

**CITY OF LOVELAND
STORM DRAINAGE CRITERIA
(ADDENDUM TO THE
URBAN STORM DRAINAGE CRITERIA MANUALS
VOLUMES 1, 2, AND 3)**

Prepared by: RESPEC, Inc.

Date: July 31, 2020

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PREFACE

In 1986 the City of Loveland Master Drainage Plan and Storm Drainage Criteria Manual were completed and adopted. The City of Loveland Storm Drainage Criteria Manual was modeled after the 1969 version of the Urban Drainage & Flood Control District (UD&FCD) in Denver, Colorado. The 1969 version of the Urban Storm Drainage Criteria Manual (USDCM) consisted of Volumes 1 & 2. Many of the local communities outside of the Denver area have since adopted the USDCM as their drainage criteria, even though they were not within the UD&FCD. However, the USDCM was written with the regional concept in mind and provides criteria and design standards for many different conditions within the UD&FCD. Late in the 1990's the UD&FCD began a process to write Volume 3 titled, Best Management Practices, which addresses stormwater quality and erosion control. Upon completion and adoption of Volume 3, the UD&FCD realized that they needed to update Volumes 1 & 2 to bring their criteria manuals current with technology. In July of 2001 the UD&FCD completed and adopted updated Volumes 1 & 2 of their drainage criteria. In 2002, the City of Loveland adopted the USDCM Volumes 1, 2 and 3 with an Addendum relating to City of Loveland's specific needs. An Amendment to the Addendum followed in April 2008 to update the Storage Chapter.

Further revisions by UD&FCD of the USDCM have been made over time. This Addendum is based upon the most recent versions of the USDCM as of December 31, 2019, and supersedes the previous Addendums that have been issued by the City of Loveland. The City of Loveland would like to provide engineering professionals working within the Loveland community with the latest tools and information related to the design of storm drainage infrastructure. The USDCM Volumes 1, 2 and 3 include several Excel Spreadsheets for consistent calculation purposes. In order to provide engineering professionals with the latest tools and information in storm drainage, implement the EPA Phase 2 Stormwater Quality Permit requirements, the City of Loveland has revised the Addendum to maintain consistency with the updated USDCM. The City of Loveland is adopting the USDCM Volumes 1, 2 and 3 with an Addendum relating to City of Loveland needs. The Addendum makes changes to the USDCM Volumes 1, 2 and 3 in order to enable the criteria to become specific to the Loveland community. The USDCM may be viewed and downloaded by visiting the UD&FCD web site at www.udfcd.org or by contacting the UD&FCD at 303-455-6277.

AMENDMENTS AND REVISIONS

The USDCM and Addendum have been prepared utilizing state-of-the-art technology and procedures. Due to the dynamic nature of urban storm drainage, amendments and revisions will be required from time to time as experience is gained in the use of the USDCM and Addendum. Amendments and revisions will be posted within the Stormwater Utility link of the City of Loveland web site at www.cityofloveland.org and on the UD&FCD web site at www.udfcd.org.

Users of the USDCM and Addendum are encouraged to submit their comments, criticism, and errors that are found. Comments can be submitted through the Stormwater Utility link of the City of Loveland web page, by email, or by mailing written comments to:

Kevin Gingery
City of Loveland
Public Works Department – Stormwater Engineering Division
2525 W. 1st Street
Loveland, CO 80537
Kevin.Gingery@CityofLoveland.org

or

Suzette Schaff
City of Loveland
Public Works Department – Stormwater Engineering Division
2525 W. 1st Street
Loveland, CO 80537
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1.0 General Provisions

1.1 Short Title

The USDCM and Addendum together with all future amendments shall be known as the Loveland Storm Drainage Criteria (LSDC).

1.2 Jurisdiction

The LSDC shall apply to all incorporated land within the City of Loveland. Lands within the Urban Growth Area considered for annexation and requiring drainage analysis, shall follow the regulations set forth herein.

1.3 Purpose

Presented in the LSDC are the minimum design and technical criteria for the analysis and design of storm drainage facilities. All new developments, or any other proposed construction submitted for acceptance, shall include adequate storm drainage system analysis and appropriate drainage system design. Such analysis and design shall conform to the criteria set forth herein.

1.4 Enactment Authority

The City of Loveland Municipal Code (CODE) has been adopted pursuant to the authority conferred within Title 31, Article 16 and other applicable sections of CRS 1973 as amended. Title 18, Unified Development Code, ” of the CODE adopts the LSDC by reference.

1.5 Amendment and Revisions

The policies and criteria are basic guidelines which may be amended as new technology is developed and/or experience gained in the use of the LSDC indicate a need for revision. Amendments and revisions will be made through ordinance adoption.

1.6 Enforcement Responsibility

It shall be the duty of the Stormwater Utility Senior Civil Engineer to enforce provisions of the LSDC.

1.7 Interpretation

The Stormwater Utility Senior Civil Engineer is responsible for the interpretation of provisions of the LSDC using the following guidelines:

1. In the interpretation and application, the provisions of the LSDC shall be held as the minimum requirements for promotion of the health, safety, and general welfare of the community.
2. The LSDC is not intended to interfere with, abrogate, or annul any other regulation, statute, or other provision of law.
3. Where any provision of the LSDC impose restrictions different from those imposed by any other provisions of the LSDC or any other regulation, or provision of law, that provision which is more restrictive or imposes higher standards shall govern.
4. The LSDC is not intended to abrogate any easement, covenant, or any other private agreement or restriction, provided that where the provisions of the LSDC are more restrictive or impose higher standards or requirements than such easement, covenant, or other private agreement or restriction, the provisions of these Regulations shall govern.

1.8 Exceptions

The City Council may at its discretion grant exceptions to the regulations of the LSDC in accordance with the provisions of Title 18, Unified Development Code, of the CODE.

2.0 Drainage Planning Submittal Requirements

2.1 Review Process

All new developments within the jurisdiction of the LSDC shall submit drainage reports and drainage plans in accordance with the requirements of this section. For all projects that disturb one acre or more, a separate Stormwater Management Plan (SWMP) is required to be submitted in electronic pdf format to COL for review and acceptance. The SWMP shall be completed in accordance with the Colorado Department of Public Health and Environment requirements.

2.2 Conceptual Drainage Report

The purpose of the Conceptual Drainage Report is to identify and define conceptual solutions to problems, which may occur on-site and off-site as a result of the development. In addition, those problems that exist on-site prior to development must be addressed during the conceptual phase. During the application review period, all reports shall be submitted by electronic means (pdf) in 8 ½" x 11" paper size format with 24" x 36" drainage plans included in the report. . . Once City approval has been granted for the development

application, the submittal of reports and 24” x 36” drainage plans shall be by both electronic means (pdf) and 8 1/2 “ x 11” unbound, hard paper copy, with the 24” x 36” drainage plans included within both forms of the report. The report needs to stand-alone and therefore all important reference material should be copied and included within the report appendix. The report shall include a cover letter presenting the conceptual design for review and shall be prepared by or supervised by an engineer licensed in Colorado. The report shall contain a certification sheet as follows:

“I hereby certify that this report for the conceptual drainage design of (Name of Development) was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Loveland Storm Drainage Criteria for the owners thereof.”

Registered Professional Engineer
State of Colorado No. _____
(Affix Seal)

2.2.1 Report Contents

The Conceptual Drainage Report shall be prepared in accordance with the following outline and contain the applicable information listed:

- I. General Location and Description
 - A. Location
 - 1. Township, range, section, ¼ section.
 - 2. Local streets within and adjacent to the development.
 - 3. Major open channels and facilities.
 - 4. Names of surrounding developments.
 - B. Description of Property
 - 1. Area in acres.
 - 2. Ground cover.
 - 3. Major open channels.
 - 4. General project description.
 - 5. Irrigation facilities.

- II. Drainage Basins and Sub-Basins
 - A. Major Basin Description
 - 1. Reference to City of Loveland Master Drainage Plan.
 - 2. Major basin drainage characteristics
 - 3. Identification of all nearby irrigation facilities within 100- feet of the property boundary.
 - B. Sub-Basin Description
 - 1. Historic drainage patterns on the subject property.
 - 2. Off-site drainage flow patterns and impact on the subject property.

- III. Drainage Facility Design
 - A. General Concept
 - 1. Concept and typical drainage patterns.
 - 2. Compliance with offsite runoff considerations.
 - 3. Anticipated and proposed drainage patterns.

4. Anticipated landscaping and permanent water quality improvements
- B. Specific Details
1. Drainage problems encountered and solutions at specific locations.
 2. Maintenance access and aspects of the design.

2.2.2 Drainage Plan Contents

A General Location Map shall be provided at a scale of 1" = 2000' or larger in sufficient detail to identify upstream off-site drainage areas flowing into the development and general drainage patterns.

A Drainage Plan of the proposed development shall be provided at a scale from 1" = 100' to 1" = 200' on a 24" x 36" drawing. If the entire development can't fit on a single 24" x 36" drawing at the scales listed, an additional drainage plan shall be included drawn at a scale where the entire development fits on one 24" x 36" drawing. The plan shall show the following information:

1. Existing contours at 2-foot maximum intervals.
2. Property lines, lot lines, and easements.
3. Streets with names.
4. Existing drainage facilities, structures, irrigation facilities, and sizes.
5. Overall drainage area boundary and sub-area boundaries.
6. Proposed flow directions using arrows.
7. Conceptual location of storm sewers, swales, open channels, culverts, permanent water quality BMPs, detention ponds, and other appurtenances.
8. Location of all defined 100-year floodplains affecting the property.
9. Any other items so noted within the Drainage Report.

2.3 Preliminary Drainage Report

The purpose of the Preliminary Drainage Report is to identify and define preliminary solutions to problems, which may occur on-site and off-site as a result of the development. In addition, those problems that exist on-site prior to development must be addressed during the preliminary phase. During the application review period, all reports shall be submitted by electronic means (pdf) in 8 1/2" x 11" paper size format with 24" x 36" drainage plans included in the report. . Once City approval has been granted for the development application, the submittal of reports and 24" x 36" drainage plans shall be by both electronic means (pdf) and 8 1/2 " x 11" unbound, hard paper copy, with the 24" x 36" drainage plans included within both forms of the report.

The report needs to stand-alone and therefore all important reference material should be copied and included within the report appendix. The report shall include a cover letter presenting the preliminary design for review and shall be prepared by or supervised by an engineer licensed in Colorado. The report shall contain a certification sheet as follows:

"I hereby certify that this report for the preliminary drainage design of (Name of Development) was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Loveland Storm Drainage Criteria for the owners thereof."

Registered Professional Engineer
State of Colorado No. _____
(Affix Seal)

2.3.1 Report Contents

The Preliminary Drainage Report shall be in accordance with the following outline and contain the applicable information listed:

- I. General Location and Description
 - A. Location
 - 1. Township, range, section, ¼ section.
 - 2. Local streets within and adjacent to the development.
 - 3. Major open channels and facilities.
 - 4. Names of surrounding developments.
 - B. Description of Property
 - 1. Area in acres.
 - 2. Ground cover.
 - 3. Major open channels.
 - 4. General project description.
 - 5. Irrigation facilities.

- II. Drainage Basins and Sub-Basins
 - A. Major Basin Description
 - 1. Reference to City of Loveland Master Drainage Plan.
 - 2. Major basin drainage characteristics.
 - 3. Identification of all nearby irrigation facilities within 100- feet of the property boundary.
 - B. Sub-Basin Description
 - 1. Historic drainage patterns on the subject property.
 - 2. Off-site drainage flow patterns and impacts on the subject development.

- III. Drainage Design Criteria
 - A. Regulations: Discussion of the optional criteria selected or the deviation from the LSDC if any.
 - B. Development Criteria Reference and Constraints
 - 1. Discussion of previous drainage studies (i.e., project master plans) for the subject property that influence or are influenced by the drainage design and how the plan will affect drainage design for the site.
 - 2. Discussion of the drainage impact of site constraints such as street, utilities, existing structures, and development or site plan.
 - C. Hydrological Criteria
 - 1. Identify design rainfall.
 - 2. Identify runoff calculation method.

- a. Rational Method shall be utilized to determine runoff for drainage basins 90 acres or less in size.
 - b. CUHP used for drainage basins over 90 acres in size. CUHP may be used, in addition to the Rational Method calculations, to determine runoff rates from design points consisting of smaller, combined sub-basins that fall under 90 acres for the purpose of routing flows through detention ponds.
 - 3. Identify detention discharge and storage calculation method.
 - 4. Identify design storm recurrence intervals.
 - 5. Discussion and justification of other criteria or calculation methods used that are not presented in or referenced by the LSDC.
 - D. Hydraulic Criteria
 - 1. Identify various capacity references.
 - 2. Identify detention outlet type.
 - 3. Identify check/drop structure criteria used.
 - 4. Discussion of other drainage facility design criteria used that are presented in the LSDC.
- IV. Drainage Facility Design
 - A. General Concept
 - 1. Discussion of concept and typical drainage patterns.
 - 2. Discussion of compliance with off-site runoff considerations.
 - 3. Discussion of the content of tables, charts, figures, or drawings presented in the report.
 - 4. Discussion of anticipated and proposed drainage patterns.
 - 5. Discussion on selection of WQ BMPs
 - B. Specific Details
 - 1. Discussion of drainage problems encountered and solutions at specific design points.
 - 2. Discussion of water quality BMPs and design
 - 3. Discussion of detention storage and outlet design.
 - 4. Discussion of maintenance access and aspects of the design.
 - 5. Discussion of anticipate temporary erosion controls (types and locations) to be used during construction (only include in Final Drainage Report)
- V. Conclusions
 - A. Compliance with the LSDC
 - B. Drainage Concept
 - 1. Effectiveness of drainage design to control damage from storm runoff.
 - 2. Effectiveness of WQ BMPs for water quality enhancement.
 - 3. Influence of proposed development on the City of Loveland Master Drainage Plan recommendations.
 - 4. Approval of affected irrigation company or other property owner to be obtained.
- VI. References

Reference all criteria and technical information used.

VII. Appendices

- A. Hydrology Computations
 1. Land use assumptions regarding adjacent properties.
 2. Initial and major storm runoff computations at specific design points.
 3. Historic and fully developed runoff computations at specific design points.
- B. Hydraulic Computations
 1. Culvert sizing.
 2. Storm sewer sizing.
 3. Street capacity evaluation.
 4. Storm inlet sizing.
 5. Swale sizing.
 6. Open channel sizing.
 7. Check and/or drop structure sizing.
 8. Detention pond area/volume capacity and outlet sizing.
 9. WQ BMP sizing
- C. Checklists
 1. Stormwater Quality BMP Point System Checklist
 2. Sediment/Erosion Control Development Submittal Checklist (with Final Drainage Report)
 3. Site Work Permit Checklist (with Final Drainage Report)

2.3.2 Drainage Plan Contents

A General Location Map shall be provided at a scale of 1" = 2000' or larger in sufficient detail to identify upstream off-site drainage areas flowing into the development and general drainage patterns.

A Drainage Plan of the proposed development shall be provided at a scale from 1" = 100' to 1" = 200' on a 24" x 36" drawing. If the entire development can't fit on a single 24" x 36" drawing at the scales listed, an additional drainage plan shall be included drawn at a scale where the entire development fits on one 24" x 36" drawing. The plan shall show the following information:

1. Existing and proposed contours at 2-foot maximum intervals.
2. Property lines, lot lines, and easements.
3. Streets with names.
4. Existing drainage facilities, structures, irrigation facilities, and sizes.
5. Overall drainage area boundary and sub-area boundaries.
6. Proposed flow directions using arrows.
7. Proposed storm sewers, swales, open channels, culverts, cross-pans, and other appurtenances, including cross-sections of swales and open channels.
8. Proposed outfall point for runoff from the development area and facilities to convey flows to the final outfall point without damage to downstream properties.
9. Routing and accumulation of flows at various critical points for the minor storm runoff.

10. Routing and accumulation of flows at various critical points for the major storm runoff.
11. Detention storage facilities and outlet works, including proposed 100-year water surface elevations.
12. Location and elevations of all defined 100-year floodplains affecting the property.
13. Location of all existing and proposed utilities.
14. Routing of off-site drainage flows through the development.
15. Minimum lowest opening elevations of residential and commercial buildings above the 100-year water surface in streets, open channels, ditches, swales, or other drainage facilities, as illustrated by the preliminary grading plans.
16. Proposed on-site private and public drainage easements.
17. Proposed off-site private and public drainage easements.

2.4 Final Drainage Report

The purpose of the Final Drainage Report is to update the conceptual or preliminary design concepts, and to present the design details for the drainage facilities discussed in the Conceptual or Preliminary Drainage Report. Also, any change to the conceptual or preliminary concept shall be presented.

During the application review process, all reports shall be submitted in electronic form (pdf) in 8 1/2" x 11" paper size format with 24" x 36" drainage plans included in the report. Once City approval has been granted for the development application, the submittal of reports and 24" x 36" drainage plans shall be by both electronic means (pdf) and unbound, hard paper copy, with the 24" x 36" drainage plans included within both forms of the report. All hard copy reports shall be reproduced on 8-1/2" x 11" paper. The 24"x 36" drainage plans shall be included in both the electronic copy and the hard copy report. The report needs to stand-alone and therefore all important reference material should be copied and included within the report appendix. The report shall include a cover letter presenting the final design for review and shall be prepared by or supervised by an engineer licensed in Colorado. The report shall contain a certification sheet as follows:

"I hereby certify that this report for the final drainage design of (Name of Development) was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Loveland Storm Drainage Criteria for the owners thereof."

Registered Professional Engineer
State of Colorado No. _____
(Affix Seal)

The final drainage report shall be prepared in accordance with the outline shown in Section 1.4.1. The report drawings shall follow the requirements presented in Section 1.4.1. Final design hydraulic calculations shall be provided for each of the proposed elements of the final drainage design.

2.4.1 Report Contents

The Final Drainage Report shall be in accordance with the following outline and contain the applicable information listed:

- I. General Location and Description
 - A. Location
 1. Township, range, section, ¼ section.
 2. Local streets within and adjacent to the development.
 3. Major open channels and facilities.
 4. Names of surrounding developments.
 - B. Description of Property
 1. Area in acres.
 2. Ground cover.
 3. Major open channels.
 4. General project description.
 5. Irrigation facilities.

- II. Drainage Basins and Sub-Basins
 - A. Major Basin Description
 1. Reference to City of Loveland Master Drainage Plan.
 2. Major basin drainage characteristics.
 3. Identification of all nearby irrigation facilities within 100- feet of the property boundary.
 - B. Sub-Basin Description
 1. Historic drainage patterns on the subject property.
 2. Off-site drainage flow patterns and impacts on the subject development.

- III. Drainage Design Criteria
 - A. Regulations: Discussion of the optional criteria selected or the deviation from the LSDC if any.
 - B. Development Criteria Reference and Constraints
 1. Discussion of previous drainage studies (i.e., project master plans) for the subject property that influence or are influenced by the drainage design and how the plan will affect drainage design for the site.
 2. Discussion of the drainage impact of site constraints such as street, utilities, existing structures, and development or site plan.
 - C. Hydrological Criteria
 1. Identify design rainfall.
 2. Identify runoff calculation method
 - a. Rational Method shall be utilized to determine runoff for drainage basins 90 acres or less in size.
 - b. CUHP used for drainage basins over 90 acres in size. CUHP may be used, in addition to the Rational Method calculations, to determine runoff rates from design points consisting of smaller, combined sub-basins that fall under 90 acres for the purpose of routing flows through detention ponds.

3. Identify detention discharge and storage calculation method.
 4. Identify design storm recurrence intervals.
 5. Discussion and justification of other criteria or calculation methods used that are not presented in or referenced by the LSDC.
- D. Hydraulic Criteria
1. Identify various capacity references.
 2. Identify detention outlet type.
 3. Identify check/drop structure criteria used.
 4. Discussion of other drainage facility design criteria used that are presented in the LSDC.
- IV. Drainage Facility Design
- A. General Concept
1. Discussion of concept and typical drainage patterns.
 2. Discussion of compliance with off-site runoff considerations.
 3. Discussion of the content of tables, charts, figures, or drawings presented in the report.
 4. Discussion of anticipated and proposed drainage patterns.
 5. Discussion on selection of WQ BMPs
- B. Specific Details
1. Discussion of drainage problems encountered and solutions at specific design points.
 2. Discussion of water quality BMPs and design
 3. Discussion of detention storage and outlet design.
 4. Discussion of maintenance access and aspects of the design.
 5. Discussion of anticipate temporary erosion controls (types and locations) to be used during construction (only include in Final Drainage Report)
- V. Sediment, Erosion Control and Stormwater Quality
- A. Temporary Sediment and Erosion Control
1. Discussion on the selection of temporary sediment and erosion control devices and methods that will be used to mitigate sediment and erosion on and off of the site.
- B. Permanent Water Quality BMPs.
1. Discussion on the selection of permanent water quality BMPs.
 2. Discussion on why each permanent water quality BMP has been specifically selected for the development.
- V. Conclusions
- A. Compliance with the LSDC
- B. Drainage Concept
1. Effectiveness of drainage design to control damage from storm runoff.
 2. Effectiveness of WQ BMPs for water quality enhancement.
 3. Influence of proposed development on the City of Loveland Master Drainage Plan recommendations.

4. Approval of affected irrigation company or other property owner to be obtained.

VI. References

Reference all criteria and technical information used.

VII. Appendices

- A. Hydrology Computations
 1. Rational Method Calculations
 2. Land use assumptions regarding adjacent properties.
 3. Initial and major storm runoff computations at specific design points.
 4. Historic and fully developed runoff computations at specific design points.
- B. Hydraulic Computations
 1. Culvert sizing.
 2. Storm sewer sizing.
 3. Street capacity evaluation.
 4. Storm inlet sizing.
 5. Swale sizing.
 6. Open channel sizing.
 7. Check and/or drop structure sizing.
 8. Modified FAA Method Detention pond area/volume capacity and outlet sizing.
 9. WQ BMP sizing
- C. Worksheets
 1. Permanent Stormwater Quality Control Measure(s) Base Design Standard Worksheet
- D. Exhibits
 1. An 11" x 17" schematic drawing into the Final Drainage & Erosion Control Report and SWMP documents titled "Permanent Stormwater Quality BMPs" that clearly identifies where each of the proposed Permanent Stormwater Quality BMPs are located within the development site, i.e., Grass Swales (GS), Grass Buffers (GB), Extended Detention Basins (EDB), etc. Please lightly shade or hatch the extent of each BMP.

2.3.2 Drainage Plan Contents

- A. A General Location Map shall be provided at a scale of 1" = 2000' or larger in sufficient detail to identify upstream off-site drainage areas flowing into the development and general drainage patterns.
- B. A Drainage Plan of the proposed development shall be provided at a scale from 1" = 100' to 1" = 200' on a 24" x 36" drawing. If the entire development can't fit on a single 24" x 36" drawing at the scales listed, an additional drainage plan shall be included drawn at a scale where the entire development fits on one 24" x 36" drawing. The plan shall show the following information:
 1. Existing and proposed contours at 2-foot maximum intervals.
 2. Property lines, lot lines, and easements.

3. Streets with names.
4. Existing drainage facilities, structures, irrigation facilities, and sizes.
5. Overall drainage area boundary and sub-area boundaries.
6. Proposed flow directions using arrows.
7. Proposed storm sewers, swales, open channels, culverts, cross-pans, and other appurtenances, including cross-sections of swales and open channels.
8. Proposed outfall point for runoff from the development area and facilities to convey flows to the final outfall point without damage to downstream properties.
9. Routing and accumulation of flows at various critical points for the minor storm runoff.
10. Routing and accumulation of flows at various critical points for the major storm runoff.
11. Detention storage facilities and outlet works, including proposed 100-year water surface elevations.
12. Location and elevations of all defined 100-year floodplains affecting the property.
13. Location of all existing and proposed utilities.
14. Routing of off-site drainage flows through the development.
15. Minimum lowest opening elevations of residential and commercial buildings above the 100-year water surface in streets, open channels, ditches, swales, or other drainage facilities, as illustrated by the preliminary grading plans.
16. Proposed on-site private and public drainage easements.
17. Proposed off-site private and public drainage easements.

2.5 Construction Drawings and Specifications

Where drainage improvements are to be constructed in accordance with the accepted Final Drainage Report, the construction plans (on 24" x 36" paper) and specifications shall be submitted in conformance with the Final Plat for review and acceptance prior to construction. The plans and specifications for the drainage improvements shall include all drainage components designed within the Final Drainage Report.

The information required for the drawings and specifications shall be in accordance with sound engineering principles, the LSDC and the City requirements for subdivision design. Construction documents shall include geometric, dimensional, structural, foundation, bedding, hydraulic, landscaping, and other details as needed to construct the storm drainage facilities. The accepted Final Drainage Plan shall be included as part of the construction documents for all facilities affected by the drainage plan.

The design engineer shall provide an electronic drawing of the proposed stormwater and water quality improvements in a GIS format suitable for use by the City in the city's GIS system. The drawing must include, as a minimum, centerlines of storm sewers and channels and outlines of all detention and water quality improvements.

2.6 Checklists

The checklists located in Appendix A of the Preface contains a list of common design items that need to be included in the final drainage report and construction drawings as well as other documents required for submittal. These checklists are not all-inclusive lists and other items may be required in the final drainage report and construction drawings, based on the nature of the design.1.7 As-Built Drawings

2.7.1 Recording of Drawings

- A. The project record drawings shall be submitted to and accepted by the Public Works Department Inspectors.
- B. Each drawing shall be labeled “DRAWINGS OF RECORD” in neat large printed letters.
- C. Construction information shall be recorded concurrently with construction progress by the Contractor.
- D. Project Record Drawings shall be marked legibly and with an indelible pen.
- E. Project Record Drawings shall record actual construction and contain, but not limited to, the following:
 - 1. Field dimensions, elevations, and details.
 - 2. Field changes which are made by minor deviations to the design drawings.
 - 3. Details, which are not on the original Construction Drawings.
 - 4. Elevations of manhole and inlet inverts in relation to project datum.
 - 5. Critical hydraulic structure dimensions.
 - 6. Orifice plate sizes.
 - 7. Detention pond volumes.
 - 8. All other critical hydraulic elevations.

2.7.2 Submission

- A. The project record drawings shall be submitted to and accepted by the Public Works Department Inspectors with a transmittal letter containing the following:
 - 1. Date.
 - 2. Project Title.
 - 3. Design Engineer’s name, address, and telephone number.
 - 4. Title and number of each Record Document.
 - 5. The signature of the Design Engineer, and their Professional Engineering stamp.
- B. The initial acceptance of the storm drainage improvements will not be made until all City installation requirements are satisfied and the Project Record Drawings are received and accepted by the City.
- C. The final drawings of the storm drainage improvements will not be made until the Project Record Drawings are received and accepted by the City.
- D. The City requires that the Project Record Drawings first be submitted in blue-line form for preliminary acceptance before final mylars are submitted.

E. The City requires the submittal of a video taping of all storm sewer lines prior to final acceptance.

APPENDIX A

DESIGN CHECKLISTS FOR FINAL DRAINAGE REPORTS AND PUBLIC IMPROVEMENTS
CONSTRUCTION PLANS

CHECKLIST – FINAL DRAINAGE REPORT	
FINAL DRAINAGE REPORT – WRITTEN PORTION	
<input type="checkbox"/>	Certification statement with professional engineer's stamp and signature
<input type="checkbox"/>	Discussion of hydrologic soil group(s) on the project site
<input type="checkbox"/>	Discussion of City of Loveland master drainage basin in which the site is located
<input type="checkbox"/>	Discussion of master-planned facilities and patterns are followed
<input type="checkbox"/>	Discussion of FEMA or local floodplains and floodways that are located on the site, as applicable
<input type="checkbox"/>	Discussion of irrigation ditches on the site and permission granted from irrigation company to complete construction operations within irrigation canal, as applicable
<input type="checkbox"/>	Discussion of where the stormwater flows after it leaves the site (based on the Civil Law Rule)
<input type="checkbox"/>	Discussion of how are upstream flows being handled through the site
<input type="checkbox"/>	Paragraph regarding temporary sediment and erosion control used on the site during construction
<input type="checkbox"/>	Paragraph regarding permanent stormwater quality designed for the development after construction
<input type="checkbox"/>	Within permanent stormwater quality paragraph, discuss what control measures are used and why they have been selected for this development.
<input type="checkbox"/>	All stormwater directed through permanent stormwater quality feature before leaving site
<input type="checkbox"/>	Include adjacent street into drainage pattern and detain and release street runoff from on-site detention pond
<input type="checkbox"/>	Discuss specific stormwater release rates for each lot within business park subdivisions
<input type="checkbox"/>	Discussion of hydrological and hydraulic capacity calculations used (UDFCD spreadsheets used as much as available)
<input type="checkbox"/>	Supporting/referenced existing drainage report(s) included in appendix
<input type="checkbox"/>	Variance Requests: Explain why a proposed design component that is not allowed by the City of Loveland Storm Drainage Standards and why it is a hardship for the owner to not use the City standard
DRAWINGS	
<input type="checkbox"/>	General Location Map
<input type="checkbox"/>	Drainage Plan
<input type="checkbox"/>	Permanent Stormwater Quality BMPs exhibit
FINAL DRAINAGE REPORT APPENDIX – DESIGN CALCULATIONS	
<input type="checkbox"/>	Rational Method shall be utilized to determine runoff for drainage basins 90 acres or less in size.
<input type="checkbox"/>	CUHP used for drainage basins over 90 acres in size. CUHP may be used, in addition to the Rational Method calculations, to determine runoff rates from design points consisting of smaller, combined sub-basins that fall under 90 acres for the purpose of routing flows through detention ponds.
<input type="checkbox"/>	UDFCD spreadsheets used when applicable
<input type="checkbox"/>	Street depths calculated for 100-year flow
<input type="checkbox"/>	Riprap sizing and bed dimension calculations
<input type="checkbox"/>	Swale hydraulic capacity calculations include freeboard and Froude Number
<input type="checkbox"/>	Swales with a Froude Number > 0.80 contain permanent erosion protection up to the swale freeboard
<input type="checkbox"/>	Inlet types chosen for site are approved for use in City of Loveland

<input type="checkbox"/>	Inlet clogging factors follow Loveland criteria
<input type="checkbox"/>	Hydraulic grade line calculations for all designed storm sewers and culverts
<input type="checkbox"/>	Energy grade line in storm sewers are no more than 6 inches under rim of inlets/manholes
<input type="checkbox"/>	Manning's $n=0.013$ used for all storm sewer pipe materials
<input type="checkbox"/>	Adjacent streets are routed back into proposed development and included in detention calculations if it is a new street or existing street that has not been included in other detention design
<input type="checkbox"/>	Rundowns designed to contain the 100-year runoff plus freeboard and are in the shape of a swale.
<input type="checkbox"/>	Street capacity calculations utilizing UD-INLET
<input type="checkbox"/>	Curb cut weir calculations
<input type="checkbox"/>	Mile High Flood District Stormwater Detention and Infiltration Design Data Sheets within the report appendix to demonstrate that the Stormwater detention ponds are designed to comply with the release rates described in Senate Bill 15-212
<input type="checkbox"/>	Required volume using Modified FAA Method to calculate the detention pond volumes
<input type="checkbox"/>	Stage-storage calculations to demonstrate available volume
<input type="checkbox"/>	WQVC orifice size calculations
<input type="checkbox"/>	EURV and 100-year pond orifice outlet sizing calculations with no clogging factors used to size orifice
<input type="checkbox"/>	Emergency spillway weir calculations
<input type="checkbox"/>	All necessary hydraulic capacity calculations for all design features
<input type="checkbox"/>	Permanent Stormwater Quality Control Measure(s) Base Design Standard Worksheet

CHECKLIST – CONSTRUCTION PLANS	
CONSTRUCTION PLANS	
<input type="checkbox"/>	Standard Erosion And Sediment Control Construction Plan Notes included
<input type="checkbox"/>	Qualified Stormwater Manager listed on Title Sheet (if none has been chosen, designate the developer, planner, engineer, etc. as the coordinator)
<input type="checkbox"/>	City of Loveland Level Net Benchmark used - no exceptions
<input type="checkbox"/>	Irrigation Ditch Agreement signature block on title sheet of construction plans
RESIDENTIAL SUBDIVISION LOTS	
<input type="checkbox"/>	Spot elevations for flowlines, lot corners, and finish grades, & top of foundations
<input type="checkbox"/>	Rear lot drainage (with easements and concrete pan) in multiple lots
<input type="checkbox"/>	Finished grade a minimum 6 inches lower than top of foundation
<input type="checkbox"/>	Type A,B, G, and W graded lots are labeled correctly
<input type="checkbox"/>	Type A, B, G or W lot layout detail
<input type="checkbox"/>	Flow direction arrows on each residential lot
<input type="checkbox"/>	Side and rear lot line slopes labeled on each residential lot (2% minimum allowable slopes)
<input type="checkbox"/>	High point spot elevations labeled on lots
<input type="checkbox"/>	Minimum opening elevation labeled on walkout basements or lots located by waterways or detention ponds
<input type="checkbox"/>	Basements not lower than 100-year WSEL in pond or pond is lined
<input type="checkbox"/>	If three or more rear lots combine their drainage waters in a common rear lot line swale, a concrete trickle channel shall be provided within the common rear lot line swale and extend to the nearest public street.
FLOODPLAINS AND FLOODWAYS	
<input type="checkbox"/>	100-year FEMA floodplain and floodway delineated on plans
<input type="checkbox"/>	Local floodplain delineation on plans
<input type="checkbox"/>	City Floodplain Development Permit Application (as applicable)
SITE GRADING	
<input type="checkbox"/>	Existing contours shown at a minimum of two foot intervals
<input type="checkbox"/>	Proposed contours shown at a minimum of two foot intervals
<input type="checkbox"/>	Contours extending a minimum 50' off-site, and tying into existing contours
<input type="checkbox"/>	Roof drains and direction of flow shown on commercial buildings
<input type="checkbox"/>	Maximum side slope of 4:1 or 3:1 on embankments within rights-of-way.
<input type="checkbox"/>	Permanent erosion protection provided on slopes steeper than 3:1 on private or public property
<input type="checkbox"/>	Permanent erosion protection provided at ends of pipes and pans
<input type="checkbox"/>	Written permission signed by neighbors provided to City if grading is planned said neighbor's property as part of site design
<input type="checkbox"/>	Sidewalk chases located at areas of concentrated flow at sidewalks/driveways
SWALES	
<input type="checkbox"/>	Cross-sections cut through each of the proposed grass swales and show the cross-sections on the grading plans with the following information on each swale cross-section: side slopes, longitudinal slope, bottom width, 100-year flow depth, and freeboard.
RUNDOWNS	
<input type="checkbox"/>	Permanent erosion protection in the form of a concrete or grouted riprap rundown provided to protect the pond embankment from erosion. Rundown designed to contain the 100-year runoff plus freeboard and is in the shape of a swale.
<input type="checkbox"/>	Details provided for each rundown including: specifying rock size (if riprap is used. Riprap should have no fines.), specifying grout depth for riprap or pan depth for concrete, cutting cross-sections

	through each one, labeling channel dimensions and showing/labeling each cross-section on the grading plans.
INLETS	
<input type="checkbox"/>	Inlet length and type labeled on plan and/or profile view
<input type="checkbox"/>	Only inlets that are approved for use in the city allowed in parking lots and streets
STORM SEWERS	
<input type="checkbox"/>	Hydraulic grade line and design storm that is represented by the hydraulic grade line is labeled on each storm sewer profile
<input type="checkbox"/>	Pipe and inlet elevations, slopes, pipe size and material labeled on profile view
<input type="checkbox"/>	Only pipe materials that are allowed within the City of Loveland used for the private and public storm sewer and culvert systems
<input type="checkbox"/>	Distance between dual pipes specified on plans
<input type="checkbox"/>	Horizontal and vertical location of existing and proposed utility crossings shown on plans per senate bill 18-167
<input type="checkbox"/>	Label calling for core drilling & grouting new pipes into existing inlets & manholes
<input type="checkbox"/>	No grates on culverts if you can see the light at the other end of the culvert
<input type="checkbox"/>	Storm sewers located within pavement of streets
<input type="checkbox"/>	No exception to 10-foot separation from water and sanitary sewer
<input type="checkbox"/>	Elevation drops in manholes
<input type="checkbox"/>	Storm sewer is locatable with manholes per senate bill 18-167 (roof drains are exempt)
<input type="checkbox"/>	Business park storm sewers: has individual lot drainage been included in street storm sewer sizing?
DETENTION POND	
<input type="checkbox"/>	Forebays at outfall of each pipe entering an extended detention basin
<input type="checkbox"/>	Maintenance access provided for detention pond outlet structure
<input type="checkbox"/>	Extents of 100-year water surface elevation shaded and 100-year water surface elevation labeled on plan.
<input type="checkbox"/>	Emergency spillway flow depth is less than or equal to 6 inch or maximum 50% of spillway height.
<input type="checkbox"/>	Minimum 1-foot freeboard from 100-yr WSEL to top of pond berm
<input type="checkbox"/>	Cut-off wall dimensions labeled
<input type="checkbox"/>	Cut-off wall structural construction plan and detail provided in construction plans
UNDERDRAINS	
<input type="checkbox"/>	Underdrains designed where ever seasonal peak groundwater tables will be within three feet of foundation bearing elevations
<input type="checkbox"/>	Laterals have tracer wire
<input type="checkbox"/>	Main line has cleanouts or manholes at all bends and junctions
<input type="checkbox"/>	All cleanouts/manholes and lateral connections labeled on plans
<input type="checkbox"/>	Designed as a separate utility line located within the street right-of-way or located within a rear lot line utility easement, in accordance with the Larimer County Urban Area Street Standards for the Loveland area
<input type="checkbox"/>	Show and label cleanouts and connections/services to each residential home foundation drain
<input type="checkbox"/>	The underdrain system is a gravity system tied into each residential home foundation drain
<input type="checkbox"/>	Gravity system daylight to detention pond or water way (but not irrigation ditch)
<input type="checkbox"/>	Plan and profile for each underdrain and label each profile view pipe as "private"
<input type="checkbox"/>	Private underdrain systems also require a formal written agreement with the City and approval by the Loveland City Attorney's Office

<input type="checkbox"/>	Backflow/flap gates installed at each outfall of underdrain into pond/waterway
<input type="checkbox"/>	No perforated pipe in ROW or public areas - main line pipe wall is solid
<input type="checkbox"/>	Detail for tracer wire included in plans
<input type="checkbox"/>	Details - LCUASS 713.1L and 713.2L included in plan set
MISCELLANEOUS ITEMS	
<input type="checkbox"/>	Channels and rundowns with large stormwater flows need label with boulder size with no fines (label example: "12" D ₅₀ No Fines")
<input type="checkbox"/>	Permanent water quality features included in design
<input type="checkbox"/>	Irrigation ditch culverts have erosion protection on either end
<input type="checkbox"/>	Retaining wall structural construction plans and details included in Public Improvement Construction Plan set (always needed despite height)
<input type="checkbox"/>	Rails around retaining walls with detail included in Public Improvement Construction Plan set
<input type="checkbox"/>	Pump station/lift station: complete construction design plans included in Public Improvement Construction Plan set
<input type="checkbox"/>	Waste stations and other contaminants set away from drainage facilities
<input type="checkbox"/>	Roof drain material slope size, tees, inverts labeled on plans
<input type="checkbox"/>	Labels to direct contractors to special details (PLDs, raingardens, sidewalk chases, curb cuts, etc.)
<input type="checkbox"/>	Details for all components included on the detail sheet of Public Improvement Construction Plans set

CHECKLIST - ADDITIONAL DOCUMENTS TO BE PROVIDED WITH THE PROJECT SUBMITTAL	
<input type="checkbox"/>	Standard Operating Procedure for Stormwater Permanent Control Measures
<input type="checkbox"/>	Stormwater Management Plan (if the project site disturbs one acre or more)
<input type="checkbox"/>	Irrigation Ditch Agreements for all private and public utility or public right-of-way ditch crossings
<input type="checkbox"/>	Water Quality Control Plan (if applicable to project)

Volume 1

Preface

Section 2.0 Purpose

Change ...USCDM...

To ...LSDC...

Section 3.0 Overview

First bullet titled “Chapter 1: Drainage Policy.”

Change ...UDFCD.

To ...the COL.

Delete: Second Bullet titled “Chapter 2: Drainage Law.”

Third bullet titled “Chapter 3: Planning.”

Delete last sentence.

Fourth bullet titled “Chapter 4: Flood Risk Management.”

Change ...UDFCD...

To ...COL...

Fifth bullet titled “Chapter 5: Rainfall.”

Change ...USDCM.

To ...LSDC.

Delete ...guidance for the development of ...

Delete Last sentence.

Tenth bullet titled “Chapter 10: Stream Access and Recreational Channels.”

Change ...UDFCD...

To ...LSDC...

Twelfth bullet titled “Chapter 12: Storage.”

Delete Last sentence beginning with “UD-FSD and UD-Detention...”.

First paragraph after bullet list

Change ...USDCM...

To ...LSDC...

Second paragraph after bullet list

Change ...USDCM...
To ...LSDC...

Change ...UDFCD.
To ...COL.

Section 4.0 List of Abbreviations

Add COL City of Loveland

Add GLIC Greeley and Loveland Irrigation Canal

Add LMDP Loveland Master Drainage Plan

Add LSDC Loveland Storm Drainage Criteria

Chapter 1 Drainage Policy

1.0 Policies and Principles

Third Paragraph:

Change ...UDFCD's principles and policies for urban drainage and floodplain...
To ...COL's principles and policies for urban drainage and floodplain...

1.1 Principles

Paragraph 1:

Delete Since 1969, UDFCD has embraced the principles of drainage planning that guide the criteria in this manual.
Add The COL embraces the principles of drainage planning that guide the criteria in this manual.

Change ...must be quantified and discussed in the master plan.
To ...are as presented in the City of Loveland's adopted Master Drainage Plan and the COL has entered into an agreement with Larimer County to cooperate on regional planning for the projected Urban Growth Boundary. The Policy of the City of Loveland shall be to pursue a jurisdictionally unified drainage effort to assure an integrated plan and to cooperate with other regional and local planning agencies on drainage matters.

Paragraph 5:

Change Urbanization tends to increase downstream peak...
To Urbanization, without mitigation, tends to increase downstream peak...

Change ...slowly released via detention facilities to manage peak flows...
To ...slowly released via detention facilities to manage and mitigate peak flows...

Paragraph 7:

Change ...plan should carefully map and identify the existing natural system.
To ...plan should carefully consider the existing natural system.

Paragraph 8:

Change ...and reduce where possible...
To ...and reduce where legally and physically possible

Paragraph 9:

Add The COL requires that the design of a site provide for historic off-site flows that enter a property be routed around or through the site in a channelized

manner in order to protect the property from damage or sedimentation.
Offsite flows are not permitted to sheet flow across a property.

Paragraph 10:

Change Local maintenance...
To Maintenance...

Add Master planned facilities will be maintained by the COL. Private on-site detention facilities shall be privately maintained.

Paragraph 11:

Change ...policy of UDFCD...
To ...policy of the COL...

Paragraph 12:

Add The COL also requires setbacks from property line along Ditches, Natural Water Courses, and Waterbodies. Refer to the Development Code for specifics regarding setbacks.

1.2 Basic Hydrologic Data Collection Policies

Delete Entire section

1.3 Planning Policies

Paragraph 1:

Delete A master plan for storm drainage should be developed and maintained in an up to date fashion at all times for each urbanizing drainage watershed.
Add The policy of the City of Loveland shall be to enforce and implement the adopted Master Drainage Plan for the Urban Growth Area. This Master Drainage Plan may be amended from time to time in the future.

Paragraph 4:

Change Storage of runoff in detention and retention reservoirs...
To Storage of runoff in detention reservoirs...

1.4 Technical Criteria

First Bullet:

Change ...presented in this Urban Storm Drainage Criteria Manual (USDCM)
To ...presented in the LSDC

Fifth Bullet:

Add In 1977 the Greeley and Loveland Irrigation Company (GLIC) filed on all stormwater entering the Company's lakes and canals in Case No. W-8665-77.

Therefore, all modifications to stormwater rates and volumes must accommodate GLIC's water rights for stormwater.

Sixth Bullet:

Change ...detention basins and retention ponds is necessary...
To ...detention basins is necessary...

Change ...detention and retention facilities...
To ...detention facilities...

Eighth Bullet:

Change The various governmental entities within the UDFCD boundary have...
To COL has...

Change Floodplain management must encompass...
To The COL's floodplain management program encompasses...

Last Bullet:

Change Exposure of life, property....
To (connect to previous paragraph)...exposure of life, property...

1.5 Flood Insurance Policy

Change UDFCD encourages the continued participation of local governments in...
To The COL participates in...

1.6 Levee Policy

Change UDFCD strongly discourages local governments from authorizing or permitting...
To The COL prohibits...

Delete 2. UDFCD will consider levees to protect existing development only as a last resort when no other mitigation option is feasible.

1.7 Criteria Implementation Policies

Delete Entire section including figure on next page

Add Refer to the COL website for a current map of the COL.

Delete Figure 1-1.

2.0 UDFCD Hydrologic Data Collection

Delete Entire section including bullets

3.1 Total Urban System

Delete Master plans for storm drainage have been developed and are maintained in an up to date fashion for most of the watersheds in the UDFCD region. An effort to complete the coverage of master plans for yet unplanned areas of UDFCD should be continued until full coverage is achieved.

3.1.1 Planning Process Elements

Paragraph 1:

Change Implementation of major drainage plans will reduce loss...

To Implementation of the COL's adopted master drainage plan will reduce loss...

Paragraph 2:

Delete Outfall system planning: Outfall system planning efforts identify detention, water quality and conveyance practices within a watershed that ultimately discharges to a receiving stream. Outfall system plans typically address storm drain improvements, stream crossing improvements, stream enlargement, stabilization, and floodplain preservation.

Paragraph 3:

Change ...the runoff from 2-year to 5-year storms...

To ...the runoff from 2-year storms...

Change ...have a 50% to 20%...

To ...have a 50%...

3.1.2 Master Planning

Delete Entire Section

Add The City of Loveland Master Drainage Plan sets forth improvements required for existing and future growth areas. The Policy of the City of Loveland regarding the design and construction of improvements within the Master Drainage Plan shall be as set forth below, subject to annual City Council budget and appropriation approval.

1. The City of Loveland shall arrange for the design and construction of improvements as set forth in the adopted Master Drainage Plan for existing and future growth areas.
2. The drainage systems for future development and redevelopment shall be designed and constructed by the Developer.
3. The Developers shall be responsible for design and construction of temporary or interim storm drainage systems required due to lack of adequate storm drainage facilities downstream of the new development.

Add The Policy of the City of Loveland shall be to enforce and implement the adopted Master Drainage Plan for the Urban Growth Area. This Master Drainage Plan may be amended from time to time in the future.

3.1.6 Managing Runoff from Frequently Occurring Storms (in blue section)

Blue Box

Water Quality Capture Volume (WQCV):

Change ...from 0.6 inches of...

To ...from 0.64 inches of...

Change UDFCD has...

To The COL has...

3.2 Multiple-Objective Considerations

Paragraph 8:

Delete First through fifth sentences.

Sixth Sentence:

Change Waterways, detention facilities and other drainage facilities...

To Public waterways, public detention facilities and public drainage facilities...

Add Private waterways, private on-site detention facilities and private drainage facilities shall be privately maintained.

3.4 Detention and Retention Storage

Delete ...and Retention... from section title

Delete Entire Section

Add The Policy of the City of Loveland shall be to require regional and/or on-site detention for all future growth areas as set forth in the adopted Master Drainage Plan. Temporary or interim detention may be required if the downstream facilities have not yet been constructed per the Master Plan. The Greeley and Loveland Irrigation Company filed on all storm water entering the Company lakes and canals. The filing was done in 1977 and is Case No. W-8665-77. The final decree was entered into on June 5, 1978 and the Company received a 1977 priority for the storm water.

Add Stormwater detention is also governed by Colorado Revised Statute.

3.4.1 Upstream Storage

Paragraph 1:

Delete ...and retention...

Paragraph 2:

Add Parking lots may be utilized to store stormwater runoff up to the 100-year storm event per City criteria set forth in the LSDC.

3.4.2 Downstream Storage

Delete ...and retention...

3.4.3 Reliance on Privately Controlled Facilities and Water Storage Reservoirs

Change Privately controlled facilities cannot be used for flood....

To Privately controlled facilities, that have legal agreement when ensure flood storage in perpetuity, cannot be...

Change ...purposes in master planning because...

To ...purposes because...

Delete Exceptions may occur where legal agreements are in place ensuring flood storage in perpetuity.

Add New Section as follows:

3.4.5 Reliance on Non-Flood Control Reservoirs

Jurisdictional dams are classified by the State Engineer as either low, moderate, or high hazard structures depending on conditions downstream. Dams are classified as high hazard structures when, in the event of failure, there is a potential loss of life. Dams presently rated as low or moderate hazard structures may be changed to high hazard rating if development occurs within the potential path of flooding due to a dam breach. In this case, the reservoir owners would need to address the State Engineer's reclassification decision by either paying the cost of upgrading the dam structure to meet the higher hazard classification or removing the dam and draining the reservoir.

The Policy of the City of Loveland shall be to:

1. Restrict upstream development to areas outside of the jurisdictional dam water surface elevation created by a 100- year storm.
2. Restrict downstream development to areas outside of the jurisdictional dam 100-year floodplain. The jurisdictional dam 100-year floodplain is defined as one of the following areas, whichever restricts downstream development most:
 - a. Either the 100-year floodplain downstream of the emergency spillway assuming the dam is full to the elevation of the emergency spillway at the beginning of the 100-year storm and the 100-year storm is routed through the dam and out the emergency spillway, or
 - b. The path that the basin's 100-year floodplain would form through the downstream development if the dam were removed and the reservoir did not exist.

4.1 Intended Use of Design Criteria

Change UDFCD revises...
To The COL revises...

Change ...USDCM...
To ...LSDC...

Add The City of Loveland Stormwater Utility Senior Civil Engineer may grant Variances from the design criteria of this Manual by his/her acceptance of the Final Drainage Report in which the variance request is well documented.

4.2.1 Design Storm Return Periods for Initial and Major Drainage Systems

Change Recommended design storms...
To The COL design storms...

Change ...drainage systems are specified in Table 1-1.
To ...drainage systems are the 2-year and 100-year storm events, respectfully.

Delete Local governments should not be tempted to specify larger than necessary design runoff criteria for the initial drainage system because of the direct impact on the cost of urban infrastructure.

Delete Table 1-1...(entire table)

Delete Paragraph starting with "There are many developed areas within the UDFCD..."

Delete Paragraph starting with "Strict application of the USDCM in the overall..."

4.2.3 Runoff Computations

Delete The note in blue labeled as "Master Plan Hydrology"

4.3 Use of Streets

Change ...criteria summarized in Table 1-2 for...
To ...criteria summarized in chapter 6 Streets, Inlets, Storm Sewers for...

Change ...storm runoff, Table 1-3 for...
To ...storm runoff, for...

Change ...and Table 1-4 for...
To ...and for...

Delete Table 1-2...(entire table)
Delete Table 1-3...(entire table)
Delete Table 1-4...(entire table)

Second Bullet:

Change ...discouraged...
To ...prohibited...

4.4 Use of Irrigation Ditches

Change ...major storm runoff should be prohibited...
To ...major storm runoff are prohibited

Change ...provided in a UDFCD master plan or approved by UDFCD and the ditch...
To ...provided in the COL's master drainage plan and approved by the ditch...

Add New first bullet under "Other irrigation ditch-related considerations include:" that states "In 1977 the Greeley and Loveland Irrigation Company (GLIC) filed on all stormwater entering the Company's lakes and canals in Case No. W-8665-77. Therefore, all modifications to stormwater rates and volumes must accommodate GLIC's water rights for stormwater."

4.6 Maintenance of Storage and Water Quality Facilities

Delete ... or retention facilities...

5.1 Purpose

Change Governmental entities within the UDFCD area should continue to implement floodplain...

To The City of Loveland has implemented a floodplain...

Change ...programs...

To ...program...

Change ...permanent state or local measures...

To ...permanent measures...

5.2 Goals

Change ...manner by local governments and other entities.

To ...manner by the COL and other entities.

5.3 National Flood Insurance Program

Change The cities and counties in the UDFCD area are encouraged to continue to participate in the National...

To The COL participants in the National...

Change ...management program by the local government that,...

To ...management program that,...

Change ...permanent state or local regulatory measures...

To ...permanent regulatory measures...

5.6 New Development

Add The Policy of the City of Loveland shall be to outsource engineering review of all CLOMR and LOMR submittals received with a development application. The Developers shall reimburse the City of Loveland Stormwater Utility for all outsourced engineering review costs. Upon FEMA approval of a CLOMR or LOMR, payment of all outsourced engineering review costs are due and payable to the City of Loveland Stormwater Utility. Developers are welcome to contract directly with our outsourced Consultant for the preparation of CLOMR's and LOMR's, if they so desire.

6.0 Implementation of Urban Storm Drainage Criteria

Change Implementation of Urban Storm Drainage Criteria

To Implementation of Storm Drainage Criteria and Master Drainage Plan

6.1 Adoption and Use of the USDCM and Master Plans

Change Adoption and Use of the USDCM and Master Plans

To Adoption and Use of the LSDC and LMDP

Change The USDCM should be adopted and used by local governments operating within the UDFCD boundary as a resource...

To The LSDC and the LMDP is a resource...

6.3 Amendments to Criteria

Change ...encountered by any governmental entity should be reviewed by UDFCD to...

To ...encountered by anyone should be reviewed by the COL to...

Change UDFCD should continually review the needs of the region...

To The COL should continually review the needs of the community....

Change ...the USDCM

To ...the LSDC

6.4 Financing Drainage Improvements

Add The City of Loveland Master Drainage Plan sets forth improvements required for existing and future growth areas. The Policy of the City of Loveland regarding the design and construction of improvements within the Master Drainage Plan shall be as set forth below, subject to annual City Council budget and appropriation approval.

1. The City of Loveland shall arrange for the design and construction of improvements as set forth in the adopted Master Drainage Plan for existing and future growth areas.
2. The drainage systems for future development and redevelopment shall be designed and constructed by the Developer and reimbursed by the City of Loveland by way of a Reimbursement Agreement.
3. The Developers shall be responsible for design and construction of temporary or interim storm drainage systems required due to lack of adequate storm drainage facilities downstream of the new development.
4. Regional detention ponds shall be designed and constructed by the Developer at the time of development. The City of Loveland shall reimburse the Developer, by way of a Reimbursement Agreement, for the design and construction cost difference between the detention volume/land area that is required to store the developed 100-year storm flows from the on-site development and the detention volume/land area required to store the developed 100-year storm flows for the entire contributory area that drains to the regional detention pond.

Chapter 2 Drainage Law

Delete entire chapter:

Add The COL follows the Civil Law Rule.

Chapter 3 Planning

1.0 Importance of Drainage Planning

Paragraph 3:

Change Urban Drainage and Flood Control District (UDFCD has...

To The COL has...

Change ...streams in the metropolitan Denver area since the early 1970s.

To ...streams since the early 1980's.

Change ...participation by sponsoring municipalities, UDFCD and other...

To ...participation by the COL, and other...

1.1 Planning Philosophy

Change ...objectives presented in the USDCM.

To ...objectives presented in the LSDC.

Paragraph 2:

Change General principles that UDFCD...

To General principles that the COL...

2.0 Minor (Initial) Drainage System Planning

Change For the area served by UDFCD...

To For the COL...

Change ...once every 2- to 10 years.

To ...once every 2-years.

Delete Generally, the initial drainage system drains a tributary no larger than 130 acres, as the runoff from this area would be in excess of the typical capacities of these features within a street section.

3.1 General

Delete Entire section in blue labeled "UDFCD's Master Planning Program"

Change Preparation of the Major Drainage Plan or Outfall System Plan...

To Preparation of the Master Plan...

Delete Entire section in blue labeled "Shelf Life"

3.2 Types of Drainage Plans

Delete Entire section

3.2.1 Major Drainageway Planning Studies

Delete Entire section

3.2.2 Outfall Systems Planning Studies

Delete Entire section

3.3 Phases of Planning

Delete Entire section

3.3.1 Baseline Hydrology

Delete Entire section

3.3.2 Alternatives Analysis

Delete Entire section including blue section labeled “Section 404 Permits”

3.3.3 Conceptual Designs

Delete Entire section

3.4 Alternative Plan Components

Change 3.4 Alternative Plan Components
To 3.4 Plan Components

3.4.5 Detention (Storage)

Paragraph 1, 1st Sentence

Delete and retention

Paragraph 1, 2nd Sentence

Delete and retention

Paragraph 1, 3rd Sentence
Change UDFCD
To COL

Delete Item #2a

Paragraph 4, 1st Sentence
Change UDFCD region
To COL

5.0 Multi-use Opportunities

Change ...(NBFs), as discussed in the UDFCD’s “Good Neighbor Policy.” The...
To ...(NBFs). The...

Delete Entire section in blue labeled “Good Neighbor Policy”

Chapter 4 Flood Risk Management

Replace entire chapter

With City of Loveland Municipal Code Chapter 15 Section 15.14 and
City of Loveland Municipal Code Chapter 18 Section 18.09.03

Chapter 5 Rainfall

Delete Entire chapter.

Add The Rainfall Chapter from the March 1986 Loveland Storm Drainage Criteria Manual in its entirety, without change, as included herein.

CITY OF LOVELAND
STORM DRAINAGE CRITERIA MANUAL

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CITY OF LOVELAND
STORM DRAINAGE CRITERIA MANUAL

SECTION 500 RAINFALL

501 INTRODUCTION

The data and procedures presented in this section were obtained from the Larimer County Storm Water Management Manual (Reference-18) for the Loveland region of Larimer County (Area II). The data and procedures for other areas of the county can be found in the referenced report.

The methods employed in this section have been adapted from procedures developed by the National Oceanic and Atmospheric Administration and published in Precipitation Frequency Atlas of the Western United States, NOAA Atlas II (Reference-16). These data and procedures presented in the NOAA Atlas II were verified utilizing 34 years of hourly precipitation data for Fort Collins. Utilizing these procedures and data, precipitation frequency curves were developed for the plains area of Larimer County.

502 BASIC DATA

A search of data and methods available for developing precipitation frequency relationships was made in order to determine the best methods and data for Larimer County. A search of published records indicated that there was a limited amount of rainfall data available for Larimer County. Review of established procedures for determining rainfall frequency relationships indicated that the most up-to-date procedures were those published in the NOAA Atlas.

A search of published rainfall data for the State of Colorado revealed that there are seven reporting stations in Larimer County. Table-501 shows the location and number of years of data available from each of these stations. The Fort Collins station is the only rainfall station with long-term hourly precipitation data. These hourly values are needed in order to analyze short-duration storms. Due to this limited amount of available data, other methods of determining precipitation-frequency relationships were employed.

The National Oceanic and Atmospheric Administration published a Precipitation Frequency Atlas of the Western United States in 1973 (mentioned above) of which Volume III contains data for Colorado. This atlas presents charts of precipitation of 6- and 24-hour duration for return periods of 2 to 100 years. The development of the atlas revises Weather Bureau Technical Paper No. 40 developed in 1961. The main emphasis of this revision was to more accurately depict the variation in the precipitation frequency regimes for mountainous regions. The atlas takes into account regional relationships between stations and therefore presents a better regional pattern of precipitation than an analysis of just the stations in Larimer County would produce.

503 FREQUENCY ANALYSIS

The development of the NOAA Atlas utilized two types of rainfall data. The main emphasis was put on utilization of the data from stations which had hourly records. To verify regional relationships, records from daily precipitation

gages were also analyzed. For short-duration storms (less than 24 hours), hourly data were used to develop precipitation-frequency relationships and were verified utilizing data from daily stations. For 24-hour duration storms, all data were analyzed.

To maintain as common a data base as possible, the atlas used 15 years of data for all stations to develop the 2-year precipitation data. Due to the low probability of obtaining a 100-year event within 15 years, data for the 100-year storm events were developed utilizing full lengths of records for stations.

The eastern slope area of Colorado was analyzed utilizing data from 75 rainfall recording stations. To further verify the NOAA Atlas data for Larimer County, a brief analysis was made of the 34 years of data for the Fort Collins station. Table-501 shows the relationships between the 6-hour storms as developed from the NOAA Atlas and as developed utilizing only the Fort Collins data. This analysis would indicate that the NOAA Atlas data does accurately predict the rainfall-frequency relationships for the Fort Collins area. A similar analysis of 86 years of Denver data was also made by the Urban Drainage and Flood Control District. The analysis produced approximately the same result as the NOAA Atlas data.

504 RAINFALL ZONES

The County was divided into three major hydrologic areas (as shown in Figure-501), and precipitation-frequency data for each area are different in order to closely match the local precipitation regimes.

The three major areas shown in Figure-501 are described as follows:

Area I: The area near Fort Collins from the east county line on to the first "hogback" on the west and from the watershed divide between the Cache la Poudre and Big Thompson rivers on the south through Township 9 North on the north.

Area II: The area near Loveland from the east county line to the first "hogback" on the west and from the south county line to the watershed divide between the Big Thompson and Cache la Poudre rivers on the north.

Area III: The remainder of the county not in Area I or Area II.

Only the data for Area II are presented herein. The data and procedures for the other areas can be found in Reference-18.

505 CUHP DESIGN STORMS

Rainfall in the Loveland area is influenced by the orographic effects of the Rocky Mountain, the topography of the high plains and the semi-arid climatology of the region. Rainstorms can often have an "upslope" character where easterly flow of moisture settles against the mountains. These types of rainstorms have durations that can exceed 6-hours and produce large amount of total precipitation. However, these storms are rarely intense and seldom result in urban flooding problems.

Very intense rainfall in the Loveland area results from convection storms or frontal stimulated convective storms. These types of storms are often less than 1-hour or 2-hours in duration and can produce brief periods of high rainfall

intensities. These short duration intense rainstorms appear to cause most of the urban flooding problems (reference-1).

Analysis of a 73 year record of rainfall at the Denver rain gage by the Urban Drainage and Flood Control District reveals that an overwhelming majority of the intense rainstorms produce their greatest intensities in the first hour of the storm. In fact, of the 73 most intense storms analyzed, 68 had the most intense period begin and end within the first hour of the storm and 52 had the most intense period begin and end within the first half hour of the storm. The data clearly shows that the leading intensity storms predominate among the "non-upslope" type storms in the Denver Region (Reference-1).

The recommended design storm distribution takes into account the observed "leading intensity" nature of the convection storms. In addition, the temporal distributions were designed to be used with the 1982 version of the CUHP (Section 600), the published NOAA 1-hour precipitation values (Reference-16), and the Horton's infiltration loss equation. They were developed to approximate the recurrence frequency of peak flows and volumes (i.e., 1- through 100-years) that were estimated for the watersheds whose rainfall/runoff data was collected. The procedure for the development of these design storm distributions and the preliminary results were reported at the 1979 International Symposium on Urban Storm Runoff. The recommendations contained in this MANUAL are the result of refinements to the work by the Urban Drainage and Flood Control District.

The recommended design storm distribution was obtained by first computing the incremental rainfall from the total rainfall data in the Larimer County Storm Water Management Manual (see Table-502) for the Loveland area. These incremental values were then rearranged to approximate the recommended distribution by the Urban Drainage and Flood Control District (Reference-1) resulting in the following ranking of values:

DESIGN STORM DISTRIBUTION

TIME	INCREMENTAL PRECIPITATION RANKING					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	9	9	9	(Towest)	(Towest)	(Towest)
10	7	7	7	10	10	10
15	4	4	4	8	8	8
20	2	2	2	4	4	4
25	1	1	1	2	2	2
30	3	3	3	1	1	1
35	5	5	5	3	3	3
40	6	6	6	5	5	5
45	8	8	8	6	6	6
50	10	10	10	7	7	7
55	11	11	11	9	9	9
60...	12...	12...	12...	11...	11...	11...

Using the distribution and the total rainfall values in Table-502, the design storms for the Loveland area were developed and are presented in Table-503 for drainage basins less than five square miles.

506 TIME-INTENSITY-FREQUENCY CURVES

The time-intensity-frequency data for the Loveland area was taken directly from the Larimer County Storm Water Management Manual and are presented in Figure-502. The data in this form are used primarily in the Rational Method Runoff Modelling Technique (see Section 600).

LARIMER COUNTY RAINFALL DATA

A) SUMMARY OF RAIN-GAGE STATIONS IN LARIMER COUNTY
(SEE TEXT, SECTION 502)

STATION	LOCATION		ELEV.	TYPE	YEARS OF RECORD
	LATITUDE	LONGITUDE			
Fort Collins	40°35'	105°05'	5004	Recording	97
Fort Collins 9NW	40°40'	105°13'	5220	Recording	4
Waterdale	40°25'	105°12'	5260	Non-recording	83
Estes Park	40°23'	105°31'	7525	Non-recording	67
Red Feather Lake 2SE	40°48'	105°34'	8237	Non-recording	15
Rustic 12 WSW	40°42'	105°48'	8080	Recording	4
Drake	40°26'	105°20'	6170	Recording	4

B) COMPARISON OF HISTORICAL DATA WITH
NOAA ATLAS 2 FOR FORT COLLINS
(SEE TEXT, SECTION 503)

RETURN FREQUENCY	34-YR. ANALYSIS 1940-1973	NOAA ATLAS 2
	6-HR. PRECIPITATION (IN.)	6-HR. PRECIPITATION (IN.)
2-Yr	1.49	1.43
5-Yr	1.83	1.96
10-Yr.	2.18	2.28
50-Yr	3.04	3.08
100-Yr	3.41	3.45

WRC ENG.

REFERENCE: Larimer County Storm Drainage Water
Management Manual, FEBRUARY 1979

DESIGN TOTAL RAINFALL
AREA II - LOVELAND

2hr-5min Storms

NOTE: All Rainfall Values are in Inches

<u>TIME</u>	<u>2-YR</u>	<u>5-YR</u>	<u>10-YR</u>	<u>25-YR</u>	<u>50-YR</u>	<u>100-YR</u>
5	0.29	0.41	0.49	0.59	0.68	0.77
10	0.45	0.64	0.76	0.92	1.06	1.20
15	0.57	0.81	0.96	1.16	1.34	1.52
20	0.66	0.94	1.12	1.36	1.54	1.78
25	0.73	1.04	1.24	1.50	1.71	1.98
30	0.79	1.12	1.33	1.61	1.86	2.10
35	0.83	1.19	1.41	1.70	2.00	2.30
40	0.87	1.25	1.48	1.78	2.10	2.39
45	0.91	1.30	1.54	1.85	2.18	2.47
50	0.94	1.34	1.60	1.91	2.25	2.54
55	0.97	1.38	1.65	1.97	2.31	2.60
60	1.00	1.41	1.69	2.03	2.36	2.66
65	1.03	1.44	1.73	2.08	2.40	2.71
70	1.06	1.47	1.76	2.12	2.44	2.75
75	1.08	1.50	1.79	2.16	2.48	2.79
80	1.10	1.52	1.81	2.18	2.52	2.82
85	1.11	1.54	1.83	2.22	2.55	2.85
90	1.12	1.55	1.85	2.25	2.58	2.88
95	1.13	1.56	1.87	2.27	2.60	2.91
100	1.14	1.57	1.89	2.29	2.61	2.93
105	1.15	1.58	1.91	2.30	2.62	2.95
110	1.16	1.59	1.92	2.31	2.63	2.97
115	1.17	1.60	1.93	2.32	2.64	2.99
120	1.18	1.61	1.94	2.33	2.65	3.01

WRC ENG.

REFERENCE: Larimer County Storm Water Management
Manual, FEBRUARY 1979

**TWO-HOUR DESIGN STORM FOR BASINS
LESS THAN 5 SQUARE MILES**

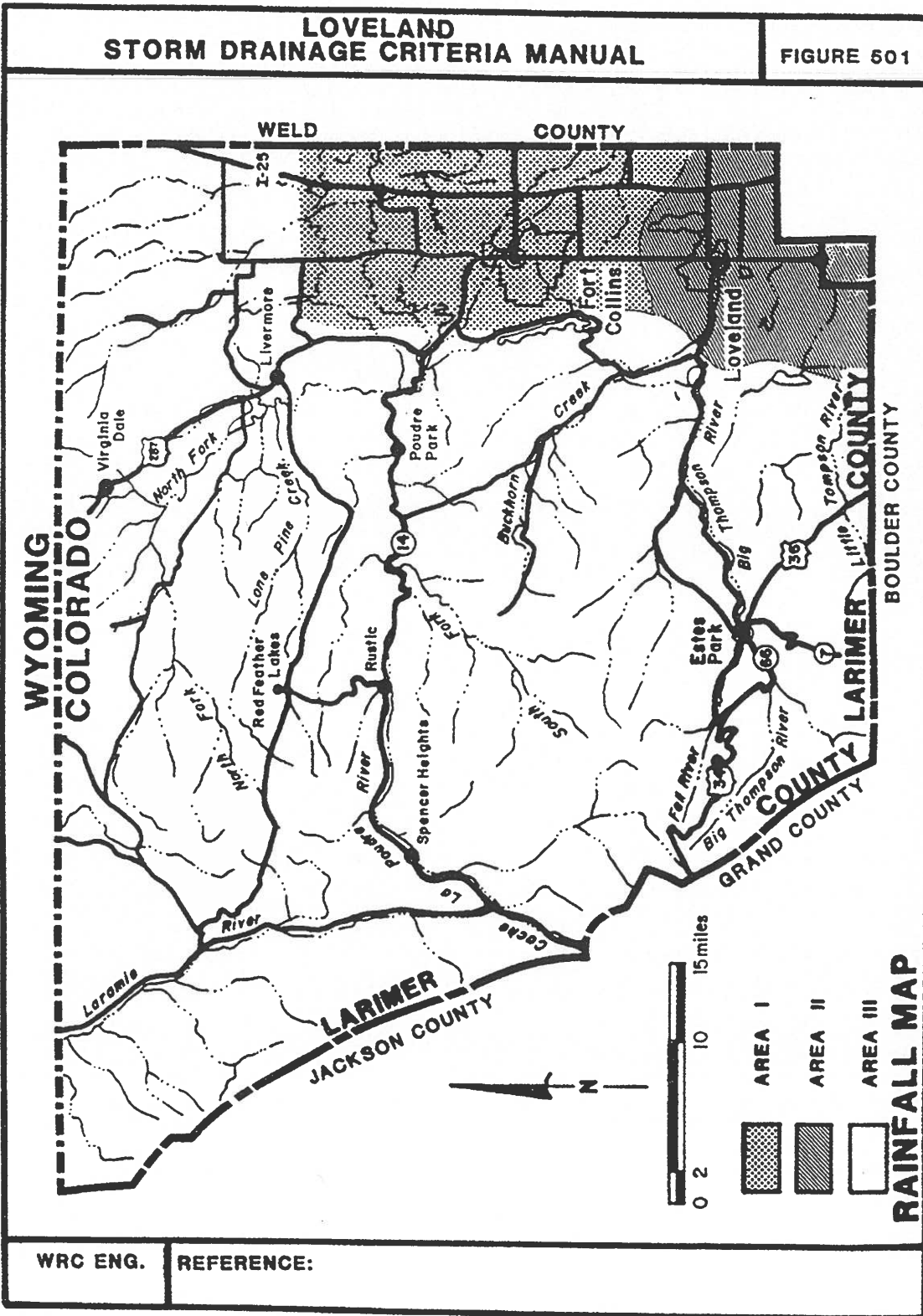
TIME (MIN)	INCREMENTAL RAINFALL DEPTH					
	2-YR (IN)	5-YR (IN)	10-YR (IN)	25-YR (IN)	50-YR (IN)	100-YR (IN)
5	0.04	0.05	0.06	0.01	0.01	0.02
10	0.04	0.07	0.08	0.06	0.07	0.07
15	0.09	0.13	0.16	0.08	0.10	0.09
20	0.16	0.23	0.27	0.20	0.20	0.26
25	0.29	0.41	0.49	0.33	0.38	0.43
30	0.12	0.17	0.20	0.59	0.68	0.77
35	0.07	0.10	0.12	0.24	0.28	0.32
40	0.06	0.08	0.09	0.14	0.17	0.20
45	0.04	0.06	0.07	0.11	0.15	0.18
50	0.03	0.04	0.06	0.09	0.14	0.14
55	0.03	0.04	0.05	0.07	0.08	0.08
60	0.03	0.03	0.04	0.06	0.06	0.06
65	0.03	0.03	0.04	0.06	0.05	0.06
70	0.03	0.03	0.03	0.05	0.04	0.05
75	0.02	0.03	0.03	0.04	0.04	0.04
80	0.02	0.02	0.02	0.04	0.04	0.04
85	0.01	0.02	0.02	0.03	0.04	0.03
90	0.01	0.01	0.02	0.03	0.03	0.03
95	0.01	0.01	0.02	0.03	0.03	0.03
100	0.01	0.01	0.02	0.02	0.02	0.03
105	0.01	0.01	0.02	0.02	0.01	0.02
110	0.01	0.01	0.01	0.01	0.01	0.02
115	0.01	0.01	0.01	0.01	0.01	0.02
120	0.01	0.01	0.01	0.01	0.01	0.02
TOTAL	1.18	1.61	1.94	2.33	2.65	3.01

WRC ENG.

REFERENCE:

LOVELAND
STORM DRAINAGE CRITERIA MANUAL

FIGURE 501

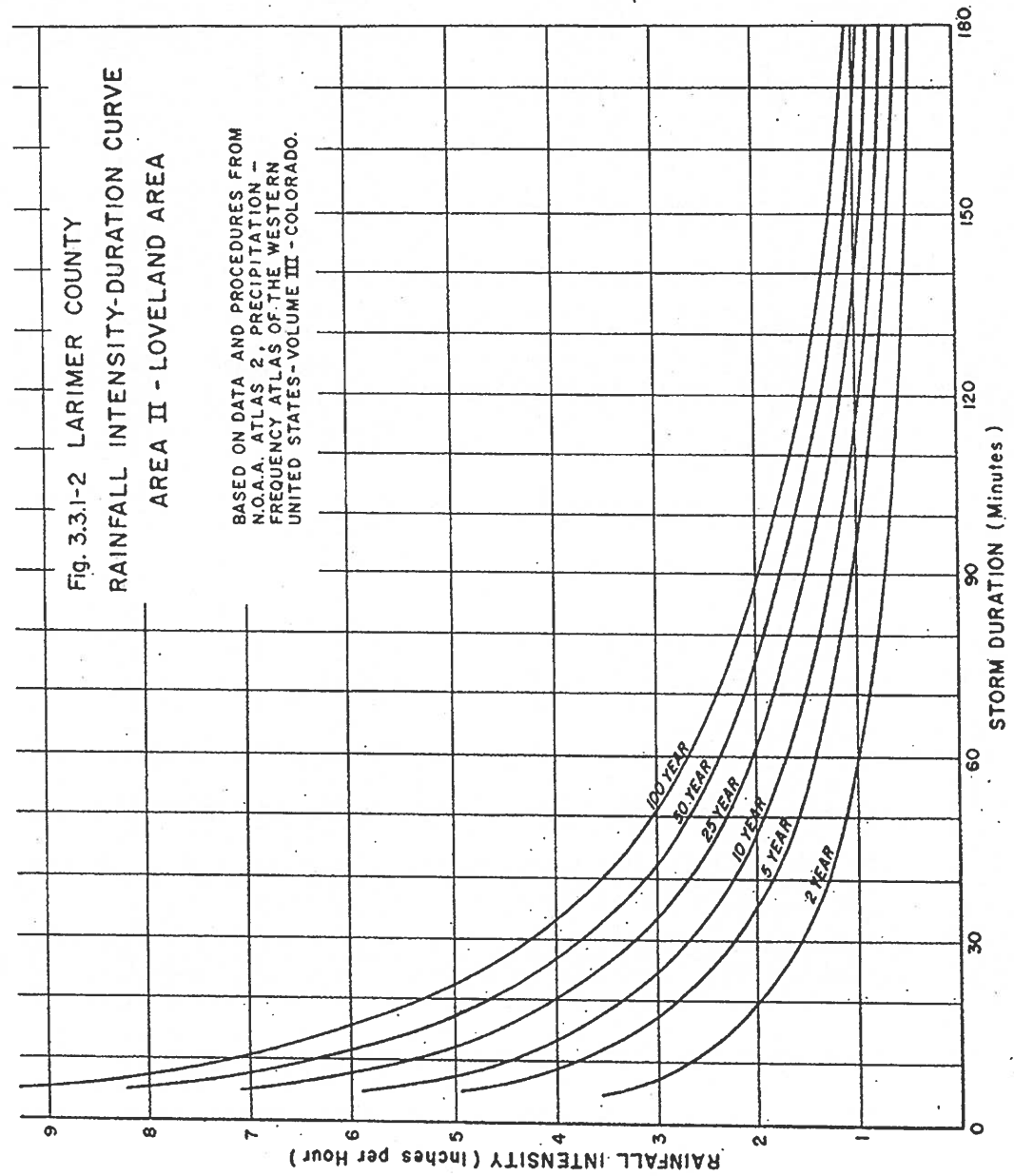


WRC ENG.

REFERENCE:

AREA I
AREA II
AREA III
RAINFALL MAP

RAINFALL INTENSITY - DURATION CURVE



WRC ENG.

REFERENCE:

Chapter 6 Runoff

1.0 Overview

Paragraph 1:

Change ...are described in the Urban Storm Drainage Criteria Manual (USDCM):
To ...are described as follows:

Paragraph 5:

Delete Statistical analyses may be used in certain situations outside the UDFCD boundary. The use of this approach requires the availability of acceptable, appropriate, and adequate data.

Table 6-1:

Change In first cell of “Is CUHP Applicable?” Column for watershed size of 0 to 90 acres, change “Yes” to “No”

Add Under sub-note under Table 6-1: “The Rational Method shall be used to determine runoff rates for all drainage basins 90 acres or less in size and the calculations submitted in the drainage report. CUHP may be used, in addition to the Rational Method calculations, to determine runoff rates from design points consisting of smaller, combined sub-basins that fall under 90 acres for the purpose of routing flows through detention ponds.

Last Paragraph:

Change ...Volume 3 of the USDCM.
To ...Volume 3 of the LSDC.

2.5 Rainfall Intensity

Paragraph 2:

Delete entire paragraph

Add Refer to the LSDC Rainfall chapter for City of Loveland rainfall intensity data.

2.5.1 Runoff Coefficient

Paragraph 5:

Change ...recommendations in Section 2.4.
To ...recommendation in Section 2.4 and are valid for the COL area.

Delete Use of these coefficients and this procedure outside of the semi-arid climate found in the Denver region may not be valid.

3.2 Effective Rainfall for CUHP

Change ...of the USDCM.
To ...of the LSDC.

3.2.1 Pervious-Impervious Areas

Change ...of the USDCM Volume 3.
To ...of the LSDC Volume 3.

3.2.3 Infiltration

Paragraph 3:

Change ...portions of UDFCD.
To ...portions of COL.

Paragraph 6:

Change ...use within UDFCD with CUHP.
To ...use within COL with CUHP.

Change ...frequently within UDFCD;
To ...frequently within the COL;

Paragraph 7:

Change ...watershed in the Denver metropolitan...
To ...watershed in the COL metropolitan...

3.3.1 Rainfall

Change ...chapter of the USDCM.
To ...chapter of the March 1986 Loveland Storm Drainage Criteria Manual.

Add See Table 502 within the Rainfall Chapter for 1-hour rainfall depths. See Table 503 within the Rainfall Chapter for detailed hyetograph distributions.

3.3.2 Catchment Description

DCIA Level:

Change ...Volume 3 of the USDCM.
To ...Volume 3 of the LSDC.

Last Paragraph:

Change ...studies within UDFCD, the...
To ...studies within COL, the...

3.3.3 Catchment Delineation Criteria

Paragraph 1:

Change UDFCD recommends an...
To The COL recommends an...

4.0 EPA SWMM and Hydrograph Routing

Paragraph 1:

Change In 2005, UDFCD adopted the use of EPA's SWMM 5.0 model and recommends its use for all future hydrology studies.

To COL has adopted the use of EPA's SWMM 5.0 model and recommends its use for all future master plan hydrological studies only.

4.1 Software Description

Paragraph 1:

Change ...not used by UDFCD because...
To ...not used by the COL because...

Change ...calibrated to UDFCD regional...
To ...calibrated to COL regional...

4.2.1 Step 1: Method of Discretization

Blue section labeled "Discretizing large catchments into smaller ones"

Change ...Chapter of the USDCM by...
To ...Chapter of the LSDC by...

5.1 Published Hydrologic Information

Delete Entire paragraph

Add Master drainage plans are available on the City of Loveland website. Hard copies of the master drainage plans can be ordered at the Stormwater Engineering office.

5.2 Statistical Methods

Delete Entire section

6.0 Software

Paragraph 1:

Change ...protocols in the USDCM.

To ...protocols in the LSDC.

Paragraph 5:

Delete entire paragraph

Add Refer to LCDS Rainfall Chapter for rainfall information within the City of Loveland.

7.1 Rational Method Example 1

Add Example 1 is based upon rainfall for a location in Denver, Colorado. For the COL, the rainfall intensity is to be obtained from the COL Rainfall Chapter 5 and not from Equation 4.3 as presented in this example.

7.2 Rational Method Example 2

Add Example 2 is based upon rainfall for a location in Denver, Colorado. For the COL, the rainfall intensity is to be obtained from the COL Rainfall Chapter 5 and not from Equation 4.3 as presented in this example.

Chapter 7 Streets, Inlets, and Storm Drains

1.4 Minor and Major Storms

- Change ...is established by local ordinances or criteria, and...
To ...for the COL is...
- Delete “or-5-“
- Change ...are commonly specified, based on many factors including street function,
traffic load, vehicle speed, etc.
To ...event.
- Change Local ordinances often also establish...
To The...
- Change ..., generally...
To ...in the COL is...
- Delete “(although it may be a lesser event for some retrofit projects with site
constraints)”

2.1 Street Function and Classification

Paragraph 1:

- Change The four street...
To The five street...

Second Bullet: Collector

- Change Collector... and arterials
To Residential Collector... and arterials in residential areas.

Add as Third Bullet

Commercial Collector: Low/moderate-speed traffic providing services
between local streets and arterials in commercial areas.

Third Bullet: Arterial

- Change Arterial... through urban areas and accessing freeways.
To Minor Arterial... through urban areas.

Add as Fourth Bullet

Major Arterial: Moderate/high-speed traffic moving through urban areas.

- Delete Fifth bullet “Freeway: Highspeed...”

- Change “Table 7-1 provides additional information on the classification of streets for
drainage purposes.”
To Table 7-1 provides the allowable street flow depths in the COL

Delete Table 7-1

Add The following Table 7-1

Table 7-1 Allowable Street Flow Depths

TRAFFIC CLASSIFICATION	DRAINAGE CLASSIFICATION	ALLOWABLE FLOW DEPTH	ALLOWABLE FLOW DEPTH
		MINOR STORM (FT)	MAJOR STORM (FT)
Local	A	0.46	0.67
Residential Collector	B	0.47	0.67
Commercial Collector	B	0.5	0.75
Minor Arterial	C	0.5	0.78
Major Arterial	C	0.5	0.75

Note: Allowable flow depth is measured vertically from the gutter flowline at the curb face.

2.2 Design Considerations

Change ...UDFCD has established encroachment and inundation standards for...
To ...the COL has established the allowable street flow depths presented in section 2.1 for...

Delete These standards were presented in the Policy chapter and are repeated in Table 7-2 for convenience.

Delete Table 7-2

Change ...UDFCD has established street inundation standards during the...
To ...The COL has established the allowable street flow depths presented in section 2.1 for the...

Delete These standards were given in the *Policy* chapter and are repeated in Table 7-3 for convenience.

Delete Table 7.3

Paragraph 3:

Delete ...intersections, sump locations, and for

Change ...were given in the Policy chapter and are repeated in Table 7-4 for convenience.

To ...are presented in Chapter 11, Section 2.0.

Add At intersections, the maximum depth of flow in crosspans is as presented in Table 7-1.

Delete These allowable street cross-flow standards were given in the *Policy* chapter and are repeated in Table 7-4 for convenience.

Delete Table 7-4

Paragraph 4:
Delete ...spread (pavement encroachment) and allowable...

2.3 Street Hydraulic Capacity (Inset)

Change ...from the face of the curb to the crown (for the minor event).
To ...based upon the allowable depth of flow in the gutter flowline

2.3.1 Curb and Gutter

Delete UDFCD prescribes a minimum longitudinal slope of 0.4% for positive drainage (Write-McLaughlin 1969).

Add COL prescribes a minimum longitudinal slope for positive drainage that is specified by the City of Loveland. The City utilizes the Larimer County Urban Area Street Standards (LCUASS) for minimum longitudinal slope guidelines.

Change UDFCD recommends...
To The COL uses...

Change ...1% for positive drainage; however, a cross slope of 2% is more typical.
To ...2% for positive drainage.

Delete “1. Calculate the street capacity based upon the allowable spread for the minor storm as defined in Table 7-2.”

Change 2...Table 7-2.
To 1...Table 7-1.

Change 3...two...
To 2...one...

Change 3...in Figure 7-3
To 2...in Figure 7-4

Delete 3...“The lesser value (limited by allowable spread or by depth with a safety factor applied) is the allowable street capacity.”

- Change 4...through three... Table 7-3
- To 3...and two... Table 7-1

- Under Section “Allowable Capacity”
- Delete “the lesser of:”

- Delete Equation 7-11 in its entirety

- Delete “or”

- Delete “ Q_T = street hydraulic capacity where flow spread equals allowable spread (cfs)”

- Change There are two sets of safety reduction factors developed for the UDFCD region (Guo 2000b).
- To There are two sets of safety reduction factors developed for the UDFCD region (Guo 2000b) and they shall also be utilized for the Loveland area.

2.3.2 Swale Capacity

- Third paragraph
- Change ...Examples 7.4 and 7.5...
- To ...Examples 6.4 and 6.5...

- At end of fifth paragraph
- Add For larger storm events, the Froude number shall not exceed 0.5 and the velocity shall not exceed 5 fps.

3.1 Inlet Function and Selection

- Table 7-5
- Delete “Slotted” inlet row.

Below Table 7-5 Add The standard inlets permitted for use in City of Loveland streets are:

<u>INLET TYPE</u>	<u>PERMITTED USE</u>
Curb Opening Inlet Type R	All street types with 6” Vertical curb
Grated Inlet Type C	All streets with a roadside Ditch
Grated Inlet Type 13	Alleys or private drives with a valley gutter
Combination Inlet Type 13	All street types with 6” Vertical curb

- Add The maximum ponding over inlets in parking lots is 12 inches.

3.2 Allowable Street Capacity (insert)

- Delete “the lesser of:”

Delete “Capacity determined by the allowable spread for the minor event”

Change UDFCD region (in photograph 7-3 reference)
To COL region

3.2.3 Combination Inlets on a Continuous Grade

Change ...UDFCD region.
To ...COL.

3.2.4 Slotted Inlets on a Continuous Grade

Delete Entire Section

3.2.5 Grate Inlets in a Sump (UDFCD CSU Model)

Delete ...(the most common grated street inlets in the UDFCD region),...

3.2.7 Other Inlets in Sump (Not Modeled in the UDFCD-CSU Study)

Table 7-8. Sump inlet discharge variables and coefficients.

Delete “Slotted Inlets” rows

3.2.8 Inlet Clogging

Delete As a common practice for street drainage, 50% clogging is considered for the design of a single grate inlet and 10% clogging is considered for a single curb-opening inlet.

Add Table 7-9, “Allowable Inlet Capacity” provides allowable inlet capacity percentages to be used with standard inlets that are permitted within the City. These values are to be used to determine the allowable clogging factors for each inlet type.

Delete The sentence beginning with “To address this phenomenon...”

Delete The remaining section starting with “With the concept...”

Add To account for effects which decrease the capacity of the various types of inlets, such as debris plugging, pavement overlaying and variations in design assumptions, the theoretical capacity calculated for the inlets is reduced by the factors presented in Table 7-9 for the standard inlets permitted for use in the COL streets.

Table 7-9. Allowable Inlet Capacity

<u>CONDITION</u>	<u>INLET TYPE</u>	<u>PERCENT OF ALLOWABLE CAPACITY ALLOWED</u>
Sump or continuous Grade	CDOT Type R	
	5' Length	88
	10' Length	92
	15' Length	95
Continuous Grade	Combination Type 13	66
Sump	Grated Type C	50
	Grated Type 13	50
Sump	Combination Type 13	65

3.3 Inlet Location and Spacing on Continuous Grades

Change ...so does the spread and depth.
 To ...so does the depth.

Change Since the spread (encroachment) and depth...
 To Since the depth...

3.3.1 Design Considerations

First Paragraph:

Delete "encroachment and"

Change ...Section 2.2.

To ...Section 2.1.

Delete "Table 7-2 lists pavement encroachment and inundation standards for minor storms in the UDFCD region."

Second Paragraph:

Delete "spread (encroachment)"

Delete "encroachment and"

Delete "spread and/or"

3.3.2 Design Procedure

First Paragraph:

Delete "encroachment and" Delete "Equation 7-11 and"

Third Paragraph:
Delete “allowable spread and”

Delete “allowable spread and”

Fourth Paragraph:
Delete “spread or”

4.1 Introduction

After Paragraph 1:
Add Refer to the COL Storm Drainage Standards, Specifications, and Details on the COL website for allowable storm sewer pipe materials and manhole details and specifications.

Paragraph 4:
Delete The first two sentences

4.2 Design Process, Considerations, and Constraints

Paragraph 3:
Change “Pipe diameters less than 15 inches are not recommended for storm drains, and many communities have adopted an 18 inch diameter minimum standard.”

To The minimum size storm sewer pipe within a Public Right-of-Way or Public Drainage Easement shall be 18 inches in diameter.

Paragraph 4:
Change ...depth 100%...
To ...depth at 100%...

Delete The last two sentences of the fourth paragraph

Paragraph 5:
Delete The two sentences that begin with “Manholes are also...”
Add Refer to the COL Storm Drainage Standards, Specifications, and Details on the COL website for manhole spacing, etc.

4.3 Storm Drain Hydrology—Peak Runoff Calculation

Change of the USDCM
To of the LSDC

4.4.1 Flow Equations and Storm Drain Sizing

Add The Manning's roughness coefficient "n" for all storm sewer pipe capacity calculations shall be 0.013 regardless of pipe material (i.e. Concrete, PVC, or HDPE)

4.4.2 Energy Grade Line and Head Loss

After first sentence:

Add Storm sewer energy loss coefficient tables, manhole and junction loss coefficient tables, and an example illustration are included on the following four pages and herein referenced as Figures 7-16, 7-17, 7-18, and 7-19.

Add The hydraulic grade line and energy grade line shall be calculated for each storm sewer system and included in the Final Drainage Report. Each storm sewer system shall be profiled on the Final Construction Drawings and shall include the design flow hydraulic grade line. The energy grade line for the design flow shall be 6 inches below the final finished elevation of the manhole rims and inlet flowlines.

Losses at the Upstream Manhole, Section 3 to Section 4:

Change K_e = entrance loss coefficient between 0.2 to 0.5

To K_e = entrance loss coefficient from Figure 7-16

Add Figure 7-16

Bend/Deflection losses:

Change K_b = bend loss coefficient

To K_b = bend loss coefficient from Figure 7-16

Change As shown in Figure 7-15 and Table 7-11, the...

To As shown in Figure 7-13 and Table 7-11, the...

Change Figure 7-16 illustrates...

To Figure 7-14 illustrates...

Change curve on Figure 7-15 labeled...

To curve on Figure 7-13 labeled...

Lateral Junction Losses:

Change K_j = lateral loss coefficient

To K_j = lateral loss coefficient from Figure 7-13

Transitions:

Change ...Table 7-12...

To Figure 7-17

Add Figure 7-17

Delete Table 7-12 in its entirety

Change ...contraction coefficient.
To ...contraction coefficient from Figure 7-17.

Delete Typically, $K_c = 0.5$ provides reasonable results.

Curved Pipes

Change ...coefficient from Figure 7-15.
To ...coefficient from Figure 7-18.

Add Figure 7-18

5.0 UD-Inlet Design Workbook

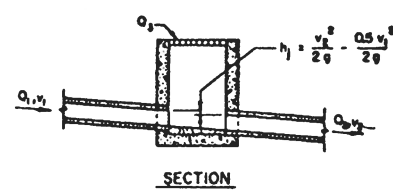
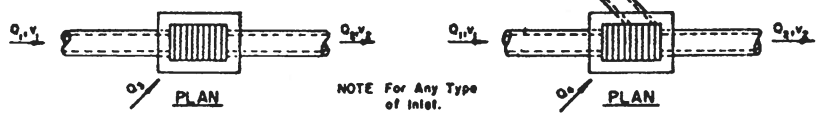
Add Only UD-Inlet is allowed in the COL for inlet capacity calculations.

Figure 7-16

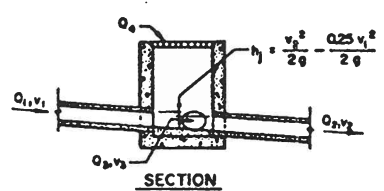
MANHOLE AND JUNCTION LOSSES

REFERENCE:

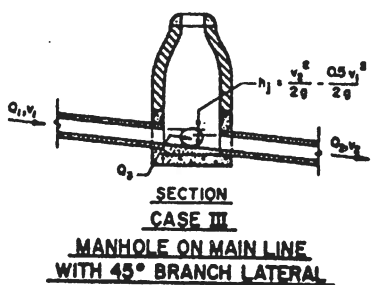
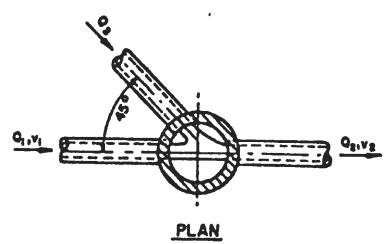
APWA Special Report No. 49, 1981



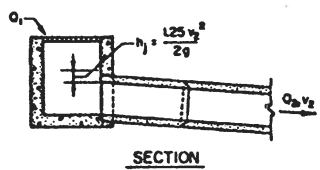
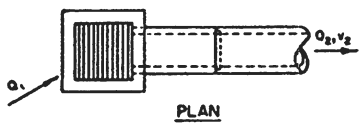
CASE I
INLET ON MAIN LINE



CASE II
INLET ON MAIN LINE WITH BRANCH LATERAL



CASE III
MANHOLE ON MAIN LINE WITH 45° BRANCH LATERAL



CASE IV
INLET OR MANHOLE AT BEGINNING OF LINE

EQUATION:

$$H_L = \left(\frac{V_2^2}{2g} \right) - K_j \left(\frac{V_1^2}{2g} \right)$$

CASE NO.	K _j	CASE III	
		θ°	K _j
I	0.50	22-1/2	0.75
II	0.25	45	0.50
IV	1.25	60	0.35
		90	0.25
		No Lateral	0.50

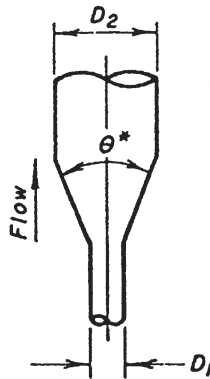
Figure 7-17

STORM SEWER ENERGY LOSS COEFFICIENT (EXPANSION, CONTRACTION)

REFERENCE: Linsley and Franzini, "Water Resources Engineering",
McGraw-Hill, 1964

(a) Expansion (K_e)

θ^*	$\frac{D_2}{D_1} = 3$	$\frac{D_2}{D_1} = 1.5$
	$\frac{D_2}{D_1}$	$\frac{D_2}{D_1}$
10	0.17	0.17
20	0.40	0.40
45	0.86	1.06
60	1.02	1.21
90	1.06	1.14
120	1.04	1.07
180	1.00	1.00



(b) Pipe Entrance from Reservoir

$$\text{Bell-mouth } H_L = 0.04 \frac{V^2}{2g}$$

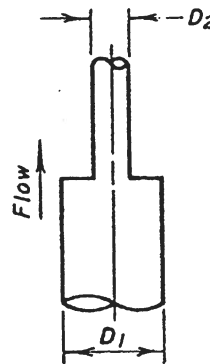
$$\text{Square-edge } H_L = 0.5 \frac{V^2}{2g}$$

$$\text{Groove and U/S For Concrete Pipe } H_L = 0.2 \frac{V^2}{2g}$$

*The angle θ is the angle in degrees between the sides of the tapering section.

(c) Contractions (K_c)

$\frac{D_2}{D_1}$	K_c
0.1	0.5
0.4	0.4
0.6	0.3
0.8	0.1
1.0	0



EQUATIONS:

$$H_L = K_e \left(\frac{V_1^2}{2g} \right) \left[1 - \left(\frac{A_1}{A_2} \right) \right]^2$$

$$H_L = K_c \left(\frac{V_2^2}{2g} \right) \left[1 - \left(\frac{A_2}{A_1} \right) \right]^2$$

Figure 7-18

STORM SEWER ENERGY LOSS COEFFICIENT (BENDS)

$$H_L = K_j (V^2 / 2g)$$

REFERENCE:

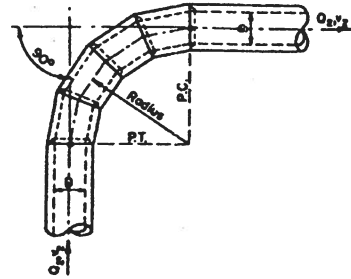
APWA Special Report No. 49, 1981

CASE I
CONDUIT ON 90° CURVES*

NOTE: Head loss applied at P.C. for length

RADIUS	K_b
1 X D	0.50
(2 to 8) X D	0.25
(8 to 20) X D	0.04
>20 X D	0

* When curves other than 90° are used, apply the following factors to 90° curves
 60° curve 85%
 45° curve 70%
 22-1/2° curve 40%



CASE II
BENDS WHERE RADIUS IS
EQUAL TO DIAMETER OF PIPE

NOTE: Head loss applied at beginning of bend

θ° BEND	K_b
90	0.50
60	0.43
45	0.35
22-1/2	0.20

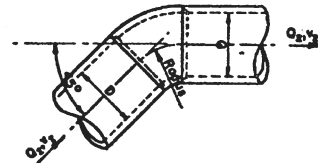
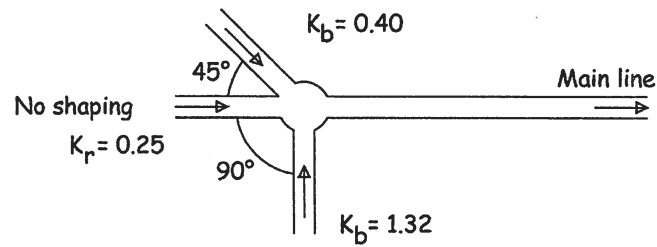
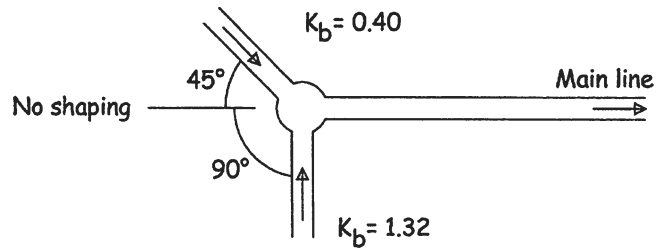


Figure 7-19



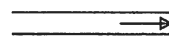
at $\theta = 45^\circ$, $K_r^1 = 0.50$

at $\theta = 90^\circ$, $K_r^2 = 0.25$

$$K_r = \min(K_r^1, K_r^2) = 0.25$$



Manhole



Sewer

Example Illustration

Chapter 8 Open Channels

3.2 Provide Ample Space for Stream and Floodplain

Provide Ample Freeboard:

Change “Urban Drainage and Flood Control District (UDFCD) recommends providing 18 inches”...

To The COL requires 12 inches...

3.3 Manage Increase Urban Runoff

Paragraph 1:

Change ...Volume 3 of the Urban Storm Drainage Criteria Manual (USDCM)>

To ...Volume 3 of the LSDC.

Paragraph 4:

Delete Entire paragraph (beginning with “Master plan modeling...”)

4.3.2 Sizing of Bankfull Channel

Based on return period:

Change ...UDFCD recommends using...

To ...the COL recommends using...

Last Paragraph

Change ...streams within the UDFCD area.

To ...streams within the COL area.

4.3.4 Floodplain Terraces

Paragraph 7:

Delete See the *Stream Access and Recreational Channels* chapter for these criteria.

Add The City of Loveland and the design engineer shall work together to provide access to all major drainageways as determined appropriate at the time of preliminary and final design.

4.5 Develop Grade Control Strategy to Manage Longitudinal Slope

Number 3:

Change ...have been estimated in an UDFCD master plan.

To ...have been estimated in the LMDP.

Number 4:

Change ...within UDFCD boundaries

To ...within COL boundaries

4.6 Address Bank Stability

After third bullet

Add In addition, consideration should be given to using structural methods at the channel bottom and vegetative / bioengineering methods on the upper banks of the channel.

4.6.1 Bioengineering Techniques

Paragraph 1:

Change ...restoration within UDFCD has...

To ...restoration within the COL has...

Paragraph 1:

Change UDFCD promotes the integration...

To The COL promotes the integration...

4.6.2 Bank Protection Approaches

Paragraph 4:

Change UDFCD recommends using purely vegetative...

To The COL recommends using purely vegetative...

Paragraph 5:

Change UDFCD experience has shown...

To The COL experience has shown...

Blue Box

Item 3.

Change ...hydraulic calculations...

To hydraulic and shear stress calculations...

Add 4. Provide sufficient evidence of high groundwater table or a proposed temporary irrigation plan to support the establishment of roots and vegetation for the proposed bioengineered system.

4.8 Evaluate Stream Hydraulics of over a Range of Flows

Paragraph 7:

Change ...with the owner and local jurisdiction,...

To ...with the owner and COL,...

5.0 Naturalized Channels

2nd Paragraph:

Add Manufactured channel linings such as gabions, interlocked concrete blocks, synthetic linings, etc. are not recommended for new developments, but will be considered on a case-by-case basis by the City of Loveland.

5.3 Establish Effective Cross-Sectional Shape

Paragraph 2:

- Delete In addition to the minimum dimensions shown in Table 8-2, a maintenance access path with a minimum per the geometry listed in Table 9-3 of the *Stream Access and Recreational Channels* chapter.
- Add In addition to the minimum dimensions shown in Table 8-2, the City of Loveland and the design engineer shall work together to provide access to all major drainageways as determined appropriate at the time of preliminary and final design.

Paragraph 3:

- Change ...a freeboard of 18 inches or more
To ...a freeboard of 12 inches or more
- Add Grass-lined open channels conveying ≤ 50 cfs may reduce the minimum 1.0-foot freeboard requirement to the freeboard required to convey 1.33 times the 100-year design flow. The reduced freeboard may only occur if a 1.0-foot minimum freeboard is not physically or reasonably possible and a variance request is submitted.

5.6 Address Bank Stability

- Add The City of Loveland is open to review and accept alternate bioengineering methods that provide protection to toe of bank slopes (i.e. riprap, etc.)

5.8 Evaluate Storm Hydraulics Over a Range of Flows

- Add Water surface profiles shall be computed for all open channels conveying > 50 cfs within the City of Loveland. Hydraulic grade lines shall be shown on the Final Construction Drawing profiles of open channels conveying > 50 cfs within the City of Loveland. It is not necessary to show energy grade lines on Final Construction Drawing profiles, but encouraged. The energy grade line for the design flow shall be at or below the final finished top of channel bank elevation.

Table 8-3:

- Add Note: The 5-year design parameters in this table are not the same as the 2-year design storm event.

6.1 Design Criteria for Swales

After Paragraph 1:

- Add To the greatest extent possible, smaller swales with smaller flows shall be designed so that the Froude Number for the 100-year stormwater flows does

not exceed 0.80. If the Froude Number exceeds 0.80, then the use of a permanent turf reinforcement mat within the swale may be used in lieu of riprap lining. The permanent turf reinforcement mat shall be installed up to the freeboard elevation of the 100-year storm flow and shall withstand the velocity and shear stress created by the 100-year storm flows within the swale.

Item 1:

Change ...5:1 or flatter.

To ...4:1 or flatter.

Add 3. Grass-lined open channels conveying ≤ 50 cfs may reduce the minimum 1.0-foot freeboard requirement to the freeboard required to convey 1.33 times the 100-year design flow. The reduced freeboard may only occur if a 1.0-foot minimum freeboard is not physically or reasonably possible and a variance request is submitted.

Add 4. The City of Loveland and the design engineer shall work together to provide access to all major drainageways as determined appropriate at the time of preliminary and final design.

Add 5. At a minimum, all swales shall be designed to convey the 100-year storm event.

6.3 Soil Riprap and Void-Filled Riprap Swales

Add For soil riprap, vegetation must be established in accordance with Section 6.2.1 above.

8.0 Rock and Boulders

Paragraph 3:

Change UDFCD recommends review...

To The COL recommends review...

8.1.1 Mild Slope Conditions

Paragraph 1:

Change ...UDFCD recommends...

To ...COL recommends...

Paragraph 2:

Change ...chapter of the USDCM, and protection...

To ...chapter of the LSDC, and protection...

8.1.2 Steep Slope Conditions

First paragraph after bullets:

Change ...standard UDFCD riprap gradations.

To ...standard COL riprap gradations.

Change ...in UDFCD specifications.

To ...in COL specifications and standard details.

8.2 Boulder and Riprap Specifications

Change ...for riprap and boulders can be found in UDFCD's Construction Specifications, available at www.udfcd.org.

To ...for riprap can be found on the COL's website. Boulder classifications and grout specifications can be found in the following Table 8-8 and Table 8-9.

Add The following Table 8-8 and Table 8-9

Table 8-8
Classification of Boulders

Boulder Classification	Nominal Size and [Range in Smallest Dimension of Individual Rock Boulders (inches)]	Maximum Ratio of Largest to Smallest Rock Dimensions of Individual Boulders
B18	18 [17-20]	2.5
B24	24 [22-26]	2.0
B30	30 [28-32]	2.0
B36	36 [34-38]	1.75
B42	42 [40-44]	1.65
B48	48 [45-51]	1.50

Table 8-9
Structural Grout Requirements for Grouted Boulders

Item	Type A ¹	Type B ²
Cement	Type II, 7 Sack	Type II, 7 Sack
Concrete Aggregate Mix – Max Diameter	½ inch	¾ inch
Compressive Strength	3,200 psi at 28 days	3,200 psi at 28 days
Slump	4 to 6 inches	4 to 6 inches
Air Entrainment	7.5% ± 1.5%	7.5% ± 1.5%
Fiber Mesh	1.5 lbs/cy	1.5 lbs/cy
Fly Ash (Class C) – Max Allowable Substitute	25%	25%
Color Additive	As Required	As Required

1 Type A grout can be used for most applications.

2 Type B grout is appropriate for waterways such as streams and rivers that have a substantial flow that could scour Type A grout.

8.2.2 Soil Riprap

Change ...UDFCD frequently specifies...
 To ...the COL frequently specifies...

8.2.3 Void-filled Rip Rap

Number 3, Paragraph 5:

Change UDFCD recommends construction...
 To The COL recommends construction...

Volume 2

Chapter 9 Hydraulic Structures

1.0 Structures in Streams

Paragraph 5:

Change ...discussed herein govern design of all structures
To ... discussed herein should be followed.

2.1 Overview

Paragraph 4:

Change ...fully developed future basin conditions, in accordance with zoning maps,
master plans, and other relevant documents.
To ...the major storm as presented in the LMDP.

Blue box labeled Key Considerations...:

Change ...master plan...
To ...LMDP...

Change ...or less to avoid...
To ...or less, if possible, to avoid...

2.2.2 Geometry

Table 9-1, Footnote 1:

Change Urban Drainage and Flood Control District (UDFCD)...
To The COL...

2.3.5 Hydraulic Jump Length

Paragraph 2:

Change ...in the UDFCD region.
To ...in the COL.

Paragraph 3:

Change UDFCD recommends...
To COL recommends...

2.4.1 Introduction

Paragraph 2:

Change ...the Urban Storm Drainage Criteria Manual (USDCM)...
To ...LSDC...

2.6.1 Description

Paragraph 2:

Delete Entire paragraph

Add In the COL, grouted boulders shall be left exposed.

2.6.3 Design Criteria

Number 3:

Change ...UDFCD...

To ...COL...

Table 9-4:

Add A row above the “Less than 5.00” cell. Within this row, the cell under the “Rock Sizing Parameter, Rp” column shall contain the wording, “Less than 4.50” The cell under the “Boulder Classification” column shall contain the term “B18”.

Table 9-4 Cell containing the wording “Less than 5.00”:

Replace “Less than 5.00”

With “4.5 to 4.99”

2.6.4 Construction Guidance

Paragraph 6:

Change ...UDFCD...

To ...COL...

2.7.1 Description

Paragraph 2:

Change ...UDFCD...

To ...COL...

2.7.4 Decorative Elements (Finishing)

Examples in Nature:

Change ...UDFCD...

To ...COL...

Change ...UDFCD...

To ...COL...

Top Dressing with Sand...:

Change ...UDFCD...

To ...COL...

2.8 Vertical Drop Structure Selection

Delete Entire Section

2.9 Low-Flow Drop Structures and Check Structures

2nd Bullet:

Delete (depending on local criteria)

3.0 Pipe Outfalls and Rundowns

Delete 2nd Paragraph

Add When a pipe outfall conveys stormwater down an embankment, permanent erosion protection in the form of a concrete or grouted riprap rundown is needed to protect the embankment from erosion. The rundown needs to be designed to contain the 100-year runoff plus freeboard and be in the shape of a swale. Rundowns conveying > 50 cfs shall have a minimum 1.0 foot freeboard above the 100-year water depth. Rundowns conveying ≤ 50 cfs may reduce the freeboard requirement to the freeboard required to convey 1.33 times the 100-year design flow.

3.1.1 Flared End Sections and Toe Walls

Paragraph 2:

Change ...UDFCD...

To ...COL...

Change ...UDFCD...

To ...COL...

Paragraph 3:

Delete Figure 9-29 and... .. for a cutoff wall.

3.1.2 Concrete Headwall and Wingwalls

Delete Entire section

Delete Figure 9-29 through Figure 9-33

3.2.4 Outfalls and Rundowns

Section Title

Change “Outfalls and Rundowns”

To “Grouted Boulder Outfalls”

Paragraph 1:
Change ...outfall or “rundown”can...
To ...outfall can...

Change ...the South Platte.
To ...Big Thompson River.

3.2.5 Rundowns

Paragraph 1:
Delete The use of rundowns is discouraged due to their high rate of failure which results in unsightly structures that become a maintenance burden.

Change ...alternative is to ...
To ...alternative, for low flow rates, is to ...

Design Flow paragraph
Change ...full design flow
To ...100-year design flow

Delete Cross-section paragraph

Add **Cross-Section**

Rundowns shall be designed to contain the 100-year runoff plus freeboard and be in the form of a swale. The rundown shall be constructed of either grouted riprap (with no fines), grouted boulders or concrete.

Design Capacity

The capacity of the channel rundown is dependent on the allowable flow depth at the entrance to the rundown. Since many rundowns begin at a curb in a parking lot or street, capacity limitations are based on maximum ponding depth at the curb equal to the curb height. The maximum depth is taken as the specific energy of the flow as it passes through critical depth at the entrance to the rundown. The minimum rundown width should equal the width of the upstream curb cut or storm sewer or as required to convey the major storm runoff, whichever is greater. At no time should the rundown width be less than 12 inches.

Outlet Configuration

The channel rundown outlet shall enter the drainageway at the trickle channel. Erosion protection of the opposite channel bank shall be provided by a layer of grouted riprap. The width of this riprap erosion protection shall be at least three times the channel rundown width. Riprap protection shall extend up the opposite bank to the minor storm flow depth in the drainageway or 2 feet, whichever is greater.

Freeboard

For rundowns conveying > 50 cfs, provide a minimum 1 foot of freeboard above the critical depth of the flow. For rundowns conveying ≤ 50 cfs, the freeboard requirement may be reduced to the freeboard required to convey 1.33 times the 100-year design flow.

Appendix A. Force Analysis for Grade Control Structures

Overall Analysis, Paragraph 2:

Change ...USDCM...

To ...COL...

Chapter 10 Stream Access and Recreational Channels

1.0 Introduction and Overview

- Delete Paragraph starting with “Boatable channels represent a subset of recreational channels...”
- Delete Paragraph starting with “Some boatable channel criteria may also be appropriate...”
- Delete The three bulleted items.

2.0 Public Safety Project Review

- Blue Box labeled Public safety criteria...
- Change ...in the Urban Storm Drainage Criteria Manual (USDCM):
To ...in the LSCM:
- From the storage Chapter, Paragraph 2:
Delete “Check requirements of the local jurisdiction.”
- Change UDFCD...
To COL...

3.0 Shared-Use Paths Adjacent to Streams

- Change ...adhere to local jurisdiction...
To ...adhere to COL...
- Change ...adhere first to local jurisdiction criteria...
To ...adhere first to COL criteria...

3.1 Path Use

- Bullet 1:
Change ...into an existing master plan where...
To ...into an existing plan where...

3.2 Frequency of Inundation

- Third Paragraph
Change ...In this case UDFCD...
To ...In this case COL...

3.3.1 Typical Sections

First Paragraph

Change ...is ten feet...
To ...is twelve feet...

Delete This is also consistent with AASHTO's width recommendations for two-directional shared-use paths.

Delete ...to 12 or even 14 feet...

Change ...path meets that of Cherry Creek.
To ...path meets that of Cherry Creek in Denver, Colorado.

3.3.4 Vertical Clearance in an Underpass

Delete Minimum values may be lower than those published by local communities within the UDFCD boundary.

Delete Always check local criteria and conform to their vertical clearance requirements.

Delete Table 10-3

Add When designing paths within City of Loveland property or rights-of-way, the current City of Loveland requirements for path geometry shall be used instead of the geometry parameters presented in Table 10-3.

3.4.2 Pumped Systems

Change ...UDFCD...
To ...COL...

Blue box labeled Underpass Safety:
Third Bullet:

Change UDFCD encourages...
To COL encourages...

Change ...in Photo 10-17 as a regional standard.
To ...in Photo 10-17.

3.5.2 Path Underpass in a Culvert

Paragraph 2:

Change UDFCD...
To COL...

Change ...in Photo 10-17 to promote consistency throughout the region.
To ...in Photo 10-17.

3.6.1 Crossing Type and Materials

Change ...UDFCD...
To ...COL...

3.7.3 Asphalt

Change UDFCD...
To COL...

3.7.4 Concrete

Add When the path is constructed on City of Loveland property or rights-of-way, the current City of Loveland criteria shall be used to determine the minimum allowable depth of the concrete.

3.7.5 Proprietary Surfaces

Change ...UDFCD...
To ...COL...

4.3 Minimum Criteria

Paragraph 1:
Change ...UDFCD...
To ...COL...

Chapter 11 Culverts and Bridges

1.0 Introduction and Overview

Paragraph 4:

Change ...the Urban Storm Drainage Criteria Manual (USDCM)...
To ...the LSDC...

2.0 Required Design Information

Drainage Master Plan:

Change Drainage Master Plan
To Planning

First Bullet:

Change ...the relevant major drainageway master plan, and...
To ...the relevant LMDP, and...

Second Bullet:

Delete Assure consistency with existing master plans and/or outfall studies.

Design Flood Frequency and Discharge:

Delete Bullet starting with “The design flood frequency for culverts...”
Add

<u>DRAINAGE CLASSIFICATION</u>	<u>MINIMUM CAPACITY (RECURRANCE INTERVAL)</u>
Local	10-Year
Residential Collector & Commercial Collector	10-Year
Minor Arterial & Major Arterial	100-Year

When the flow in a roadside ditch exceeds the capacity of the culvert and overtops the cross street, the flow over the street crown shall not exceed the limits established in Chapter 7, Section 2.1.

Allowable Headwater Depth for Culverts:

Delete Items 1 through 3. Add The maximum culvert headwater to diameter ratios are:

<u>STORMWATER FREQUENCY</u>	<u>HEADWATER TO DIAMETER</u>
10-Year	HW/D ≤ 1.0
100-Year	HW/D ≤ 1.5

Allowable Outlet Velocities for Culverts:

Change Use UD Culvert, available at www.udfed.org to...
To Refer to Section 3.0 in Chapter 9 to...

Culvert Details:

Add To second bullet: Refer to the “City of Loveland, Colorado Storm Drainage Standards”, latest edition, for allowable culvert pipe materials. The storm drainage standards can be found on the City of Loveland Public Works Stormwater Engineering Stormwater Standards page.

3.1 Key Hydraulic Principles

Add Culvert hydraulic analysis must include analysis of both inlet and outlet control conditions as steady state open channel flow calculations do not apply to culvert hydraulics.

Change Manning roughness coefficient (See Table 11-1)
To Manning roughness coefficient

Delete Table 11-1. Manning’s roughness coefficients with 3.5.3 page 53 (last paragraph)

Add The Manning’s roughness coefficient “n” for all culvert pipe sizing calculations shall be 0.013 regardless of pipe material (Concrete, PVC, or HDPE).

3.1.1 Energy and Hydraulic Grade Lines

Add The hydraulic grade line and energy grade line shall be determined for each culvert system and included in the Final Drainage Report. Each culvert system shall be profiled on the Final Construction Drawings and shall include the design flow hydraulic grade line.

4.1 Capacity Charts

Paragraph 2: Delete Sentence starting with “Perhaps most important to recognize...”

Delete Sentence starting with “This is important because...”

4.1.2 Culverts Under Outlet Control

Paragraph 1:

Delete Sentence that begins with “In addition, the hydraulic roughness of the culvert material...”

Paragraph 2:

Delete Sentence starting with “Also, as stated in section 2.2, UDFCD...”

4.3 Computer Applications

Paragraph 1:

Change ...UDFCD...

To ...COL...

Delete Paragraph starting with “In addition to the public domain...”

4.4.3 Minimum Culvert Diameter

Delete Sentence starting with “Since smaller diameter pipes...”

Add Culverts smaller than 18 inches in diameter may only be used to convey roadside ditches under driveways where basin location, site grading, and roadside ditch depths do not make an 18 inch diameter culvert practical. A variance shall be requested for use of culverts smaller than 18 inches in diameter.

4.4.6 Minimum Slope

Delete Entire section

5.1.1 Inlets with Headwalls

Corrugated Metal Pipe:

Delete Entire Section

5.1.2 Special Inlets

Corrugated Metal Pipe:

Delete Entire Section

Concrete Pipe:

Delete As is the Case with Corrugated Metal Pipe, concrete end-sections....

Mitered Inlets:

Delete They are most commonly used with corrugated metal pipe.

5.1.3 Projecting Inlets

Delete ...metal or...

Add At a minimum all culvert entrances and outlets shall include a flared end section or headwall.

5.2.2 Buoyancy

3rd Paragraph:

Delete ...particularly on corrugated metal pipe with mitered, skewed, or projecting ends.

5.3 Safety Grates

Delete 2nd Bullet.

Paragraph 6:

Change ...the USDCM to size the grate...

To ...the LSDC to size the grate...

Blue box labeled Safety Grate Design:

Change ...the USDCM to size the grate.

To ...the LSDC to size the grate.

5.3.1 Collapsible Grating

Delete Entire Section.

6.0 Outlet Protection

Paragraph 4:

Change ...the USDCM and...

To ...the LSDC and...

7.1 General

Last Paragraph:

Change ...owner and local jurisdiction.

To ...owner and COL.

Change Contact the local government to...

To Contact the COL to...

7.3 Freeboard

Delete Criteria for bridge freeboard vary from 1 foot to 4 feet in Colorado depending on the jurisdiction and risk of debris specific to the channel.

Add The bridge low chord elevation shall be a minimum of 1-foot above the 100-year water course energy grade line.

Delete Sentence starting with “Additionally, some criteria define freeboard based...”

Delete Sentence starting with “When the local jurisdiction does...”

9.0 Checklist

Delete Sentence starting with “HW/D ratio...”

Delete Second bullet starting with “The culvert...”

Chapter 12 Storage

1.0 Overview

Paragraph 1:

Change ...USDCM.
To ...LSDC.

Bullet 1:

Change Regional sub-regional, and onsite detention facilities,
To Regional and onsite detention facilities,

Last Paragraph:

Change UDFCD...
To COL...

2.0 Implementation of Regional, Sub-regional, and On-site Detention Facilities

Section Title

Change Implementation of Regional, Sub-regional, and On-site Detention Facilities
To Implementation of Regional and On-site Detention Facilities

Paragraph 1:

Change There are three basic ...
To There are two basic ...

Bullet 2:

Delete Subregional Detention

Last sentence:

Change These three approaches ...
To These two approaches ...

2.1 Regional Detention

Paragraph 1:

Change ...watershed areas ranging from about 130 acres to one square mile.
To ...watershed areas.

Paragraph 2:

Delete Sentence starting with “In some cases, regional detention has been shown...”

Paragraph 3:

Delete Sentence starting with “Regional detention facilities may be...”

Add

Regional Master Planned detention ponds, designed and constructed by or on behalf of the City of Loveland, shall be owned and maintained by the City of

Loveland Stormwater Utility. All other detention ponds shall be considered privately owned and privately maintained.

Paragraph 5:

Delete Entire paragraph

Add Release rates for master planned regional detention facilities shall be as identified in the LMDP or as determined by the COL.

2.2 Subregional Detention

Delete Entire section including Figure 12-2.

2.3 Onsite Detention

Paragraph 1:

Change ...one lot, generally commercial or industrial sites draining areas less than 20 to 30 acres.

To ...one lot, or development.

Paragraph 2:

Delete On-site facilities are usually designed to control runoff from a specific land development site and are not typically located or designed to effectively reduce downstream flood peaks along the receiving stream.

Figure 12-3:

Change Onsite drainage area generally <20AC

To Onsite drainage area

Change “Minor drainage”

To “Drainageway”

Change “Major drainage”

To “Drainageway”

Change Onsite detended facility

To Onsite detention facility

Delete Applicable to certain commercial, multi-family, and industrial land uses

Paragraph 3:

Change ...is that developers can be required to build them as a condition of site approval.

To ...is that development can occur before master planned facilities are fully constructed.

Delete Sentence starting with “Approximately 100 onsite facilities built...”

2.4 Detention and UDFCD 100-Year Floodplain Management Policy

Delete Entire section

3.2 Excess Urban Runoff Volume

Paragraph 1:

Change ...UDFCD...

To ...COL...

Paragraph 3:

Delete The upper portion of volume in a full spectrum detention facility is designed to reduce the developed condition 100-year peak discharge down to 90 percent of the pre-development 100-year peak flow rate from the tributary sub-watershed.

To The upper portion of volume in a full spectrum detention facility is designed to reduce the developed condition 100-year peak discharge down to the historic rate as presented in Table 12-6 in Section 4.1.2.

Blue Box labeled Benefits of Implementing...:

Change ...UDFCD...

To ...COL...

3.3 Compatibility of Full Spectrum Detention with Minor and Major Event Detention

Paragraph 1:

Change ...in magnitude to 10-year/100-year detention...

To ...in magnitude to traditional 10-year/100-year detention...

Change ...based on past criteria provided in this manual.

To ...based on traditional design criteria.

Paragraph 2:

Delete Sentence starting with “Where existing master plans recommend...”

Paragraph 3:

Delete Sentence starting with “There may be opportunities to convert existing...”

3.4 Water Quality Capture Volume and Full Spectrum Detention

Bullet 2:

Delete Retention ponds,

Bullet 4:

Delete Sand filters, and

Paragraph 2:

Change ...UDFCD does not recommend adding any part...
To ...COL does not add any part...

Add Within the City of Loveland the water quality capture volume shall be considered a portion of the total 100-year detention pond volume obtained using the simplified full spectrum detention pond design method.

Table 12-1, Maximum Release Rate for Zone 3:

Change 0.9 (predevelopment Q₁₀₀)
To Based on the 100-year release rates in Table 12-6.

Paragraph 4:

Delete Sentence starting with “The design of a retention pond...”

Delete Figure 12-7

Delete Table 12-2

Table 12-3, Maximum Release Rate for Zone 3:

Change 0.9 (predevelopment Q₁₀₀)
To Based on the 100-year release rates in Table 12-6.

Delete Paragraph starting with “The design of a sand filter combined with full...”

Delete Figure 12-9

Delete Figure 12-10

Delete Figure 12-11

Table 12-4, Title

Change Sand Filter or bioretention facility combined with full spectrum detention
To Bioretention facility combined with full spectrum detention

Table 12-4, Maximum Release Rate for Zone 3:

Change 0.9 (predevelopment Q₁₀₀)
To Based on the 100-year release rates in Table 12-6.

4.0 Sizing of Full Spectrum Detention Storage Volumes

Change ...USDCM...
To ...LSDC...

Item 2:

Change UD-Detention workbook
To Modified FAA Method

- Add The excess urban runoff and 100-year storm shall be the design parameters for all detention pond designs within the COL, unless so dictated by COL.
- Add Hydrograph Routing through the CUHP and SWMM method is mainly used for master planning purposes.
- Add The Rational Method and Modified FAA Method is required for all detention volume sizing calculations.
- Delete Table 12-5

4.1.1 Full Spectrum Detention Volume

- Delete Entire section.

4.1.2 100-year Release Rates

- Delete All paragraphs, equations, and tables
- Add The maximum allowable unit flow release rates in COL are presented in Table 12-6

Table 12-6:
Maximum Allowable Unit Flow Release Rates (cfs/acre) of Tributary Catchment

Design Return Period (Years)	NRCS Hydrologic Soil Group		
	A	B	C & D
2	0.02	0.03	0.04
5	0.07	0.13	0.17
10	0.13	0.23	0.30
25	0.24	0.41	0.52
50	0.33	0.56	0.68
100	0.50	0.85	1.00

4.2 UD-Detention Workbooks

- Delete Entire Section
- Add 4.2 Modified FAA Method
The Modified FAA Method shall be used to design all detention pond 100-year volumes for drainage basins that contain 160 acres or less. The City of Loveland does not have better values to use for the C1, C2, C3 coefficients within the “Detention Volume by Modified FAA Method” spreadsheet. Please use the Denver area values. When utilizing the spreadsheet provided on the City of Loveland website, do not alter the default values for C1, C2, and C3 provided in the spreadsheet. Use the values from Table 12-6 to insert into

the Allowable Unit Release Rate input cell and do not use the default “q” provided in the button in the “Modified FAA” tab.

4.2.1 Hydrograph Routing using CUHP and SWMM

Paragraph 2:

Change ...USDCM...

To ...LSDC...

Paragraph 3:

Delete The maximum allowable 100-year release rate should not exceed 90 percent of the approved predevelopment release rate determined through CUHP/SWMM modeling of the upstream watershed (this may vary slightly from the predevelopment discharge values presented in Section 4.1.2), or maximum flow rates recommended in an accepted master plan.

Add The 100-year release rate should not exceed the maximum allowable release rates presented in Table 12-6.

5.0 Design Considerations

Paragraph 2:

Change ...USDCM...

To ...LSDC

Change UDFCD...

To COL...

Paragraph 3:

Change ...USDCM.

To ...LSDC.

5.2 Storage Volume

Change ...three...

To ...two...

5.3 Embankments

Side Slope bullet:

Add Embankments within Regional Detention Ponds shall be no steeper than 4(H):1(V).

Delete ...with no trees or shrubs above the basin floor.

Delete ...especially in retention ponds.

Freeboard bullet:

Change ...minimum of 1 foot above the water surface elevation when the emergency spillway is conveying the maximum design or emergency flow.

To ...minimum of 1 foot above the 100-year water surface elevation in the detention pond.

Delete Sentence starting with “When the embankment is designed to withstand...”

5.4 Emergency Spillways

Paragraph 1:

Delete Sentence beginning with “Generally, embankments should...”

Add After the second paragraph:

- Spillway Sizing – Each detention pond shall contain an emergency spillway capable of conveying the peak 100-year storm discharge draining into the detention pond. The invert of the emergency spillway shall be set equal to or above the 100-year water surface elevation. The depth of flow out the emergency spillway shall be ≤ 6 inches or 50% of the spillway height, if the spillway height is greater than one foot.
- Emergency Spillway Downstream Protection – From the emergency spillway downhill to the embankment toe of slope, protection shall consist of either riprap or soil riprap in order to protect the emergency spillway from catastrophic erosion failure. The riprap shall be sized at the time of final engineering design.
- Concrete Cutoff Wall – A concrete cutoff wall, 8 inches thick, 3 foot deep, extending 5 feet into the embankment beyond the emergency spillway opening, is encouraged on all private detention ponds and required on all public regional detention ponds. A concrete cutoff wall will permanently define the emergency spillway opening. The emergency spillway elevation shall be tied back into the top of embankment using a maximum slope of 4:1.

Paragraph 3:

Change soil riprap...

To Riprap or soil riprap...

5.4.1 Soil Riprap Spillway

Paragraph 2:

Delete (based on local jurisdiction criteria)

Delete Sentence starting with “A concrete wall is recommended...”

5.5 Outlet Structure

Paragraph 1:

Change USDCM
To LSDC

Paragraph 2:

Change ...USDCM...
To ...LSDC...

Last Paragraph:

Change ...USDCM...
To ...LSDC...

5.5.4 Raised Grate with Offset Vertical Openings

Paragraph 1:

Change ...USDCM).
To ...LSDC).

After 5.5.5 Outlet Pipe Hydraulics:

Add 5.5.6 Outlet Pipe:

The outlet pipe of a regional detention pond shall contain a minimum of two (2) concrete cutoff walls embedded a minimum of 18” into undisturbed earthen soil. The cutoff walls shall be 8 inches thick. The outlet pipe bedding material shall consist of native earthen soil and not granular bedding material to at least the first downstream manhole or daylight point.

5.7 Inlets

Change ...USDCM...
To ...LSDC...

5.8 Vegetation

Change UDFCD...
To COL...

5.9 Retaining Walls

Paragraph 1:

Delete The use of retaining walls within detention basins is generally discouraged due to the potential increase in long-term maintenance access and costs as well as concerns regarding the safety of the general public and maintenance personnel.

- Delete Where walls are used, limit the length of the retaining walls to no more than 50 percent of the basin perimeter.
- Change Check requirements of the local jurisdiction.
To Check requirements of the COL
- Change UDFCD...
To COL...
- Add Before second paragraph: The COL requires all retaining walls to be designed by a licensed structural engineer and comply with COL codes for fall protection.

5.10 Access

- Add Drivable access applies only to Regional Detention facilities within the City of Loveland. Each regional detention pond will be considered on a case-by-case basis at the time of final design.
- Change USDCM
To LSDC

5.12 Linings

- 2nd Sentence
Delete ...and retention...
- Delete An impermeable liner may also be warranted for a retention pond where the designer seeks to limit seepage from the permanent pool.
- Delete See the Retention Pond Fact Sheet in Volume 3 of the USDCM for guidance and benefits associated with the constructing a safety wetland bench.

5.13 Environmental Permitting and Other Considerations

- Paragraph 2:
Change UDFCD...
To COL...

5.14.2 Weirs

- Figure 12-21:
Delete “1’ min Freeboard” label from “Emergency Spillway Profile”
- Delete “Top of footing at or below bottom of soil riprap” label from “Emergency Spillway Profile”

Delete “1’ Min Freeboard” label from “Emergency Spillway Section and Spillway Channel”

Delete “3” to 4” Topsoil cover” label from “Emergency Spillway Section and Spillway Channel”

Change Cross-Slope Label “ ≥ 2.5 ” from “Emergency Spillway Section and Spillway Channel”
 To Cross-Slope Label; “ ≥ 4 ” from “Emergency Spillway Section and Spillway Channel”

6.1 Water Storage Reservoirs

Delete Entire section

6.3 Side-Channel Detention Basins

Change ...limited application, but may be one of the storage alternatives considered during watershed master planning studies.
 To ...limited application.

6.4 Parking Lot Detention

Paragraph 2:

Delete Sentence starting with “If 100-year parking lot detention is allowed...”

Add Above ground parking lot detention ponds may be utilized when land area for a grassed lined detention pond is not available. To prevent damage to and floatation of automobiles, parking lot detention ponds shall not exceed 12 inches in depth at any point. Parking lot detention ponds shall be signed as such to inform the general public about the potential for flooding. A parking lot detention pond shall not encroach into a public street.

6.5 Underground Detention

Change ... UDFCD.
 To ...COL.

Delete 2nd Sentence

Add Underground detention is discouraged but will be considered if a variance is requested. The variance request will need to explain why the engineer is proposing to use the method of underground detention and why it is a hardship for the owner to not provide an above-ground detention system. In addition, the owner’s written permission to maintain the underground detention system will need to be provided to the COL.

6.6 Blue Roofs

Delete Entire section including image

6.7 Retention Facilities

Delete Entire section

7.0 Designing for Safety, Operation, and Maintenance

Item 2:

Change Easements and/or rights-of-way are required to allow access to the facility by the owner or agency responsible for maintenance.

To Easements and/or rights-of-way are required for all access to all regional facilities by the COL.

Delete Bullet starting with “3. Permanent ponds should have provisions...”

Delete Bullet starting with “6. Use of fertilizer, pesticides...”

Change ...USDCM...

To ...LSDC...

Add Regional Master Planned detention ponds, designed and constructed by or on behalf of the City of Loveland, shall be owned and maintained by the City of Loveland Stormwater Utility. All other detention ponds shall be considered privately owned and privately maintained.

8.2 Example – Design of a Full Spectrum Detention Sand Filter Basin using UD-Detention

Paragraph beginning with “Enter the depth...”:

Change ...per USDCM criteria.

To ...per LSDC criteria.

Chapter 13 Revegetation

This chapter is for reference purposes and no additional changes shall be made to this chapter.

VOLUME 3

Preface

2.0 Purpose

Change Urban Storm Drainage Criteria Manual (USDCM)
To Loveland Storm Drainage Criteria (LSDC)

3.0 Overview

Chapter 1: Stormwater Management and Planning:

Change ...UDFCD's approach to reducing the impacts of urban runoff through implementation of a holistic...

To ...the four step process to minimize adverse impacts of urbanization

Change UDFCD
To The COL

Remove ...only minimally...

Blue Box Titled "The Four Step Process for Stormwater Quality Management"

Change The Four Step Process for Stormwater Quality Management
To The Four Step Process to Minimize Adverse Impacts of Urbanization

Step 2

Add The COL does not require a WQCV be implemented in every detention pond. If other stormwater quality devices and methods are implemented throughout the development that efficiently clarify the stormwater before it leaves the site, then a WQCV may not be needed.

Step 3 Stabilize Drainageways:

Delete Sentence beginning with "Many drainageways within..."
Add Channel stabilization measures are either included in the LMDPs or are as identified by the COL at the time of development.

Delete Entire fourth sentence beginning with "If this can be done early, it is far..."

Chapter 3: Calculation the WQCV and Volume Reduction:

Change incentive
To incentives

Chapter 4: Treatment BMPs

Add This section also includes discussion of the COL's Stormwater Quality BMP Point System Checklist.

Chapter 5: Source Control BMPs:

Add Provided for information purposes only. Not a part of the LSDC.

Blue box titled “Volume 3 BMPs”

Treatment BMPs

Delete Retention Pond

4.0 Revisions to USDCM Volume 3

Title

Change USDCM

To LSDC

Paragraph 1:

Change USDCM

To LSDC

Change UDFCD

To the COL

Bullet 1:

Delete Second Sentence beginning with, “Although UDFCD has previously included....”

Bullet 2:

Change UDFCD

To COL

Bullet 4:

Change UDFCD

To COL

5.0 Acronyms and Abbreviations

Insert “COL - City of Loveland” between COD and CRS

Insert “LMDP - Loveland Master Drainage Plan” between LEED and LID

Insert “LSDC - Loveland Storm Drainage Criteria” between LID and MCM

Chapter 1 Stormwater Management and Planning

1.0 Introduction

Bullet 3:

Change UDFCD's
To COL's

Change ...reduce the impacts of urban runoff.
To ...minimize adverse impacts of urbanization.

Last Paragraph:

Change UDFCD
To The COL

2.0 Urban Stormwater Characteristics

Paragraph 2:

Change ...primary focus.
To ...primary focus due to its proximity to the COL and similar climatic conditions.

3.2 Colorado's Stormwater Permitting Program

Paragraph 3:

Change ...area communities.
To ...area communities as well as the COL.

Change MS4 permit holders are...
To The COL is...

Within Blue Box Titled "Common Stormwater Management Terms":

Minimizing Directly Connected Impervious Area (MDCIA):

Change UDFCD
To the COL

Water Quality Capture Volume (WQCV):

Change UDFCD
To COL

Change 0.6
To 0.64

3.2.2 Post-construction Stormwater Management

Paragraph 1:

Delete ...and Chapter 5, Source Control BMPs,...

Last Paragraph:
Change UDFCD
To the COL

Change USDCM
To LSDC

Remove ...in 1992.

4.0 Four Step Process to Minimize Adverse Impacts of Urbanization

Paragraph 1:
Change UDFCD has long recommended a...
To The COL recommends a...

4.1 Step 1. Employ Runoff Reduction Practices

Permeable Pavement:
Add Currently, where fire protection vehicles need to access streets, alleys or driveway and parking aisles, permeable pavement shall not be used. Permeable pavement may be used in parking spaces and other paved areas that do not need to be accessed by fire protection vehicles.

Last Paragraph:
Change UDFCD
To COL

4.2 Step 2. Implement BMPs That Provide a Water Quality Capture Volume with Slow Release

Change ...wetland ponds, and retention ponds.
To ...wetland ponds.

Change ...Denver metropolitan area...
To ...COL...

4.3 Step 3. Stabilize Streams

Change Many streams within UDFCD boundaries are included in major drainageway or outfall systems plans...
To Several streams within the COL boundaries are included in the LMDP's,...

Add Streams requiring stream stabilization are either shown in the LMDPs or are as identified by the COL. The developer is responsible for implementing these improvements at the time of development.

5.0 Onsite, Subregional and Regional Stormwater Management

Delete “Subregional” from title

2nd Paragraph:

Delete ...subregionally (serving two or more development parcels with a total drainage area less than 130 acres),...

Delete ...or subregional...

Delete ...subregional,...

Change ...regional/subregional...
To ...regional...

5th Paragraph:

Delete ...or subregional...

Change ...regional/subregional...
To ...regional...

Change ...regional/subregional...
To ...regional...

Delete Last sentence

6th Paragraph:

Delete ...subregional...

6.0 Conclusion

Change UDFCD
To The COL

Chapter 2 BMP Selection

1.1 Physical Site Characteristics

Watershed Size Bullet:

Delete As a practical limit, the maximum drainage area contributing to a water quality facility should be no larger than one square mile.

Base Flows Bullet:

Delete retention ponds

1.3 Targeted Pollutants and BMP Processes

Pollutant Removal/Treatment Processes:

Number 1: Sedimentation

Delete ..., retention ponds, ...

Number 4: Adsorption/Absorption:

Delete ..., retention ponds, ...

Number 5: Biological Uptake:

Change ...bioretention, constructed wetlands and retention ponds...

To ...bioretention and constructed wetlands...

Number 1 beginning with “Be designed according to...”:

Change UDFCD

To COL

1.4 Storage-Based Versus Conveyance-Based

Delete ...retention ponds,...

1.5 Volume Reduction

Paragraph 1:

Change UDFCD has developed a...

To The COL has a...

Paragraph 3:

Delete ...retention and...

1.6 Pretreatment

Change ...constructed wetland basins, and retention ponds.

To ...and constructed wetland basins.

1.8 Online Versus Offline Facility Locations

Paragraph 1:

Change Outfall system plans and other reports
To The LMDP

Change ...a master planning study has been completed that...
To ...the LMDP...

Paragraph 2:

Change ...a master plan identifying...
To ...the LMDP identifies...

Paragraph 3:

Delete The maximum watershed recommended for a water quality facility is
 approximately one square mile.
Add These on-line facilities must be constructed on-site.

1.9 Integration with Flood Control

Paragraph 1:

Delete ...sub-regional or...

Paragraph 2:

Delete This manual does not stipulate or recommend which policy should be used.
 When a local policy has not been established, UDFCD suggests the following
 approach:

Add For the COL the following approach shall be used:

Delete Entire bullet named “Minor Storm (not EURV):”

Delete Entire bullet named “100-year Storm:”

1.9.1 Sedimentation BMP’s

Delete “and retention ponds.”

1.11 Maintenance and Sustainability

Paragraph 1:

Change MS4 permit holder may also require
To COL requires

3.0 Life Cycle Cost and BMP Performance Tool

Change To do so, UDFCD has developed an...
To To do so, COL has an...

3.1 BMP Whole Life Costs

Paragraph 1:

Change UDFCD
To COL

Paragraph 3:

Change UDFCD's
To COL's

Bullet 2:

Change ...Denver-area...
To ...Loveland-area...

Bullet 5:

Change ...Denver-area...
To ...Loveland-area...

3.2 BMP Performance

Change ...UDFCD...
To ...the COL...

Chapter 3 Calculating the WQCV and Volume Reduction

2.1 Development of the WQCV

Blue Box titled “Using and Flood Control Hydrology”:

Change UDCFD...

To The COL...

2.3 Attenuation of the WQCV (BMP Drain Time)

First Paragraph:

Delete ...,retention ponds...

Change Retention ponds and constructed...

To Constructed...

3.0 Calculation of the WQCV

Equation 3.1

Delete Equation 3-1

Add

Equation 3-1:

$WQCV = a(0.91l^3 - 1.19l^2 + 0.78l) b$

Where $b = 1.067$ (COL adjustment factor for the 0.64 inch, 80th percentile of COL runoff producing storms)

And I = Imperviousness (percent expressed as a decimal).

Paragraph below Table 3-2:

Delete Sentence starting with “For areas beyond this region...”

Add For COL, use a precipitation depth of 0.64 inches for the WQCV event.

4.2 CUHP-SWMM Modeling of Volume Reduction

Change ...MHFD...

To ...COL...

Delete CUHP-SWMM can be applied to a lot or block scale as well, but simplified modeling methods, including UD-BMP, UD-Rational and/or UD-Detention (all of which are available at MHFD.org, are more common at the finer scales.

Add

Simplified modeling methods, including UD-BMP, UD-Rational (both of which are available at MHFD.org) and the Modified FAA Method Spreadsheet (which is available on the COL website) shall be used at the finer scale.

5.0 Example Calculation of WQCV

Add Example 5.0 is based on the WQCV for Denver, Colorado. For the COL, the WQCV in this example will need to be adjusted per Equation 3.1 in Section 3.0

Chapter 4 Treatment BMPs

Contents

Remove T-7 Retention Pond

1.0 Overview

Blue box

Delete Retention Pond bullet

After third paragraph

Add COL discourages the design of micropools within detention ponds, due to safety and maintenance issues which have arisen within the community. Therefore, all references to micropools in Chapter 4 of the UDSCM are removed from the LSDC.

Add The COL does not recommend the use of well-screens that are placed in front of Water Quality Capture Volume orifices due to Homeowners Association and Business Owners Association maintenance issues. Therefore, all references to well-screens and trash racks in front of the Water Quality Capture Volume orifices in Chapter 4 of the UDSCM are removed from the LSDC.

Add A narrative of the permanent stormwater quality best management practices (BMPs) shall be included as a subsection in the drainage and erosion control report. The narrative shall provide a description of each permanent water quality BMP and how each practice will provide stormwater quality prior to the stormwater leaving the site. An 11” x 17” schematic drawing shall be inserted into the drainage and erosion control report and SWMP documents titled “Permanent Stormwater Quality BMPs” that clearly identifies where each of the proposed Permanent Stormwater Quality BMPs are located within the development site, i.e., Grass Swales (GS), Grass Buffers (GB), Extended Detention Basins (EDB), etc. The extent of each BMP shall be lightly shade or hatched. The purpose of the Permanent Stormwater Quality BMP schematic is to include it in a maintenance notebook that COL prepares to provide guidance for the property owner to easily identify the BMPs that need to be maintained in the future.

Add In compliance with the COL MS4 permit, COL requires all development applicants who’s sites contain Stormwater Permanent Control Measures to submit Standard Operating Procedures (SOPs) for all Stormwater Permanent Control Measures at the time of Site Plan Review. This is in an effort to establish the maintenance needs of a site/structure prior to acceptance of plans, building of structures and transfer of ownership of said structures to owners. The SOP should be brief and written in simple “layperson” terms so that the persons assigned the maintenance responsibilities can easily

understand how each measure should be maintained and cleaned. The following needs must be outlined in the criteria:

- Requirements for standalone SOP submittals for all sites where there are proposed Stormwater Permanent Control Measures
- Within the SOP's the following must be included:
- Documentation of operation and maintenance procedures to ensure the long term observation, maintenance, and operation of the control measures. The documentation shall include frequencies for routine inspection and maintenance.
- Inspection and maintenance forms
- Owner acknowledgement form (a form in which the Engineer and Owner of structure signs acknowledging the prescribe inspection and maintenance of all Control Measures
- Contact Verification form – The City of Loveland Verification form shall be included as the first page within the SOP which spells out owner name, address, phone number and email address.
- Submittal of a plan sheet showing location of all Stormwater Permanent Control Measures. Verbiage that if any in field changes are made to plan that a new plan/as built must be submitted to City and owner prior to issuance of Certificates of Occupancy. The plan sheet shall be presented as an 11" x 17" schematic drawing and titled "Permanent Stormwater Quality BMPs". The schematic shall clearly identify where each of the proposed Permanent Stormwater Quality BMPs are located within the development site, i.e., Grass Swales (GS), Grass Buffers (GB), Extended Detention Basins (EDB), etc. The extent of each BMP shall be lightly shade or hatched.

*SOPs must be standalone documents not included in drainage report or SWMP.

Add

The City of Loveland requires Permanent Stormwater Quality Control Measures on all development and redevelopment within COL including those under 1 acre of disturbance. These Permanent Stormwater Quality Control Measure(s) must meet a Base Design Standard as outline within the Colorado Department of Public Health and Safety (CDPS) Permit No. COR090000. The "base design standard" is the minimum design standard for new development and redevelopment. The applicant shall complete and submit to COL a worksheet, provided on the City website, which outlines "base design standard" criteria. The purpose of this worksheet is to demonstrate which of the "minimum base standards" are being met on the development/redevelopment and to demonstrate to the COL how the minimum base design standards were met. The worksheet shall address each requirement set forth in the most recent modification of the Colorado Department of Public Health and Safety (CDPS) Permit No. COR090000. The COL refers to the Colorado Department of Public Health and Safety (CDPS) Permit No. COR090000 for definition of development/redevelopment and for exclusions to this requirement.

2.0 Treatment BMP Fact Sheets

3rd Paragraph:

Change ...UDFCD...
To ...COL...

Table 4-1

Delete Retention Pond Column

Fact Sheet T-0 Quantifying Runoff Reduction

Table RR-1, Parameters for quantifying runoff reduction

Underdrain Row

Change ...UDFCD...
To ...COL...

Design Procedure

Item 4, “Characterize on-site topsoil and determine suitability of topsoil for the RPA”

2nd Paragraph

Change UDFCD...
To COL...

Item 5, “Calculate Runoff from each UIA:RPA Pair”

First Paragraph

Add The WQCV event precipitation depth in COL is 0.64 inches.

Item 6, “Compare runoff from each UIA:RPA pair to runoff from UIA alone”

Add The example in Item 6 is based on the WQCV for Denver, Colorado. For the COL, the WQCV in this example will need to be adjusted per Equation 3.1 in Section 3.0 of Chapter 3, “Calculating the WQCV and Volume Reduction.”

Design Example

Add The design example is based on the WQCV for Denver, Colorado. For the COL, the WQCV in this example will need to be adjusted per Equation 3.1 in Section 3.0 of Chapter 3, “Calculating the WQCV and Volume Reduction.”

Fact Sheet T-2 Grass Swale

Design Procedure and Criteria

Item 7, Design Flow Depth

Add The 100-year flow plus freeboard shall be fully contained within the swale.

Fact Sheet T-3 Bioretention (Rain Garden or Porous Landscape Detention)

Description

Add The Bioretention Specifications available in the Loveland Storm Drainage Standards, located on the COL website, must be followed for construction of

all bioretention facilities. If conflicts arise between the Bioretention Specifications and the LSDC, then the Bioretention Specifications shall govern.

Designing for Maintenance

2nd Bullet:

- Delete 2nd Sentence beginning with “Use rock mulch sparingly...”
- Add COL does not allow the use of rock mulch in rain gardens.
- Delete Some municipalities may not allow wood mulch for this reason.
- Add COL does not allow wood mulch for this reason. COL requires the use of triple shredded mulch.

Design Procedure and Criteria

Item 1, Subsurface Exploration and Determination of No-Infiltration, Partial Infiltration, or full Infiltration Section

Bullet 3, Full Infiltration Section:

- Change UDFCD
- To COL
- Add The design of full infiltration sections in bioretention facilities requires a variance and proof by a licensed professional engineer that appropriate soils at each bioretention facility are present to the minimum depth equal to the bottom of the bioretention facility.

Item 3, Basin Geometry

- Change UDFCD
- To COL

Item 4, Growing Medium

- Delete All paragraphs and Table B-1, “Material specification for bioretention/rain garden facilities”
- Add Refer to the Bioretention Specifications available in the Loveland Storm Drainage Standards for the growing medium specifications.

Item 5, Underdrain System

- Add “Refer to the Bioretention Specifications available in the Loveland Storm Drainage Standards for the underdrain specifications.

Delete 3rd Paragraph

Delete 4th Paragraph

Add Reference the Bioretention Specifications within the COL Storm Drainage Standards for the underdrain bedding material and reservoir storage layer.

Item 6, Impermeable Geomembrane Liner and Geotextile Separator Fabric

Delete 1st Paragraph

Delete Table B-2, Physical Requirements for Separator Fabric

Add Refer to the Bioretention Specifications available in the Loveland Storm Drainage Standards for the impermeable liner specifications.

Item 7, Inlet/Outlet Control

Delete ...or can be designed without an underdrain (provided the subgrade meets the requirements above).

Item 8, Vegetation

Delete 1st Paragraph

Delete 2nd Paragraph

Delete Table B-3, Native Seed Mix for Rain Gardens

Add Refer to the Bioretention Specifications available in the Loveland Storm Drainage Standards for the vegetation specifications.

Aesthetic Design

Delete No-Infiltration Section Detail

Delete Full Infiltration Section Detail

Delete Section C Detail

Delete Section D Detail

Delete Section E Detail

Fact Sheet T-4 Green Roof

Design Procedure and Criteria

8th Bullet

Change ...in Denver.

To ...in Loveland.

Construction Considerations

1st Bullet

Change ...in the local jurisdiction.
To ...in Loveland.

Fact Sheet T-5 Extended Detention Basin (EDB)

1st Paragraph

Delete Fourth Sentence beginning with “Soluble pollutant removal...”

Designing for Maintenance

1st Bullet

Delete Entire Sentence.

2nd Bullet

Delete ...or toward the micropool...

5th Bullet

Change ...spillway, and micropool...

To ...and spillway...

6th Bullet

Delete Entire Bullet.

Add The COL does not recommend the use of well-screens due to Homeowners Association and Business Owners Association maintenance issues.

Design Procedure and Criteria

Item 5, Forebay Design

1st Paragraph

Delete Sentence beginning with “Refer to Table EDB-4...”

Delete Sentence beginning with “When using this table,...”

Delete 2nd Paragraph

Add Forebays need to be proportional to the detention pond in which they are located. Forebay volumes shall be determined using the following equation:

$$\text{Volume Required (cubic feet)} = 0.000265 \times \text{Tributary Area (square feet)}$$

The forebay outlet shall be designed to release 2% of the 100-year peak inflow. Forebay dimensions shall be proportional to each other, e.g. the length and width should be similar.

Item 6, Trickle Channel

- Add A concrete trickle pan may be designed in the flowline of the extended detention basin. The City of Loveland Stormwater Detail SW-21 provides design guidelines for concrete trickle pans options within extended detention basins.
- Change ...to the micropool...
To ...to the EDB outlet structure...
- 2nd Bullet
Change ...UDFCD...
To ...COL...
- Change ...of the local jurisdiction.
To ...of the COL.
- Change ...to micropool...
To ...to the EDB outlet structure...

Item 7, Micropool and Outlet Structure

Section Title

- Delete “Micropool and...”

1st Paragraph:

- Delete ...and provide a permanent micropool directly in front of the structure.

- Delete Remainder of first paragraph after the first sentence

- Delete 2nd Paragraph

- Add The COL does not require nor desire micropools within extended detention basins due to safety and liability issues.

3rd Paragraph:

- Delete Fourth, Fifth, Sixth, Seventh and Eighth Sentences.

Item 8, Initial Surcharge Volume

1st Paragraph

- Change ...the micropool...
To ...the pond bottom located at the outlet structure...
- Delete Third Sentence beginning with “The initial surcharge...”
- Change ...the micropool...
To ...the pond bottom located at the outlet structure...

Second Paragraph

Delete First sentence beginning with “The initial surcharge volume...”

Delete ...micropool...

Item 9, Trash Rack

Add Screens placed over the WQCV orifices are discouraged by COL due to Homeowners Association or Business Owners Association maintenance difficulties.

Item 12, Access

Delete ...an micropool.

Blue Box “Designing for Baseflows”

1st Bullet

Delete ...or retention pond.

Delete Table EDB-4, EDB Component Criteria

Fact Sheet T-6 Sand Filter

Delete Entire Section.

Fact Sheet T-7 Retention Pond

Delete Entire Section.

Fact Sheet T-8 Construction Wetland Pond

Design Procedure and Criteria

1st Paragraph:

Delete Last Sentence.

Item 7, Inlet

Change ...UDFCD...

To ...COL...

Fact Sheet T-10 Permeable Pavement Systems

Site Selection

Add Permeable Pavement Systems are prohibited in fire access drives or other areas that will be accessed by fire vehicles, unless otherwise approved by the Fire Code Official.

Design Procedure and Criteria

Item 1, Subsurface Exploration and Determination of a No-Infiltration, Partial Infiltration, or Full Infiltration Section

3rd Bullet, Full Infiltration Section

Change ...UDFCD...
To ...COL...

Add the design of full infiltration sections in permeable pavement requires a variance and proof that appropriate soils are present on the site.

Item 3, Depth of Reservoir
Change UDFCD...
To COL...

Item 6, Filter Material and Underdrain System

Third Paragraph
Change ...USDCM...
To ...COL...

Fact Sheet T-10.1 Permeable Interlocking Concrete Pavement

Site Selection
Delete First Bullet

Second Bullet
Add ...with the exception of the parking lot areas that will be accessed by fire vehicles,

Delete Third Bullet

Delete Fifth Bullet

Add Permeable Interlocking Concrete Pavement is prohibited in fire access drives or other areas that will be accessed by fire vehicles, unless otherwise approved by the Fire Code Official.

Fact Sheet T-10.2 Concrete Grid Pavement Site Selection

Site Selection
First Bullet
Add ...with the exception of the parking lot areas that will be accessed by fire vehicles,

Delete Second Bullet

Delete Third Bullet

Add Concrete Grid Pavement is prohibited in fire access drives or other areas that will be accessed by fire vehicles, unless otherwise approved by the Fire Code Official.

Fact Sheet T-10.3 Pervious Concrete

Delete Entire paragraph

Add The COL allows pervious concrete in areas that do not need to be accessed by fire vehicles or are located within rights-of-ways. Pervious Concrete is prohibited in fire access drives or other areas that will be accessed by fire vehicles, unless otherwise approved by the Fire Code Official.

Fact Sheet T-10.4 Porous Gravel

Site Selection

First Bullet

Add ...with the exception of the parking lot areas that will be accessed by fire vehicles,

Second Bullet

Add ...with the exception of the driveway areas that will be accessed by fire vehicles,

Delete Fourth Bullet

Add Porous Gravel is prohibited in fire access drives or other areas that will be accessed by fire vehicles, unless otherwise approved by the Fire Code Official.

Fact Sheet T-10.5 Reinforced Grass

Description

Delete Fifth Sentence starting with “This BMP is frequently used to...”

Add Reinforced Grass is prohibited in fire access drives or other areas that will be accessed by fire vehicles, unless otherwise approved by the Fire Code Official.

Site Selection

Second Bullet

Delete “Maintenance roads including...”

Delete Third Bullet

Selection Considerations

Delete Fourth Bullet

Fact Sheet T-11 Underground BMPs

Delete Second Paragraph

Site Selection

Third Bullet

Delete ...and some communities may not allow pumped systems.

Delete Third Sentence beginning with, “If a pumped system must be used...”

Underground BMPs Based on a Surface BMP Design

First Paragraph

Delete ...and retention facilities...

Delete ...and the difficulty of creating an effective underground micropool.

Underground Proprietary BMPs

Second Paragraph

Delete ...or retention ponds.

Item 3:

Change ...UDFCD...

To ...LSDC...

Last Paragraph

Change UDFCD...

To COL...

Change Local governments should reserve the right...

To COL reserves the right...

Delete Fifth Sentence beginning with, “In addition, a local government may require collection...”

Delete Sixth Sentence, “Finally, local governments may require agreements...”

Fact Sheet T-12 Outlet Structures

First Paragraph

Delete ...retention ponds...

Second Paragraph

Change ...UDFCD recommends...

To ...COL recommends...

Photograph OS-1

Delete ...with a screen (or grate) protecting the orifice plate from clogging,...

Outlet Design

Large Watershed Considerations

Change UDFCD recommends...

To COL recommends...

Change UDFCD recommends...

To COL recommends...

Orifice Plates, Trash Racks, and Safety Grates

Section Title

Delete , Trash Racks,...

Orifice Sizing

Change ...UDFCD...

To ...COL...

Trash Rack Sizing

Delete Entire Section.

Add COL does not recommend screens or trash racks in front of the WQCV orifice plates due to Homeowners Association or Business Owner Association maintenance issues.

Delete Figure OS_1

Outlet Geometry

Second Paragraph

Delete ...and sometimes a vertical barrier from the micropool of an EDB,...

Micropools with the Outlet Structure

Delete Entire Section.

Delete Figure OS-2

Delete Figure OS-3

Figure OS-4

Delete EURV and WQCV Trash Racks Items 1 through 4.

Figure OS-5

Delete Micropool configuration

Delete Well screen and associated graphic information in front of WQCV orifice plate

Delete Outlet pipe (optional location)

Figure OS-6:

Delete Micropool configuration

Delete Well screen and associated graphic information in front of WQCV orifice plate

Delete Outlet pipe (optional location)

Figure OS-7

Delete Micropool configuration

Delete Well screen and associated graphic information in front of WQCV orifice plate

Delete Outlet pipe (optional location for vertical constraints)

Figure OS-8

Delete Micropool configuration

Delete Well screen and associated graphic information in front of WQCV orifice plate

Delete Outlet pipe (optional location for vertical constraints)

Chapter 5 **Source Control BMPs**

Add This Chapter 5 is provided only for information purposes.

Chapter 6 BMP Maintenance

2.0 Defining Maintenance Responsibility for Public and Private Facilities

Delete Entire second bullet starting with “Publicly owned regional drainage...”

Third bullet:

Add The COL will periodically inspect these facilities and will require any deficiencies be corrected by the property owner.

Delete Entire fourth bullet starting with “Privately owned BMPs may be...”

After the paragraph beginning with “MS4 permittees can utilize...”:

Add The COL’s authority for BMP maintenance is included in the COL Municipal Code, Chapter 13.20.

Delete Entire paragraph (including bullets) from “Examples of some of the specific requirements...” through the bullet titled “Remedies”.

3.0 Developing a Maintenance Plan

Delete Entire first paragraph

Add The Col has developed Standard Operation Procedures (SOPs) for BMP maintenance. These SOPs are available for reference for use on the COLs website. For BMPs that do not have SOPs, the COL will advise on the developer’s preparation of a SOP for the specific BMP.

A Sediment / Erosion Control BMP agreement is also required to be executed prior to construction of the selected BMP. The standard COL agreement and associated Sediment /Erosion Control BMP documents are available on the COL website.

Add As part of the development application, a Standard Operating Procedure (SOP) for the development shall be completed per the specifications provided in LSCDC Volume 3, Chapter 4, “Treatment BMPs”, Section 1.0, and submitted to the COL.

Number 5:

Delete (For BMPs maintained by UDFCD, the owner, rather than UDFCD, should be contacted).

Paragraph beginning with “On a general note...”:

Change UDFCD

To COL

5.6 Sediment Removal and Growing Media Replacement

Delete Sentence beginning with “To date UDFCD is not aware...”

6.1 Inspection

4th Bullet

Change ...of 0.6 inches or more.
To of 0.64 inches or more.

8.0 Sand Filters

Delete Entire Section.

9.0 Retention Ponds and Constructed Wetland Ponds

Title

Delete Retention Ponds and...

9.3 Aquatic Plant Harvesting

First Paragraph

Delete 2nd sentence beginning with, “Additionally, the plants growing on the safety wetland bench...”

Change ...UDFCD...

To ...COL...

10.3 Aquatic Plant Harvesting

First Paragraph

Change UDFCD...

To COL...

Chapter 7 Construction BMPs

1.0 Introduction

- Add Within the COL, an Erosion and Sediment Control Plan must be developed and submitted to the COL as part of a development application process.
- Add The final Erosion and Sediment Control Plan must be consistent with the Drainage Report.
- Add The City of Loveland Stormwater Utility Senior Civil Engineer or designated representative thereto, may grant variances from the criteria of the Construction BMPs chapter by his/her acceptance of the Final Drainage Report in which the variance request is well documented.
- Add For all construction projects, a written narrative shall be included in the drainage report that provides a brief summary of the temporary sediment and erosion control measures implemented throughout the site to mitigate sedimentation and erosion on and off the site. The narrative shall include the following information:
1. Sediment and Erosion Control Techniques
 - a. A description of the methods presented in the Construction BMPs chapter used to mitigate erosion and sediment on the site.
 2. Stormwater Management
 - a. An explanation of how the stormwater runoff on the site will be managed on and off the site.
 3. Maintenance
 - a. A discussion of how and when the sediment and erosion control devices will be inspected, repaired and replaced throughout the duration of construction, after each storm event and after construction until the time that all vegetation is established.
 4. Calculations
 - a. All calculations that are used to size the various construction BMPs shall be included in the appendix of the drainage and erosion control report.
 5. Additional Information
 - a. Any additional information that is necessary to describe the sediment and erosion control BMPs or may be required by the COL to fully describe how the site is being treated.
- Add Sediment and erosion control construction drawings shall be prepared and included in the Public Improvement Construction Plan set. The drawings shall divide the sedimentation and erosion control BMPs into phases of implementation in order to adequately reflect each of the four major development phases:
- Phase 1 - Grading Phase – BMPs for initial installation of perimeter controls.

Phase 2 - Infrastructure Phase – BMPs for utility; paving; curb & gutter installation.

Phase 3 - Vertical Construction Phase – BMPs for individual lot construction.

Phase 4 - Permanent BMPs & Final Stabilization.

A minimum of two sediment and erosion control construction drawings shall be provided. The first sediment and erosion control construction drawing needs to show details for Phases 1 and 2 of construction and include all BMPs necessary for these phases and only these phases of construction. The second sediment and erosion control construction drawing needs to show details for Phases 3 and 4 of construction and only Phase 3 and 4 of construction.

Add When a development will create construction disturbance within an irrigation ditch, a water body or waterway, a Water Quality Control Plan shall be prepared and submitted as part of the development application process. The Water Quality Control Plan shall describe the methods that will be used during construction to avoid sedimentation, erosion and to maintain the water quality within the irrigation ditch, water body, or waterway

3.0 Colorado Construction Stormwater Discharge Permits

First Paragraph:

Change ...UDFCD's...

To ...the COL's...

Second Paragraph:

Change ...most local governments require...

To ...the COL...

Change ...the local government and...

To ...the COL and...

Change ...the local government...

To ...COL...

Delete Many local governments require documentation that goes beyond the state permit requirements

Table 7-1

Add Table 7-1 is provided only for information purposes.

3.1 Preparing and Implementing a Stormwater Management Plan (SWMP)

Add For disturbed areas of 1 acre or larger, the SWMP shall be submitted to the COL for review and acceptance.

3.1.1 General SWMP Recommendations

Bullet beginning with “Implement the provisions...”:

Change UDFCD recommends...

To The COL requires...

Change UDFCD...

To The COL...

3.1.2 SWMP Elements

Final Bullet: Inspections and Maintenance

Change UDFCD recommends providing...

To The COL requires...

3.2.1 Inspection Frequency

First Paragraph:

Change UDFCD...

To The COL...

3.4 Disposition of Temporary Measures

Last Paragraph

Change ...by the local jurisdiction...

To ...by COL...

4.0 Overview of Construction BMPs

After paragraph 2:

Add The COLs standard details as presented on the COL website must be followed for all source control BMPs. If conflicts arise between the details on the COL website and the LSDC, the details on the COL website shall govern. Additional information regarding the COLs Sediment / Erosion Control requirements may be found on the COLs website.

4.2 Sediment Control Measures

First Paragraph:

Change UDFCD...

To The COL...

7.0 Construction in Waterways

Second Paragraph:

Change Other UDFCD criteria...

To COL criteria...

First Three Bullets Below Second Paragraph:
Change UDFCD...
To COL...

8.1 General Considerations

“Jurisdictional Considerations” Bullet:
Change ...municipalities...
To ...entities...

Change ...municipalities...
To ...entities...

Change ...municipality...
To ...entity...

Fact Sheet EC-2 Temporary and Permanent Seeding (TS/PS)

Design and Installation
2nd Paragraph

Change ...USDCM...
To ...LSDC...

3rd Paragraph

Delete Last sentence beginning with, “Some jurisdictions do not allow...”

Seed Mix for Permanent Revegetation

1st Paragraph

Delete ...or the local jurisdiction...

Fact Sheet EC-4 Mulching (MU)

Appropriate Uses

Change ...in most jurisdictions...
To ...in COL...

Delete ...; however, hydromulching may not be allowed in certain jurisdictions or may not be allowed near waterways.

Fact Sheet EC-7 Temporary Slope Drain (TSD)

Maintenance and Removal

Last Paragraph

Change ...by the local jurisdiction.
To ...by COL.

Fact Sheet EC-10 Earth Dikes and Drainage Swales (ED/DS)

Maintenance and Removal

Last Paragraph

Change ...by the local jurisdiction.

To ...by COL.

Fact Sheet EC-12 Check Dams (CD)

Design and Installation

5th Paragraph

Delete Many jurisdictions also prohibit or discourage use of straw bales for this purpose.

Add COL prohibits the use of straw bales for this purpose.

Fact Sheet SC-3 Straw Bale Barriers (SBB)

Delete Entire Section.

Fact Sheet SC-6 Inlet Protection (IP)

Design and Installation

2nd Paragraph

Change ...for use by local governments.

To ...for use by COL.

Fact Sheet SM-1 Construction Phasing/Sequencing (CP)

Design and Installation

Delete 3rd Sentence

Delete 4th Sentence

Change Some local governments require...

To COL requires...

Chapter 8

Glossary

This chapter is for reference only.