Section 2
Previous Studies and Existing Data

2.1 Previous Studies

The following are the previous studies that provided key information for this project. A full list of previous studies reviewed is in Appendix A.

- *Section 205 Feasibility Study Salt Creek, Lincoln, NE: Problem identification Phase Documentation, March 1994.*

- *Section 205 Feasibility Study Salt Creek, Lincoln, NE: Plan Formulation Phase Evaluations of Structural Alternatives Documentation – USACE Omaha District, July 1996.*

  This study evaluated the feasibility of structural alternatives to mitigate flooding on Salt Creek. The alternatives evaluated were offline storage basins at the locations this study evaluated on Middle Creek and the Oak Creek upstream site. This study found a benefit cost ratio of 0.08.

- *Middle Creek and Oak Creek Flood Storage Detention Area Pre-Feasibility Study – HWS Consulting Group Inc, January 1996.*

  This pre-feasibility study evaluated hydrologic issues at the sites identified in the Section 205 Feasibility Study Plan Formulation Phase. Issues studied included geology with respect to groundwater occurrences, location of the water table, and likely water table fluctuations over time as well as the suitability of the existing soils encountered at both sites for use as engineered earth fill. This study recommended further groundwater monitoring to understand seasonal changes in groundwater. It also determined that standing groundwater may be a problem for a basin at the Middle Creek site. In addition, it was determined that some soil types at both sites, after manipulation, are suitable for use as fill material.

- *Salt Creek at Wilderness Park Hydrologic Study – US Army Corps of Engineers, June 1999.*

  This study simulated the effect of various alternatives on peak flows and water surface elevations on Salt Creek through, and downstream of, Wilderness Park. These alternatives included the following changes: stormwater runoff changes, channel modifications, bridge removal/addition, bridge opening reduction, Wilderness Park storage changes, channel confinement, and channel alignment modification. Of particular interest to this study are the results from the channel confinement study. These are compared to this study's analysis of the storage benefits of Wilderness Park as described in Section 3.4 and shown in Appendix B.

- *Geotechnical Engineering Report: Oak Creek Levee Study – HWS Consulting Group Inc, December 2006.*

  This report evaluated the levee on Oak Creek which extends from West Mathis Street to Interstate 80. It determined that the existing levee does not meet minimum requirements

for FEMA freeboard requirements of 3 feet. In addition, it determined through subsurface exploration and the analysis of subsurface materials that the stability of the levee is adequate under base flood conditions both before and after an event. However, dispersive soils were found, which were recommended to be addressed to improve the levee system.

2.2 Watershed Inventory

The project team collected and reviewed applicable information from several sources. A list of the existing information collected during the study included:

- Existing land use and street network
- Existing floodway and flood fringe boundaries
- Existing hydrologic and hydraulic models
- Land ownership information
- Stream gage and precipitation data
- As-built plans for drainage structures/bridges
- City of Lincoln Flood Insurance Study
- Color aerial photography
- U. S. Geological Survey LiDAR data (non-bare earth points)
- LOMR submittals within project area
- City Drainage Manual
- Past public involvement correspondence
- Lancaster County soil map

Several new datasets were developed using GIS technology to organize the technical evaluations during the study and are included in Appendix C under GIS datasets. A description of each GIS dataset created during the study is provided below.

- **Potential Offline Storage Locations** - This dataset includes a polygon shapefile identifying offline storage locations

- **Proposed Contours** - These datasets include GIS polyline shapefiles showing proposed contours for both offline storage and excess cut spoils locations. These contours were used for to calculate storage volume in the offline basins and cut and fill calculations and for the benefit-cost analysis.

- **Hydrologic Evaluation** - These datasets include the HEC-HMS model input files used during the hydrologic evaluation process. The files include time of concentration flow paths, subbasins, detention ponds, merged land-use and soils curve number files, and location of divergence nodes.

- **Hydraulic Information** - These datasets relate to the hydraulic model output and include the stream centerlines and the cross sections from the hydraulic models.

- **Benefit-Cost Analysis** - These datasets were used to develop the benefit-cost analysis described in Section 6. Shapefiles include structures impacted by the existing conditions floodplain as well as those impacted by the recommended storage alternative (Section 7). Also included are the depth grids used in the estimation of damages and a comparison of existing conditions flooding depths versus flooding depths with proposed offline detention basins for the 100-year event.

- **Fieldwork Photographs** - This dataset includes location of photographs taken throughout the project sites with a reference to the photo identification number.

2.2.1 Electronic Files

The electronic files associated with the study have been organized according to the following folder structure:

- Study Report and Appendix Information
- Field Photographs
- GIS Datasets (as described above; can be accessed using ArcGIS)
- Hydrologic and Hydraulic Models

2.3 Drainage Structures

All drainage structure information required to refine the Salt Creek DFIRM model for this study was obtained from as-built surveys provided by the City, NRD, and the LAA. Table 2-1 lists the structure location, source of information, and description of the structure. No field survey data was collected for this study.

Table 2-1 Structure Data Information

Structure Location	Source of Information	Description
West Mathis Street	As-builts from LAA	West Mathis Street Crossing over Oak Creek
South of Lincoln Airport	As-builts from LAA	Located on airport property, bridge crossing over Oak Creek that is not accessible to the public
I-80	As-builts from the City	I-80 bridge crossing over Oak Creek
1st Street	As-builts from the City	1st Street bridge crossing over Oak Creek
I-180	As-builts from the City	I-180 bridge crossing over Oak Creek
10th Street	Salt Creek DFIRM Update Model	10th Street bridge crossing over Oak Creek
14th Street	Salt Creek DFIRM Update Model	14th Street bridge crossing over Oak Creek
Homestead Expressway	As-builts from the City	Homestead Expressway bridge crossing over Middle Creek

- **Bridges** - The types of information needed 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 piers. The upstream cross-section representing the bridge opening was obtained from the LiDAR contour data and supplemented with record drawings. All other information for the 8 bridges was obtained from available record drawings or was taken from the Salt Creek DFIRM HEC-RAS model.

- **Detention Facilities** – Two upstream detention facilities located in two subareas along Middle Creek were evaluated during the hydrologic analysis. However these two facilities were not included in the hydrologic analysis because they lack sufficient size to have an impact on the overall results and there was not any available information on the control structure for either of these facilities.

2.4 Base Mapping

The base map used for the hydrologic and hydraulic model and floodplain mapping was created using ArcInfo technology by converting the City's 2003 bare earth LiDAR data into a triangular irregular network (TIN). The TIN is a three-dimensional representation of the ground topography. The 2003 LiDAR data are the most recent information and were assumed to represent existing conditions. The creation of the hydrologic and hydraulic models is discussed in greater detail in Section 3.

The quality control results, which evaluated the accuracy of the LiDAR TIN, were evaluated as part of a separate project, Salt Creek DFIRM project completed by CDM in December 2007. In summary, the quality control analysis indicated that the data met the National Mapping Accuracy Standards criteria for vertical accuracy as a function of horizontal accuracy, as required in *Appendix A of the FEMA Guidelines and Specifications for Flood Hazard Mapping Partners*. Therefore, the LiDAR data were used for the hydraulic evaluation and mapping process.

2.5 Salt Creek DFIRM Update

The Salt Creek DFIRM project included the development of hydrologic and hydraulic computer models using HEC-HMS 2.2.2 and HEC-RAS 3.1.3, respectively. For the hydraulic modeling, the unsteady option in HEC-RAS was used. For this project, these models were used as a tool to model offline storage at the previously identified locations. Updates to the hydrologic and hydraulic models, as described in Section 3, were completed to more accurately represent the effects of offline storage.

2.6 Groundwater Data Evaluation

Available groundwater data for the Middle and Oak Creek sites were reviewed and evaluated by the project team. The data included two separate groundwater table monitoring efforts. The first measured depth to groundwater on a monthly basis. It spanned from March 1996 to May 2000, with a data gap from May 1998 to May 1999. For this effort, 3 wells were located at the Oak Creek proposed storage site, and 4 were located at the Middle Creek proposed storage site. These are shown in Figures 2-1 and 2-2.

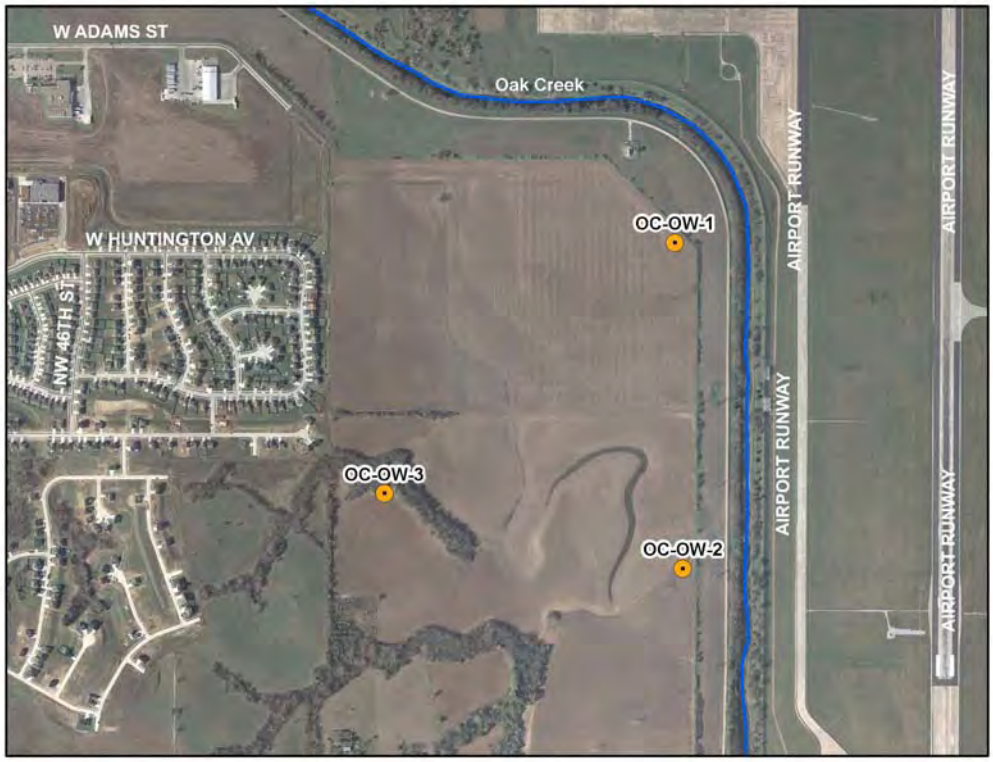

Figure 2-1 Oak Creek Well Monitoring Locations (Monitoring Period 1)

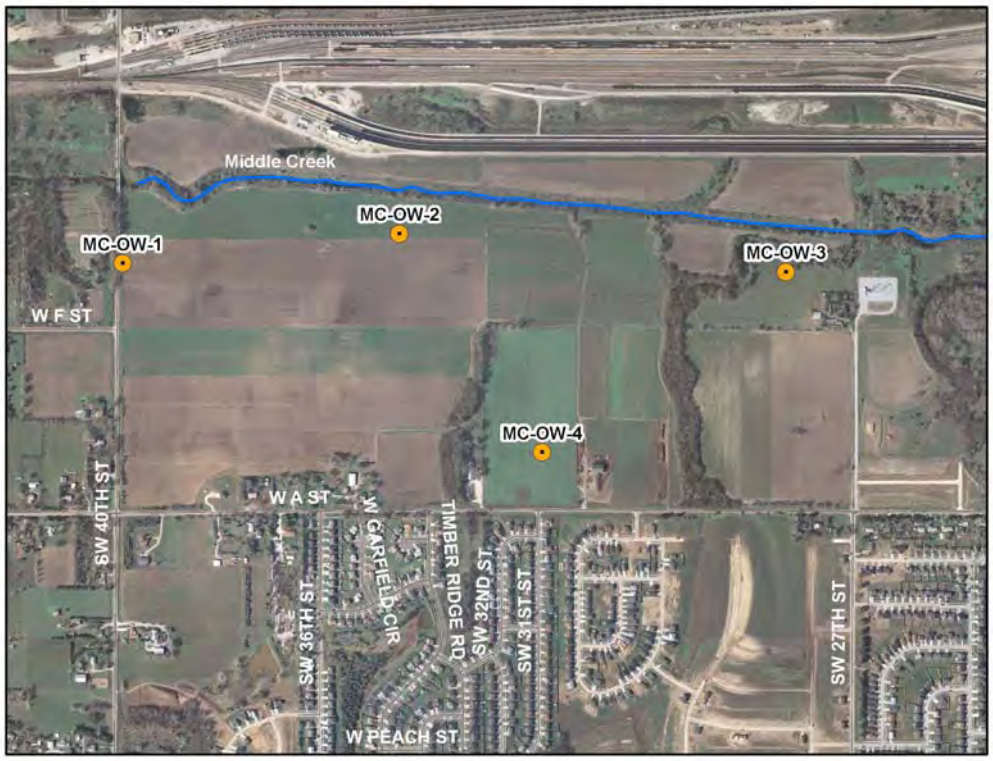

Figure 2-2 Middle Creek Well Monitoring Locations (Monitoring Period 1)

The second monitoring effort was conducted from April 1999 to April 2000. Depth to groundwater was measured in the spring of 1999, the fall of 1999, and spring of 2000. For this effort, 4 wells were located at the Middle Creek proposed storage site. These are shown in Figure 2-3.

Figure 2-3 Middle Creek Well Monitoring Locations (Monitoring Period 2)

In general, the groundwater data indicated that groundwater levels vary throughout the year depending on the amount of rainfall. The first monitoring effort indicated that at the Middle Creek site, the depth to groundwater varied from 1,147 feet to 1,152 feet with an average of 1,150 feet. At the Oak Creek site, similar results were found with the depth to groundwater varied from 1,141 feet to 1,161 feet with an average of 1,148 feet.

The complete analysis of the groundwater data is provided in Appendix D.

2.7 Stream Baseflow

The average monthly stream baseflow was calculated using USGS stream gage data for the gages located on Salt Creek at Pioneers Boulevard (Gage #06803080); Middle Creek at Southwest 40th Street (Gage #06803170); and Oak Creek at Air Park Road (Gage #06803486). These values are listed in Table 2-2. The maximum average stage values were used to establish the offline storage basin bottom elevations in the design of offline storage. Using the stage data in Table 2-2 and LiDAR data the bottom elevations were determined to be 1,146 feet at Middle Creek and 1,140 feet for both sites on Oak Creek.

Table 2-2 Average Monthly Stream Baseflow Values

Salt Creek at Pioneers Boulevard		Middle Creek at Southwest 40th Street		Oak Creek at Air Park Road	
Month	**Average Stage, ft**	**Month**	**Average Stage, ft**	**Month**	**Average Stage, ft**
January	4.1	January	1.3	January	0.9
February	4.2	February	1.4	February	1.0
March	4.3	March	1.4	March	0.9
April	4.5	April	1.4	April	0.9
May	5.5	May	1.8	May	1.1
June	5.0	June	1.7	June	1.0
July	4.2	July	1.3	July	0.7
August	4.0	August	1.2	August	0.9
September	4.0	September	1.2	September	0.8
October	4.0	October	1.2	October	0.9
November	4.1	November	1.3	November	0.9
December	4.1	December	1.3	December	0.9
Yearly Average	4.3	Yearly Average	1.4	Yearly Average	0.9

Maximum Average Monthly Stage shown in shaded cells

2.8 Airport Issues

Lincoln Municipal Airport has and will continue to receive federal funds, which means that they are obligated by grant assurance to identify and mitigate potential hazards to navigable airspace at the airport. Further, it is prudent for the Authority to protect the airspace around the airport to prevent loss of existing approaches or other negative impacts affecting utilization of the airport.

Under FAA guidelines the following shall be completed should the design be carried forward to a preliminary design phase. This would include any and all improvements.

- Coordinate preliminary designs with Lincoln Airport Authority staff for local requirements.
- 7460 forms must be filed during the preliminary design following AC 70/7460-2K. This will give all Departments at FAA Central Region an opportunity to review the proposed improvements.
- Coordinate with AC 150/5200-33 Hazardous Wildlife Attractions on or near Airports and the local wildlife control programs.