy or Mango family

Rhus glabra L.

smooth sumac

Apocynaceae / Dogbane family

Apocynum cannabinum L.

Indian hemp, dogbane

Asclepiadaceae / Milkweed family

Asclepias speciosa Torrey

Asclepias stenophylla A. Gray

showy milkweed
whorled milkweed

Asteraceae / Sunflower family

Achillea millefolium L.

Ambrosia psilostachya DC.

**Ambrosia trifida* L. H-12099

Antennaria parvifolia Nutt.

**Arctium minus* (J. Hill) Bernhardt

**Artemisia absinthium* L.

Artemisia dracunculus (L.) Poljakov

Artemisia frigida Torr.

Artemisia ludoviciana Nutt.

Aster cf. falcatus Lindl.

Aster cf. sericeus Vent

Bidens cernua L.

Brickellia eupatorioides (L.)

Carduus acanthoides* L. **Noxious

Carduus nutans* L. **Noxious

Cirsium arvensis* (L.) Scop. **Noxious

Cirsium undulatum (Nutt.) Sprengel

Conyza canadensis (L.) Cronquist

Coreopsis tinctoria Nutt.

Crepis spp.

yarrow, milenrama
western ragweed
giant ragweed
pussytoes
burdock
wormwood
wild tarragon
fringed sage
white sage, LA sage
frost flower
silky aster
nodding begger-ticks
large-flower brickell-bush
plumeless thistle
musk thistle
Canadian thistle
wavy-leaf thistle
horseweed
plains coreopsis
hawksbeard

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Asteraceae / Sunflower family (continued)

Echinacea angustifolia De Candolle
Euthamia graminifolia (L.) Nutt.
Grindelia squarrosa (Pursh) Dun.
Helianthus annuus L.
Helianthus maximiliani Schrad.
Helianthus petiolaris Nutt.
Heterotheca villosa (Pursh) Shinnars
Iva xanthifolia Nutt.
Lactuca spp.
Liatris ligulistylis (A. Nelson) K. Schum,
Liatris mucronata DC.
Liatris punctata Hook.
Lygodesmia juncea (Pursh) Greene
Ratibida columnifera (Nuttall) Wooton & Standley
Silphium laciniatum L.
Solidago canadensis L.
Solidago missouriensis Nuttall
Solidago spp.
Taraxacum officinale Weber
Tragopogon dubius Scop
Vernonia spp.
**Xanthium strumarium* Nutt.

Echinacea, black sampson
Euthamia
Curly-top gumweed, rosinweed
common sunflower
Maximilian sunflower
plains sunflower
golden aster
marsh elder
Blue lettuce
blazing star
cusp blazing star
blazing star, gayfeather
skeletonweed, goldenweed
prairie coneflower, Mexican hat
Compass plant
Canada goldenrod
Missouri goldenrod
goldenrod
dandelion
goat's beard, yellow salsify
ironweed
Cocklebur, porcupine eggs

Boraginaceae / Four-o'clock family

Onosmodium molle Michaux.

Marbleseed, stoneseed,

Cactaceae / cactus family

Coryphantha vivipara (Nutt.) Britt. & Rose

pincushion cactus

Cannabaceae / Hemp Family

**Cannabis sativa* L.

hemp, marijuana

Caprifoliaceae / Honeysuckle family

Sambucus canadensis L.
Symphoricarpos occidentalis Hook.

common elderberry
snowberry

Chenopodiaceae / Goosefoot family

**Chenopodium album* L.
Chenopodium glaucum L.
Chenopodium leptophyllum (Moq.)
Nutt. ex. S. Wats
**Kochia scoparia* (L.) Schrad.
**Salsola tragus* L.
[S. australis, S. iberica & S. kali]

lamb's quarters, goosefoot
oak-leaved goosefoot
prairie goosefoot

kochia, alkaliweed, fireweed
Russian thistle, tumbleweed

Convolvulaceae / Morning glory family

**Convolvulus arvensis* L.

bindweed

Cyperaceae / Sedge family

Carex spp.
Schoenoplectus pungens (M. Vahl) Palla
Schoenoplectus validus

Several sedges
common threesquare bulrush
softstem bulrush

Elaeagnaceae / Olive family

**Elaeagnus angustifolia* L.

Russian olive

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Euphorbiaceae / Spurge family

Agaloma marginata (Pursh) Love & Love
Chamaesyce spp.
Euphorbia esula L. **NOXIOUS**
Poinsettia dentata (Michaux) Klotsch & Gracke

snow-on-the-mountain
 spurges (several species)
 leafy spurge
 toothed spurge

Fabaceae / Legume Family

Amorpha canescens Pursh
Desmanthus illinoensis (Michx.) MacM.
Glycyrrhiza lepidota Pursh.
Lotus cf. purshianus Clem & Clem
 **Medicago lupulina* L.
 **Medicago sativa* L.
 **Melilotus albus* Medikus
 **Melilotus officinalis* (L.) Lam.
Pedimelum argophyllum (Pursh) J. W. Grimes
 **Trifolium pratense* L.
 **Trifolium repens* L.

leadplant
 Illinois bundleflower
 wild licorice
 prairie trefoil, deer vetch
 black medic, hop clover
 alfalfa
 white sweet clover
 yellow sweet clover
 silver scurf-pea
 red clover
 white clover, Dutch or Ladino clover

Juncaceae / Rush family

Juncus arcticus Willd. var. *balticus*
 (Willd.) Trautv. [J. *balticus*]
Juncus nodosus L.
Juncus spp.

Baltic rush
 knotted rush
 Rush

Juncaginaceae / Arrowgrass family

Triglochin cf. martima L. **POISONOUS**

Arrowgrass (in fringed orchid habitat)

Lamiaceae / Mint Family

Lycopus americanus Muhlenberg ex W. Barton
 **Nepeta cataria*

American bugleweed
 catnip

Lemnaceae / Duckweed family

Lemna minor L.

duckweed

Malvaceae / Mallow family

**Abutilon theophrasti* Medic
 **Hibiscus trionum* L.
 **Malva neglecta* L.
Sphaeralcea coccinea (Nutt.) Rydb.

velvet leaf
 Flower-of-an-hour
 Cheeseweed
 scarlet globemallow, cowboy's delight

Moraceae / Mulberry family

**Morus alba* L.

white mulberry

Nyctaginaceae / Four-O'clock Family

Mirabilis hirsuta (Pursh) MacMill.
Mirabilis spp.

hairy four o'clock
 four o'clock

Onagraceae / Evening Primrose Family

Gaura villosa Torrey

hairy gaura

Orchidaceae / Orchid Family

Spiranthes magnicamphorum Sheviak

Great Plains Lady's tresses

Plantaginaceae / Plantain Family

Plantago lanceolata L.

English plantain

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Poaceae / Grass Family

- **Agropyron cristatum* (L.) Gaertn. var. *cristatum*
- **Agropyron elongatum* (Host.) Beauv.
- **Agropyron intermedium* (Host) Beauv.
- Agrostis stolonifera* L.
- Andropogon gerardii* Vitman
- Andropogon hallii* Hackel.
- Aristida purpurea* Nutt.
- Bouteloua curtipendula* (Michx.) Torr.
- Bouteloua gracilis* (Willd. ex Kunth)
Lag. ex Griffiths [Chondrosum]
- Bouteloua hirsuta* Lag. [Chondrosum]
- **Bromus inermis* Leyss. [Bromopsis]
- **Bromus cf japonicus* Thub. ex Murr.
[*B. commutatus*]
- **Bromus tectorum* L. [*Anisantha*]
- Cenchrus longispinus*
(Hackel in Kneucker) Fernald
- Dichanthelium* spp.
- Distichlis spicata* (L.) Greene
- **Echinochloa crus-galli* (L.) Beauv.
- Hordeum jubatum* L. [Critesion]
- Koeleria macrantha* (Ledeb.) Schult.
- Panicum capillare* L.
- Panicum virgatum* L.
- Pascopyron smithii* (Rydb.) A. Love [*Agropyron*]
- Phalaris arundinacea* L.
- Phragmites australis* (Cav.) Trin ex Steud.
- **Poa pratensis* L.
- Poa* spp.
- Puccinellia nuttalliana* (Schult.) A. Hitchc.
- Schizachyrium scoparium* (Michx.)
Nash var. *scoparium*
- **Setaria glauca* (L.) P. Beauvois
- **Setaria viridis* (L.) P. Beauv.
- Sorghastrum nutans* (L.) Nash
- Spartina pectinata* Link.
- Sporobolus cryptandrus* Torr. A. Gray
- Sporobolus heterolepis* (A. Gray) A. Gray
- Stipa comata* Trin. & Rupr. [*Hesperostipa*]
- crested wheatgrass
- tall wheatgrass [*Elymus*]
- intermediate wheatgrass [*Elymus*]
- red top
- big bluestem
- Hall's bluestem
- purple three-awn, noeatum
- sideoats grama
- blue grama
- hairy grama
- Smooth brome
- Japanese brome
- downy brome, cheatgrass
- longspine sandbur
- rosette grass
- saltgrass
- barnyard grass
- foxtail barley
- Junegrass
- witch-grass, tickle-grass
- Switch-grass
- western wheatgrass
- reed canary grass
- Common reed
- Kentucky bluegrass
- Native Poa
- Alkali grass
- little bluestem
- yellow bristlegrass, foxtail
- green bristlegrass, foxtail
- Indian grass
- prairie cordgrass
- sand dropseed
- prairie dropseed
- needle-and-thread

Polygalaceae / Milkwort Family

- Polygala alba* Nutt.
- white milkwort

Polygonaceae /buckwheat family

- **Polygonum aviculare* L.
- Polygonum lapathifolium* L. (Persicaria)
- Polygonum* spp.
- **Rumex crispus* L.
- Rumex* spp.
- knotweed
- pale smartweed
- Smartweed (several species)
- curly dock
- Dock (several species)

Portulacaceae / Purslane Family

- **Portulaca oleracea* L.
- purslane

Ranunculaceae / Buttercup Family

- Anemone canadensis* L.
- Pulsatilla patens* (L.) P. Miller
- meadow anemone
- pasque flower

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Rosaceae / Rose Family

Prunus virginiana L. Sargent [Padus]
Rosa cf woodsii Lindl
Potentilla spp.

chokecherry
wild prairie rose
Cinquefoil

Salicaceae / Willow Family

Populus deltoides H. Marshall
Salix amygdaloides Andress.
Salix exigua Nuttall

Plains cottonwood
Peachleaf willow
sandbar willow

Scrophulariaceae / Figwort Family

Agalinis tenuifolia (Vahl) Raf.

Gerardia

Solanaceae / Nightshade Family

Physalis longifolia Nutt.
Physalis pykanthum Dun. Ex DC.
Solanum rostratum Dun.
Solanum triflorum Nutt.

common ground cherry
black nightshade **POISONOUS**
buffalo bur
cut-leaf nightshade

Typhaceae / Cattail Family

Typha angustifolia L.

narrowleaf cattail

Ulmaceae / Elm Family

Celtis occidentalis L.
Ulmus americana L.
**Ulmus pumila* L.

netleaf hackberry
American elm
Siberian elm

Verbenaceae / Vervain Family

Verbena stricta Vent.

Hoary vervain

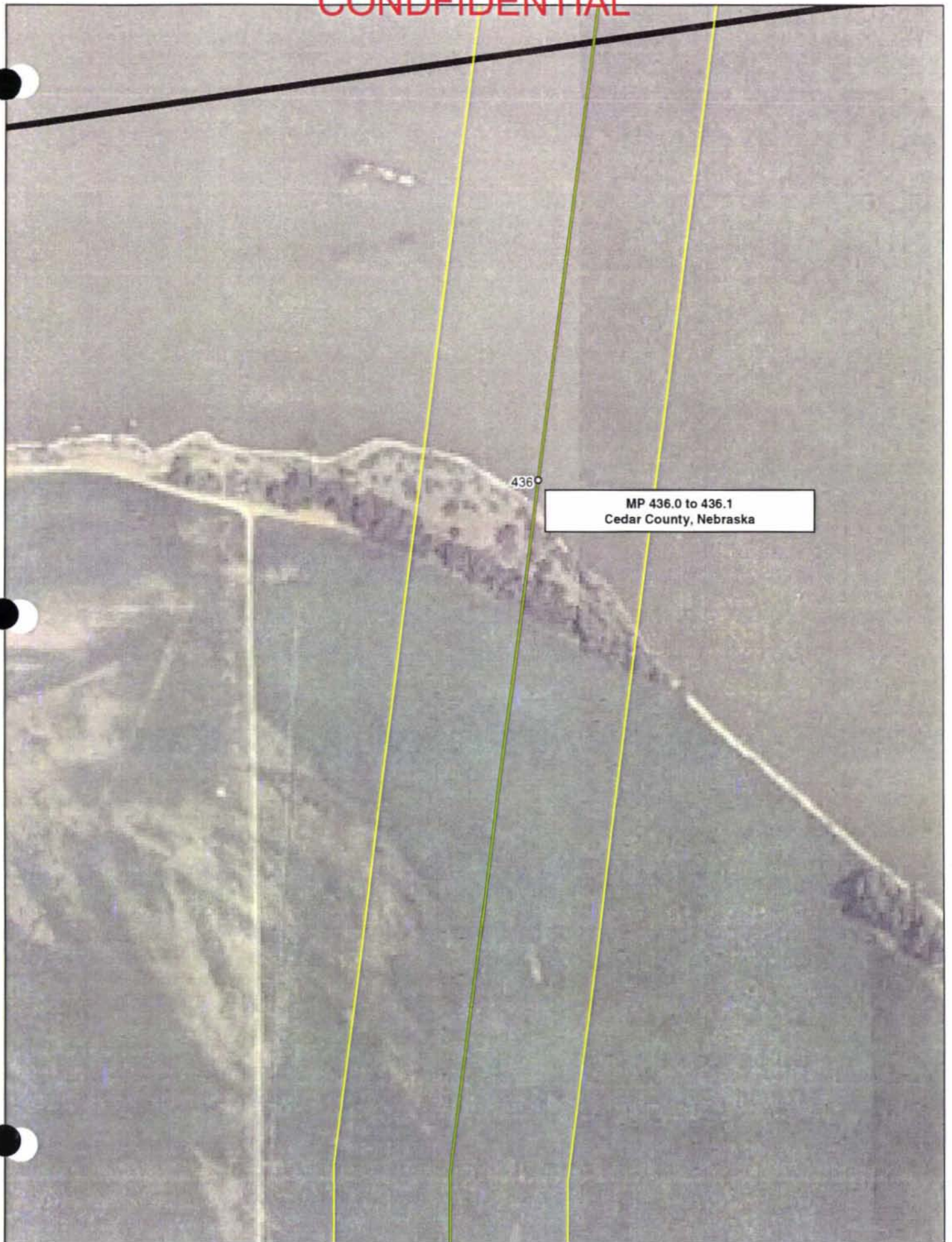
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Appendix III

Aerial Photographs of Additional Grassland Survey Areas in Nebraska

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436

MP 436.0 to 436.1
Cedar County, Nebraska

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MP 436.0 to 436.1
Cedar County, Nebraska



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5410

MP 540.9 to 541.2
Colfax County, Nebraska

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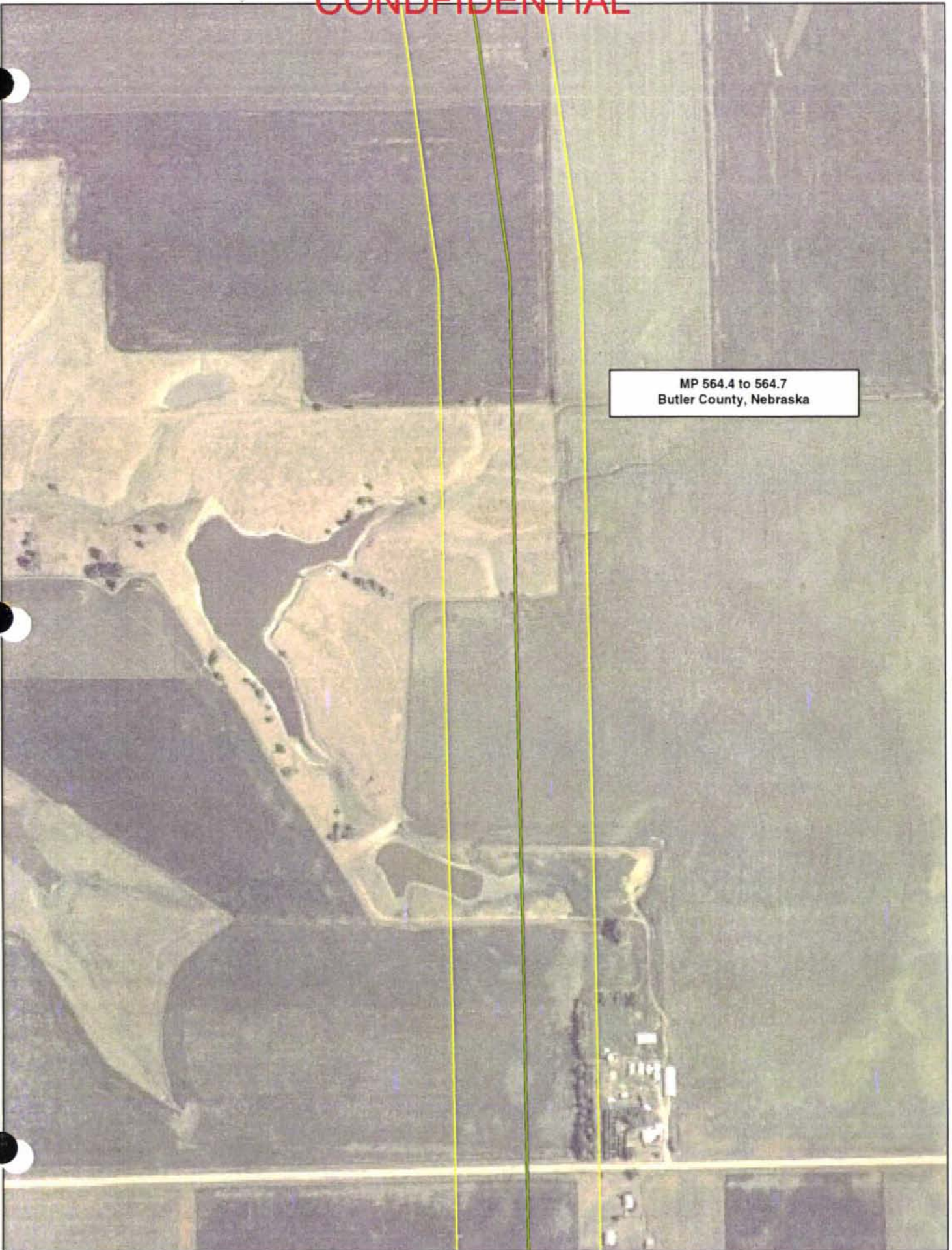
5480

MP 548.1 to 548.2
Butler County, Nebraska



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MP 564.4 to 564.7
Butler County, Nebraska



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606.4 to 606.5
Saline County, Nebraska



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MP 594.8 to 595.1
Saline County, Nebraska

595



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622

MP 622.2 to 622.4
Jefferson County, Nebraska



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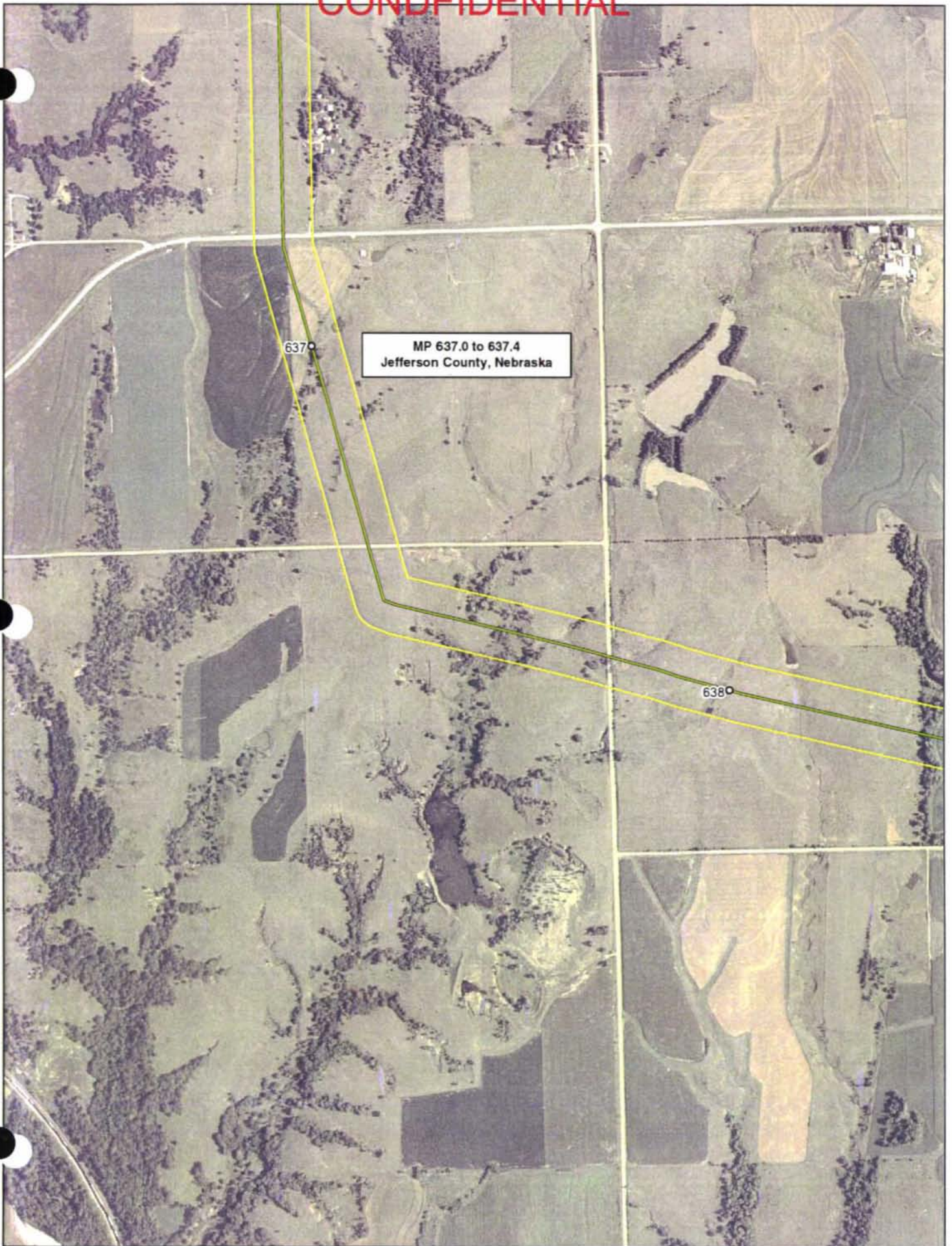
635

MP 635.1 to 636.8
Jefferson County, Nebraska

636



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637

MP 637.0 to 637.4
Jefferson County, Nebraska

638

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Prepared for:
Keystone Pipeline Project



Keystone Pipeline Project Progress Report for Wetland Surveys October 2006

ENSR Corporation
October 2006
Document No.: 10623-004

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Executive Summary

Wetlands, waterbodies (including rivers, streams, lakes, and ponds), and riparian areas have been identified along the proposed Keystone Pipeline Project right-of-way (ROW) through ongoing field surveys and the review of aerial photographs for areas where reroutes have been developed. The purpose of this report is to review the methodologies being used to collect wetland and waterbody data, summarize the data that were collected for wetlands during the summer 2006 field effort, provide an update of ongoing (fall 2006) wetland surveys and discuss projected wetland survey needs for 2007.

1.0 Introduction

As part of federal regulatory requirements under the Clean Water Act, wetland and other waters of the U.S. (WUS) field surveys were completed to assist in estimating project surface disturbance. Information gathered during the inventories will be used to complete notification and permitting requirements under Section 401 and 404 of the Clean Water Act, as managed by the U.S. Army Corps of Engineers (USACE) and applicable state agencies. The Keystone Pipeline Project crosses four USACE districts including the Omaha, Kansas City, St. Louis, and Tulsa districts. Each of these districts has slightly different surveying and permitting requirements. Meetings were held in 2006 with the Omaha (February 6, March 29), Tulsa (March 13), Kansas City (March 27), and St. Louis Districts (February 17, May 24, and July 14), to discuss surveying, permitting, and construction requirements.

Consultation with the various USACE Districts resulted in the following general survey requirements:

- Omaha District (North Dakota, South Dakota, Nebraska): Field surveys along the Keystone Mainline ROW route will be conducted only at specific locations (larger wetland complexes, larger stream systems). Information will be provided to the USACE on other crossings, such as ephemeral streams, using remote sensing (aerial photography).
- Kansas City District (Kansas and the majority of Missouri): The Keystone Mainline ROW through Kansas and Missouri parallels an existing pipeline ROW and the proposed Rockies Express Pipeline ROW. Field data obtained from the Rockies Express Pipeline Project surveys has been used to identify wetlands and other WUS crossed by the Keystone Pipeline Project in these states. All wetland and drainage crossings along the Cushing Extension in Kansas will require ground surveys.
- St. Louis District (eastern Missouri and Illinois): All wetland and drainage crossings along the Mainline Route in eastern Missouri and in Illinois will require ground surveys.
- Tulsa District (Oklahoma): All wetland and drainage crossings along the Cushing Extension in Oklahoma will require ground surveys.

More specific information regarding discussions with the USACE districts' personnel, level of effort, wetland and other WUS delineation methodology and permitting requirements has been provided in a submittal to the Department of State (September 16, 2006). In partial fulfillment of USACE requirements, field surveys commenced in the summer of 2006 and will be completed by summer 2007. The remainder of this report provides a summary of data collection efforts for wetlands through October 2006 and discusses projected wetland survey needs for the spring/summer of 2007.

2.0 Data Collection Methods for Wetlands and other WUS

To initiate this project, ENSR completed a review of U.S. Geological Survey (USGS) topographic maps, National Wetland Inventory (NWI) maps, available soil surveys, and 2005 aerial photographs pertaining to the proposed ROW. The objectives of this data review were to identify wetlands and other WUS intercepted by the proposed pipeline route, including intermittent and ephemeral streams, and to identify specific wetlands and other WUS that will require field evaluation to confirm their status. Areas identified for field verification included: 1) NWI-mapped wetlands intercepted by the pipeline route that are not farmed; 2) areas that appear

to meet the wetlands three-parameter criteria (discussed below), but are not mapped on NWI maps; and 3) forested areas where wetland boundaries could not be estimated from aerial photographs. Additional areas to be field verified were included if recommended by the various USACE districts.

ENSR coordinated with USACE representatives regarding features requiring field verification and delineation. Preliminary survey areas were identified on maps of the proposed ROW previously provided by the district offices. For each site surveyed, a decision was made by the field team regarding the presence of wetlands and other WUS. For drainages with no wetland characteristics (e.g., unvegetated channel, defined bed and bank), a Stream Data Form developed by ENSR was completed to evaluate stream crossing characteristics. This form applied to stream crossings whether or not it supported adjunct wetland plant communities. If both wetlands and other WUS were present, a Stream Data Form and a Routine Wetland Determination Form was completed for the survey site.

The methods and techniques used to evaluate and delineate wetlands and other WUS on the maps of the proposed route corresponded to those specified for "routine on-site delineations" in the Corps of Engineers Wetlands Delineation Manual (Manual; USACE 1987). The Manual identifies a "three-parameter" approach used for defining wetlands which requires that all three of the conditions listed below be met under normal circumstances for an area to be defined and delineated as wetland.

1. The prevalent vegetation consists of hydrophytic plants that have the ability to grow in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content and depleted soil oxygen levels.
2. Soils are present and are classified as hydric or possessing characteristics that are associated with reducing soil conditions. Hydric soils are poorly drained and have a seasonal high water table within 6 inches of the surface.
3. The area is inundated either permanently or periodically at mean water depths less than or equal to 6.6 feet or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation (usually 12.5 percent of the growing season) (USACE 1987).

Vegetation, soil, and hydrology data was collected at each sample point within the wetlands and immediately adjacent uplands and was entered onto a standardized wetland delineation field data form. The form also included a field sketch, which illustrated the wetlands and uplands. Wetland/upland boundaries were delineated using a handheld Global Positioning System (GPS) receiver. Photographs showing a representative view of each wetland visited also were taken. In addition to collecting sufficient data for "routine on-site delineations" and channel characteristics data for drainage crossings, wetland survey teams collected sufficient data (e.g., defined bed and bank and connectivity to navigable waters) for the USACE to make jurisdictional determinations for all wetlands and drainage crossings surveyed in the field.

Wetlands and other WUS along the proposed route were delineated in accordance with the direction provided by the USACE – Omaha, Kansas City, St. Louis, and Tulsa districts. The requirements and level of effort to complete wetland other WUS delineations differed within each district. The level of effort completed within each of the respective states has been provided below.

Keystone Mainline

- North Dakota: Key wetlands and other WUS were field delineated; key wetlands and other WUS along a reroute in southeastern North Dakota were identified based on the review of aerial photographs; the delineation of wetlands and other WUS along the reroute will be completed by summer of 2007.
- South Dakota: Key wetlands and other WUS were field delineated; key wetlands and other waters of U.S. along a reroute in northeastern South Dakota were identified based on the review of aerial photographs; the delineation of wetlands and other WUS along the reroute will be completed by summer of 2007.

- Nebraska: Key wetlands and other WUS were field delineated; key wetlands and waters of U.S. along a reroute were identified based on the review of aerial photographs; the delineation of wetlands and other WUS along the reroute will be completed in the fall of 2006.
- Kansas: Delineations were completed for wetlands and other WUS except where survey access was unavailable.
- Missouri: Delineations were completed for wetlands and other WUS crossed by the Keystone Mainline, except where survey access was unavailable.
- Illinois: Delineations were completed for wetlands and other WUS from the Mississippi River to the Patoka Terminal, except where survey access was unavailable.

Cushing Extension

- Nebraska: Preliminary identification of wetlands and other WUS was based on the review of aerial photographs. Delineations of wetlands and other WUS will be initiated and completed in 2007.
- Kansas: Preliminary identification of wetlands and other WUS was based on the review of aerial photographs. Delineations of wetlands and other WUS will be initiated and completed in 2007.
- Oklahoma: Preliminary identification of wetlands and other WUS was based on the review of aerial photographs. Delineations of all wetlands and other WUS will be initiated and completed in 2007.

3.0 Results of Summer 2006 Wetland Surveys

Maps of the proposed route, including USGS topographic maps and high resolution aerial photography overlaid with NWI wetland polygons, were evaluated for wetland crossings. Based on this evaluation, priority wetland survey areas were identified for that portion of the ROW occurring in UTM Zone 14 under Omaha District (USACE) jurisdiction, where the majority of wetlands along the proposed route occur. The boundaries of lower priority areas in UTM Zone 14 were delineated using aerial photo interpretation. The remainder of the ROW outside of the Omaha District requires 100 percent on-the-ground field surveys to evaluate wetlands crossed by the proposed project. Wetland data for the Project thus represents a combination of data collected through delineations in the field recorded with a GPS unit, and data digitized from maps and high-resolution aerial photography overlaid with NWI polygons. A total of 2,472 wetlands have been identified along the Keystone Mainline ROW, which cross 57.4 linear miles of the route. Of these wetland areas, 12.8 miles (22 percent) have been field delineated and the boundaries accurately captured with a GPS receiver, while wetlands that cross 44.6 miles (78 percent) have been delineated using high quality aerial photography where survey access was unavailable or survey protocol allowed this delineation approach as discussed with the USACE.

Palustrine emergent (PEM) wetlands represent 71 percent of the total wetland miles (**Figure 1**). PEM wetlands are dominated by persistent and nonpersistent grasses, rushes, sedges, forbs and other herbaceous and grass-like plants. Open water (OW) represents 16 percent of the total wetland miles crossed by the Project. OW is a broad category that describes lakes, ponds, streams, and rivers, as well as associated vegetation found within their geomorphologic boundaries (i.e., stream banks). Thus, this category represents surface waters found within wetlands or in defined channels, as well as riverine or seasonally flooded wetlands associated with open water. Palustrine forested wetlands (PFO) occur along 9 percent of the wetland miles identified along the route. PFO wetlands are dominated by woody vegetation, generally greater than ten feet in height. The remaining 4 percent of wetlands crossed by the Keystone Mainline are classified a palustrine scrub-shrub (PSS), which are typically dominated by shrubs and other short, woody plants.

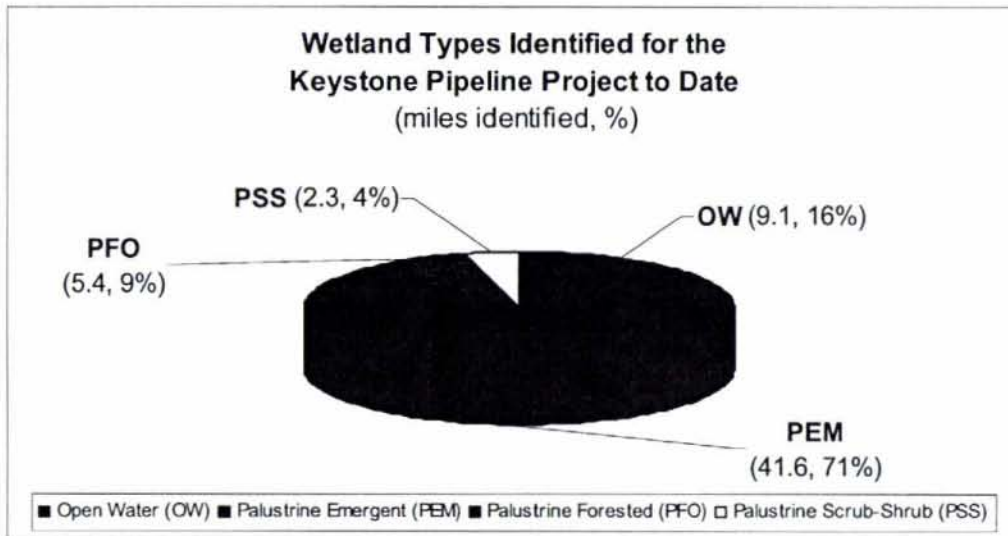


Figure 1 Wetland Types Identified for the Keystone Pipeline Project to Date

Wetland surveys for the Mainline of the Keystone Pipeline Project are approximately 80 to 90 percent complete (**Table 1**). The current wetland survey status by state is provided below.

- North Dakota: Wetland delineations are approximately 79 percent complete. Of 107 total locations requiring survey, 85 have been successfully completed. By the end of the 2006 field season in November approximately 93 percent of wetland surveys should be complete, depending on available access. The Hecla Sandhills area in extreme southern North Dakota will not be surveyed in 2006, thus wetland surveys for North Dakota will resume in the spring/summer of 2007 for this area and those tracts where access is not yet available.
- South Dakota: Wetland delineations are approximately 81 percent complete. Of 52 total locations requiring survey, 42 have been successfully completed. By the end of the 2006 field season in November approximately 90 percent of wetland surveys should be complete, depending on available access. The Hecla Sandhills in northern South Dakota will not be surveyed in 2006, thus wetland surveys for South Dakota will resume in the spring/summer of 2007 for this area and those tracts where access is not available.
- Nebraska: Wetland delineations are approximately 87 percent complete. Of 39 total locations requiring survey, 34 have been successfully completed. By the end of the 2006 field season in November it is projected that 100 percent of wetland surveys should be complete, depending on available access.
- Kansas: Wetland delineations have been completed for all wetlands and other WUS crossed by the Project, excluding land tracts where survey access was not available. Further wetland surveys for such tracts, or for possible re-routes, may be necessary in 2007.
- Missouri: Wetlands and other WUS from the western Missouri border to the eastern boundary of Audrain County have been completed, excluding land tracts where survey access was not available. Wetland delineations from the eastern boundary of Audrain County to the Mississippi River are currently 83 percent complete. Of 101 total miles requiring survey, 76 miles have been completed.
- Illinois: Of the 56 total miles requiring wetland survey from the Mississippi River to the Patoka Terminal, 50 miles have been completed.

Table 1 Wetlands Survey Progress as of October 13, 2006

State	Locations Requiring Pedestrian Survey ^a	Total Locations or Miles (L/M) Surveyed ^a	Percent Complete
North Dakota	107 (L)	85 (L)	79
South Dakota	52 (L)	42 (L)	81
Nebraska	39 (L)	34 (L)	87
Kansas REX	99 REX data (L)	98 (L)	99
Missouri REX	172 REX data (L)	165 (L)	96
Missouri	101 (M)	76 (M)	75
Illinois	56 (M)	50 (M)	89
Total locations	469(L)	424(L)	90
Total miles	157(M)	126(M)	80

NOTE: L indicates locations surveyed or available for survey; M indicates miles surveyed or available for survey.

^a Numbers of wetlands for survey subject to verification.

4.0 Projected Survey Needs (Spring/Summer 2007)

Keystone Mainline

Remaining wetland survey work on the Keystone Mainline includes:

- North Dakota, South Dakota, Kansas, Missouri and Illinois: tracts requiring access and re-routes (if there are any changes from the current alignment). This work will be completed in spring/summer 2007
- North Dakota and South Dakota: Hecla Sandhills (discussed in more detail below). This area will be completed by summer 2007.

Hecla Sandhills

The Hecla Sandhills and their associated vegetation and wetland complexes are currently crossed by the Keystone Mainline ROW from approximate milepost 210 in North Dakota south to approximate milepost 224 in South Dakota. The area consists of stabilized sand dunes that are occupied by native grasslands and extensive small wetlands. Wetland delineation surveys will be completed after the pipeline route has been refined across this area.

Cushing Extension

The Cushing Extension has been evaluated for wetlands and other WUS using aerial photographs and NWI maps, but pedestrian surveys of wetlands and drainage crossings will be necessary:

- Nebraska, Kansas, and Oklahoma: Delineations of wetlands and other WUS will be initiated and completed in the spring/summer of 2007.

References

U.S. Army Corps of Engineers (USACE). 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Available online at: <http://www.wes.army.mil/el/wetlands/pdfs/wlman87.pdf>

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Appendix I

Photographs of Wetland Types Delineated Along the Keystone Mainline

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Appendix II

Mainline Wetlands Identified for the Keystone Pipeline Project

