

# **PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM**

## **Least Tern and Piping Plover Monitoring Protocol Implementation Report for 2006**

**Prepared for:  
Technical Advisory Committee**

**Prepared by:  
Executive Director's Office**

**June 18, 2008**

### **INTRODUCTION**

The Cooperative Agreement's Technical Committee agreed to implement the protocol for "Monitoring Reproductive Success and Reproductive Habitat Parameters of Least Terns and Piping Plovers in the Central Platte River valley" (Tern and Plover Monitoring Protocol) dated May 1, 2002 in 2006 for the purpose of documenting the reproductive efforts of least terns and piping plovers. Existing cooperator staff and equipment was used to conduct the fieldwork. The Executive Director's Office (EDO) was tasked to compile data and write the report. This report summarizes the data collected in the 2006 season.

### **METHODS**

Surveys of the central Platte River were conducted in 2006 to locate active nests and individual birds (Component 1 of the protocol design). Surveys were conducted of all channels wider than 75m that could safely be navigated. Two airboats were used during the survey. Personnel from the Grand Island Field Office, U.S. Fish and Wildlife Service (USFWS) conducted the river survey from Chapman upstream to the Kearney Canal headgates (near Elm Creek) on May 17, 18 and 19. No surveys of this section of river were conducted in June or July due to low water conditions. Nebraska Public Power District (NPPD), Central Nebraska Public Power and Irrigation District (Central), and Central Platte Natural Resources District (CPNRD) personnel conducted the river survey from the Kearney Canal headgates upstream to Lexington on May 18, and June 6. No surveys of this section of river were conducted in July due to low water conditions. The lengths of river surveyed for each of the surveys are in Table 1. The daily average in-stream flows and stage levels for the Overton, Kearney and Grand Island gages during the river surveys are in Table 2 and during the months of May, June and July are in Figures 1-6.

Sandpits and islands constructed for tern and plover reproductive habitat were surveyed either two or three times to locate active nests and individual birds (component 2 of the protocol). NPPD personnel surveyed 5 sandpits and 4 constructed islands from the Lexington bridge to the Odessa bridge. CPNRD personnel surveyed 9 sandpits from the Gibbon bridge to the Chapman bridge. Several pits between the Kearney bridge and the Odessa bridge were not surveyed as they did not meet size or vegetation criteria noted in the monitoring protocol. The Leach-owned pit just east of the Minden (Nebraska Highway 10) bridge was not surveyed and the Bruner-Shelton sandpit was only partially surveyed once because permission to access was not obtained.

With the exception of two sites (see below), nests located during the river survey, or sandpit and constructed island survey were monitored throughout the nesting period. Nests were visited every 3 days until the nest failed or until the nestlings fledged. Nest level habitat characteristics were measured at nests after the birds had left the colony area. Colony level characteristics will be measured in a geographic information system using the most recent spatially referenced color photographs during a future analysis. Access to two pits owned by Broadfoot Sand and Gravel in the Kearney area (Broadfoot Newark and Broadfoot Kearney South) was granted to conduct the three monthly surveys to count adult birds and document nesting, though access was not granted to monitor nests every three days.

The data were entered into the Program's Microsoft Access database. The database contains 11 data tables. Three tables contain information about the river survey, 4 tables document the nest monitoring, 1 table documents the nest habitat, 1 table lists the names and phone numbers for observers cited in the data tables, and 1 table documents all the sandpit and constructed islands considered for the survey. The database also contains 4 data entry forms corresponding to the 4 datasheets. Raw data sheets are housed at the EDO.

## **RESULTS**

### **Survey Results**

River surveys required 3 days to complete in May. Surveys were only conducted for one day in June, from the J-2 return to the Kearney Diversion. There were 0 least tern nests and 0 piping plover nests detected during the river surveys. The most birds detected during one river survey period in 2006 were 16 least tern adults and 10 piping plover adults (Table 3). Counts of birds detected during the river survey were not adjusted to account for the birds assumed to be reproducing at the nearby sandpits. The locations of each river survey observation and the distance to the closest known nesting colony are in Tables 4 and 5.

Fourteen sandpits and four constructed islands were surveyed during both the May and June survey. Thirteen sandpits and four constructed islands were surveyed during the July survey. There were 54 least tern and 22 piping plover nests located on sandpits in 2006. No nests were observed on constructed islands in 2006. The number of adults, nests, chicks and fledglings detected on the site visit nearest to May 15, June 15, and July 15 were summed across the sites surveyed (Table 6). The most birds detected during one of these surveys to sandpits and constructed islands were 110 least tern adults, 34 piping plover adults, 36 least tern fledglings, and 11 piping plover fledglings.

Least tern nests were located at 5, and piping plover nests were located at 6 of the 18 sandpits/constructed islands surveyed (Table 7; Figures 7 and 8). Three of these sites were monitored every three days while nests were active.

There were 54 least tern nests located in 2006; 19 nests at Blue Hole Pit, 4 nests at Broadfoot-Kearney South Pit, 1 nest at Broadfoot-Newark Pit, 10 nests at Johnson Pit, and 20 nests at Lexington Pit (Table 8). Fourteen of the 49 nests monitored successfully fledged at least 1 least tern for a total of 25 least tern fledglings.

There were 22 piping plover nests located in 2006; 6 nests at Blue Hole Pit, 5 nests at Broadfoot-Kearney South Pit, 2 nests at Broadfoot-Newark Pit, 4 nests at Johnson Pit, and 5 nests at Lexington Pit (Table 9). Ten of the 15 nests monitored successfully fledged at least 1 piping plover for a total of 29 piping plover fledglings.

The numbers of piping plover and least tern individuals and nests documented at the Broadfoot-Kearney South Pit and the Broadfoot-Newark Pit represent minimums present.

Surveys to determine exact counts of birds were hindered by the large number of birds present at these sites, the size of the area and the availability of hiding cover for fledglings.

### **Reproductive Parameters**

Reproductive parameters listed in the protocol were estimated with the data collected in 2006. Formulas for reproductive habitat calculations are located in the protocol. The reproductive parameters calculated for this report were based only on the nests monitored in 2006.

#### Total Nests Initiated

The total nests initiated are the number of nests detected during the site surveys. There were 54 least tern and 22 piping plover nest initiations documented in 2006. There were 49 least tern nests and 15 piping plover nests monitored until the nest failed or the fledglings departed the colony (Tables 10 and 11).

#### Nest-based Hatching Success

Nest-based hatching success was estimated to be 0.78 for least terns (38 eggs/49 nests) and 2.47 for piping plovers (37 eggs/15 nests) monitored in 2006. This estimate is calculated as the number of hatched eggs divided by the number of nests initiated. The number of eggs that hatched was estimated as the maximum of number of chicks initially observed or number of chicks 15 days old (fledged by protocol definition).

#### Nesting Loss

Nesting loss was estimated to be 0.61 for least terns (30 nests lost/49 nests) and 0.27 for piping plovers (4 nests lost/15 nests) monitored in 2006. This estimate is calculated as the number of unsuccessful nests divided by the number of nests initiated. A nest is defined as unsuccessful if no eggs hatch.

#### Nesting Success

Nesting success was estimated to be 0.39 for least terns (19 successful nests/49 nests) and 0.73 for piping plovers (11 successful nests/15 nests) monitored in 2006. This estimate is calculated as the number of successful nests divided by the number of nests initiated. A nest is successful if at least one chick is observed initially or one 15 day old chick is observed.

#### Number of Pairs

Number of pairs was estimated to be 33 for least terns and 11 for piping plovers at sites monitored in 2006 for reproductive success (every 3 days). This estimate is calculated as the maximum number of nests and number of broods detected during one survey. An alternative estimate is one-half of the number of adults detected during one survey. Using this method, the number of pairs was estimated to be 36.5 for least terns and 10 for piping plovers for sites monitored in 2006.

#### Nest-based Fledgling Success

Nest-based fledgling success was estimated to be 0.51 for least terns (25 fledglings/49 nests) and 1.93 for piping plovers (29 fledglings/15 nests) monitored in 2006. This estimate is calculated as the number of fledglings divided by the number of nests initiated. The number of

fledglings for each nest was estimated as the maximum of the number of chicks 15 days old or observed flying.

#### Pair-based Fledgling Success

Pair-based fledgling success for 2006 was estimated to be 0.76 for least terns (25 fledglings/33 pair) and 2.64 for piping plovers (29 fledglings/11 pair) using the first estimate of pairs above and 0.68 for least terns (25 fledglings/36.5 pair) and 2.90 for piping plovers (29 fledglings/10 pair) using the second estimate of pairs above. This estimate is calculated as the number of fledglings divided by the number of pairs.

#### Mayfield Daily Survival Rate

Mayfield daily nest survival rate was estimated to be 0.9635 (95% CI: 0.9504, 0.9766) for least terns (1-(30 nests/822 days)) and 0.9845 (95% CI: 0.9691, 0.9999) for piping plovers (1-(4 nests/258 days)) monitored in 2006 (Tables 12 and 13). This estimate is calculated as one minus the quantity: number of nest failures divided by the number of days nests were monitored (exposure days).

#### **Trend Detection**

Trends of reproductive parameters through time were not estimated with the data. As the monitoring data is accumulated throughout the Program's first increment, these analyses will be possible.

#### **Before-After Program Analysis**

A before-after analysis of reproductive parameters was not estimated for this year of monitoring data. As the monitoring data is accumulated throughout the Program's first increment, these analyses will be possible.

#### **Nest-level Habitat Characteristics**

Nest characteristics were visually estimated at 5 of the least tern and 7 piping plover nests located in 2006 (Tables 14 and 15).

#### Distance to Nearest Bank

There were no least tern nests or piping plover nests monitored in the river channel in 2006.

#### Nest Elevation

The nest elevation above the water surface was 1 meter for the 1 least tern nest visually estimated on sandpits and 2.75 meters (95% CI: 2.26, 3.24) over the 2 piping plover nests visually estimated on sandpits.

#### Nest Management

There were no nest enclosures placed on piping plover or least tern nests in 2006.

#### Vegetation Composition

The average vegetation cover visually estimated within the 1 m<sup>2</sup> area over the 5 least tern nests was 0% grass, 4.6% forb, and 0% woody. The average vegetation cover estimated within

the 1 m<sup>2</sup> area over the 7 piping plover nests was 0.86% grass, 0.86% forb, and 0% woody. The average vegetation cover estimated within the 5 m<sup>2</sup> area over the 5 least tern nests was 0% grass, 4.6% forb, and 0% woody. The average vegetation cover estimated within the 5 m<sup>2</sup> area over the 7 piping plover nests was 0.43% grass, 0.43% forb, and 0% woody.

#### Vegetation Density

The average density of stems visually estimated within the 1 m<sup>2</sup> area over the 5 least tern nests was 0 stems of grass per m<sup>2</sup>, 9.0 stems of forb per m<sup>2</sup>, and 0 stems of woody per m<sup>2</sup>. The average density estimated within the 1 m<sup>2</sup> area over the 7 piping plover nests was 0.86 stems of grass per m<sup>2</sup>, 3.00 stems of forb per m<sup>2</sup>, and 0 stems of woody per m<sup>2</sup>. The average density estimated within the 5 m<sup>2</sup> area over the 5 least tern nests was 0 stems of grass per 5 m<sup>2</sup>, 44 stems of forb per 5 m<sup>2</sup>, and 0 stems of woody per 5 m<sup>2</sup>. The average density estimated within the 5 m<sup>2</sup> area over the 7 piping plover nests was 1.57 stems of grass per 5 m<sup>2</sup>, 5 stems of forb per 5 m<sup>2</sup>, and 0 stems of woody per 5 m<sup>2</sup>.

#### Vegetation Height

The average height of stems visually estimated within the 1 m<sup>2</sup> area over the 5 least tern nests was 0.16 meters. The average height estimated within the 1 m<sup>2</sup> area over the 7 piping plover nests was 0.07 meters. The average height estimated within the 5 m<sup>2</sup> area over the 5 least tern nests was 0.16 meters. The average height estimated within the 5 m<sup>2</sup> area over the 7 piping plover nests was 0.07 meters.

#### **Colony-level Habitat Characteristics**

Nesting colony characteristics were measured at the 5 pits with active nests in 2006 (Table 16).

#### Colony management

Three of the pits with active least tern or piping plover nests (Johnson pit, Lexington pit and Blue Hole pit) were managed for nesting activities through the use of electric predator fences, predator trapping by USDA from late May to August and pre-emergent herbicide application in March. The two other pits received no management for nesting activities.

#### Adjacent Land Use

Two of the five pits with active least tern or piping plover nests were adjacent to active sandpits in 2006. Other land uses adjacent to these pits included residential, commercial development, river, grassland, and riparian woodland.

#### Bare Sand Area

This colony habitat characteristic was not estimated for any colonies in 2006.

#### Pond Size

Pond size will be calculated with the most recent photos during a GIS analysis of the data.

#### Distance from Colony to River

Distance from the colony to the river will be calculated with the most recent photos during a GIS analysis of the data.

#### Sandbar/Island Height

There were no least tern nests or piping plover nests monitored in the river channel in 2006.

#### Channel Width

There were no least tern nests or piping plover nests monitored in the river channel in 2006.

### **INCIDENTAL OBSERVATIONS**

There were no incidental observations of least terns or piping plovers reported in the study area for 2006.

**TABLES**

Table 1. Length of river surveyed in 2006 based on river miles.

Survey	From	To	River Miles
May 2006	Chapman	Kearney Diversion	87
May 2006	Kearney Diversion	J2 Return	16.6
May Total			103.6
June 2006	Kearney Diversion	J2 Return	16.6
July 2006			0
Total			120.2

Table 2. Daily average discharge (cfs) and stage (feet) at Overton, Nebraska (USGS Gage No. 06768000), Kearney, Nebraska (USGS Gage No. 06770200) and Grand Island, Nebraska (USGS Gage No. 06770500) during river survey dates.

Date	Overton		Kearney		Grand Island	
	Discharge	Stage	Discharge	Stage	Discharge	Stage
5/17/2006	114	1.98	19	1.57	125	2.77
5/18/2006	113	1.98	18	1.57	114	2.74
5/19/2006	116	1.99	18	1.56	104	2.71
6/9/2006	69	1.79	4.6	1.37	15	2.41

Table 3. The number of adults, nests, chicks, and fledgling least terns and piping plovers observed during each monthly airboat survey of the river, 2001-2006.

Survey	Least Tern				Piping Plover			
	# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
May 2006	16	0	0	0	10	0	0	0
June 2006	3	0	0	0	2	0	0	0
May 2005	18	0	0	0	1	0	0	0
June 2005	27	0	0	0	10	0	0	0
July 2005	3	0	0	0	0	0	0	2
May 2004	26	0	0	0	5	0	0	0
June 2004	6	0	0	0	3	0	0	0
May 2003	28	0	0	0	10	0	0	0
June 2003	17	0	0	0	9	0	0	0
May 2002	4	0	0	0	0	0	0	0
June 2002	18	0	0	0	1	0	0	0
July 2002	31	0	0	7	5	0	0	5
May 2001	16	0	0	0	2	0	0	0
June 2001	23	0	0	0	5	0	0	0
July 2001	16	0	0	5	17	0	0	12



Table 4. Locations of least terns observed during the river survey. The distance to nearest constructed island or sandpit with nesting least terns was estimated as the straight-line distance using the location reported for each site.

Date	UTM x	UTM y	# Adults	# Juveniles	Activity	Distance to Closest Known Nesting Area (miles)
5/17/2006	470474	4504108	2	0		1.08
5/17/2006	471560	4503770	2	0	Foraging	1.76
5/17/2006	472153	4503674	1	0	Flying	2.13
5/17/2006	479339	4501401	2	0	Foraging	6.51
5/18/2006	461736	4503894	2	0	Flying	4.35
5/18/2006	468747	4503732	2	0	Foraging	0.19
5/18/2006	517357	4505386	2	0	Loafing	8.30
5/18/2006	519206	4506172	2	0	Foraging	9.51
5/19/2006	571568	4537009	1	0	Foraging	46.80
6/9/2006	468747	4503732	3	0	Flying	0.19

Table 5. Locations of piping plovers observed during the river survey. The distance to nearest constructed island or sandpit with nesting piping plovers was estimated as the straight-line distance using the location reported for each site.

Date	UTM x	UTM y	# Adults	# Juveniles	Activity	Distance to Closest Known Nesting Area (miles)
5/17/2006	471188	4503854	1	0		1.53
5/17/2006	479343	4501395	2	0	Foraging	6.51
5/17/2006	505847	4501279	1	0	Foraging	1.73
5/17/2006	506406	4501526	1	0	Foraging	1.86
5/17/2006	506620	4501761	1	0	Foraging	1.87
5/17/2006	508248	4501804	1	0	Foraging	2.76
5/18/2006	516995	4505165	1	0	Foraging	8.06
5/18/2006	520265	4506681	1	0		10.22
5/18/2006	521488	4507234	1	0	Foraging	11.03
6/9/2006	468747	4503732	2	0	Foraging	0.19

Table 6. The number of adults, nests, chicks, and fledgling least terns and piping plovers observed during each monthly survey at sand pits and constructed islands, 2001-2006.

Survey	# Sites	Least Tern				Piping Plover			
		# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
May 2006	18	45	0	0	0	31	15	0	0
June 2006	18	110	35	0	0	34	3	17	11
July 2006	17	87	13	2	36	5	1	0	9
May 2005	19	30	0	0	0	36	14	0	0
June 2005	19	125	40	10	0	35	3	22	9
July 2005	15	136	21	8	20	19	2	7	7
May 2004	20	21	0	0	0	21	12	0	0
June 2004	19	111	39	8	0	35	5	15	2
July 2004	13	86	7	20	41	16	0	4	5
May 2003	20	40	0	0	0	22	10	0	0
June 2003	20	87	46	0	0	23	6	23	0
July 2003	17	79	15	16	33	9	1	0	6
May 2002	22	3	0	0	0	18	4	0	0
June 2002	22	90	41	3	0	34	7	22	2
July 2002	22	82	9	22	29	16	0	0	5
May 2001	23	6	0	0	0	11	3	0	0
June 2001	23	27	14	0	0	15	1	20	0
July 2001	23	21	0	15	14	2	1	0	1

Table 7. Sandpits and constructed islands monitored for least tern and piping plover reproduction in 2006. Number of adults, pairs, and nests is the maximum observed on one day for all the surveys at the site.

Site	Site type	# Surveys	UTM x	UTM y	Least Tern			Piping Plover			Site management
					# adults	# pairs	# nests	# adults	# pairs	# nests	
Johnson Pit	sandpit	39	468881	4502069	12	6	6	6	3	3	Permanent predator fence, trapping, pre-emergent herbicide
Blue Hole	sandpit	35	468736	4504032	34	16	14	8	5	4	Portable predator fence, predator removal, pre-emergent herbicide
Lexington Pit	sandpit	33	438763	4509268	27	12	12	6	3	3	Permanent predator fence, trapping, pre-emergent herbicide
Cottonwood Ranch	constructed island	9	460254	4503961	4	0	0	0	0	0	
Elm Creek Island	constructed island	9	469434	4503790	0	0	0	2	0	0	
Paulsen's Lexington Pit	sandpit	8	434039	5409125	0	0	0	2	1	1	
Lexington Island	constructed island	8	438770	4508453	0	0	0	0	0	0	
Lilley-Wood River	sandpit	3	536428	4509875	0	0	0	0	0	0	
Deweese-Alda	sandpit	3	548759	4521648	0	0	0	0	0	0	
Island Landhandlers- GI	sandpit	3	552343	4524639	0	0	0	0	0	0	
Hooker Bros -GI South	sandpit	3	555613	4525340	0	0	0	0	0	0	
Hooker Bros - GI West	sandpit	3	551433	4526439	0	0	0	1	0	0	
Broadfoot-Kearney South	sandpit	3	492659	4501284	37	5	5	12	4	4	
Mid-Nebraska Aggregate-Minden	sandpit	3	507012	4503037	0	0	0	0	0	0	
Broadfoot-Newark	sandpit	3	504135	4503466	6	1	1	4	2	2	
Overton Island	constructed island	3	452604	4503365	0	0	0	0	0	0	
Central Sand &Gravel -GI	sandpit	3	555873	4527165	0	0	0	0	0	0	
OSG Overton Pit	sandpit	2	454962	4503998	2	0	0	0	0	0	

Table 8. Least tern nests located in the Cooperative Agreement study area in 2006. Nests at all sites except the Broadfoot-Kearney S. and Broadfoot-Newark sites were monitored every three days.

Site	Nest #	First Date Observed	# Eggs	Date Hatched	# Chicks Initially Observed	# Chicks Fledged	Date Fledged	Final Status	Nest Management
Blue Hole	5	5/26/2006		6/15/2006	2	2	7/3/2006	Fledged	
Blue Hole	6	5/26/2006		6/15/2006	2	2	7/3/2006	Fledged	
Blue Hole	8	5/31/2006		6/20/2006	2	2	7/3/2006	Fledged	
Blue Hole	9	5/31/2006		6/23/2006	3	3	7/11/2006	Fledged	
Blue Hole	10	5/31/2006		6/20/2006	3	3	7/11/2006	Fledged	
Blue Hole	11	5/26/2006		6/15/2006	2	2	7/7/2006	Fledged	
Blue Hole	12	6/5/2006		6/26/2006	2	2	7/17/2006	Fledged	
Blue Hole	13	6/5/2006		6/26/2006	3	3	7/17/2006	Fledged	
Blue Hole	14	6/10/2006						Failed- Unknown	
Blue Hole	15	6/10/2006		7/1/2006	2			Failed- Predated	
Blue Hole	16	6/15/2006						Failed- Predated	
Blue Hole	17	6/15/2006						Failed- Unknown	
Blue Hole	18	6/15/2006						Failed- Predated	
Blue Hole	19	6/15/2006		7/1/2006	2			Failed- Predated	
Blue Hole	20	6/23/2006						Failed- Predated	
Blue Hole	21	6/23/2006						Failed- Predated	
Blue Hole	23	6/23/2006						Failed- Predated	
Blue Hole	24	6/23/2006						Failed- Predated	
Blue Hole	25	6/23/2006						Failed- Predated	
Broadfoot-Kearney South	5								
Broadfoot-Kearney South	6								
Broadfoot-Kearney South	7								
Broadfoot-Kearney South	8	6/14/2006	3						
Broadfoot-Newark	3	6/14/2006							
Johnson Pit	4	5/26/2006						Failed- Other	

Johnson Pit	5	6/12/2006						Failed- Other	
Johnson Pit	6	5/31/2006						Failed- Other	
Johnson Pit	7	6/22/2006	2	7/10/2006	1	1	7/27/2006	Fledged	
Johnson Pit	8	6/22/2006		7/10/2006	2	2	7/27/2006	Fledged	
Johnson Pit	10	7/3/2006						Failed- Other	
Johnson Pit	11	7/3/2006		7/20/2006	1	1	8/10/2006	Fledged	
Johnson Pit	12	7/5/2006		7/26/2006	1	1	8/14/2006	Fledged	
Johnson Pit	13	7/11/2006		7/26/2006	1	1	8/21/2006	Fledged	
Johnson Pit	14	7/11/2006						Failed- Abandoned	
Lexington Pit	5	5/29/2006						Failed- Other	
Lexington Pit	6	5/29/2006		6/18/2006	2			Failed- Predated	
Lexington Pit	7	5/29/2006		6/18/2006	2			Failed- Predated	
Lexington Pit	8	6/6/2006						Failed- Predated	
Lexington Pit	9	6/6/2006						Failed- Predated	
Lexington Pit	10	6/6/2006						Failed- Predated	
Lexington Pit	11	6/6/2006						Failed- Unknown	
Lexington Pit	12	6/8/2006						Failed- Unknown	
Lexington Pit	13	6/8/2006						Failed- Predated	
Lexington Pit	14	6/15/2006						Failed- Abandoned	
Lexington Pit	16	6/15/2006						Failed- Predated	
Lexington Pit	17	6/23/2006						Failed- Unknown	
Lexington Pit	18	6/30/2006						Failed- Predated	
Lexington Pit	19	6/26/2006		7/16/2006	3			Failed- Predated	
Lexington Pit	20	7/3/2006						Failed- Predated	
Lexington Pit	21	7/3/2006						Failed- Predated	
Lexington Pit	22	7/5/2006						Failed- Predated	
Lexington Pit	23	7/5/2006						Failed- Predated	
Lexington Pit	24	7/5/2006		7/25/2006	2		8/17/2006	Fledged	
Lexington Pit	25	7/11/2006						Failed- Predated	

Table 9. Piping plover nests located in the Cooperative Agreement study area in 2006. Nests at all sites except the Broadfoot-Kearney S. and Broadfoot-Newark sites were monitored every three days.

Site	Nest #	First Date Observed	# Eggs	Date Hatched	# Chicks Initially Observed	# Chicks Fledged	Date Fledged	Final Status	Nest Management
Blue Hole	1	5/5/2006	4	5/29/2006	4	4	6/22/2006	Fledged	
Blue Hole	2	5/8/2006	4	6/2/2006	4	4	6/23/2006	Fledged	
Blue Hole	3	5/11/2006	4	6/5/2006	4	3	6/26/2006	Fledged	
Blue Hole	4	5/26/2006		6/5/2006	3	3	6/26/2006	Fledged	
Blue Hole	7	5/29/2006		6/4/2006	3	3	6/26/2006	Fledged	
Blue Hole	22	6/26/2006		6/24/2006	4	4	7/17/2006	Fledged	
Broadfoot-Kearney South	1	5/17/2006	4						
Broadfoot-Kearney South	2	5/17/2006	4						
Broadfoot-Kearney South	3	5/17/2006	4						
Broadfoot-Kearney South	4								
Broadfoot-Kearney South	9								
Broadfoot-Newark	1	5/17/2006	4						
Broadfoot-Newark	2	5/17/2006	2						
Johnson Pit	1	5/8/2006						Failed- Unknown	
Johnson Pit	2	5/8/2006		6/4/2006	4	1	6/26/2006	Fledged	
Johnson Pit	3	5/15/2006		6/6/2006	3	2	6/28/2006	Fledged	
Johnson Pit	9	6/30/2006		7/10/2006	3	3	7/27/2006	Fledged	
Lexington Pit	1	5/3/2006						Failed- Unknown	
Lexington Pit	2	5/12/2006						Failed- Predated	
Lexington Pit	3	5/17/2006						Failed- Predated	
Lexington Pit	4	5/17/2006		6/8/2006	3	2	6/30/2006	Fledged	
Lexington Pit	15	6/15/2006		7/7/2006	2			Failed- Predated	

Table 10. Least tern reproductive parameter estimates for the 2006 nesting season. These estimates are based on nests monitored.

Site	# Pairs <sup>1</sup>	# Pairs <sup>2</sup>	# Nests Initiated	# Chicks Initially Observed	# Successful Nests	# Unsuccessful Nests	# Eggs Hatched	# Fledglings	Nest-based Hatch Success	Nesting Loss	Nesting Success	Nest-based Fledging Success	Pair-based <sup>1</sup> Fledging Success	Pair-based <sup>2</sup> Fledging Success
Blue Hole	16	17	19	23	10	9	23	19	1.21	0.47	0.53	1.00	1.19	1.12
Johnson Pit	6	6	10	6	5	5	6	6	0.60	0.50	0.50	0.60	1.00	1.00
Lexington Pit	12	13.5	20	9	4	16	9	0	0.45	0.80	0.20	0.00	0.00	0.00
	34	36.5	49	38	19	30	38	25	0.78	0.61	0.39	0.51	0.74	0.68

<sup>1</sup>. Pair defined as the maximum number of nests and number of broods detected during one survey.

<sup>2</sup>. Pair defined as one-half of the maximum number of adults detected during one survey.

Table 11. Piping plover reproductive parameter estimates for the 2006 nesting season. These estimates are based on nests monitored.

Site	# Pairs <sup>1</sup>	# Pairs <sup>2</sup>	# Nests Initiated	# Chicks Initially Observed	# Successful Nests	# Unsuccessful Nests	# Eggs Hatched	# Fledglings	Nest-based Hatch Success	Nesting Loss	Nesting Success	Nest-based Fledging Success	Pair-based <sup>1</sup> Fledging Success	Pair-based <sup>2</sup> Fledging Success
Blue Hole	5	4	6	22	6	0	22	21	3.67	0.00	1.00	3.50	4.20	5.25
Johnson Pit	3	3	4	10	3	1	10	6	2.50	0.25	0.75	1.50	2.00	2.00
Lexington Pit	3	3	5	5	2	3	5	2	1.00	0.60	0.40	0.40	0.67	0.67
	11	10	15	37	11	4	37	29	2.47	0.27	0.73	1.93	2.64	2.90

<sup>1</sup>. Pair defined as the maximum number of nests and number of broods detected during one survey.

<sup>2</sup>. Pair defined as one-half of the maximum number of adults detected during one survey.



Table 12. Mayfield daily nest survival rate and incubation survival rate for least terns in 2006. Incubation survival rate is the daily rate times itself for every day of incubation (21 times). These estimates are based on nests monitored.

Site	# Nests	# Nests Lost	Exposure Days	Mayfield Daily Nest Survival Rate	Mayfield Daily Nest Survival Rate Variance	Mayfield Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Blue Hole	19	9	362	0.9751	0.0001	0.9588	0.9915	0.5894	0.4131	0.8360
Johnson Pit	10	5	153	0.9673	0.0002	0.9386	0.9961	0.4977	0.2641	0.9206
Lexington Pit	20	16	307	0.9479	0.0002	0.9225	0.9733	0.3250	0.1838	0.5659
All Sites	49	30	822	0.9635	0.0000	0.9504	0.9766	0.4581	0.3438	0.6080

Table 13. Mayfield daily nest survival rate and incubation survival rate for piping plovers in 2006. Incubation survival rate is the daily rate times itself for every day of incubation (28 times). These estimates are based on nests monitored.

Site	# Nests	# Nests Lost	Exposure Days	Mayfield Daily Nest Survival Rate	Mayfield Daily Nest Survival Rate Variance	Mayfield Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Blue Hole	6	0	88	1.0000				1.0000		
Johnson Pit	4	1	80	0.9875	0.0002	0.9627	1.0123	0.7031	0.3445	1.4099
Lexington Pit	5	3	90	0.9667	0.0004	0.9288	1.0045	0.3870	0.1265	1.1343
All Sites	15	4	258	0.9845	0.0001	0.9691	0.9999	0.6456	0.4154	0.9966

Table 14. Nest level habitat characteristics estimated at least tern nests in 2006 (estimations were not made at all nests as indicated by sample size).

Habitat Parameter	Site Type	Sample Size	Mean	95% CI		Minimum Value	Maximum Value
				Lower Bound	Upper Bound		
Nest Elevation	sandpit	1	1.00	.	.	1.00	1.00
Cover of Grass in 1 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Cover of Forb in 1 m2 area	sandpit	5	4.60	1.53	7.67	1.00	10.00
Cover of Woody in 1 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Density of Grass in 1 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Density of Forb in 1 m2 area	sandpit	5	9.00	7.04	10.96	5.00	10.00
Density of Woody in 1 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 1 m2 area	sandpit	5	0.16	0.11	0.21	0.10	0.20
Cover of Grass in 5 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Cover of Forb in 5 m2 area	sandpit	5	4.60	1.53	7.67	1.00	10.00
Cover of Woody in 5 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Density of Grass in 5 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Density of Forb in 5 m2 area	sandpit	5	44.00	32.24	55.76	20.00	50.00
Density of Woody in 5 m2 area	sandpit	5	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 5 m2 area	sandpit	5	0.16	0.11	0.21	0.10	0.20

Table 15. Nest level habitat characteristics estimated at piping plover nests in 2006 (estimations were not made at all nests as indicated by sample size).

Habitat Parameter	Site Type	Sample Size	Mean	95% CI		Minimum Value	Maximum Value
				Lower Bound	Upper Bound		
Nest Elevation	sandpit	2	2.75	2.26	3.24	2.50	3.00
Cover of Grass in 1 m2 area	sandpit	7	0.86	0	2.24	0.00	5.00
Cover of Forb in 1 m2 area	sandpit	7	0.86	0	2.24	0.00	5.00
Cover of Woody in 1 m2 area	sandpit	7	0.00	0.00	0.00	0.00	0.00
Density of Grass in 1 m2 area	sandpit	7	0.86	0	2.24	0.00	5.00
Density of Forb in 1 m2 area	sandpit	7	3.00	0	8.56	0.00	20.00
Density of Woody in 1 m2 area	sandpit	7	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 1 m2 area	sandpit	7	0.07	0.02	0.13	0.00	0.20
Cover of Grass in 5 m2 area	sandpit	7	0.43	0	1.01	0.00	2.00
Cover of Forb in 5 m2 area	sandpit	7	0.43	0	1.01	0.00	2.00
Cover of Woody in 5 m2 area	sandpit	7	0.00	0.00	0.00	0.00	0.00
Density of Grass in 5 m2 area	sandpit	7	1.57	0	3.57	0.00	6.00
Density of Forb in 5 m2 area	sandpit	7	5.00	0	13.28	0.00	30.00
Density of Woody in 5 m2 area	sandpit	7	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 5 m2 area	sandpit	7	0.07	0.02	0.13	0.00	0.20

Table 16. Colony level habitat characteristics for each sandpit with least tern (LETE) or piping plover (PIPL) nests in 2006.

Site name	Nesting Species	Colony Management	Adjacent Land Use
Johnson Pit	LETE PIPL	Permanent predator fence, trapping, pre-emergent herbicide	
Lexington Pit	LETE PIPL	Permanent predator fence, trapping, pre-emergent herbicide	
Blue Hole	LETE PIPL	Portable predator fence, predator removal, pre-emergent herbicide	
Broadfoot-Newark	LETE PIPL		Active sandpit surrounded by riparian woodland, grassland, and residential.
Broadfoot-Kearney South	LETE PIPL		Large active pit surrounded by river, commercial development, and cultivated cropland

Figure 1. Discharge (cfs) at Overton, Nebraska (USGS Gage No. 06768000) from May 1 through August 31, 2006.

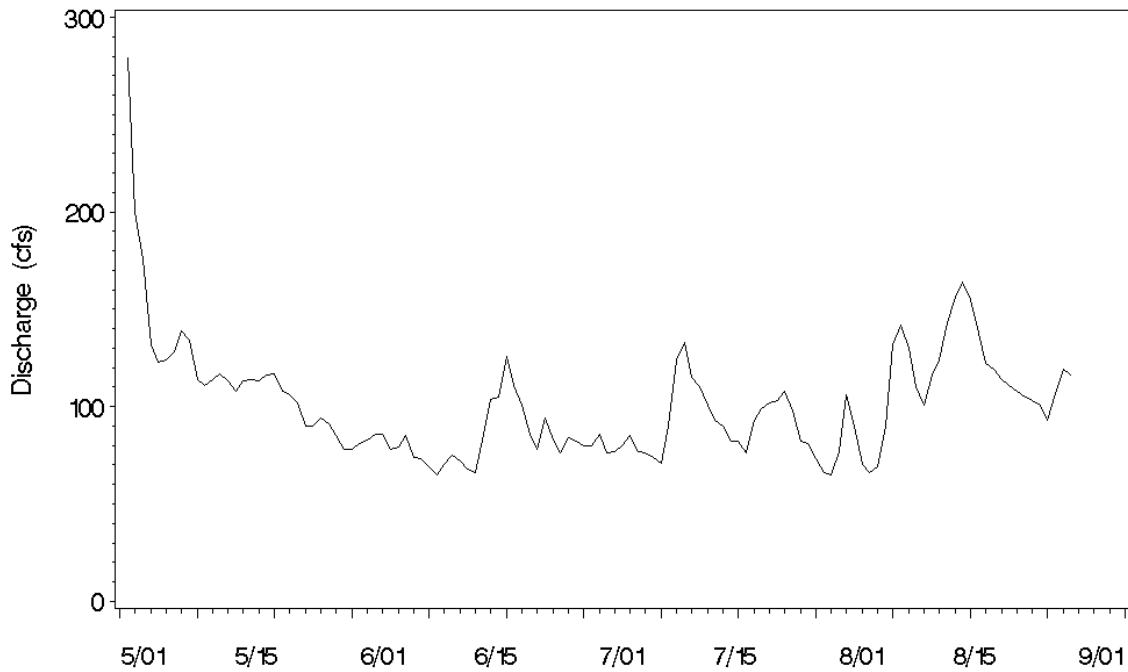


Figure 2. Stage (ft) at Overton, Nebraska (USGS Gage No. 06768000) from May 1 through August 31, 2006.

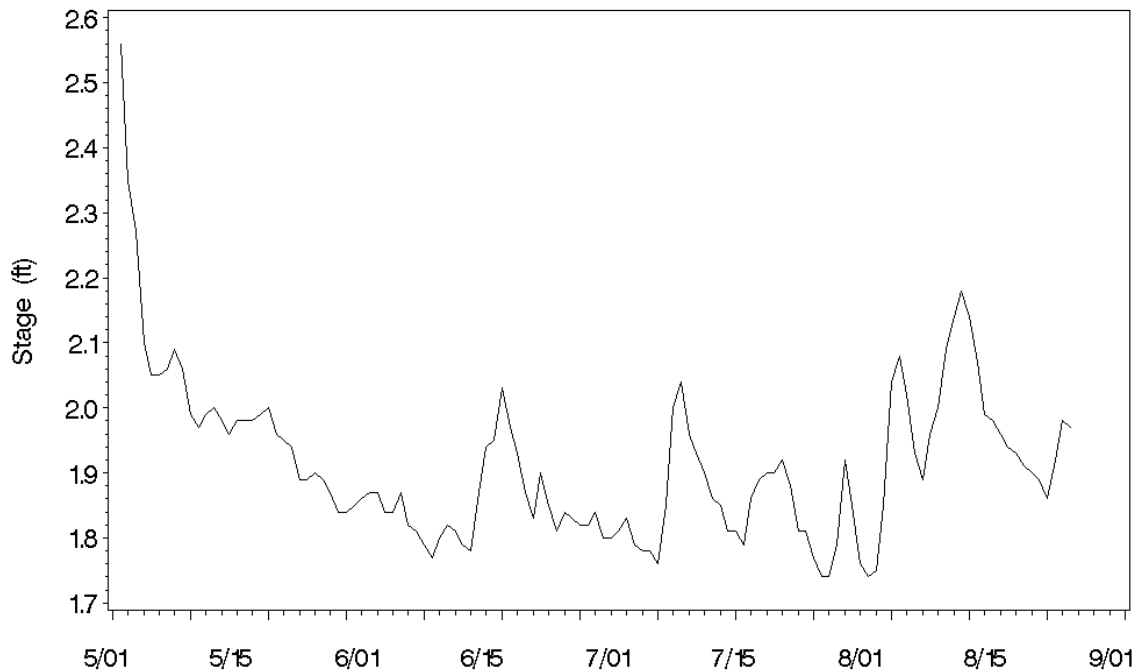


Figure 3. Discharge (cfs) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2006.

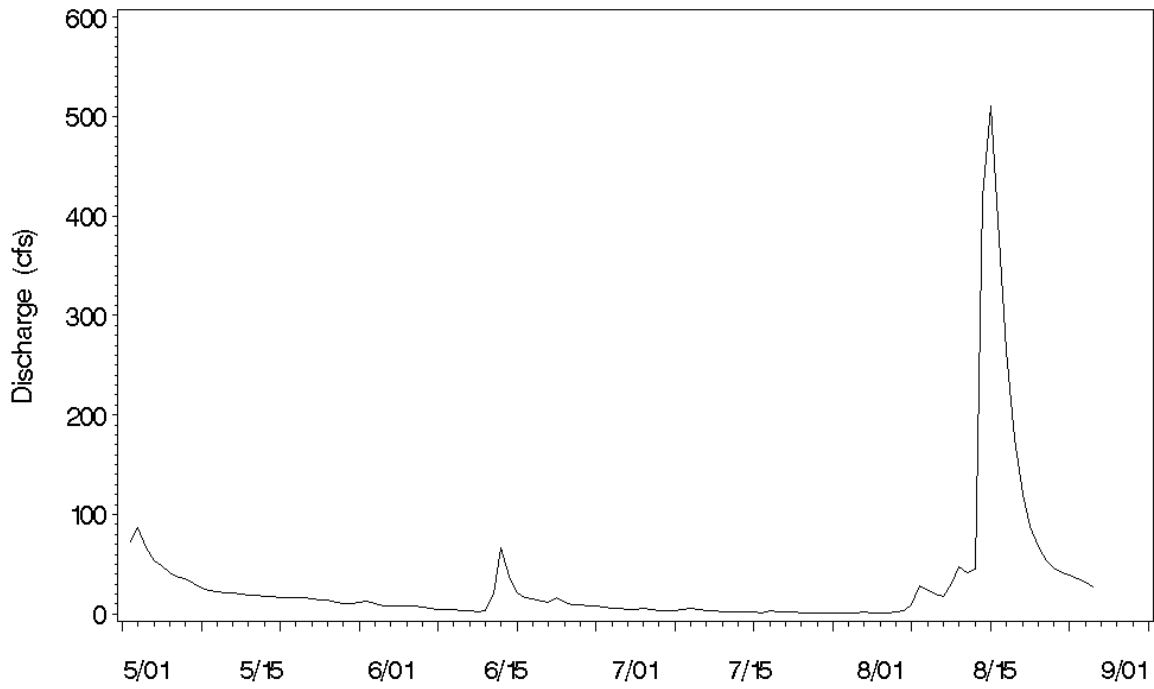


Figure 4. Stage (ft) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2006.

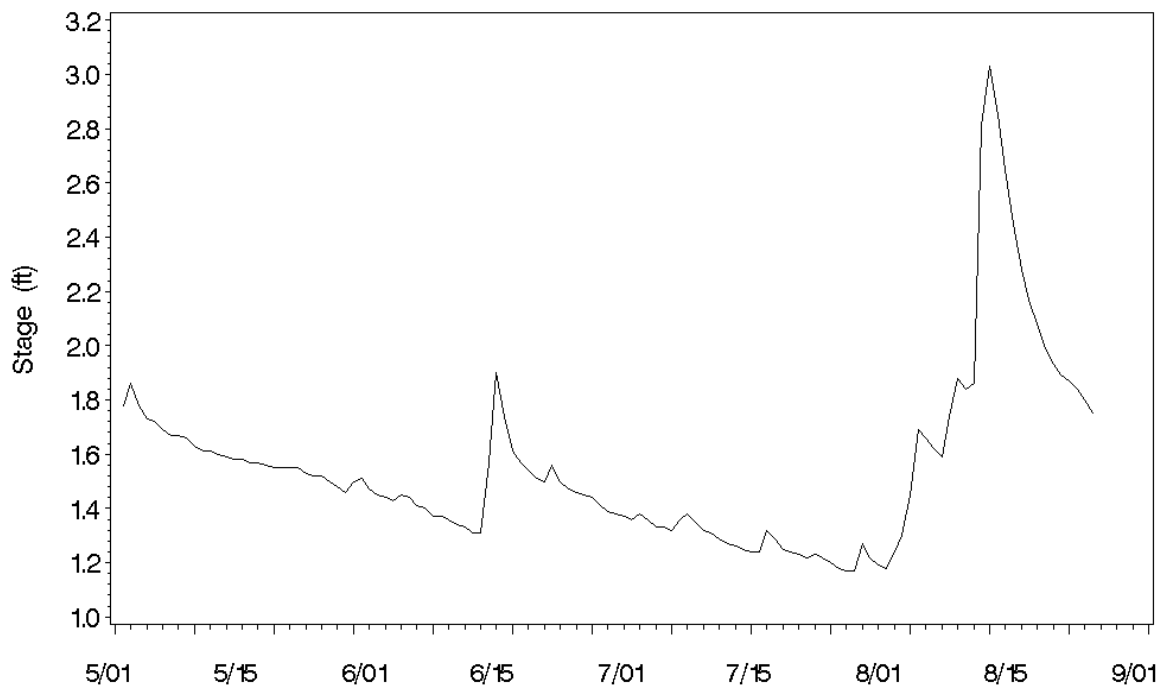


Figure 5. Discharge (cfs) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2006.

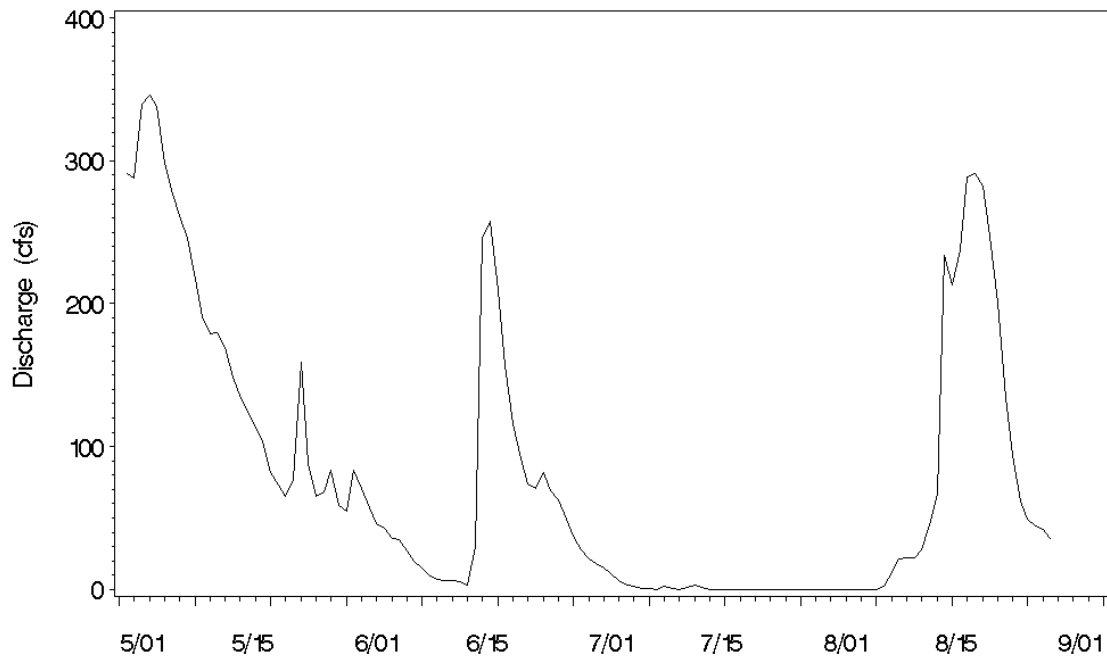


Figure 6. Stage (ft) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2006.

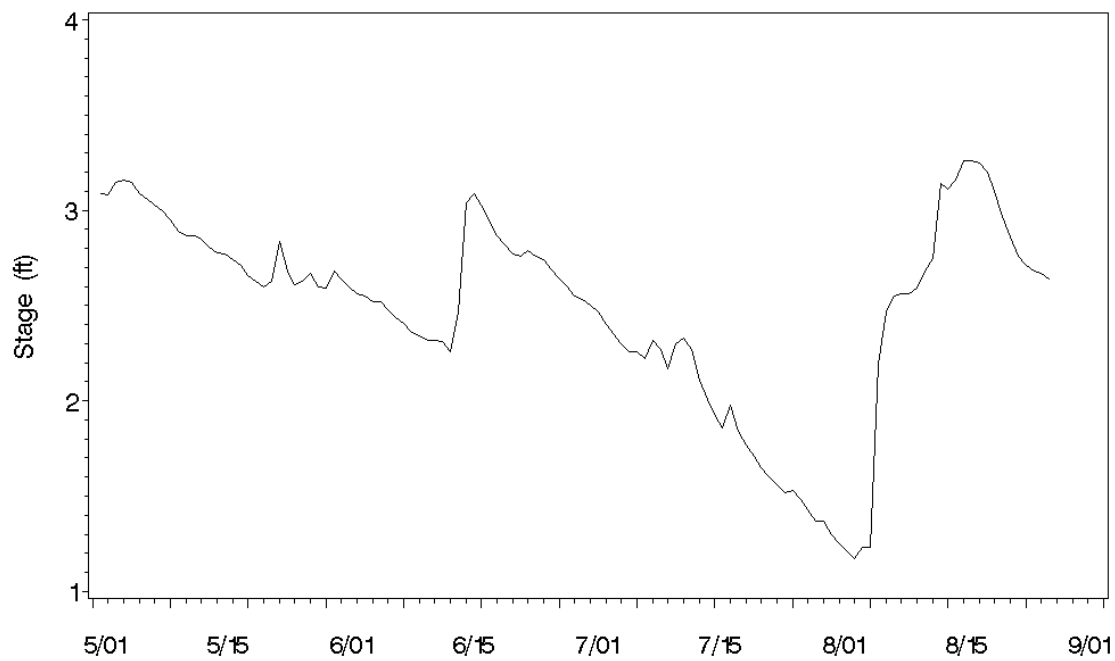
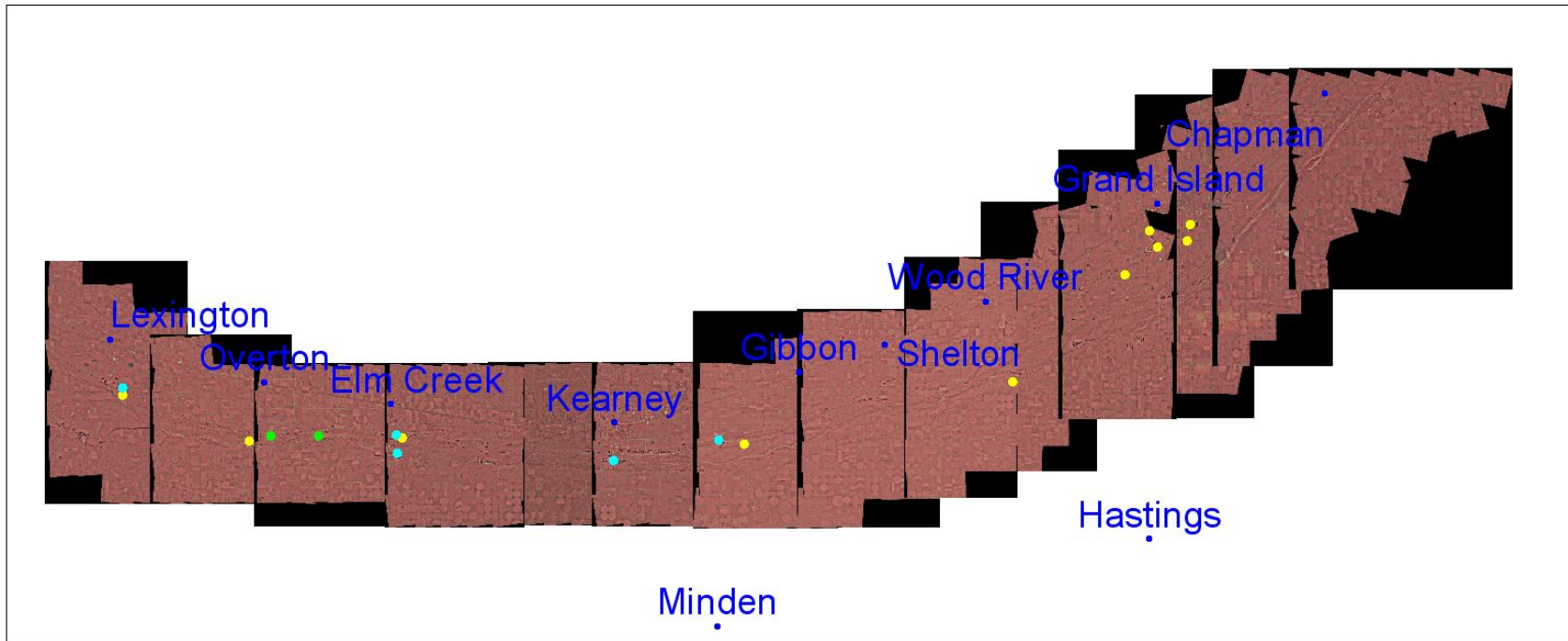


Figure 7. Sandpits and constructed islands surveyed for the 2006 season and locations of least tern sightings and nesting. Background image is the Fall 2003 color infrared photograph.



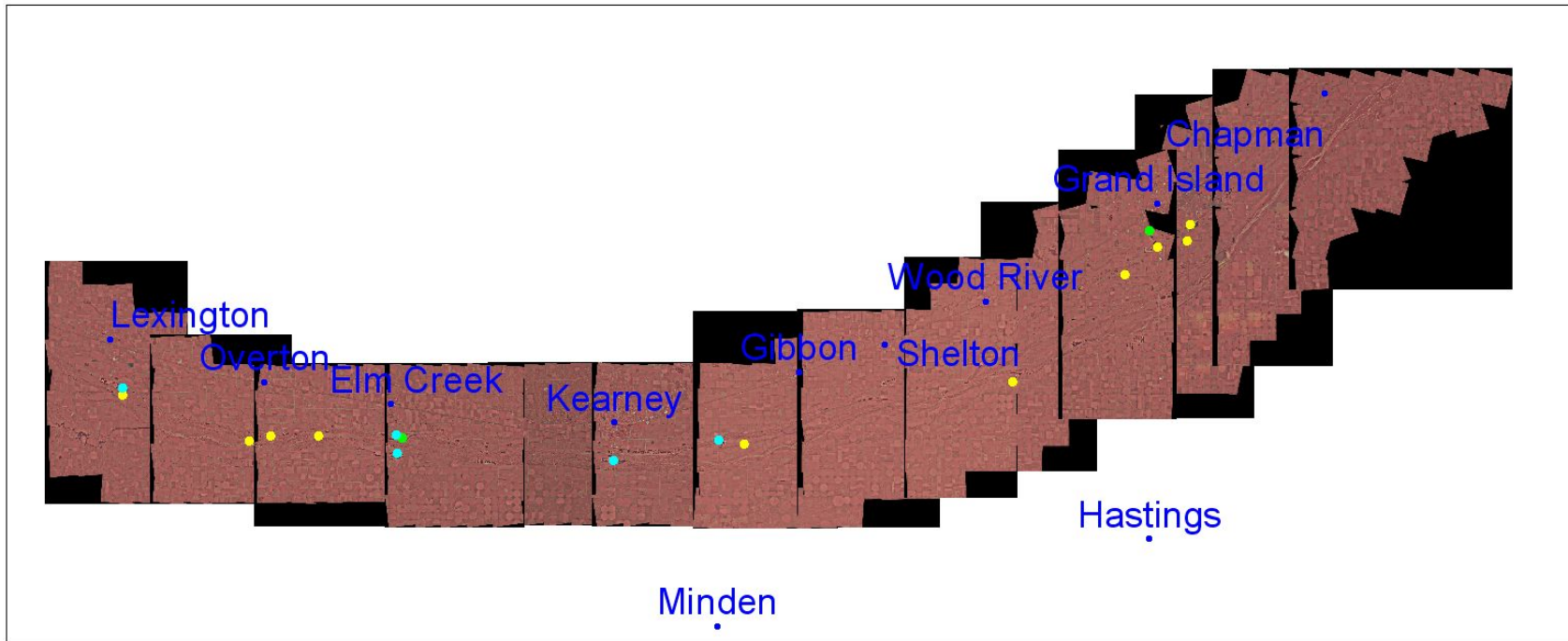
**Cooperative Agreement Platte River Study Area: Lexington to Chapman, NE**



Least tern legend	
<span style="color: cyan;">●</span>	Least tern nesting
<span style="color: green;">●</span>	Least tern presence
<span style="color: yellow;">●</span>	No least terns observed
<span style="color: blue;">●</span>	Cities



Figure 8. Sandpits and constructed islands surveyed for the 2006 season and locations of piping plover sightings and nesting. Background image is the Fall 2003 color infrared photograph.



**Cooperative Agreement Platte River Study Area: Lexington to Chapman, NE**



**Piping plover legend**

- Piping plover nesting
- Piping plover presence
- No piping plovers observed
- Cities

