Section 2
Data Collection and Development

2.1 Watershed Inventory

The watershed inventory consisted of collecting, compiling, and evaluating existing data applicable to the Stevens Creek Watershed Master Plan development. A data search was conducted to identify existing information to be used by the project team. The digital and hardcopy information collected and compiled during the study is provided below.

Digital Information

- Existing and future land use data
- Comprehensive plan tiers and priority areas for future growth
- Existing and future trails, native prairies, wetlands, historical and cultural assets
- 2002 color aerial photography
- 1997 topographic contour maps with 2-foot contour intervals
- USGS LiDAR information, flown between November 2003 and January 2004
- Existing FEMA floodplain and floodway boundaries
- Land parcel information

Hardcopy Information

The hardcopy information was organized into five Project Information Notebooks, which were compiled and submitted to the City/NRD under separate cover. Table 2-1 summarizes the information contained in each information notebook.

Table 2-1
Project Information Notebooks – Summary of Data

Section	*Title*	*Date*	*Source*	*Project Notebook No.*
1	Dry Weather Stormwater Monitoring	April 29, 2001	U of N at Lincoln	I
2	Design Drawings for Ponds and Drainage Structures/Bridges	Various	NRD - Ponds Lancaster Co. - Drainage Structures/Bridge	I
3	Beltway EIS	June 14, 2002	NDOR	II
4	BMP (Best Management Practices)	Jan-Feb 2003	U of N at Lincoln	II
5	Floodplain Task Force Recommendations	Various	City of Lincoln	II
6	Stevens Creek Planning Initiative	April 2001	City of Lincoln	II
7	Stevens Creek Reconnaissance Study: Lower Channel Analysis; Open Space Preservation Lower Platte South Natural Resource District	Various	NRD	II
8	Results of the Nationwide Urban Runoff Program	December 1983	EPA	II
9	City Water Quality Data	Various	City of Lincoln	III
10	Quantity and Quality of Urban Stormwater Runoff from Selected Drainage Basins, Omaha, Nebraska, Water Resources Investigation Report 98-4168	1992-1993	USGS	III
11	Historical and Ecological Resources Survey	1985 rev 1990	Lancaster County	III
12	City of Lincoln Flood Insurance Study	Sept. 21, 2001	FEMA	III
13	Aerial Photographs 1940, 1949, 1959, and 1971	Various	City of Lincoln	III
14	Draft Master Plan Map for CIP 2002-2008, with Comprehensive Plan Tiers	April 2002	City of Lincoln	III
15	Waterway Flyer for South Basins	Various	City of Lincoln	III

Table 2-1 (Continued)

Section	Title	Date	Source	Project Notebook No.
16	Summary Report of Initial Project Investigations (Basin Planning Project-Precursor Document to Specific Basin Plans)	March 17, 1997	Olsson Assoc.	III
17	Paper on Impacts of Urbanization on Downstream Receiving Waters	Unknown	(Unknown Author)	III
18	Stevens Creek Watershed Advisory Group Comments on NRD Study of Stevens Creek	October 1996	NRD	III
19	Letter to NRD, Re: Comments on Stevens Creek dated May 10, 1996	May 1996	City of Lincoln	III
20	Interim Report, Concept Comprehensive Flood Management Plans Alpha, Delta, Epsilon and Zeta, Stevens Creek Watershed Study for NRD	Feb. 1996	NRD	III
21	Addendum to the Interim Report, Concept Comprehensive Flood Management Plan Lambda, Stevens Creek Watershed Study for NRD	June 1997	NRD	III
22	Memo from Wright Water Engineers Re: Comparison of Lincoln Stormwater Quality Data with National Urban Runoff and Other Data	Feb. 28, 1997	City of Lincoln	III
23	Matrix of Stormwater Management Issues in Selected Midwest Cities	Unknown	City of Lincoln	III
24	Urban Water Quality Data		City of Lincoln	IV
25	Lancaster County Soil Maps	1977	NRCS	IV
26	Design Criteria Manual	Feb. 22, 2000	City of Lincoln	IV
27	Land Ownership Information		City of Lincoln	IV
28	Trends in Channel Gradation-Water Resources Investigations Report 99-4103	1913-1995	USGS	V
29	2025 Comprehensive Plan, 2002 Draft Comprehensive Plan	April-May 2002	City of Lincoln	V
30	Floodplain Task Force Information	Various	City of Lincoln	V
31	Regulated National Pollutant Discharge Elimination System (NPDES) Industries and Confined Animal Feedlot Operations (CAFOs) within the Watershed	Various	Internet NRD	V
32	Soil Data from the NRCS	Various	Internet NRCS	V
33	Non Point Source News Notes	May 2003	EPA	V
34	Engaging and Involving Stakeholders in Your Watershed	Unknown	EPA TetraTech	V
35	Rain Gage Data	Various	City of Lincoln	V
36	Meeting Notes/Correspondence	Various	Various	V

As part of the study evaluation process, numerous new data sets were developed using geographic information system (GIS) technology to organize the drainage structure and geomorphic field surveys and key results of the study. A description of each GIS data set is provided in Section 11.

2.2 Drainage Structure Field Survey

A drainage structure field survey was conducted to obtain the necessary hydraulic data along the study reaches. The information was collected using a combination of Global Positioning System (GPS) and total station technology to obtain the required elevations for each drainage structure, while inventory sheets were used to graphically document the data. The drainage structures were categorized based on three types, including bridges, culverts, and detention facilities.

Highway 6 Bridge Crossing (SC05)

- **Bridges** – The types of information collected for each bridge included a stream cross section to define the upstream face of the bridge opening, centerline profile of the bridge decking, low chord elevation of the bridge, physical characteristics of the support system, and upstream and downstream photographs.

Culvert (SC040) extending beneath Havelock Avenue, just east of 70th Street

- **Culverts** – The types of information collected included a stream cross section immediately upstream of the culvert, centerline profile of the roadway crossing, upstream and downstream invert locations, opening dimensions, material type, wing-wall configuration, and upstream and downstream photographs.

Magee Detention Facility (SC642) located near 120th and Yankee Hill Road

- **Detention Facilities** – Information was collected for detention facilities located along the stream centerlines, as shown on Figure 2-1, that provided significant watershed storage or impacted floodplain elevations. The types of information collected included the location and dimensions of the inlet and outlet structures, dimensions of the emergency spillway, centerline profile of the detention embankment, a cross section of the emergency spillway at the embankment toe and crest, and representative photographs. In addition, design drawings for regional detention facilities located upstream of the stream centerline were collected.

The drainage structures were given a unique alphanumeric name with the format SC-BBB. “SC” is the two-letter code for the Stevens Creek Watershed. “BBB” is a three-digit structure number. The numbering system begins at Highway 6 with structure SC-05, and moves incrementally upstream. The drainage structures located along the Stevens Creek Overflow were named in a similar manner using a prefix of “SCOF.”

Figure 2-1 graphically illustrates the approximate location of each drainage structure surveyed, along with those that contained useable design drawing information. A hardcopy printout of the electronically recorded data, inventory sheets, and photographs for each surveyed drainage structure were provided to the City/NRD under separate cover. Appendix A located in Volume II of the report, contains a CD-ROM that includes the electronically recorded survey data and photographs for each drainage structure.

2.3 Base Mapping/Triangular Irregular Network

The base mapping used for the project consisted of topographic data with 2-foot contour intervals developed from two data sources. The primary source is the 1997 topographic mapping, which was supplemented by USGS LiDAR data at specific locations. The LiDAR data were used in areas where either the 1997 contour data appeared to be inaccurate or significant development occurred since 1997 that had altered the floodplain contours. Figure 2-2 shows the specific locations where LiDAR data were used in place of the 1997 topographic data.

A triangular irregular network (TIN) was created from the base mapping data using ArcInfo technology. A TIN is a three-dimensional representation of the ground topography that was used to automate the development of input data for the hydrologic and hydraulic computer models. The TIN is also used in conjunction with other GIS tools to automate the floodplain delineation process (Section 5 - Floodplain Mapping).

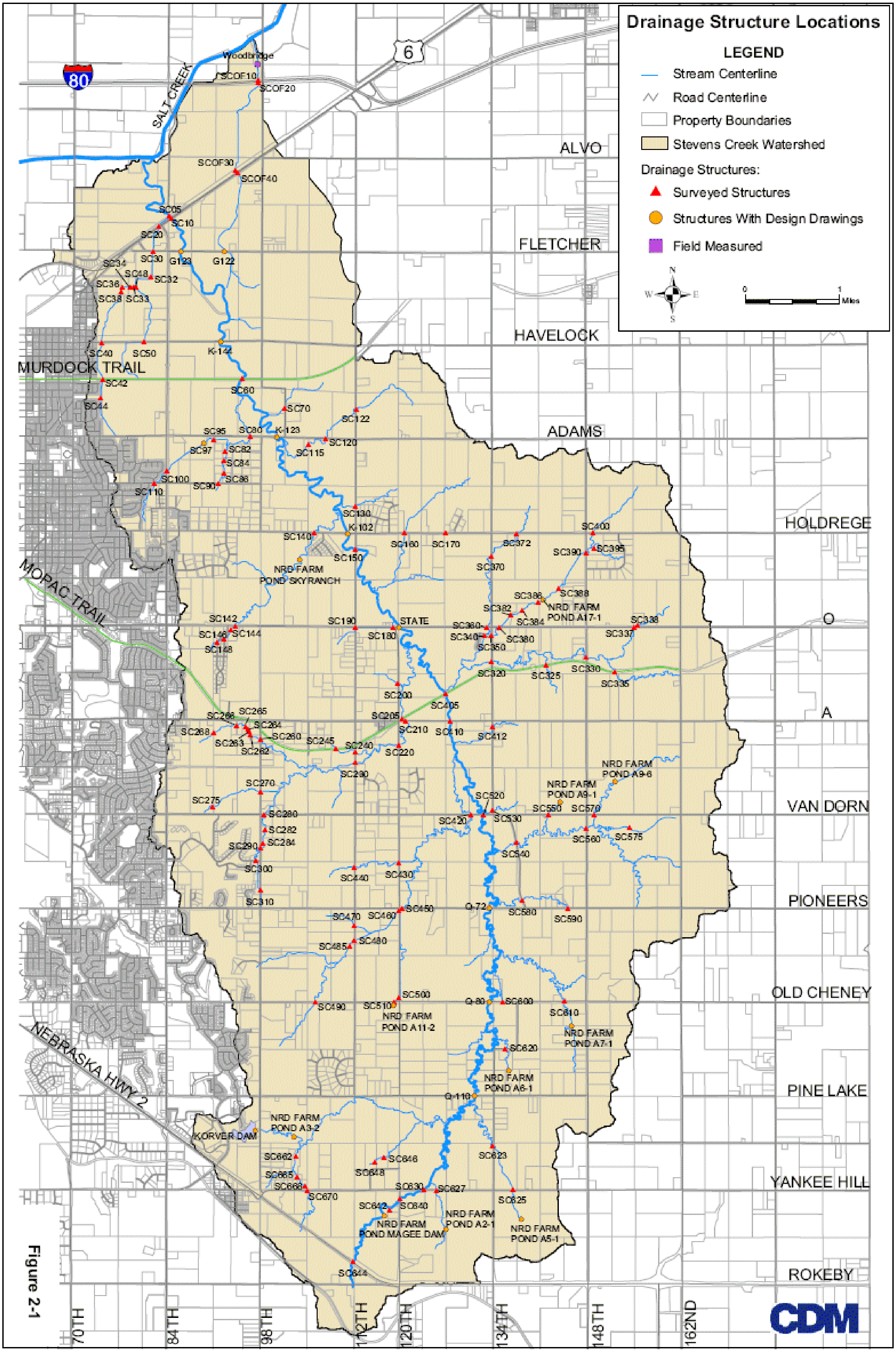
2.4 Longitudinal Profile Survey

The longitudinal (long) profile is among the more important diagnostic methods in fluvial geomorphology. The locations of the thalweg survey are shown on Figure 2-2. The surveyed long profile was used to calibrate the profile layer developed in GIS throughout the watershed. The long profile is a surveyed description of the bed slope, accomplished by traversing the channel and surveying the elevation of the thalweg or deepest part of the channel. The thalweg represents the flowline as distinct from the channel centerline. The long profile is particularly useful for diagnosing and locating channel incision and reveals sudden breaks in bed slope called knickpoints and the subtler but still recognizable change in slope over a short distance, indicating a knick zone.

2.5 Geomorphic Investigation

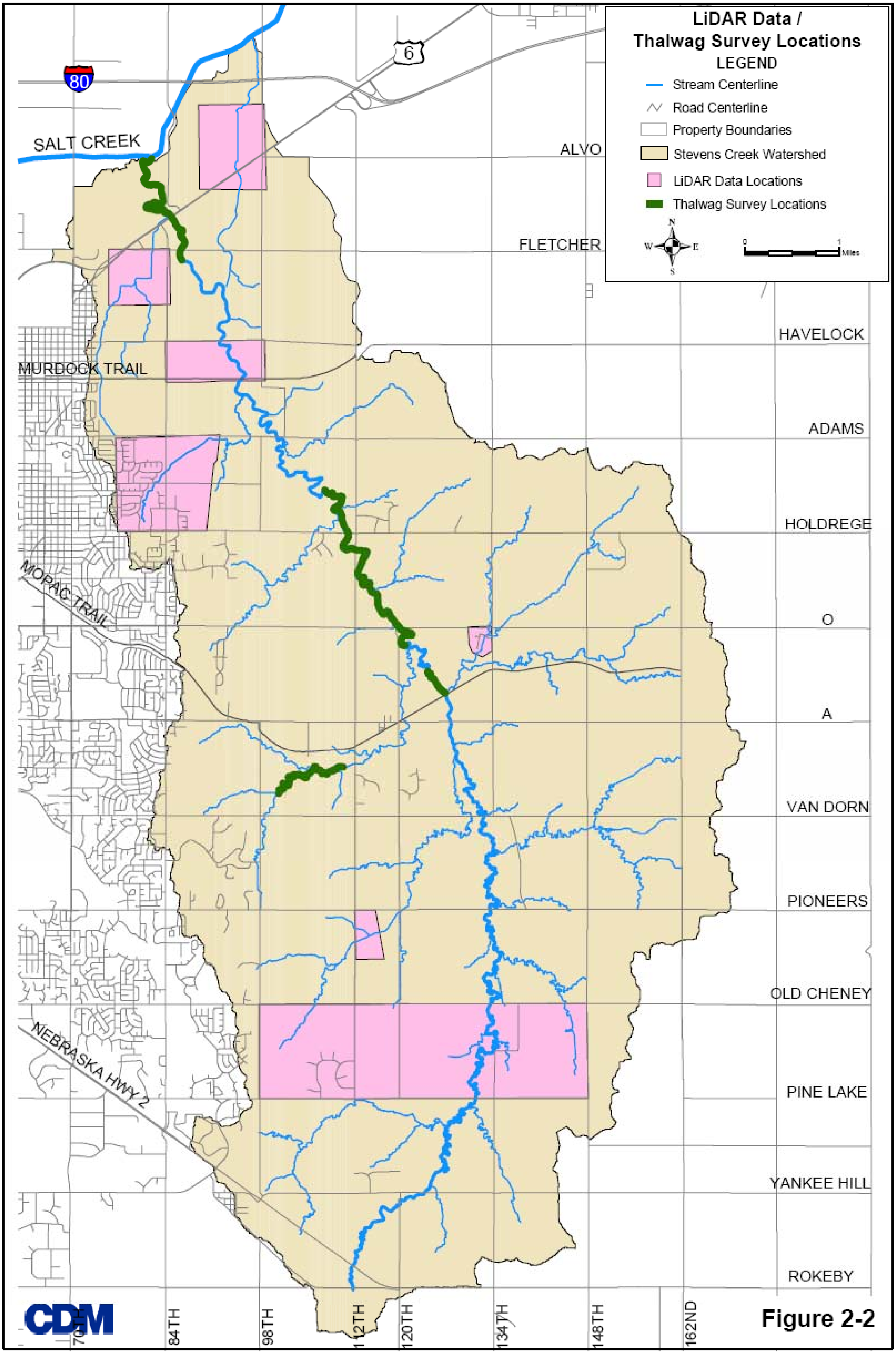
The purpose of the geomorphic investigation was threefold: first, to evaluate the physical stability of the stream under current and past conditions; second, to make reasonable predictions about how the stream will change under the proposed future conditions; and third, to make concept-level design recommendations for managing the stream.

Geomorphology is a data-intensive endeavor. Because Stevens Creek is not in equilibrium and reliable regional data regarding channel form is not available, equilibrium conditions must be estimated using sediment transport functions, the continuity and roughness equations, and hydraulic and hydrologic conditions. This approach does not depend on current or previous channel stability for its validity; therefore, data collection focuses on stream process indicators rather than on extensive documentation of the current channel form.



Drainage Structure Locations
LEGEND
Stream Centerline
Road Centerline
Property Boundaries
Stevens Creek Watershed
Drainage Structures:
Surveyed Structures
Structures With Design Drawings
Field Measured
N
W
E
S
0
1
Miles
80
6
SALT CREEK
Woodbridge
SCOF10
SCOF20
SCOF30
SCOF40
ALVO
FLETCHER
HAVELOCK
MURDOCK TRAIL
ADAMS
HOLDREGE
MOPAC TRAIL
O
A
VAN DORN
PIONEERS
OLD CHENEY
PINE LAKE
YANKEE HILL
ROKEBY
NEBRASKA HWY 2
KORVER DAM
NRD FARM POND SKYRANCH
NRD FARM POND A17-1
NRD FARM POND A9-6
NRD FARM POND A9-1
NRD FARM POND A11-2
NRD FARM POND A7-1
NRD FARM POND A6-1
NRD FARM POND A3-2
NRD FARM POND A2-1
NRD FARM POND A5-1
NRD FARM POND MAGEE DAM
STATE
70TH
84TH
98TH
112TH
120TH
134TH
148TH
162ND
CDM

Figure 2-1


LiDAR Data /
Thalwag Survey Locations
LEGEND
Stream Centerline
Road Centerline
Property Boundaries
Stevens Creek Watershed
LiDAR Data Locations
Thalwag Survey Locations
Miles
80
6
SALT CREEK
ALVO
FLETCHER
HAVELOCK
MURDOCK TRAIL
ADAMS
HOLDREGE
MOPAC TRAIL
O
A
VAN DORN
PIONEERS
OLD CHENEY
NEBRASKA HWY 2
PINE LAKE
YANKEE HILL
ROKEBY
70TH
84TH
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112TH
120TH
134TH
148TH
162ND
CDM

Figure 2-2

2.5.1 Geomorphic Background Investigation

The purpose of the background investigation is assessment of basin behavior as a whole. The elements of the evaluation were a drainage basin analysis, plan form analysis, and interpretation of historical aerial photographs. The City provided aerial photographs and GIS layers for all three analyses. Both drainage basin analysis and photo interpretation were conducted in general agreement with the methods of Lueder (1959).

The drainage basin analysis provides insight on how local geology influences stream behavior and whether one or more subareas behave in ways distinct from the basin as a whole. This may be an indication that such subareas require different methods of analysis or management.

The meander patterns for Stevens Creek reveal rough guidelines for how the geometries change throughout the watershed. The measurements were conducted in general compliance with Chang (1998), Leopold and Langbein (1969), and USACE (1993). Those areas where meander geometry, particularly radius of curvature, was substantially outside the norm for alluvial streams were noted for closer examination in the field. Other photographic evidence of active channel adjustment such as multiple in-channel bars, advancing bars, or evidence of systemic mass wasting were also noted for field examination.

The historical photo interpretation provides insight into how the land uses and channel conditions have changed over time. It also provides useful information on the relative intensity and duration of channel process for a given set of stresses. The City supplied historical aerial photographs for the years 1940, 1949, 1959, and 1971. The analysis did not include photogrammetry but did include notation of channel adjustment such as changes in meander amplitude, wavelength or radius of curvature, scour and deposition patterns, tree scrolls, and altered lag sections.

2.5.2 Geomorphic Field Investigation

Geomorphologists collected field data on approximately 426,400 linear feet of channel. Most of the data collection occurred between October 2003 and April 2004. To improve the efficiency of data collection and reduce the likelihood of transcription errors, all field data were collected in hand-held computers in ArcPad format. The City supplied base data and projection files. Immediately after field collection, all data were downloaded to ArcView files.

The following 10 themes shown in Table 2-2 represent the collected field data. The themes include 109 data parameters. An electronic version of the data is available in Appendix A, GIS Data Sets.

The data organization is a modification of the approach described by Johnson, Gleason, and Hey (1999). Dr. Johnson's team developed an approach of rapid, efficient data collection that is oriented towards assessing stability in streams affected by infrastructure. The paragraphs below detail the data collected and their relevance to channel process.

Table 2-2
Geomorphic Field Data

Bed and Bank material type (collected separately) and bed consolidation
Channel bar type and condition
Channel profile
Channel cross section
Erosion and mass wasting
Vegetative bank protection and condition of riparian corridor
Outfalls
Infrastructure crossings
Photographs
Notes

Material

The material theme consists of 12 bed and bank material parameters, including bed or bank material type, bed material shape, degree of consolidation or imbrication, and approximate bed material gradation (D90, D60, etc.). These data and their distribution through the project reach inform assessments of present and future resistance to erosion. Particle sizes, such as D90 and D50, are indicators of stream power. In addition, consolidation and imbrication of bed material is used in conjunction with bar data to evaluate sediment transport competency.

Bar

The bar theme is used primarily for developing an understanding of sediment transport, an often overlooked but critically important stream process.

The bar theme includes 16 parameters. These include extent and type of bed sorting (generally coarse to fine proceeding downstream), pattern of bar placement, bar width relative to stream width, consolidation, vegetative condition, and other indicators of potential bar advance. Assessment of bar condition is particularly useful in distinguishing between widening and meander adjustment, two stream processes associated with systemic bank failures. Bar evaluation is also helpful in temporal analysis of stream process and helps distinguish between ongoing and completed channel adjustments.

Profile Features (non-surveyed)

This theme included the location of knickpoints and the tops of pool-riffle sequences. The height of the knickpoint, bed material type, presence or absence of debris jams, and erosion patterns are all used to distinguish between active and completed channel incision. Evaluation of pool-riffle sequence, particularly relative to location in plan form, is useful in assessing potential plan form migration.

Channel Dimensions

The channel dimensions theme is essentially channel cross section information. In this theme there are 27 parameters, including bed width, bank height, bank angle, top of bank width, scour line elevation, and lower limit of woody vegetation. The combined bank height and angle data are useful in distinguishing between fluvial and geotechnical causes of bank failure and therefore the appropriate approach to management.

Erosion and Mass Wasting

The erosion and mass wasting theme includes both quantitative and qualitative data used to identify lengths of channel experiencing active erosion or mass wasting, as well as the dominant mode of failure, such as scour, toppling, flow, wedge, or circular failure. Identifying the type of mass wasting is essential to understanding the failure mode and to distinguish between systemic, local, and geotechnical failures. Scour patterns are also helpful in determining the systemic process driving the erosion.

Vegetation

The vegetation theme contains 16 elements. Vegetative data include the quality, size, and structure of the riparian forest, percent of canopy cover, and presence or absence of invasive species. Native vegetation plays a role in stabilizing stream systems through mechanical reinforcement of streambanks by plant roots, soil moisture management through evapotranspiration, and hydraulic roughness at the bank toes. Vegetative conditions such as surfed or toppled trees, freshly exposed, or barked over roots are useful in estimating the degree of instability and progress towards recovery.

Dominant and subdominant tree species and the successional status of the riparian corridor are also important to urban stream management. Invasive nonnative species can interrupt the succession of more desirable tree and understory species that would not only provide greater habitat and ecological benefits, but also provide improved bank stability and scour resistance. The timing and degree of disturbance are reflected in the same vegetation characteristics. For example, sudden changes in vegetation type often accompany localized problems, which help distinguish between systemic and local concerns. Vegetative status also indicates how well the streambanks will respond to soil biostabilization and provides insight into the potential for habitat recovery.

Outfalls and Infrastructure Crossings

The outfall and crossing themes locate in-stream or near stream infrastructure. The location of outfalls, bridges, and culverts is essential when considering design limitations and construction access. In addition, the condition of in-stream infrastructure can also provide clues to past and present channel conditions. For example, culverts and crossings can also act as process indicators. Undermined outfalls and culverts indicate the extent of channel incision while discontinuities in energy distribution and sediment transport can be inferred from the depth and consolidation of deposits in culvert or bridge bays.

Photos and Notes

The last two themes mainly include supporting or miscellaneous information. Notes generally consist of short site descriptions or information that does not otherwise fit into any of the previously mentioned themes. Photos are taken at regular intervals, not only for internal quality assurance and quality control practices, but also to provide the user with a virtual walk through of the study reach.