Update of Wastewater Facilities Master Plan

November 2007
Adopted March 17, 2008
# TABLE OF CONTENTS

| 1.1 | BACKGROUND | 1-1 |
| 1.2 | PLANNING GOALS AND OBJECTIVES | 1-1 |
| 1.3 | STUDY AREA BOUNDARIES | 1-1 |
| 1.4 | POPULATION PROJECTIONS | 1-2 |
| 1.5 | COLLECTION SYSTEM MODELING | 1-4 |
| 1.6 | COLLECTION SYSTEM IMPROVEMENTS | 1-8 |
| 1.7 | THERESA STREET WWTF IMPROVEMENTS | 1-17 |
| 1.7.1 | Projected Flows | 1-17 |
| 1.7.2 | Summary of Theresa Street WWTF Tier I and II Improvements | 1-17 |
| 1.7.3 | Summary of Theresa Street WWTF Tier III Improvements | 1-17 |
| 1.8 | NE WWTF IMPROVEMENTS | 1-20 |
| 1.8.1 | Summary of NE WWTF Tier I, II, and III Improvements | 1-21 |
| 1.9 | EMERGING WWTF TECHNOLOGIES AND OTHER CONSIDERATION | 1-21 |
| 1.10 | ADDITIONAL RECOMMENDATIONS | 1-24 |
| 1.10.1 | Collection System Operation and Maintenance | 1-24 |
| 1.10.2 | Peak Flow Reduction | 1-26 |
| 1.10.3 | Collection System Flow Monitoring Program | 1-26 |
| 1.10.4 | Hydraulic Modeling | 1-26 |
| 1.10.5 | Industrial Pre-Treatment Program | 1-27 |
| 1.10.6 | Wastewater Lift Stations | 1-27 |
| 1.11 | CIP - PLANNING LEVEL COSTS | 1-27 |
| 1.11.1 | Collection System | 1-27 |
| 1.11.2 | Wastewater Treatment Facilities | 1-27 |
| 1.11.3 | Combined Total Costs | 1-27 |

| 2.1 | BACKGROUND | 2-1 |
| 2.1.1 | History | 2-1 |
| 2.1.2 | Reason for Updating the Wastewater Facilities Master Plan | 2-1 |
| 2.1.3 | 2030 Comprehensive Plan | 2-1 |
| 2.2 | FACTORS THAT AFFECT FACILITIES PLANNING | 2-2 |
| 2.2.1 | Population Increases | 2-2 |
| 2.2.2 | Regulatory Changes | 2-2 |
| 2.2.3 | Condition and Age of Facilities | 2-2 |
| 2.3 | PLANNING GOALS AND OBJECTIVES | 2-3 |
| 2.4 | IDENTIFIED IMPROVEMENTS | 2-3 |
Chapter 3 - PLANNING CONSIDERATIONS ................................................................. 3-1

3.1 GENERAL .............................................................................................................. 3-1
3.2 STUDY LIMITS ...................................................................................................... 3-1
  3.2.1 Geographical Boundaries ........................................................................ 3-1
  3.2.2 Wastewater Drainage Basins .................................................................. 3-1
  3.2.3 Planning Areas ......................................................................................... 3-1
  3.2.4 100 Year Floodplain Areas .................................................................... 3-6
3.3 PLANNING AGENCIES ..................................................................................... 3-6
3.4 EXISTING LAND USAGE ................................................................................... 3-6
3.5 FUTURE LAND USE .......................................................................................... 3-8
3.6 POPULATION ...................................................................................................... 3-8
  3.6.1 Historical Population ............................................................................. 3-8
  3.6.2 Projected Population .............................................................................. 3-9
  3.6.3 Comparison of Land Inventory to Projected Population ....................... 3-10

Chapter 4 - EXISTING COLLECTION SYSTEM .................................................. 4-1

4.1 BACKGROUND .................................................................................................. 4-1
  4.1.1 Existing Collection System .................................................................... 4-1
  4.1.2 Collection System Operation and Maintenance ...................................... 4-5
4.2 WASTEWATER COLLECTION SYSTEM BASINS TRIBUTARY TO THE THERESA STREET WWTF ........................................................................................................... 4-7
  4.2.1 Salt Valley (Salt Creek) ........................................................................... 4-7
  4.2.2 Antelope Creek ....................................................................................... 4-8
  4.2.3 West ‘O’ Street ....................................................................................... 4-8
  4.2.4 Middle Creek ......................................................................................... 4-8
  4.2.5 Haines Branch ....................................................................................... 4-9
  4.2.6 Beal Slough ........................................................................................... 4-9
  4.2.7 Oak Creek .............................................................................................. 4-9
  4.2.8 Lynn Creek ........................................................................................... 4-9
  4.2.9 Little Salt Creek ..................................................................................... 4-10
  4.2.10 East Campus ....................................................................................... 4-10
4.3 WASTEWATER COLLECTION SYSTEM BASINS TRIBUTARY TO THE NORTHEAST WWTF ........................................................................................................... 4-11
  4.3.1 Deadmans Run ....................................................................................... 4-11
  4.3.2 Havelock ................................................................................................. 4-11
  4.3.3 Stevens Creek ....................................................................................... 4-11
4.4 WASTEWATER LIFT STATIONS ................................................................... 4-12
  4.4.1 General Summary ................................................................................... 4-12
  4.4.2 Wastewater Lift Station Telemetry ........................................................ 4-13
  4.4.3 Lift Station Operation and Maintenance .............................................. 4-13
Chapter 5 - EXISTING WASTEWATER TREATMENT FACILITIES

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>THERESA STREET WWTF</td>
<td>5-1</td>
</tr>
<tr>
<td>5.1.1</td>
<td>Overview</td>
<td>5-1</td>
</tr>
<tr>
<td>5.1.2</td>
<td>Liquid Treatment</td>
<td>5-10</td>
</tr>
<tr>
<td>5.1.3</td>
<td>Biosolids Treatment</td>
<td>5-10</td>
</tr>
<tr>
<td>5.1.4</td>
<td>Odor Control</td>
<td>5-12</td>
</tr>
<tr>
<td>5.1.5</td>
<td>Recently Completed Improvements</td>
<td>5-12</td>
</tr>
<tr>
<td>5.1.6</td>
<td>Historical Influent Flows</td>
<td>5-13</td>
</tr>
<tr>
<td>5.1.7</td>
<td>Historical Influent Quality</td>
<td>5-16</td>
</tr>
<tr>
<td>5.1.8</td>
<td>Treatment Facility Performance</td>
<td>5-17</td>
</tr>
<tr>
<td>5.1.9</td>
<td>Discharge Permit</td>
<td>5-20</td>
</tr>
<tr>
<td>5.1.10</td>
<td>Future Capacity</td>
<td>5-20</td>
</tr>
<tr>
<td>5.2</td>
<td>NORTHEAST WWTF</td>
<td>5-24</td>
</tr>
<tr>
<td>5.2.1</td>
<td>Overview</td>
<td>5-24</td>
</tr>
<tr>
<td>5.2.2</td>
<td>Liquid Treatment</td>
<td>5-31</td>
</tr>
<tr>
<td>5.2.3</td>
<td>Odor Control</td>
<td>5-31</td>
</tr>
<tr>
<td>5.2.4</td>
<td>Biosolids Treatment</td>
<td>5-33</td>
</tr>
<tr>
<td>5.2.5</td>
<td>Recently Completed Improvements</td>
<td>5-33</td>
</tr>
<tr>
<td>5.2.6</td>
<td>Historical Influent Flows</td>
<td>5-34</td>
</tr>
<tr>
<td>5.2.7</td>
<td>Historical Influent Quality</td>
<td>5-37</td>
</tr>
<tr>
<td>5.2.8</td>
<td>Treatment Facility Performance</td>
<td>5-41</td>
</tr>
<tr>
<td>5.2.9</td>
<td>Discharge Permit</td>
<td>5-42</td>
</tr>
<tr>
<td>5.2.10</td>
<td>Future Capacity</td>
<td>5-43</td>
</tr>
<tr>
<td>5.3</td>
<td>COMPARISON OF WATER USAGE TO WASTEWATER FLOW</td>
<td>5-45</td>
</tr>
<tr>
<td>5.4</td>
<td>HISTORICAL PER CAPITA WASTEWATER FLOW</td>
<td>5-46</td>
</tr>
<tr>
<td>5.5</td>
<td>INDUSTRIAL CONTRIBUTIONS</td>
<td>5-46</td>
</tr>
</tbody>
</table>

Chapter 6 - REGULATORY REQUIREMENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>CURRENT REGULATORY REQUIREMENTS</td>
<td>6-1</td>
</tr>
<tr>
<td>6.1.1</td>
<td>Surface Water Quality Standards</td>
<td>6-1</td>
</tr>
<tr>
<td>6.1.2</td>
<td>Effluent Discharge Permitting System</td>
<td>6-2</td>
</tr>
<tr>
<td>6.1.3</td>
<td>Residuals Disposal Regulations</td>
<td>6-5</td>
</tr>
<tr>
<td>6.1.4</td>
<td>Air Permits</td>
<td>6-8</td>
</tr>
<tr>
<td>6.1.5</td>
<td>Stormwater Permits</td>
<td>6-9</td>
</tr>
<tr>
<td>6.2</td>
<td>EVOLVING REGULATIONS</td>
<td>6-9</td>
</tr>
<tr>
<td>6.2.1</td>
<td>Effluent Limits</td>
<td>6-9</td>
</tr>
<tr>
<td>6.2.2</td>
<td>Biosolids Use and Disposal Regulations</td>
<td>6-11</td>
</tr>
</tbody>
</table>

Chapter 7 - BASIS FOR ALTERNATIVE EVALUATIONS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>GENERAL</td>
<td>7-1</td>
</tr>
<tr>
<td>7.2</td>
<td>ECONOMIC EVALUATION</td>
<td>7-1</td>
</tr>
<tr>
<td>7.2.1</td>
<td>Probable Opinion of Estimated Costs</td>
<td>7-1</td>
</tr>
<tr>
<td>7.2.2</td>
<td>Future Costs</td>
<td>7-1</td>
</tr>
<tr>
<td>7.2.3</td>
<td>Assigning Costs</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.4</td>
<td>Contingencies</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.5</td>
<td>Collection System Costs</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.6</td>
<td>Wastewater Treatment Facility Costs</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.7</td>
<td>Summary or Recommendation</td>
<td>7-2</td>
</tr>
</tbody>
</table>
Chapter 12 - BEAL SLOUGH BASIN

12.1 BEAL SLOUGH TRUNK SEWER SYSTEM

12.2 EXISTING CONDITIONS

12.2.1 Model Results

12.2.2 Improvements

12.3 TIER I CONDITIONS

12.3.1 Model Results

12.3.2 Alternative Identification

12.4 SUMMARY OF RECOMMENDED IMPROVEMENTS

Chapter 13 - UPPER SOUTHEAST SALT CREEK BASIN

13.1 UPPER SOUTHEAST TRUNK SEWER SYSTEM

13.2 MODELING RESULTS

13.2.1 Tier I Conditions

13.2.2 Tier II Conditions

13.3 IMPROVEMENTS

13.3.1 Tier I Improvements

13.3.2 Tier II Improvements

13.4 SUMMARY OF RECOMMENDED IMPROVEMENTS

Chapter 14 - UPPER SOUTHWEST SALT CREEK BASIN

14.1 UPPER SOUTHWEST TRUNK SEWER SYSTEM

14.2 MODELING RESULTS

14.2.1 Tier I Conditions

14.2.2 Tier II Conditions

14.2.3 Tier III Conditions

14.3 IMPROVEMENTS

14.3.1 Tier I Improvements

14.3.2 Tier II Improvements

14.3.3 Tier III Improvements

14.4 SUMMARY OF RECOMMENDED IMPROVEMENTS

Chapter 15 - HAINES BRANCH BASIN

15.1 HAINES BRANCH TRUNK SEWER SYSTEM

15.2 MODELING RESULTS

15.2.1 Existing Conditions

15.2.2 Tier I Conditions

15.2.3 Tier II Conditions

15.2.4 Tier III Conditions

15.3 IMPROVEMENTS

15.3.1 Tier I Improvements

15.3.2 Tier II Improvements

15.3.3 Tier III Improvements

15.4 SUMMARY OF RECOMMENDED IMPROVEMENTS

Chapter 16 - MIDDLE CREEK AND WEST 'O' STREET BASINS
16.1 MIDDLE CREEK AND WEST ‘O’ STREET TRUNK SEWER SYSTEMS ............ 16-1
16.2 MODELING RESULTS .............................................................................. 16-1
  16.2.1 Existing Conditions .............................................................................. 16-1
  16.2.2 Tier I Conditions .................................................................................. 16-5
  16.2.3 Tier II Conditions .................................................................................. 16-6
  16.2.4 Tier III Conditions .................................................................................. 16-6
16.3 IMPROVEMENTS ...................................................................................... 16-7
  16.3.1 Existing Conditions .............................................................................. 16-7
  16.3.2 Tier I Improvements .............................................................................. 16-9
  16.3.3 Tier II Improvements .............................................................................. 16-10
  16.3.4 Tier III Improvements .............................................................................. 16-10
16.4 SUMMARY OF RECOMMENDED IMPROVEMENTS .................................. 16-17

Chapter 17 - OAK CREEK AND LYNN CREEK BASINS................................. 17-1

17.1 TRUNK SEWER SYSTEM ........................................................................... 17-1
17.2 MODELING RESULTS .................................................................................. 17-1
  17.2.1 Existing Conditions .............................................................................. 17-1
  17.2.2 TIER I CONDITIONS ......................................................................... 17-12
  17.2.3 Tier II Conditions .............................................................................. 17-12
  17.2.4 Tier III Conditions .............................................................................. 17-12
17.3 IMPROVEMENTS ...................................................................................... 17-13
  17.3.1 Existing Improvements ........................................................................ 17-13
  17.3.2 Tier I Improvements .............................................................................. 17-13
  17.3.3 Tier II Improvements .............................................................................. 17-14
  17.3.4 Tier III Improvements .............................................................................. 17-14
17.4 SUMMARY OF RECOMMENDED IMPROVEMENTS .................................. 17-18

Chapter 18 - LITTLE SALT CREEK BASIN.................................................. 18-1

18.1 LITTLE SALT CREEK TRUNK SEWER SYSTEM ..................................... 18-1
18.2 MODELING RESULTS .................................................................................. 18-1
  18.2.1 Existing Conditions .............................................................................. 18-1
  18.2.2 Tier I Conditions .................................................................................. 18-3
  18.2.3 Tier II Conditions .................................................................................. 18-3
  18.2.4 Tier III Conditions .................................................................................. 18-3
18.3 IMPROVEMENTS ...................................................................................... 18-3
  18.3.1 Existing Conditions .............................................................................. 18-4
  18.3.2 Tier I Improvements .............................................................................. 18-4
  18.3.3 Tier II Improvements .............................................................................. 18-4
  18.3.4 Tier III Improvements .............................................................................. 18-4
18.4 SUMMARY OF RECOMMENDED IMPROVEMENTS .................................. 18-9

Chapter 19 - DEADMANS RUN, EAST CAMPUS, AND HAVELOCK BASINS...... 19-1

19.1 TRUNK SEWER SYSTEMS ....................................................................... 19-1
19.2 MODELING RESULTS .................................................................................. 19-1
  19.2.1 Existing Conditions .............................................................................. 19-1
  19.2.2 Tier I Conditions .................................................................................. 19-8
19.3 IMPROVEMENTS ...................................................................................... 19-8
  19.3.1 Existing Conditions .............................................................................. 19-8
Chapter 24 - WASTEWATER TREATMENT FACILITIES FUTURE IMPROVEMENTS

24.1 INTRODUCTION

24.2 THERESA STREET WWTF - FUTURE IMPROVEMENTS
   24.2.1 Current Through Tier II Improvements
   24.2.2 Recent and Current Improvements
   24.2.3 Tier I Improvements - Current and Recommended
   24.2.4 Tier II Improvements
   24.2.5 Tier III Improvements
   24.2.6 Summary of Tier III Improvements
   24.2.7 Summary of Theresa Street WWTF Improvements

24.3 NORTHEAST STREET WWTF
   24.3.1 Overview
   24.3.2 Tier I Improvements
   24.3.3 Tier II Improvements
   24.3.4 Tier III Improvements
   24.3.5 Summary of NE WWTF Improvements

24.4 EMERGING WASTEWATER TREATMENT TECHNOLOGIES AND OTHER CONSIDERATIONS

24.5 SUMMARY OF IDENTIFIED WWTF IMPROVEMENTS

Chapter 25 - ADDITIONAL RECOMMENDATIONS

25.1 GENERAL

25.2 COLLECTION SYSTEM OPERATION AND MAINTENANCE

25.3 PEAK FLOW REDUCTION
   25.3.1 I/I Flow Reduction
   25.3.2 Foundation Drains - Sump Pumps
   25.3.3 Service Lateral Repairs
   25.3.4 Low Flow Plumbing Devices

25.4 COLLECTION SYSTEM FLOW MONITORING PROGRAM
   25.4.1 Components of Wastewater Flows
   25.4.2 Need for Flow Monitoring Program

25.5 INDUSTRIAL PRE-TREATMENT PROGRAM

Chapter 26 - SUMMARY OF PLANNING COSTS AND PHASING

26.1 GENERAL

26.2 SUMMARY OF ESTIMATED IMPROVEMENT COSTS
   26.2.1 Collection System
   26.2.2 Wastewater Treatment Facilities

26.3 OVERVIEW

APPENDIX A - History of Wastewater Collection and Treatment in Lincoln
APPENDIX B - Abbreviations
APPENDIX C - Wastewater Lift Stations
APPENDIX D - Hydraulic Model Results
APPENDIX E - WWTF Process and Equipment Identification
APPENDIX F - Theresa Street and Northeast WWTF’s Discharge Permits
APPENDIX G - Industrial Audit (FY 2005/2006)
APPENDIX H - Air Permit for Theresa Street WWTF
APPENDIX I - Stormwater Permits for Both WWTF’s
APPENDIX J - Biosolids Agreement and 2006 Reports
APPENDIX L - Theresa Street WWTF Odor Abatement Study
APPENDIX M - Theresa Street WWTF Hydraulic Profile Calculations

LIST OF TABLES

Table 1.1 Population Projections from 2005 to 2060 \(^{(1)}\) ................................................ 1-4
Table 1.2 Modeled Theresa Street WWTF Drainage Areas \(^{(1,2)}\) ........................................... 1-5
Table 1.3 Modeled NE WWTF Drainage Areas \(^{(1,2)}\) .............................................................. 1-8
Table 1.4 Summary of Collection System Pipeline Improvements \(^{(1)}\) ................................. 1-9
Table 1.5 Summary of Collection System Storage Improvements \(^{(1)}\) ............................ 1-10
Table 1.6 Summary of Tier III Planning Level Costs .................................................. 1-20
Table 1.7 Summary of Collection System Improvement Costs \(^{(1)}\) ............................. 1-28
Table 1.8 Summary of Wastewater Treatment Facility Improvement Costs \(^{(1,2)}\) ........ 1-29
Table 1.9 Total of Collection and WWTF Improvements Costs \(^{(1,2)}\) ......................... 1-29
Table 3.1 Historical Population From 1880 to 1980 \(^{(1)}\) .................................................. 3-9
Table 3.2 Population Projections from 2005 to 2060 \(^{(1)}\) ............................................... 3-10
Table 3.3 Acreage Calculations Based on Population ............................................. 3-11
Table 4.1 Historical Length of Sanitary Sewer Pipe Installed .................................... 4-2
Table 4.2 Increase in Existing Wastewater Drainage Basin Areas .............................. 4-3
Table 4.3 Existing Collection System Operations and Maintenance Requirements .... 4-5
Table 4.4 Summary of Wastewater Lift Stations ......................................................... 4-12
Table 5.1 Rated Capacity of the Theresa Street WWTF ............................................ 5-8
Table 5.2 Theresa Street WWTF Secondary Treatment Summary ............................ 5-10
Table 5.3 Theresa Street WWTF Annual Biosolids Land Application Volumes ........ 5-12
Table 5.4 Theresa Street WWTF Historical Influent Flows ........................................... 5-13
Table 5.5 Theresa Street WWTF Average Influent Loading Concentrations ............... 5-16
Table 10.1  Salt Valley Trunk Sewer System Existing and Future Tributary Areas...... 10-4
Table 10.2  Surcharged Pipes Salt Valley System - Tier I Conditions......................... 10-6
Table 10.3  Results of Flow Maximization of Existing System................................ 10-9
Table 10.4  Simulation Results of Storage with Flow Maximization.......................... 10-11
Table 10.5  Comparison of d/D Ratios for various I/I Flow Reduction Target Levels .. 10-16
Table 10.6  Manholes with Modeled SSO’s Under Tier II Conditions.......................... 10-18
Table 10.7A Surcharged Pipes Salt Valley System - Tier II Conditions...................... 10-19
Table 10.7B Surcharged Pipes Salt Valley System - Tier II Conditions...................... 10-20
Table 10.7C Surcharged Pipes Salt Valley System - Tier II Conditions...................... 10-21
Table 10.8  Recommended Improvements - Salt Valley Trunk Sewer System .......... 10-29
Table 11.1  Antelope Creek Trunk Sewer System Modeling Areas (ac) (1,2)............... 11-1
Table 11.2  Surcharged Pipes - Existing Conditions - Antelope Creek Trunk Sewer .... 11-3
Table 11.3  Surcharged Pipes - Tier I Conditions - Antelope Creek Trunk Sewer ...... 11-10
Table 11.4  Recommended Improvements - Antelope Creek Trunk Sewer ................ 11-12
Table 12.1  Beal Slough Trunk Sewer Tributary Areas (ac) (1,2) Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska.............................. 12-1
Table 12.2  Surcharged Pipes - Tier I Conditions....................................................... 12-4
Table 12.3  Recommended Improvements - Beal Slough Trunk Sewer System.......... 12-8
Table 13.1  Service Area and Flows - Upper Southeast Basin (1,2) ......................... 13-1
Table 13.2  Upper Southeast Basin Tier I Modeling Results.................................... 13-3
Table 13.3  Design Characteristics of Proposed Sewers - Upper SE Basin............... 13-6
Table 13.4  Modeling Results of Proposed Sewers - Upper Southeast Basin............ 13-6
Table 13.5  Recommended Improvements - Upper Southeast Basin ......................... 13-8
Table 14.1  Service Areas and Flows - Upper Southwest Basin ............................... 14-1
Table 14.2  Design Characteristics of Proposed Sewers - Upper SW Basin.............. 14-4
Table 14.3  Modeling Results of Proposed Sewers - Upper Southwest Basin ............ 14-5
<table>
<thead>
<tr>
<th>Table Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 17.7</td>
<td>Recommended Improvements - Oak and Lynn Creek Basins</td>
<td>17-22</td>
</tr>
<tr>
<td>Table 18.1</td>
<td>Service Areas and Flows - Little Salt Creek Basin</td>
<td>18-1</td>
</tr>
<tr>
<td>Table 18.2</td>
<td>Design Characteristics of Proposed Sewers - Little Salt Basin</td>
<td>18-5</td>
</tr>
<tr>
<td>Table 18.3</td>
<td>Modeling Results of Proposed Sewers - Little Salt Basin</td>
<td>18-6</td>
</tr>
<tr>
<td>Table 18.4</td>
<td>Recommended Improvements – Little Salt Creek Basin</td>
<td>18-10</td>
</tr>
<tr>
<td>Table 19.1</td>
<td>Service Area and Flows - Deadmans Run, East Campus, &amp; Havelock Basins</td>
<td>19-1</td>
</tr>
<tr>
<td>Table 19.2</td>
<td>Surcharged Pipes - Existing Conditions- Deadmans Run Basin Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska</td>
<td>19-5</td>
</tr>
<tr>
<td>Table 19.3</td>
<td>Comparison of d/D Ratios for I/I Flow Reduction Target Levels - Deadmans Run Basin</td>
<td>19-9</td>
</tr>
<tr>
<td>Table 20.1</td>
<td>Service Areas and Flows - Northeast Salt Creek Basin</td>
<td>20-1</td>
</tr>
<tr>
<td>Table 20.2</td>
<td>Un-Developable Areas in Northeast Salt Creek Basin</td>
<td>20-1</td>
</tr>
<tr>
<td>Table 20.3</td>
<td>Northeast Salt Creek Tier I Phased Basin Development Plan</td>
<td>20-3</td>
</tr>
<tr>
<td>Table 20.5</td>
<td>Design Characteristics of Proposed Sewers - Northeast Salt Creek Basin</td>
<td>20-8</td>
</tr>
<tr>
<td>Table 20.6</td>
<td>Modeling Results of Proposed Sewers - Northeast Salt Creek Basin</td>
<td>20-9</td>
</tr>
<tr>
<td>Table 20.7</td>
<td>Recommended Improvements – Northeast Salt Creek Basin</td>
<td>20-11</td>
</tr>
<tr>
<td>Table 21.1</td>
<td>Service Areas and Flows - Stevens Creek Basin</td>
<td>21-1</td>
</tr>
<tr>
<td>Table 21.2</td>
<td>Design Characteristics of Proposed Sewers - Stevens Creek Basin</td>
<td>21-7</td>
</tr>
<tr>
<td>Table 21.3</td>
<td>Modeling Results of Proposed Sewers - Stevens Creek Basin</td>
<td>21-10</td>
</tr>
<tr>
<td>Table 21.4</td>
<td>Recommended Improvements – Stevens Creek Basin</td>
<td>21-15</td>
</tr>
<tr>
<td>Table 21.5</td>
<td>Recommended Improvements – Stevens Creek Basin</td>
<td>21-16</td>
</tr>
<tr>
<td>Table 21.6</td>
<td>Recommended Improvements – Stevens Creek Basin</td>
<td>21-17</td>
</tr>
<tr>
<td>Table 21.7</td>
<td>Recommended Improvements – Stevens Creek Basin</td>
<td>21-18</td>
</tr>
<tr>
<td>Table 22.1</td>
<td>Service Areas and Flows - Southeast Basin</td>
<td>22-1</td>
</tr>
</tbody>
</table>
Table 22.2  Design Characteristics of Proposed Sewers - Southeast Basin .......... 22-4
Table 22.3  Modeling Results of Proposed Sewers - Southeast Basin .............. 22-4
Table 22.4  Recommended Improvements – Southeast Basin .......................... 22-7
Table 23.1  Summary of Collection System Pipeline Improvements (1) .......... 23-1
Table 23.2  Summary of Collection System Storage Improvements (1) .......... 23-7
Table 23.3  Modeled Theresa Street WWTF Drainage Areas (1,2) ................. 23-14
Table 23.4  Modeled NE WWTF Drainage Areas (1,2) ...................................... 23-16
Table 24.1  Modeled Tier III Theresa Street and SW WWTF Drainage Areas (1,2) ........ 24-8
Table 24.2  New SW WWTF - Tier III Alternative 1 ........................................ 24-9
Table 24.3  New West Side Salt Creek Trunk Sewer - Tier III Alternative 2 .... 24-12
Table 24.4  Parallel East Side Salt Creek Trunk Sewer - Tier III Alternative 3 .... 24-13
Table 24.5  Increased Storage - Tier III Alternative 4 ....................................... 24-14
Table 24.6  Summary of Tier III Planning Level Costs ................................... 24-17
Table 24.7  Recommended Improvements – Theresa Street Wastewater Treatment Facility .......................................................... 24-27
Table 24.8  Recommended Improvements – Northeast Wastewater Treatment Facility .......................................................... 24-28
Table 25.1  Collection System Projected Cleaning and Videoing Crew Needs .... 25-2
Table 26.1  Summary of Collection System Improvement Costs (1) ............... 26-2
Table 26.2  Summary of Wastewater Treatment Facility Improvement Costs (1,2) ............ 26-2
Table 26.3  Comparison of City CIP and Master Plan Update Costs for Tier I Period (1,2) ................. 26-3

LIST OF FIGURES

Figure 1.1 - Study Area Boundaries .................................................................. 1-3
Figure 1.2 - Modeled Peak Collection System Flows at Theresa Street WWTF ...... 1-6
Figure 8.3 - Theresa Street WWTF Ratio of Instantaneous Flow and Peak Wet Weather Flow ................................................................. 8-12

Figure 8.4 - Beal Slough Ratio of Instantaneous Flow and Peak Wet Weather Flow ................................................................. 8-13

Figure 10.1 - Salt Valley Basin Trunk Sewer System ................................................................. 10-2

Figure 10.2 - Locations of Pipes with Velocities <= 2.0 ft/sec - Existing Conditions ............ 10-3

Figure 10.3 - Location of Surcharged Pipes - Tier I Conditions ........................................... 10-7

Figure 10.4 - Hydraulic Profile of Surcharged Pipes - Tier I Conditions.............................. 10-8

Figure 10.5 - Modeled Water Surface Levels With and Without Flow Maximization - Tier I Conditions ........................................................................................................ 10-10

Figure 10.6 - Location of Modeled Storage - Tier I Conditions ............................................ 10-12

Figure 10.7 - Comparison of Water Surface Elevations - Tier I Conditions ......................... 10-14

Figure 10.8 - Comparison of Water Surface Elevation for Various I/I Flow Reduction Target Levels - Tier I Conditions ................................................................. 10-17

Figure 10.9 - Locations of Surcharged Pipes - Tier II Conditions ......................................... 10-22

Figure 10.10 - Hydraulic Profile of Surcharged Pipes - Tier II Conditions ......................... 10-23

Figure 10.11 - Comparison of Water Surface Elevations for Various I/I Flow Reduction Target Levels - Tier II Conditions ......................................................... 10-25

Figure 10.12 - Location of Storage with 20% I/I Flow Reduction - Tier II Conditions ....... 10-26

Figure 10.13 - Hydraulic Profile - Tier II Conditions with Storage Improvements ............... 10-27

Figure 11.1 - Antelope Basin Trunk Sewer System ................................................................. 11-2

Figure 11.2 - Location of Surcharged Pipes - Antelope Creek Trunk Sewer - Existing Conditions ........................................................................................................ 11-4

Figure 11.3 - Hydraulic Profile of Surcharged Pipes - Antelope Creek Trunk Sewer - Existing Conditions ..................................................................................... 11-5

Figure 11.4 - Locations of Pipes with Velocities <= 2.0 ft/sec - Antelope Creek Trunk Sewer - Existing Conditions .............................................................................. 11-7

Figure 11.5 - Location of Surcharged Pipes - Antelope Creek Trunk Sewer - Tier I Conditions ........................................................................................................ 11-8
Figure 11.6 - Hydraulic Profile of Surcharged Pipes - Antelope Creek Trunk Sewer - Tier I Conditions

Figure 12.1 - Beal Slough Trunk Sewer System

Figure 12.2 - Location of Pipes with Velocities <=2.0 ft/sec - Existing Conditions

Figure 12.3 - Location of Surcharged Pipes - Tier I Conditions

Figure 13.1 - Upper Southeast Salt Creek Basin Map

Figure 13.2 - Proposed Tier I and II Sewer Improvements - Upper Southeast Basin

Figure 14.1 - Upper Southwest Basin Map

Figure 14.2 - Proposed Sewer Improvements - Upper Southwest Basin

Figure 15.1 - Haines Branch Basin Map

Figure 15.2 - Proposed Sewer Improvements - Haines Branch Trunk Sewer System

Figure 16.1 - Middle Creek and West ‘O’ Street Trunk Sewer System

Figure 16.2 - Location of Surcharged Pipes - Existing Conditions

Figure 16.3 - Proposed Sewer Improvements - West ‘O’ St and Middle Creek Basins

Figure 17.1 - Oak Creek Basin Schematic

Figure 17.2 - Lynn Creek Basin Schematic

Figure 17.3 - Surcharged Pipes - Oak and Lynn Creek Basins - Existing Conditions

Figure 17.4A - Hydraulic Profile Surcharged Pipes - Oak Creek Basin - Existing Conditions

Figure 17.4B - Hydraulic Profile Surcharged Pipes - Oak Creek Basin - Existing Conditions

Figure 17.5 - Hydraulic Profile of Surcharged Pipes- Existing Conditions - Lynn Creek

Figure 17.6 - Proposed Sewer Improvements - Oak Creek Basin

Figure 18.1 - Little Salt Creek Basin Map

Figure 18.2 - Proposed Sewer Improvements - Little Salt Creek Basin

Figure 18.3 - Proposed Sewer Improvements with Storage Alternative - Little Salt Creek Basin
Figure 19.1 - Deadmans Run Trunk Sewer System ........................................................ 19-2
Figure 19.2 - East Campus Trunk Sewer System ......................................................... 19-3
Figure 19.3 - Havelock Basin Trunk Sewer System ...................................................... 19-4
Figure 19.4 - Surcharged Pipes - Existing Conditions - Deadmans Run, East Campus, and Havelock Basins ........................................................... 19-6
Figure 19.5 - Hydraulic Profile of Surcharged Pipes - Existing Conditions - Deadmans Run Trunk Sewer ........................................................... 19-7
Figure 19.6 - Locations of Pipes with Velocities <= 2.0 ft/sec - Existing Conditions - Deadmans Run, East Campus, and Havelock Basins ................. 19-11
Figure 20.1 - Basin Map - Northeast Salt Creek .............................................................. 20-2
Figure 20.2 - Hydraulic Profile of Surcharged Pipes - Northeast Basin - Deadmans Run 20-4
Figure 20.3 - Proposed Sewer Improvements - Northeast Salt Creek....................... 20-7
Figure 21.1 - Stevens Creek Basin Map ....................................................................... 21-2
Figure 21.2 - Hydraulic Profile - Stevens Creek Trunk Sewer - Existing Conditions .... 21-3
Figure 21.3 - Proposed Sewer Improvements - Stevens Creek Trunk Sewer System .... 21-5
Figure 22.1 - Southeast Basin Map .............................................................................. 22-2
Figure 22.2 - Proposed Sewer Improvements – Southeast Basin ............................... 22-5
Figure 23.1 - Planning Area Tier I Improvements .......................................................... 23-3
Figure 23.2 - Planning Area Tier II Improvements ....................................................... 23-4
Figure 23.3 - Planning Area Tier III Improvements ...................................................... 23-5
Figure 23.4 - Planning Area Storage Improvements ..................................................... 23-6
Figure 23.5 - Schematic Drawing of Storage Facilities .................................................. 23-8
Figure 23.6 - General Layout of Storage Facilities ........................................................ 23-9
Figure 23.7- Planning Level O&M Costs for Storage Facilities ................................... 23-11
Figure 23.8 - Modeled Peak Flows at Theresa Street WWTF ...................................... 23-15
Figure 23.9 - Modeled Peak Flows at NE WWTF ....................................................... 23-17
Figure 24.1 - Existing WWTF Service Areas ............................................................... 24-2

November 2007 xix
Figure 24.2 - Theresa Street WWTF Projected MMAD Flows ........................................ 24-3
Figure 24.3 - Theresa Street WWTF Aerial Photo with Future Tier I and II Improvements ................................................................. 24-4
Figure 24.4 - Proposed Southwest WWTF Service Area - Alternative 1 ...................... 24-10
Figure 24.5 - West Side Salt Creek Trunk Sewer - Alternative 2 .................................. 24-11
Figure 24.6 - Parallel East Side Salt Creek Trunk Sewer - Alternative 3 ....................... 24-15
Figure 24.7 - Increased Storage - Alternative 4 ............................................................ 24-16
Figure 24.8 - Theresa Street WWTF Tier III Improvements Area .............................. 24-18
Figure 24.9 - Northeast WWTF Projected MMAD Flows ........................................... 24-21
Figure 24.10 - Northeast WWTF Future Improvements ............................................. 24-22
Figure 24.11 - General Layout of WWTF Facilities ..................................................... 24-26
Figure 25.1 - Collection System Projected Maintenance Crew Requirements ............... 25-3
Figure 25.2 - Proposed Locations for Flow Monitoring Facilities .............................. 25-10
Figure 26.1 - Annual Cost of Collection System Improvements .................................. 26-4
Figure 26.2 - Annual Cost of Theresa Street & Northeast WWTF Improvements .......... 26-5
Figure 26.3 - Summary of Annual Improvements ....................................................... 26-6