Board of Trustees Regular Meeting

807 Mountain Avenue
Town Board Meeting Room
Berthoud, Colorado 80513
Tuesday, April 28, 2026, at 6:30 PM

This meeting will be streamed live on YouTube. The live stream is accessible by visiting www.berthoud.org/stream.

The Board of Trustees may act on any of the following agenda items as presented or modified prior to or during the meeting and items necessary or convenient to effectuate the agenda items.

I. Call to Order

II. Pledge of Allegiance

III. Roll Call

IV. Oath of Office - Newly Elected Official

V. Citizen Participation

VI. Scheduled Items and Estimated Times for Discussion

1. Consent Agenda **(5 Min)**

Consent Agenda items are considered to be routine by the Town Board and will be enacted with a single vote. There will be no separate discussion of these items. If discussion is deemed necessary, an item may be removed from the Consent Agenda and considered separately.

a. April 28, 2026 Meeting Agenda

b. April 14, 2026 Meeting Minutes

c. April 21, 2026 Meeting Minutes

d. April 2026 Board Report

e. Berthoud Industrial Annexation Petition Substantial Compliance - Resolution 13-2026

f. Appointment of Municipal Officers - Resolution 14-2026

g. Berthoud Recreation Center Scheels Sponsorship Contract

April 28, 2026, Meeting Agenda

The order of agenda items listed above is approximate and intended as a guideline for the Town Board. Individuals needing special accommodation may request assistance by contacting the Town Clerk 807 Mountain Avenue, Berthoud, Colorado 80513, 970-532-2643 at least 24 hours in advance.

h. Open Stage Denver Contract for July 3rd Event Stage, Sounds, and Lighting

2. Appointment of Mayor Pro-Tem **(15 Min)**

3. Town Board Committee Liaison Assignments **(10 Min)**

4. Appointment of Planning Commission Members **(5 Min)**

5. INTRODUCTION: Amendment of the Municipal Code Regarding Backflow Prevention and Cross-Connection Control - Ordinance 1380 **(15 Min)**

6. 2026 Drought Response Plan Update **(15 Min)**

7. Storm Water Master Plan Presentation and Contract Award **(20 Min)**

8. Newell Farm Park Project Concept Design Update **(30 Min)**

9. Sidewalk Cost Share Program Expansion **(10 Min)**

10. Elected Official Reports **(20 Min)**

a. Town Board - Sean Murphy, May Albrecht, Brett Wing, Casey Grace, Karen Anderson, and Arno Olbricht.

b. Mayor -

c. Staff - Town Administrator, Attorney

VII. Adjourn

Town Clerk or Deputy Town Clerk

William Karspeck, Mayor

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h. Stage, Sound & Lighting Vendor for July 3rd

2. Appointment of Mayor Pro-Tem **(15 Min)**

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b. Mayor -

c. Staff - Town Administrator, Attorney

VII. Adjourn

Town Clerk or Deputy Town Clerk

William Karspeck, Mayor

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Board of Trustees Meeting Minutes

807 Mountain Avenue
Town Board Meeting Room
Berthoud, Colorado 80513
Tuesday, April 14, 2026, at 6:30 PM

4/14/2026 – Minutes

I. Call to Order

Mayor Karspeck called the meeting to order at 6:31 PM.

II. Pledge of Allegiance

Mayor Karspeck led the Pledge of Allegiance.

III. Roll Call

The following Board members were present:

Trustee May Albrecht
Trustee Karl Ayers
Trustee Mark Brodie
Trustee Tim Hardy
Trustee Brett Wing
Mayor Pro-Tem Sean Murphy
Mayor Will Karspeck

The following staff members were present:

Town Attorney Kathryn Sellars
Town Administrator Chris Kirk
Town Clerk Christian Samora
Deputy Town Clerk Lexi Dovel
Larimer County Sheriff Sergeant Justin Williamson
Planning Intern Lakin Dickson
Community Development Director Anne Johnson

IV. Citizen Participation

Jeff Hindman spoke regarding Board Member conduct at the March 24, 2026 meeting.

Maureen Dower thanked the Board for their service, congratulated the incoming new Board

members, and thanked staff for their work on the election. Dower encouraged Board members to review the development code and the budget.

V. Scheduled Items and Estimated Times for Discussion

1. Consent Agenda (5 Min)

Trustee Wing requested item F be removed from the Consent Agenda for individual consideration.
Trustee Albrecht requested item G be removed from the Consent Agenda for individual consideration.

Trustee Wing moved to combine and approve the items on the Consent Agenda, less items F and G. Trustee Hardy seconded the motion. In a 7-0 roll call vote, the motion Passed.

The Board had further discussion on item F) Berthoud Arboretum at Waggener Farm Park Bid Results.
Mayor Karspeck opened the item to public comment.
Kathy Mitchell spoke during public comment.

Trustee Wing moved to delay any Arboretum funding until 2030. Trustee Albrecht seconded the motion. In a 4-3 roll call vote, the motion Passed, with Trustee Ayers, Mayor Pro-Tem Murphy, and Mayor Karspeck having the dissenting vote(s).

The Board had further discussion on item G) Berthoud Historical Society Community Program Agreement.

Trustee Wing moved to approve item G. Trustee Ayers seconded the motion. In a 6-0 roll call vote, the motion Passed, with Mayor Pro-Tem Murphy abstaining.

- **a.** April 14, 2026 Meeting Agenda
- **b.** March 24, 2026 Meeting Minutes
- **c.** 2026 Road and Sidewalk Improvement Projects Bid Award
- **d.** 3rd of July Event Service Agreements
- **e.** A Little Help Senior Services Contract
- **f.** Berthoud Arboretum at Waggener Farm Park Bid Results
- **g.** Berthoud Historical Society Community Program Agreement
- **h.** February 2026 Financial Information

i. Local Planning Capacity Grant Amendment to Accept No-Match Award by DOLA

j. Hometown Heroes Program Fee Waiver

2. Sustainability Action Plan Adoption (10 Min)

Administrator Kirk gave an introduction to the Sustainability Action Plan final draft.

Mayor Karspeck opened the item to public comment.
No one spoke during public comment.

Trustee Ayers moved to adopt the Final Town of Berthoud Sustainability Action Plan. Trustee Hardy seconded the motion. In a 4-3 roll call vote, the motion Passed, with Trustee Albrecht, Trustee Brodie, and Trustee Wing having the dissenting vote(s).

3. Discussion of Certificates of Participation and Approval of Resolution Authorizing Engagement with Piper Sandler & Co for COP Financing – Mountain Vista Park Phase 1 (Richardson) (45 Min)

Administrator Kirk gave an introduction on the Certificates of Participation financing for Mountain Vista Park.

Mayor Karspeck opened the item to public comment.
Jeff Hindman, Casey Grace, Maureen Dower, Michael Patrick, Bill Hindman, Woody Geoghegan, Tony Armstrong, and Ann Karspeck spoke during public comment.

Trustee Wing moved to adopt Resolution 2026-11, a Resolution of the Board of Trustees of the Town of Berthoud, Colorado, authorizing the engagement of Piper Sandler & Co. as Underwriter for the Town of Berthoud in connection with the issuance of Certificates of Participation for the construction of Mountain Vista Park, and authorizing the Town Administrator to execute an agreement for such services. Said agreement shall be subject to final review and approval by the Town Attorney prior to execution. Trustee Brodie seconded the motion. In a 5-2 roll call vote, the motion Passed, with Mayor Pro-Tem Murphy and Mayor Karspeck having the dissenting vote(s).

Mayor Karspeck called for a 5-minute break.

4. PUBLIC HEARING: Comprehensive Plan Update to Include Water Conservation Element (20 Min)

Planning Intern Lakin Dickson gave a presentation on the Water Conservation Element update to the Comprehensive Plan.

Mayor Karspeck opened the Public Hearing.
No one spoke during the Public Hearing.
Mayor Karspeck closed the Public Hearing.

Trustee Wing moved to approve Ordinance 1379, an Ordinance of the Town of Berthoud, amending the Comprehensive Plan to add Section 5: Water Conservation Element. Trustee Hardy seconded the motion. In a 7-0 roll call vote, the motion Passed.

5. PUBLIC HEARING: Lewis Valley Annexation, Annexation Agreement, Zoning, and Neighborhood Master Plan (60 Min)

Community Development Director Anne Johnson gave an introduction to the Land Use planning process and the Lewis Valley annexation.

Applicant, Alex Hoime with HT Land Partners, gave a presentation.

Mayor Karspeck opened the Public Hearing.
Sarah Aavang, Michael Patrick, Charlene June, Dave Lilja, Timothy Uhrik, Kendall Carroll, Dee Davis, Jessica Hansen, Julian Schmidt, Charlotte Roe, Brandon Jones, Jason Hepp, and Justin Raddatz spoke during the Public Hearing.
Mayor Karspeck closed the Public Hearing.

Mayor Pro-Tem Murphy moved to extend the meeting past 9:30 pm. Trustee Ayers seconded the motion. With all in favor, the motion Passed.

The applicant provided additional information.

Trustee Wing moved to approve Resolution 2026-09, a Resolution of the Town of Berthoud approving a Neighborhood Master Plan for a development known as Lewis Valley. Trustee Brodie seconded the motion. In a 6-1 roll call vote, the motion Passed, with Mayor Pro-Tem Murphy having the dissenting vote(s).

Trustee Ayers moved to approve Resolution 2026-10, a Resolution of the Town of Berthoud making certain Findings of Fact regarding the proposed annexation to the Town of the real property known as Lewis Valley. Trustee Hardy seconded the motion. In a 6-1 roll call vote, the motion Passed, with Mayor Pro-Tem Murphy having the dissenting vote(s).

Trustee Ayers moved to approve Ordinance 1378, an Ordinance of the Town of Berthoud annexing real property known as Lewis Valley to the Town of Berthoud and zoning the property Suburban Residential and Agricultural, and approving an associated Annexation Agreement. Trustee Brodie seconded the motion. In a 6-1 roll call vote, the motion Passed, with Mayor Pro-Tem Murphy having the dissenting vote(s).

6. Establish Interview Committee to Fill Vacancies on the Planning Commission (5 Min)

Clerk Samora provided an introduction to the interview committee to fill vacancies on the Planning Commission.

Trustee Wing and Mayor Pro-Tem Murphy were selected to serve on the Interview Committee for the purpose of interviewing and making recommendations for the

appointment of two Planning Commission Members.

7. Elected Official Reports (20 Min)

a. Town Board -

Trustee Hardy reported on Main Street discussions regarding the upcoming Sundance Festival in Boulder and potential offerings for temporary short-term rentals in Town.

Trustee Ayers reported on PORT committee discussions regarding Newell Farm Park, the upcoming Arbor Day celebration, the Jaskowski property, summer activities, the Summer Craft fair, and Mountain Vista and Waggener Farm parks. Ayers discussed PORT Committee concerns and a request for a review of communication between staff, the Town Board and committees. Ayers discussed the Board's response to citizen feedback and inquired about details of the RAFT/BATS merger.

Board members expressed gratitude to each other and recognized outgoing Trustees for their service on the Board.

b. Mayor -

Mayor Karspeck thanked the outgoing Board Members for their service. Karspeck reported on a meeting of the Behavioral Health Policy Council and on discussions regarding environmental concerns and wildfire preparations.

c. Staff - Town Administrator, Attorney

Administrator Kirk reported that on next Tuesday, April 21st, the Town will hold a reception at 5:30 pm to recognize the outgoing and newly elected Trustees, followed by a Special Meeting at 6:30 pm to swear in the new members and provide a light orientation and training.

Sergeant Williamson reported on ongoing issues with e-bikes in town.

VI. Adjourn

The meeting was adjourned at 10:57 pm.

Town Clerk or Deputy Town Clerk

William Karspeck, Mayor

Board of Trustees Meeting Minutes

807 Mountain Avenue
Town Board Meeting Room
Berthoud, Colorado 80513
Tuesday, April 21, 2026, at 5:30 PM

4/21/2026 – Minutes

I. Town Board Reception - 5:30 PM

II. Call to Order - 6:30 PM

Mayor Karspeck called the meeting to order at 6:31 PM.

III. Pledge of Allegiance

Mayor Karspeck led the Pledge of Allegiance.

IV. Roll Call

The following Board members were present:

Trustee May Albrecht
Trustee Karl Ayers
Trustee Mark Brodie
Trustee Tim Hardy
Trustee Brett Wing
Mayor Pro-Tem Sean Murphy
Mayor Will Karspeck

The following staff members were present:

Town Attorney Kathryn Sellars
Town Administrator Chris Kirk
Town Clerk Christian Samora
Deputy Town Clerk Lexi Dovel
Larimer County Sheriff Sergeant Justin Williamson

V. Recognition of Outgoing Officials

Mayor Karspeck recognized outgoing officials Trustee Karl Ayers, Trustee Mark Brodie, and Trustee Tim Hardy and thanked each of them for their service.

VI. Oath of Office - Newly Elected Officials

Clerk Samora swore in re-elected Mayor Pro-Tem Sean Murphy, and newly elected Trustees Karen Anderson and Casey Grace. Newly elected Trustee Arno Olbricht was not present and will be sworn in at the April 28, 2026 Regular Board Meeting.

VII. Board Orientation and Training - 7:00 PM

Town Attorney Sellars provided orientation and training for Board members serving on the Town Board.

VIII. Elected Official and Staff Reports

Trustee Grace inquired about the sign approval process for Berthoud Elementary School.

Trustee Anderson reported on the Berthoud Re-Store Earth Day celebration and donation event being held on Saturday, April 25, as well as the Berthoud Local Community Garden Plant Sale on Saturday, May 2.

Trustee Albrecht reported on discussions with the Fire Chief regarding the fire weather outlook for this summer. Albrecht requested she be referred to as Trustee Soricelli-Albrecht from now on to avoid confusion with the new Trustee Olbricht.

Trustee Wing congratulated the new Trustees on being elected.

Mayor Pro-Tem Murphy noted that the Tree Advisory Committee would like to give a presentation to the Board on the Arboretum project. At least three Trustees were supportive of having the Arboretum added as an agenda item in May or June. Murphy reported on other Tree Advisory Committee discussions regarding the upcoming Arbor Day event on Saturday, April 25, America in Bloom, potentially changing their meeting date to May 4, tree recommendations for the Town, the Tree Share and Banner programs, staff work around Town, and new trees received from Trees across Colorado. Murphy welcomed the new Trustees.

Mayor Karspeck reported on SB 26-172, which changes the district boundaries for the Front Range Passenger Rail, and on an upcoming meeting with CDOT regarding Spartan Avenue and intersections at Highway 287. Karspeck reported he will be attending Carrie Martin Elementary School's Leadership Day.

Administrator Kirk will be scheduling the Board's Strategic Planning Session.

IX. Adjourn - 8:30 PM

The meeting was adjourned at 8:43 pm.

Town Clerk or Deputy Town Clerk

William Karspeck, Mayor

Berthoud Board Update

April 2026





MAY EVENTS

Plant Sale with Berthoud Local
Community Garden in Pioneer Park
May 2, 9:00 AM - 12:00 PM
Whether you're a seasoned gardener or just starting out, you'll find something for everyone at this vibrant community event. Shop a wide selection of heirloom seeds, herbs, annuals, baskets, birdhouses, and so much more!
Learn More Here.

6th Annual Business Breakfast
TPC Colorado Clubhouse, 2375 TPC Parkway
May 6, 7:30 AM - 9:00 AM
The Town of Berthoud invites local businesses to join them for this Business Appreciation Breakfast. The guest speaker will be Richard L. Wobbekind, Associate Dean for Business & Government Relations, Senior Economist and Faculty Director of the Business Research Division at the University of Colorado Boulder.
Sign Up Here

Lemonade Day with The Berthoud Chamber of Commerce
May 16
Support young entrepreneurs across town as they set up their own lemonade stand and learn real-world skills. Stands will be set up on Mountain Avenue, Massachusetts Avenue, Fickel Park, Waggener Farm Park, and Town Park.
Learn More Here.

PROJECTS

Submitted By Daniel Buendia, Project Engineer

The Berthoud Arboretum went out to bid, with responses due in early April. Mountain Vista Park is continuing towards completion of designs with the help of the selected General Contractor, ECI Site Construction. The new pickleball court at Pioneer Park is complete, with all the Public Works departments working to get it landscaped, with final surfacing of the court planned for June. The first drafts of the Newell Conceptual design were presented to the PORT Committee. Bids for the 2026 Roadway and Sidewalk Improvements Projects and the relocation of the Water Utilities Department building were received, with presentations to the Board planned for the future. The Stormwater Master Plan RFP received multiple excellent submissions, moving the project forward.







Installation of the piclkeball court at Pioneer Park.

FORESTRY / OPEN SPACE

Submitted By Paul Furnas, Town Forester

In March, last minute winter projects were wrapped up to clear room for tasks that get the town ready for summer. Forestry staff removed trees in poor shape at Neilson Trail and Bein Park to make room for new spring plantings. Forestry staff ground at least 10 stumps around town for sod replacement at Greenlawn Cemetery or tree replacements if possible. Both departments helped with cutbacks and brush clearing at the round-about on 1st Street. Open Space staff worked on fence repair at Hillsdale and gave their mowers a spa day to get them in good running condition for spring. Open space staff also began watering using their new water trailer. Both departments attended a Wildlands Fire Chainsaw safety course to get their S212 chainsaw certificates. The population of Russian Olives at the Jackowski Property were cut back.



With assistance from the Parks department, Forestry and Open Space cleared out a thicket of sumac growing behind the 1st Street roundabout sign. This thicket had been collecting trash and getting bigger every year.







Cutbacks were done at the 1st Street roundabout to get it ready for spring growth.







1) Forestry staff repaired baseball nets at the ballfields in Town Park. 2) Damage to trees from recent storms was cleaned up. 3) Dead and dying trees and stumps were cleared to make room for spring plantings.



A tree at Bein Park had a large section of the trunk bark peeled off in an act of vandalism. Town staff will monitor the tree's health in the coming weeks, but tree mortality is expected in a matter of weeks.



Forestry and Open Space staff attended a free training hosted by the Overland FIre District cew on chainsaw usage and the art of felling trees.



After obtaining their S212 chainsaw certification, the Open Space and Forestry crews used the large Russian Olive Trees at the Jaskowski Property to train. These trees are invasive and needed to be removed.

STREETS DEPARTMENT

Submitted By Brandon Keegan, Streets Supervisor

The Streets crew was very busy throughout March with a variety of projects around town. At the 2nd Street Detention Pond, they have been mowing and removing weeds and cattails to improve drainage. County Road 7 was also graded to maintain a smooth and safe roadway. On 1st Street and Turner Avenue, a new stop sign base that anchors into the concrete was installed. Decorative light bases on Spartan Avenue were replaced where the previous ones were broken and additional 30 mph speed limit signs were installed along County Road 19. The Streets crew has also begun replacing street blades throughout several neighborhoods, including Northpark, Gateway, Matthews Farm, Collins Park, Serenity Ridge, and Heron Pointe.





Streets crew mowing and cleaning up the 2nd Street Detention Pond.



Crews graded County Road 7.



Street blades throughout town have been replaced.



Streets crew assisted in opening a cemetery plot.



The Streets crew is installing a new type of base for signs that anchors directly into concrete. The stop sign at 1st Street and Turner Avenue has been replaced multiple times over the years because trucks have driven over it. The sign was repositioned to a safer location in hopes that it will no longer be damaged.



Decorative light bases were installed to replace broken ones.



Additional 30 mph speed limit signs were installed along County Road 19 to improve safety.



Streets crew screened large chunks of road base to produce usable material.

RECREATION

Submitted By Amanda Gustafson, Director of Recreation | Cultural Services

Operations, Memberships & Marketing

The Operations and Management team continued to optimize schedules, internal information sharing, and facility space for the best performance. The team also began coordinating for future facility improvements, including gym flooring and lighting. The Marketing team advanced the Recreation sponsorship program by securing more All-Star sponsorships and finalizing an MVP agreement with SCHEELS.

Sports & Programs

In March, the Sports department prepped for the beginning of Spring Sports. The Spring coaches meeting had large success with 49 coaches joining. There will be 50 soccer coaches and 20 football coaches this year. The annual Mother-Son Nerf Mania was a sold-out event. The event had a variety of different competitions and activites.





Mother-Son Nerf Mania.



The Junior Nuggets offers a coaches clinic. A supervisor, coordinator, and an attendant were able to attend this event and learn valuable tips to share with our volunteers.

Aquatics

Swim lessons continued to see a high enrollment this month, with growing waitlists and additional private lessons and expanded class capacities. Extended open swim hours were offered during spring break, accommodating 1,625 drop-in swimmers over five days. Staff continued to be trained in customer service skills and lifeguarding skills. CPR certification training was also held for full-time Town Staff.

Active Adults (50+)

March had another very successful Wellness Wednesday session. The Senior Cards program now has extended hours to accommodate the increased participation and interest.

Fitness

The St. Paddy's Day Run was a success with great weather and 115 participants. The event brought the community together while promoting health and wellness. The Fitness team also worked on staff development by hosting meetings to share expertise, collaborate, and align on best practices to grow.







COMMUNITY DEVELOPMENT

Submitted By Anne Johnson, Planning Director

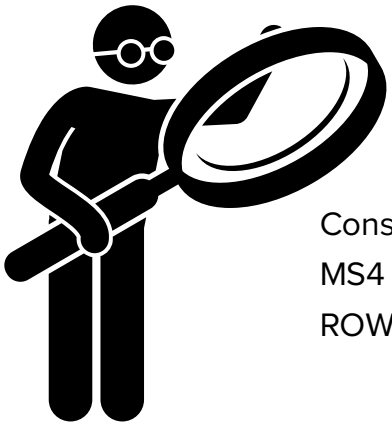
Building Division data for March 2026

 # New Residential
March 2026: 15
YTD: 33

 # New Commercial
March 2026: 4
YTD: 7

Total Number of Permits
March 2026: 66

Total Valuation
$13,615,376.06 - March



Engineering

Construction Site Inspections: 61
MS4 Inspections: 32
ROW Permits Processed: 0

Planning

Public Assistance
Emails: 6,579
Phone calls: 94
Site Visits: 6

Pre-Application meetings: 2
Public Hearings/Applications presented: 5
Codes/Comp Plan Action Items in-process: 0
Applications in Process: 38

PARKS / CEMETERY

Submitted By Sami Kouns, Parks Supervisor

In March, the Parks and Cemetery crew focused on park safety, seasonal maintenance, and cemetery improvements. Key work included redistributing rock around the splash pad at Town Park to eliminate trip hazards, installing additional dog waste stations and ordinance signage at multiple locations, repairing and reinforcing the restroom wall at Bein Park, and adjusting bathroom access hours during the school year. Athletic field maintenance continued at Bein Par with regular batter's box repairs, grass line edging, and dugout bench restoration. Additional safety improvements included installing fence toppers at the new Pioneer pickleball courts and completing several playground repairs at Waggener Farm Park. At Greenlawn Cemetery, staff managed three burials, installed a new backflow cover, and coordinated the removal of six tree stumps.



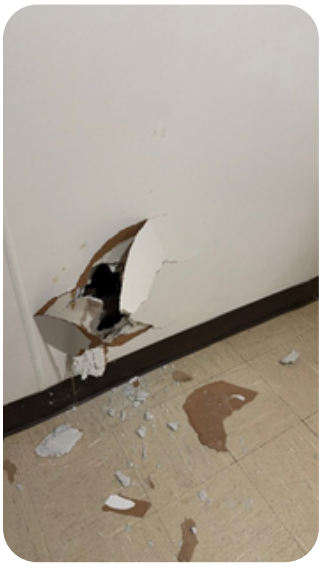


At Town Park, the rock depth in the ornamental beds around the splash pad was thin in some areas, exposing the weed barrier underneath. These rocks were redistributed to create a more uniform look and to avoid tripping hazards.



More dogs waste bag holders and signs were installed around town.

The wall seperating the men's and women's restroom at Bein was kicked through again. The wall was repaired and reinforced to limit the chances of this type of damage occuring for a third time. The bathrooms are now scheduled to be locked during the day, when school is in session, and unlocked at the end of the workday for the public and those who use the park for practices and games.









The 1st base line on the North field and the 3rd base grass line on the south field were measured and edged to create clean grass lines for mowing, spraying, and maintenance purposes.





The dugout benches at Bein were stripped of their paint and repainted with a paint that should better withstand wear and tear.





At Waggener Farm Park, staff used rakes to remove mulch that had been tossed into the sand pit, improving the safety and look. Staff also discovered a large hole that had been dug underneath one of the features in the playground. Expanding foam was used to fill the space to prevent children from climbing into the hollow rock.



The same fence topper that was used at Waggener Farm Park was installed at the new court at Pioneer Park. This topper reduces injuries and improves appearance.

WATER/WASTEWATER

Submitted By Marie Mitchell, Administrative Tech Water

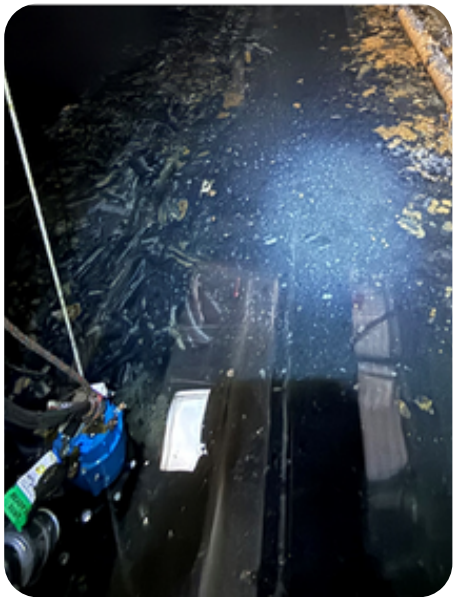
Water/Wastewater Operations Summary

In March, the Water/Wastewater department maintained steady operation during the coordination of an increased workload in utilities locates. Staff participated in regional training and inspections and attended the Colorado Rural Water Association Conference. Staff also participated the Carter Lake Outlet Tour and conducted facility outreach through in-house tours of the Wastewater Treatment Facility.

Water Treatment Plant



Annual Sedimentation Basins cleaning project.





Before and after cleaning the sedimentation basins.

Wastewater Treatment Plant
(Ramey Environmental Compliance)



Staff from Public Works, Community Development, FInance/HR, and Administration toured the Wastewater Treatment Plant to learn about the Wastewater cleaning process and future plans for the facility.

Final clarifier weirs were cleaned and inspected, ensuring all equipment is operational and reliable. Clarifiers are used in wastewater treatment to separate solids, A weir controls the flow of water.





The grit cycle cone reducer was replaced. These parts remove grit in the process of treating wastewater.

ADMINISTRATION

Submitted By Christian Samora, Town Clerk, and
Nathan Gabbard GIS Analyst

April 2026 Election

The Town of Berthoud held its regular biennial election on April 7, 2026. The ballot included four Town Trustee seats and two ballot questions. Final results were certified on April 16, with a total of 3,793 ballots cast.

Town Trustee Results

2065 - Casey Grace – Elected to a 4-year term
1940 - Sean Murphy – Elected to a 4-year term
1292 - Arno Olbricht – Elected to a 2-year term
1878 - Karen L. Anderson – Elected to a 4-year term

Ballot Question 1A

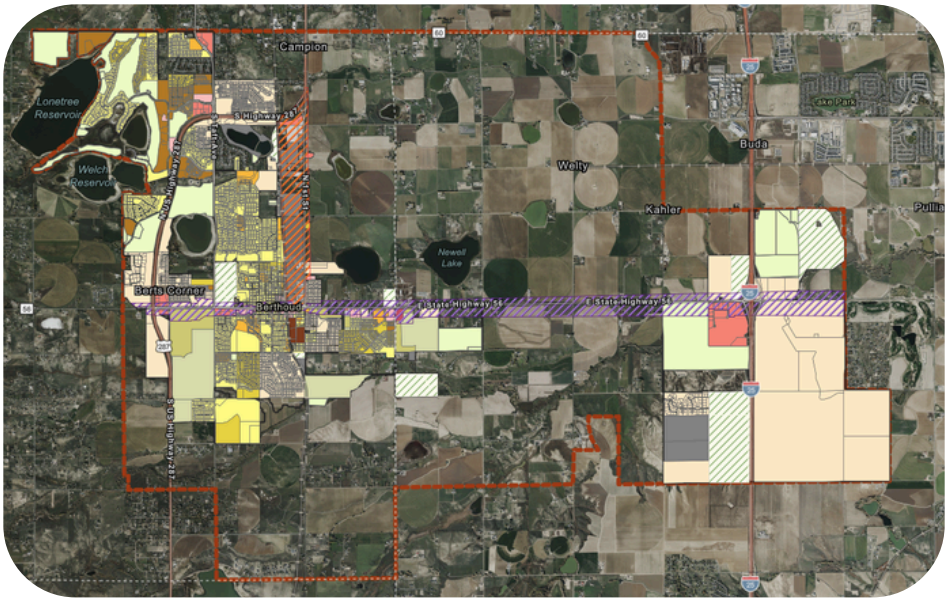
1144 - Yes/For
2636 - No/Against

Ballot Question 3A

2585 - Yes/For
1192 - No/Against

The Town of Berthoud conducts regular elections on the first Tuesday in April of even-numbered years. Trustees are elected to staggered four-year terms. In the event of a vacancy, a shorter two-year term may be used to maintain the staggered election cycle.

GIS



The zoning map for Berthoud has been recreated, with the goals of making it easier to update and improving user experience.
The map was added to the Town website and can be found **here.**

ADMINISTRATION

Submitted By Chris Kirk, Town Administrator

- Staff continued early-stage work on an Economic Resiliency Plan. An online survey was sent to over 500 local businesses in the Town's database to gather their feedback about what the Town can do to strengthen local businesses. Feedback from the survey will give a foundation for staff for future focus group meetings.

- Staff continued recruitment efforts for an anchor tenant at the Westside Crossing project. Specifically, outreach and marketing were sent to a national retailer specializing in farm and ranch supplies, as well as a national specialty grocer. The Town meets the site selection criteria for both retailers, and staff will be meeting with them at the annual International Council of Shopping Centers (ICSC) annual conference and expo in May.

- The Town's branding committee continued work on new design options for a refreshed Town brand, consistent with the Brand Assessment completed last year. The two Trustees who joined the committee have been fully committed to ensuring that we develop a new design that captures the spirit of Berthoud and will serve to enhance our tourism efforts for years to come. We are looking forward to sharing the product of these efforts with you in May.

- Town staff continues to meet with Main Street as they continue their efforts to organize. Business Sustainability and Community Outreach staff have been participating in their board meetings to offer support and guidance.

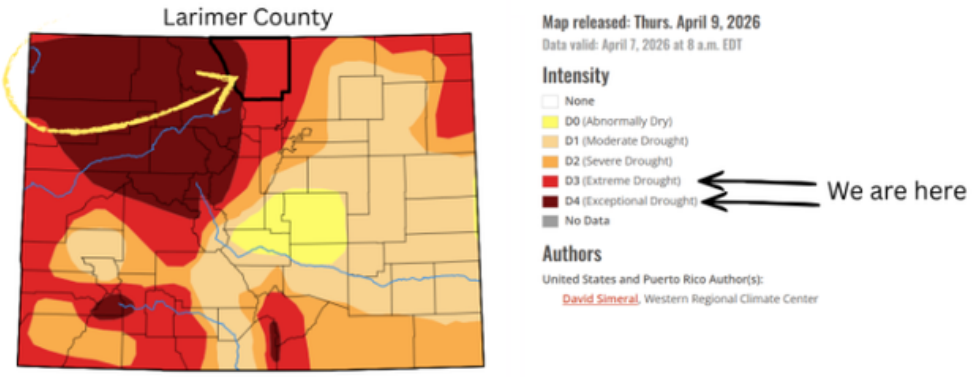
- Staff met with a company that is interested in partnering with the Town to establish a new solid waste and recycling convenience center in Berthoud. We discussed appropriate siting, needed commitments, and potential costs. More information will come to the board in early summer.

- The Town held our quarterly meeting with downtown non-profits, hosted by the Berthoud Historical Society at the McCarty-Fickel house. These meetings are an opportunity to coordinate with our local partners, hear about their challenges and opportunities, and collaborate with them on successful events and projects in Town.

- Staff participated in a regional meeting with other regional municipalities to continue work on an effort to establish consistent performance measurement data between our jurisdictions. This benchmarking effort will provide some apples-to-apples comparisons between our respective agencies on performance and service quality.

ENGAGEMENT

Drought Water Usage Webpage



With a warm winter and low snowpack, the Town made a webpage to address the questions that have been received from residents. There are currently no mandatory water restrictions in Berthoud, but the Town is encouraging residents' HOAs and businesses to observe voluntary water restrictions.
The webpage includes a list of resources from local partners and organizations to help people with reducing water usage.
Visit **Berthoud.org/Drought** for more information.

Hometown Heroes Banner Program



The Hometown Heroes recognition program is established by the Town of Berthoud, with support from the Veterans of Foreign Wars, the American Legion, and the American Legion Auxiliary, to allow residents and business owners to recognize current and former service members of the United States Armed Forces.
The banners will be hung on Town-owned streetlight poles from approximately Memorial Day until approximately Veteran's Day.
Visit **Berthoud.org/HomeTownHeroes** for more information.

Public Art Survey

As the Town develops a Public Art Master Plan, we are looking for feedback from the community about the types of art they want to see. The survey closes May 15th, 2026, with an online version and paper copies available at the Building and Planning Department window at Town Hall.

Take the survey here.



Worth Noting

The public open space open house held on March 30 was a success. The Board Room at Town Hall was completely filled with attendees including local ag landowners and interested citizens. Presentations were given by Town Staff and our partners at Larimer County and Colorado Open Lands. The Town's overall open space efforts were discussed and information about land preservation was provided. Following the presentations, there was a lively Q&A session that lasted approximately an hour.

Visit **Berthoud.org/OpenSpace** to view the presentation and video shown during the event.

Read the article in the **Berthoud Weekly Surveyor**



Welcome



The Community Development Department welcomed Matt Larson in January as a second inspector for private development projects. Matt is currently working with development communities to ensure stormwater management plans (MS4) are adhered to. Matt grew up in Wyoming where he participated in 4-H and FFA. He moved to Berthoud in 2024, drawn to the small-town atmosphere and some of Colorado's best golf courses.
The Community Development team is excited to have him on!

Welcome to Korina Burn, the new Executive Assistant to the Town Administrator. Korina joins the Town with significant experience as an executive assistant at Colorado State University.



Board of Trustees Information

Community Development Department

Meeting Date:	**April 28, 2026**
Agenda Title/Subject:	**Berthoud Industrial Annexation Petition Substantial Compliance - Resolution 13-2026**
Type of Item:	**Consent Agenda**
Purpose:	**Consider acceptance of an Annexation Petition and setting a public hearing date for June 9, 2026**
Presented by:	**Bella Manzo**

Attachments:

1. 01 Resolution
2. 02 PPT Adequacy Findings
3. 03 Berthoud Industrial Annexation Map
4. 04 Petition for Annexation

Background:

The applicant, Peak Investments, LLC has submitted a petition to annex 1.988 +/- acres of land generally located west of 1st Street/Larimer County Road 15, north of the Larimer County Rd 10E, and south of State Highway 287. This proposed annexation is adjacent to Lot 4, High Ground Industrial Park, which has been annexed into the Town of Berthoud.

This particular agenda item is to establish that the Petition was filed correctly and that there is an interest to hear the Annexation request by establishing a public hearing in accordance with Colorado Revised Statutes (C.R.S.) and the Municipal Code Section 30-8-104.B.3. This particular agenda item does not consider the merits of the Annexation or Zoning request. These items will be discussed at the future public hearing. This particular agenda item only sets the record that the Annexation Petition has been filed correctly, that there exists an interest in the act of annexation, and to establish a public hearing date to hear the details of the proposed project.

Findings of compliance with the adequacy of filing the petition and establishing an interest in hearing the request are found below:

1. Staff has reviewed the application materials submitted and find they are in substantial compliance with Section 30-8-103 of the Municipal Code. Staff further finds the Petition submitted substantially complies with the criteria established in C.R.S. § 31-12-104 for annexation eligibility as follows:
    a. That not less than 1/6 of the perimeter of the area proposed for annexation is contiguous with the Town of Berthoud.
        i. The Town's Surveyor has confirmed that the property meets the 1/6 perimeter

contiguity requirement. The property is 49% contiguous.

b. That a community of interest exists between the area proposed to be annexed and the annexing municipality; that the area is urban or will be urbanized in the near future; and that area is integrated with or is capable of being integrated with the Town of Berthoud. The fact that the area proposed for annexation has the contiguity with the Town of Berthoud shall be a basis for finding of compliance with these requirements.

i. The Town of Berthoud has envisioned the property to be annexed on the Future Land Use Map as being appropriate for the Innovation District. Per the 2021 Comprehensive Plan, the Innovation District is envisioned to continue supporting existing technical businesses and production uses, while also integrating emerging business types that focus on research and development (R&D), technology startups, makerspaces, and other related commercial dn light industrial uses. While the Comprehensive Plan and the Future Land Use Map adopted by the Town in 2021 are not legislative and rather a vision document only, the intent illustrated on the map has been adhered to with the Petition presented. Should the Town Trustees proceed to establish a date for a public hearing to consider the annexation and change of zone, the Trustees, Planning Commission and public will have the opportunity to hear the details of the envisioned land uses.

Municipal Code Section 30-8-104.B.3 outlines the steps that the Town Board of Trustees must take to determine if the submitted Annexation Petition is in substantial compliance with the Colorado Annexation Act, as follows:

a. If the petition is found to be in substantial compliance with C.R.S. § 31-12-107, as amended, the Town Board may, by the adoption of a Resolution of Substantial Compliance, set the annexation (and zoning if requested) for public hearing on a specified date, time, and place, not less than 30 days nor more than 60 days from the effective date of the Resolution, subject to compliance with C.R.S. § 31-12-108, as amended.

1. Staff has found that the Annexation Petition filed is in substantial compliance with the requirements for annexation petition application materials found in C.R.S. § 31-12-107. June 9, 2026 is not less than 30 days nor more than 60 days from the date of the filing of the Annexation Petition.

b. If the petition is found to not be in compliance with the Act, no further action shall be taken, except that the determination shall be made by resolution of the Town Board.

1. This provision is not applicable as the Annexation Petition was found to be in compliance with Colorado Revised Statutes.

c. If the Town Board, in its sole discretion, finds that the annexation is not in the best interest of the Town, it may deny the petition by resolution.

1. The Town Board may, in its sole discretion, find that the annexation is not in the best interest of the Town and deny the petition by resolution.

Update/Next Steps:

Should the Town Board of Trustees find the annexation petition has been filed correctly and that there is an interest to hear the Annexation request, the Trustees shall establish a public hearing date of June 9, 2026. It is at this public hearing where the merits of the application request including the annexation and zoning will be reviewed and public testimony is taken.

Fiscal Impact and Fund Source:

An Annexation Impact Report shall be prepared and presented at the June 9, 2026 public hearing along with an Annexation Agreement. Both documents will indicate how public services may be impacted and the applicant's agreement to fund impacts.

Community Touchstones:
The 2021 Comprehensive Plan Future Land Use Map identifies this property as being compatible with future development and contains areas suitable for the uses identified in the Comprehensive plan under the Innovation District designation. Adherence to the intent of the 2021 Plan ensures the vision of the community established through the master planning process is upheld inclusive of the objective to establish a clear new vision for the future of Berthoud reflecting community values.

Should the Board of Trustees set a public hearing date, staff will evaluate the submitted application materials for an annexation and zoning to ensure substantial compliance with Colorado Revised States and the Municipal Code processing standards, the intent of the vision established in the 2021 Comprehensive Plan. By doing so, the applications will also be evaluated to meet the community touchstones of maintaining community identity, resiliency and sustainability.

Recommended Action(s):
Staff recommends the Town Board of Trustees find the annexation petition substantially compliant with C.R.S. 31-12-107 and 31-12-108 as well as Sections 30-8-103 and 30-8-104 of the Municipal Code and set June 9, 2026 as a public hearing date to evaluate the Annexation and Zoning.

The following motion is provided for consideration:
I move to accept the annexation petition filed by Peak Investments, LLC as being substantially compliant with C.R.S. 31-12-107 and 31-12-108 as well as Sections 30-8-103 and 30-8-104 of the Municipal Code and set June 9, 2026 as a public hearing date to evaluate the Annexation and Zoning.

Resolution No. 13
Series 2026

A Resolution of the Town of Berthoud Accepting a Petition for Annexation Filed by Peak Investments, LLC and Setting a Public Hearing on the Annexation

Whereas, Peak Investments, LLC ("Petitioner") is the owner of the real property located in unincorporated Larimer County and more particularly described in **Exhibit A**, attached hereto and incorporated herein by this reference (the "Property");

Whereas, on April 18, 2026, Petitioner filed with the Town Clerk a petition for annexation of the Property to the Town (the "Petition"); and

Whereas, on April 28, 2026 the Board of Trustees reviewed the Petition and various documents in support of the Petition.

Now Therefore be it Resolved by the Board of Trustees of the Town of Berthoud as follows:

Section 1. *Findings*. The Board of Trustees hereby finds that the Petition substantially complies with C.R.S. § 31-12-107(1), and that a public hearing should be held to determine whether the Property is eligible for annexation, whether the annexation complies with C.R.S. §§ 31-12-104 and 31-12-105, and whether the Property should be annexed to the Town.

Section 2. *Public Hearing*. The public hearing on the annexation shall be set for June 9, 2026 beginning at 6:30 P.M., or as soon thereafter as the matter may be heard, at the Board of Trustees Chambers, 807 Mountain Avenue, Berthoud, Colorado. The purpose of such hearing shall be to consider the Petition to determine whether the Property is eligible for annexation, whether the annexation complies with C.R.S. §§ 31-12-104 and 31-12-105, and whether the Property should be annexed to the Town. Any person living within the area proposed to be annexed, any landowner of lands thereof, any resident of the Town, any municipality located within one mile of the proposed annexation, or the Board of County Commissioners of Larimer County may appear at such hearing and present evidence upon any matter to be determined by the Board of Trustees.

Introduced, approved and adopted this 28th day of April, 2026.

Town of Berthoud

_____
William Karspeck, Mayor

Attest

_____
Christian Samora, Town Clerk

Exhibit A
Legal Description

Parcel 9411000034

THAT PORTION OF THE NE 1/4 OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 69 WEST OF THE 6TH P.M., COUNTY OF LARIMER, STATE OF COLORADO, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

CONSIDERING THE EAST LINE OF THE NE 1/4 OF SAID SECTION 11 AS BEARING N 0 DEGREES 52' 30" E AND WITH ALL BEARINGS CONTAINED HEREIN RELATIVE THERETO:

BEGINNING AT THE E 1/4 CORNER OF SAID SECTION 11; THENCE ALONG THE EAST LINE OF SAID SECTION 11, N 0 DEGREES 52' 30" E, 440.07 FEET; THENCE S 88 DEGREES 55' 15" W, 30.02 FEET; THENCE PARALLEL WITH THE EAST LINE OF THE NE 1/4 OF SAID SECTION 11, N 0 DEGREES 52' 30" E, 651.02 FEET TO THE TRUE POINT OF BEGINNING;

THENCE N 89 DEGREES 07' 30" W, 320.00 FEET; THENCE N 0 DEGREES 52' 30" E, 288.49 FEET; THENCE S 89 DEGREES 10' 37" E, 320.00 FEET, MORE OR LESS, TO A LINE WHICH BEARS S 0 DEGREES 52' 30" W, AND PASSES THROUGH THE TRUE POINT OF BEGINNING; THENCE ALONG SAID LINE, S 0 DEGREES 52' 30" W, 288.78 FEET TO THE TRUE POINT OF BEGINNING.

EXCEPT THAT PORTION THEREOF DEDICATED TO THE PUBLIC FOR PUBLIC HIGHWAY IN DEED OF DEDICATION RECORDED SEPTEMBER 17, 1986 AT RECEPTION NO. 86053344.

SAID PARCEL CONTAINS 86,588 SQ. FT. OR 1.988 ACRES, MORE OR LESS

Town Board of Trustees Public Hearing
April 28, 2026







Land Use Planning Process: Overview Annexation Petition

1. PRE-APPLICATION

Discussions with staff
Pre-Application meetings
Staff input and direction
Application preparation

2. APPLICATION SUBMITTAL

Application materials received
Completeness review performed
Referral notification and comments
Staff review and comments
Schedule and notice public meetings/hearings

3. MEETING

Staff presentation
Discussion and vote

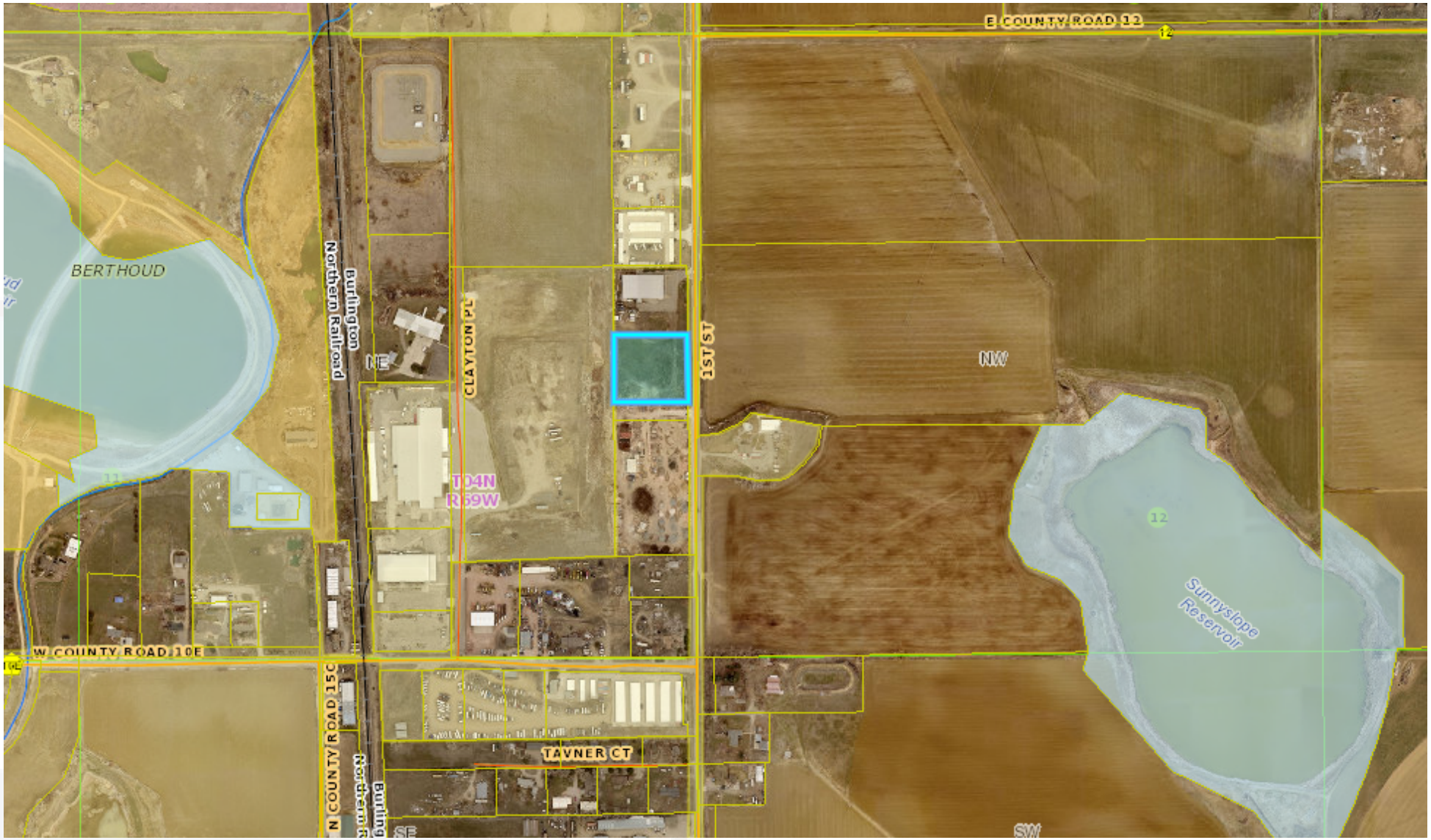
4. POST-APPROVAL ACTIONS

Record documents
Next steps

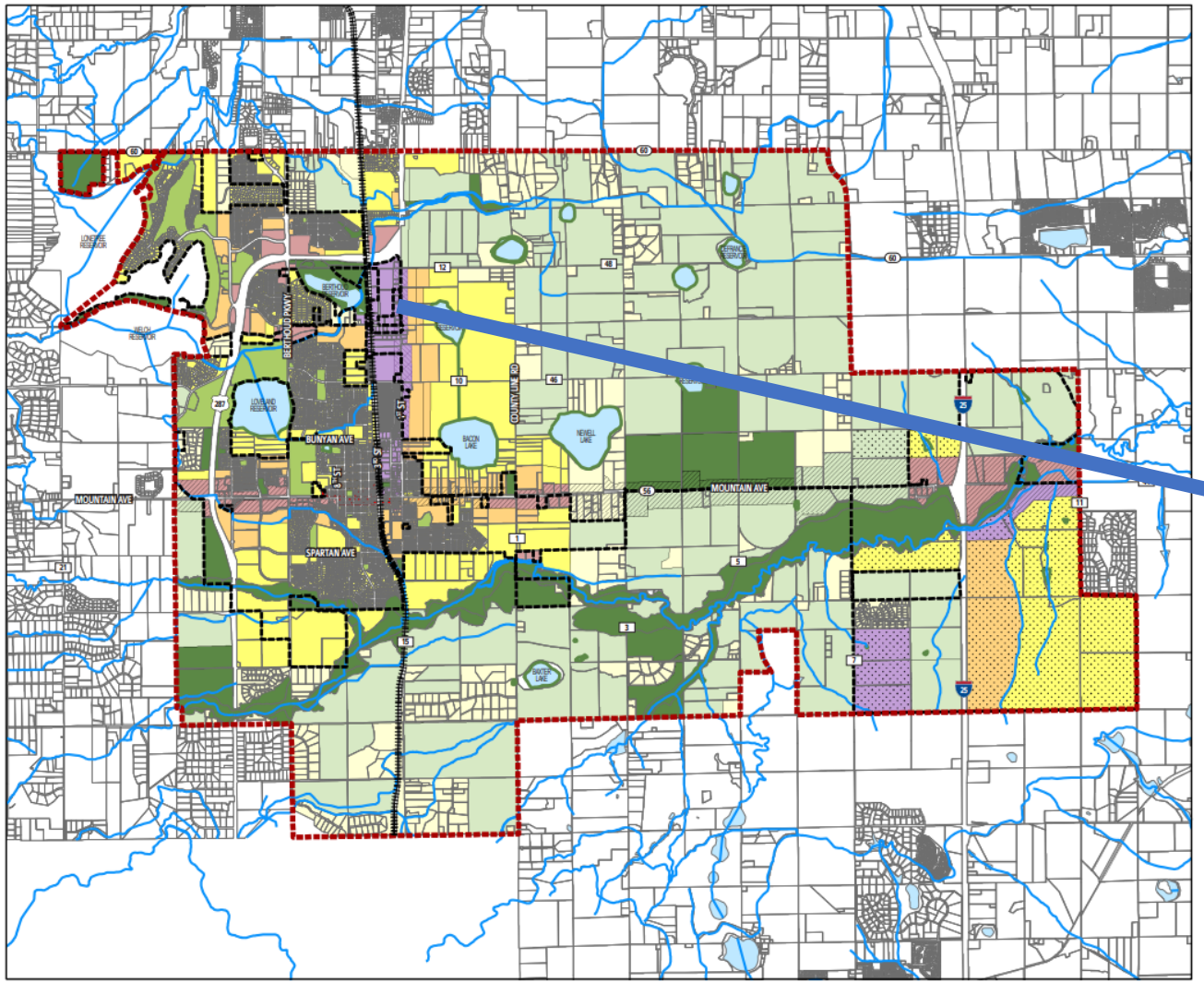
Land Use Planning Process

1. Annexation
   Change of Zone
2. Preliminary Plat
   80% Construction Drawings
3. Final Plat
   100% Construction Drawings
   Development Agreement
4. Site Plan/USR

Annexation Petition – Adequacy Review



Future Land Use Map



FUTURE LAND USE PLAN MAP
BERTHOUD COMPREHENSIVE PLAN

Last Revised: September 9, 2021

- Growth Management Area

Place Type: Natural Areas
- Environmentally Sensitive Area
- Open Space
- Parks, Recreation & Trails
- Ditch/Canal - Potential Trail Connections

Place Type: Rural Areas
- Agricultural
- Rural Residential

Place Type: Suburban Areas
- Suburban Residential
- Suburban Business

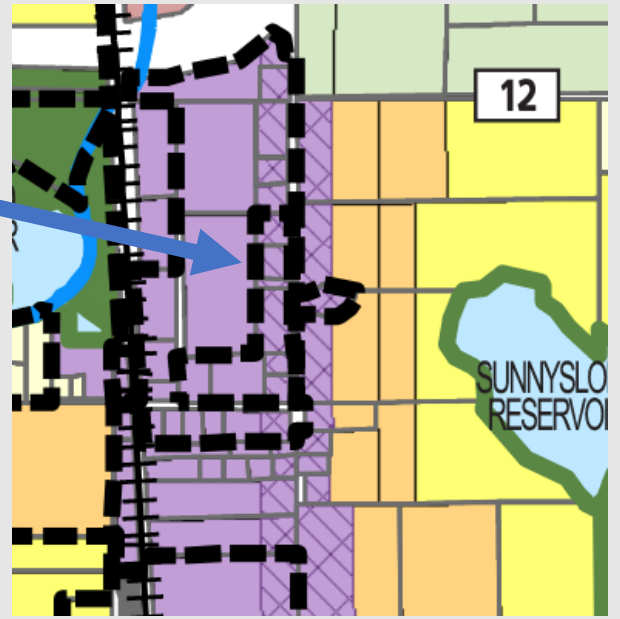
Place Type: General Urban Areas
- Urban Residential
- Innovation District

Place Type: Urban Center
- Old Town Residential
- Downtown

Place Type: Special Districts
- New Berthoud
- 1st Street Corridor
- Mountain Avenue Corridor

0 0.5 1 2 Miles

Property location





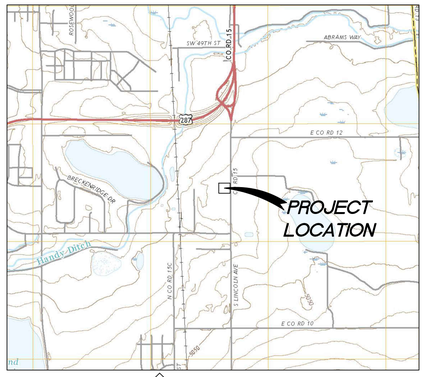






BERTHOUD INDUSTRIAL ANNEXATION

TO THE TOWN OF BERTHOUD, COLORADO
PARCEL 1, BUCKNER NORTH EXEMPTION, BEING A PART OF THE NORTHEAST 1/4 OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 69 WEST OF THE 6TH P.M.
TOWN OF BERTHOUD, COUNTY OF LARIMER, STATE OF COLORADO
1.988 ACRES



VICINITY MAP
1" = 2000'

DESCRIPTION

KNOWN ALL MEN BY THESE PRESENTS: THAT THE UNDERSIGNED, BEING THE OWNERS OF PARCEL 1, BUCKNER NORTH EXEMPTION, RECORDED AT REC. NO. 20120055489, BEING A PORTION OF THE NE 1/4 OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 69 WEST OF THE 6TH P.M., TOWN OF BERTHOUD, COUNTY OF LARIMER, STATE OF COLORADO, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

THAT PORTION OF THE NE 1/4 OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 69 WEST OF THE 6TH P.M., COUNTY OF LARIMER, STATE OF COLORADO, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

CONSIDERING THE EAST LINE OF THE NE 1/4 OF SAID SECTION 11 AS BEARING N 0 DEGREES 52' 30" E AND WITH ALL BEARINGS CONTAINED HEREIN RELATIVE THERETO:

BEGINNING AT THE E 1/4 CORNER OF SAID SECTION 11; THENCE ALONG THE EAST LINE OF SAID SECTION 11, N 0 DEGREES 52' 30" E, 440.07 FEET; THENCE S 88 DEGREES 55' 15" W, 30.02 FEET; THENCE PARALLEL WITH THE EAST LINE OF THE NE 1/4 OF SAID SECTION 11, N 0 DEGREES 52' 30" E, 651.02 FEET TO THE TRUE POINT OF BEGINNING;

THENCE N 89 DEGREES 07' 30" W, 320.00 FEET; THENCE N 0 DEGREES 52' 30" E, 288.49 FEET; THENCE S 89 DEGREES 10' 37" E, 320.00 FEET, MORE OR LESS, TO A LINE WHICH BEARS S 0 DEGREES 52' 30" W, AND PASSES THROUGH THE TRUE POINT OF BEGINNING; THENCE ALONG SAID LINE, S 0 DEGREES 52' 30" W, 288.78 FEET TO THE TRUE POINT OF BEGINNING.

EXCEPT THAT PORTION THEREOF DEDICATED TO THE PUBLIC FOR PUBLIC HIGHWAY IN DEED OF DEDICATION RECORDED SEPTEMBER 17, 1986 AT RECEPTION NO. 86053344.

TOTAL ANNEXED AREA: FOR THE BERTHOUD INDUSTRIAL ANNEXATION IS 86,588 SQ. FT. OR 1.988 ACRES, MORE OR LESS

OWNERS APPROVAL AND DEDICATION

THE UNDERSIGNED, BEING SOLE OWNERS OF THE LAND DESCRIBED HEREIN, HAVE CAUSED SAID LAND TO BE LAID OUT AND ANNEXED UNDER THE NAME OF BERTHOUD INDUSTRIAL ANNEXATION AND DO HEREBY DEDICATE TO THE PUBLIC FOREVER ALL STREETS, ALLEYS AND UTILITY EASEMENTS AS INDICATED HEREON, IN COMPLIANCE WITH THE TOWN OF BERTHOUD SUBDIVISIONS AND BY CONTRACTURAL AGREEMENT, THE UNDERSIGNED SHALL BEAR ALL EXPENSES INVOLVED IN IMPROVEMENTS.

OWNER: PEAK INVESTMENTS, LLC, A COLORADO LIMITED LIABILITY COMPANY

_____
OWNER

_____
TITLE

STATE OF COLORADO)
)SS
COUNTY OF LARIMER)

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME BY _____

THIS _____ DAY OF _____, 20_____.

MY COMMISSION EXPIRES: _____

_____
NOTARY PUBLIC

SURVEYOR'S NOTES:

1. THIS ANNEXATION MAP DOES NOT CONSTITUTE A TITLE SEARCH BY RIDGETOP ENGINEERING AND SURVEYING. FOR ALL INFORMATION REGARDING EASEMENTS, RIGHTS-OF-WAY, OR TITLE OF RECORD, RIDGETOP ENGINEERING AND SURVEYING RELIED ON THE TITLE INSURANCE COMMITMENT FILE NO: 383-F07558-24, AMENDMENT NO. 3, ISSUED BY LAND TITLE GUARANTEE COMPANY, EFFECTIVE JULY 22, 2025 AT 8:00 A.M.
2. THE LINEAL UNIT USED IN THE PREPARATION OF THIS ANNEXATION MAP IS THE U.S. SURVEY FOOT AS DEFINED BY THE UNITED STATES DEPARTMENT OF COMMERCE, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY.
3. BASIS OF BEARINGS: CONSIDERING THE EAST LINE OF THE NORTHEAST 1/4 SECTION 11, TOWNSHIP 4 NORTH, RANGE 69 WEST AS BEARING NORTH 00°52'30" EAST, MONUMENTED BY A 2-1/2" ALUMINUM CAP, LS12374 AT THE EAST 1/4 CORNER OF SAID SECTION 11 AND BY A 2-1/2" ALUMINUM CAP, LS12374 AT THE NORTHEAST CORNER OF SAID SECTION 11.
4. THE SUBJECT PROPERTY IS LOCATED IN UNSHADED ZONE X, THE AREA DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN. ALL ACCORDING TO FIRM MAP NO. 08069C1400G, DATED FEBRUARY 6, 2013.

GENERAL DEVELOPMENT STANDARD NOTES:

1. PROJECT APPROVAL:
   THE PLANS CONTAINED ON THIS MAP/PLAT AS WELL AS THE STAFF REPORT DATED _____ AND RESOLUTION _____ (AND/OR) ORDINANCE _____ ARE THE LIMITS OF THE APPROVAL. ANY CHANGES TO THE APPROVED PLANS MAY NECESSITATE AN AMENDMENT OR NEW PERMIT.
2. DEVELOPMENT IMPROVEMENTS:
   ALL DEVELOPMENT IMPROVEMENTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE PLAT AND PLANS AS WELL AS THE REQUIREMENTS OF THE BERTHOUD MUNICIPAL CODE. IF APPLICABLE: THE DEVELOPMENT SHALL ADHERE TO THE DEVELOPMENT AGREEMENT ENTERED INTO BETWEEN THE DEVELOPER AND THE TOWN OF BERTHOUD.
3. EROSION CONTROL:
   PRIOR TO COMMENCEMENT OF CONSTRUCTION OF ANY DEVELOPMENT IMPROVEMENTS INCLUDING ALTERATIONS TO EXISTING GRADING CONTOURS, REMOVAL OF VEGETATION AND/OR EXCAVATING, THE TOWN-APPROVED EROSION CONTROL PLAN WILL BE IMPLEMENTED. THE TOWN-APPROVED EROSION CONTROL PLAN MEASURES SHALL BE INSTALLED AND MAINTAINED THROUGHOUT THE CONSTRUCTION OF DEVELOPMENT IMPROVEMENTS AND SHALL NOT BE REMOVED OR ABANDONED UNTIL AUTHORIZED BY THE TOWN. AT ALL TIMES DURING CONSTRUCTION ON THE PROPERTY, OR OFF-SITE PROJECTS ASSOCIATED WITH DEVELOPMENT OF THE PROPERTY, DEVELOPER SHALL MAINTAIN ALL STREETS, DRAINAGE, AND DRAINAGE FACILITIES IN AN ORDERLY AND WORKMANLIKE FASHION.
4. CONSTRUCTION RULES AND REGULATIONS:
   CONSTRUCTION ACTIVITIES SHALL ADHERE TO THE CONSTRUCTION RULES AND REGULATIONS FOUND IN CHAPTER 30 OF THE BERTHOUD MUNICIPAL CODE AT ALL TIMES.
5. DARK SKY:
   THE TOWN OF BERTHOUD HAS ADOPTED A DARK SKY ORDINANCE. ALL DEVELOPMENT SHALL ADHERE TO THE TOWN OF BERTHOUD DARK SKY ORDINANCE NO. 1230, ADOPTED JANUARY 9, 2018, AND AS MAY BE AMENDED, AT ALL TIMES.
6. RIGHT TO FARM STATEMENT:
   THE TOWN OF BERTHOUD HAS ADOPTED A 'RIGHT TO FARM POLICY'. ALL NEW AND EXISTING RESIDENTS ARE EXPECTED TO READ AND UNDERSTAND THE POLICY. FOR A COPY OF THE POLICY, PLEASE CONTACT THE TOWN OF BERTHOUD.

THE TOWN OF BERTHOUD IS A UNIQUE COMMUNITY LOCATED WITHIN AN AGRICULTURAL AREA THAT PROVIDES MANY BENEFITS TO THE TOWN AND A VARIETY OF AGRICULTURAL PRODUCTS TO THE PEOPLE OF THE STATE OF COLORADO. AGRIBUSINESS IS AN IMPORTANT PART OF OUR STATE'S ECONOMY. THE TOWN OF BERTHOUD RECOGNIZES THAT WITHOUT THE FARMERS AND RANCHERS IN THE AREA, THE TOWN WOULD NOT MAINTAIN ITS SMALL TOWN CHARACTER, LIFESTYLE AND APPEAL. THEREFORE, IT BECOMES IMPERATIVE TO EDUCATE PEOPLE MOVING TO THIS AREA RELATIVE TO THE DAY TO DAY ACTIVITIES AND EVENTS THAT OCCUR IN AREAS OF LARIMER AND WELD COUNTIES ADJACENT TO RESIDENTIAL AREAS OF THE TOWN.

THE LAWS OF COLORADO CLASSIFY IT AS A "RIGHT TO FARM" STATE. NEW AND EXISTING RESIDENTS OF THE TOWN OF BERTHOUD AND THOSE TO WHOM THE TOWN SUPPLIES MUNICIPAL SERVICES SHOULD UNDERSTAND THAT ALL OF US BENEFIT FROM THE LARGE AREAS OF OPEN FARMLANDS AND FIELDS THAT SURROUND OUR COMMUNITY. IN ORDER FOR THESE LANDS TO REMAIN PRODUCTIVE, THE FARMING AND RANCHING OPERATIONS ON THESE PROPERTIES MUST CONTINUE. THEREFORE, IT IS THE RESPONSIBILITY OF THE NEIGHBORING PROPERTY OWNERS TO UNDERSTAND AND RESEARCH THE AREA THEY ARE CONSIDERING MOVING INTO, AND FULLY UNDERSTAND AND ACCEPT THAT THE ACTIVITIES, SIGHTS, SOUNDS AND SMELLS OF AGRICULTURAL OPERATIONS ARE NORMAL FACTS OF LIFE WHEN LIVING IN THE AREAS WITHIN AND AROUND THE TOWN OF BERTHOUD.

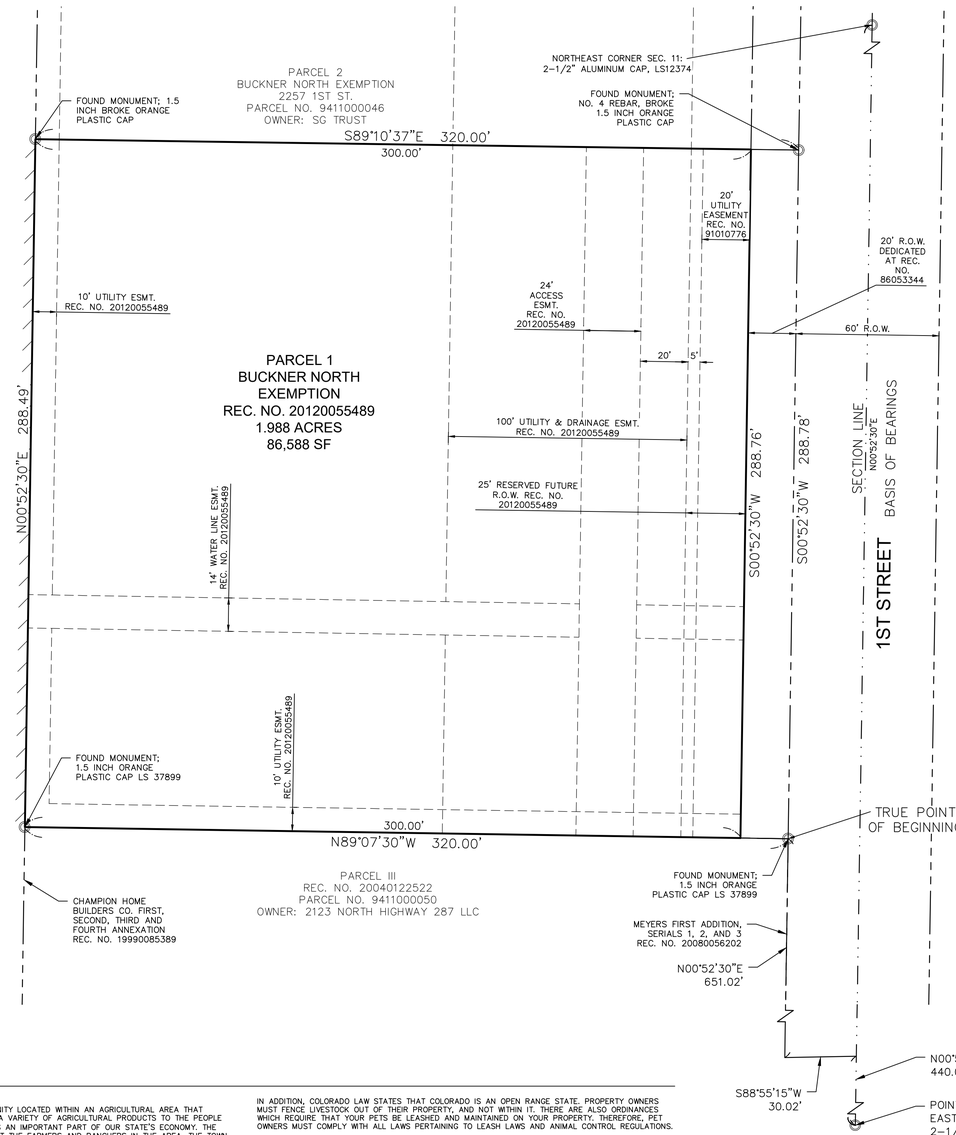
SOME INDIVIDUALS MAY NOT APPRECIATE THESE AGRICULTURAL OPERATIONS AND MAY PERCEIVE THEM AS ANNOYANCES, EYESORES OR NUISANCES. STATE LAW AND TOWN RESOLUTIONS RECOGNIZE THAT RANCHING, FARMING OR OTHER AGRICULTURAL ACTIVITIES AND OPERATIONS WITHIN THE AREAS SURROUNDING BERTHOUD SHALL NOT BE CONSIDERED TO BE NUISANCES SO LONG AS THEY ARE OPERATED IN CONFORMANCE WITH THE LAW IN A NON-NEGLIGENT MANNER. THEREFORE, LOCAL RESIDENTS SHOULD BE PREPARED TO ENCOUNTER NOISES, 24 HOUR OPERATIONS, ODORS, LIGHTS, MUD, DUST, SMOKE, CHEMICALS, MACHINERY ON PUBLIC ROADS, LIVESTOCK, STORAGE AND DISPOSAL OF FEED AND MANURE, THE APPLICATION BY SPRAYING OF OTHER CHEMICAL FERTILIZERS, SOIL AMENDMENTS, HERBICIDES AND PESTICIDES, ANYONE OR MORE OF WHICH MAY NORMALLY OCCUR AS PART OF LEGAL AND NON-NEGLIGENT AGRICULTURAL OPERATIONS.

IN ADDITION, COLORADO LAW STATES THAT COLORADO IS AN OPEN RANGE STATE. PROPERTY OWNERS MUST FENCE LIVESTOCK OUT OF THEIR PROPERTY, AND NOT WITHIN IT. THERE ARE ALSO ORDINANCES WHICH REQUIRE THAT YOUR PETS BE LEASHED AND MAINTAINED ON YOUR PROPERTY. THEREFORE, PET OWNERS MUST COMPLY WITH ALL LAWS PERTAINING TO LEASH LAWS AND ANIMAL CONTROL REGULATIONS.

OWNERS OF EASEMENTS AND RIGHTS-OF-WAY FOR DITCHES AND UTILITIES MUST HAVE REASONABLE ACCESS TO BURN, CONTROL WEEDS, MAINTAIN AND SERVICE THEIR LINES AND DITCHES. THESE DITCHES AND EASEMENTS ARE NOT FOR PUBLIC USE AND MAY NOT BE USED WITHOUT THE WRITTEN CONSENT OF THE DITCH OWNER. THE WATER CONTAINED IN THESE DITCHES IS PRIVATE PROPERTY AND ANY USE OF THIS WATER WITHOUT WRITTEN CONSENT IS TO BE CONSIDERED THEFT. RESIDENTS AND LANDOWNERS ARE ENCOURAGED TO LEARN. MORE ABOUT THESE RIGHTS AND RESPONSIBILITIES AND THE POSITION THE STATE OF COLORADO AND THIS TOWN HAVE ADOPTED REGARDING THESE ISSUES. THE TOWN BELIEVES FARMING AND RANCHING OPERATIONS CAN PROVIDE MANY BENEFITS TO LOCAL RESIDENTS AND THAT AGRICULTURE AND RESIDENTIAL USES CAN COEXIST.

FOR ADDITIONAL INFORMATION PLEASE REFER TO LARIMER COUNTY'S "THE CODE OF THE WEST," AND WELD COUNTY'S "RIGHT TO FARM COVENANT," ADOPTED MAY 1997

7. 1ST STREET CORRIDOR PLAN
   THE TOWN OF BERTHOUD HAS ADOPTED THE 1ST STREET CORRIDOR PLAN. THIS DEVELOPMENT FALLS WITHIN THE 1ST STREET CORRIDOR OVERLAY DISTRICT AND IS REQUIRED TO ADHERE TO THE OVERLAY PLAN, ADOPTED APRIL 25, 2023, AND AS MAY BE AMENDED.



APPROVAL CERTIFICATES

APPROVED BY THE BOARD OF TRUSTEES OF THE TOWN OF BERTHOUD, COLORADO THIS _____ DAY OF _____, 2026.

_____
MAYOR, WILLIAM KARSPECK

THE FOREGOING MAP IS APPROVED FOR FILING AND ACCEPTED BY THE TOWN OF BERTHOUD, COLORADO THIS _____ DAY OF _____, 2026.

ATTEST: _____
TOWN CLERK, CHRISTIAN R. SAMORA

APPROVED BY THE PLANNING COMMISSION OF THE TOWN OF BERTHOUD, COLORADO THIS _____ DAY OF _____, 2026.

_____
CHAIRPERSON

THE FOREGOING MAP IS APPROVED FOR FILING AND ACCEPTED BY THE TOWN OF BERTHOUD, COLORADO THIS _____ DAY OF _____, 2026.

ATTEST: _____
PLANNER

SURVEYOR'S CERTIFICATE:

I, MICHAEL MASSEY, A REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF COLORADO, DO HEREBY STATE THAT THIS PROPERTY DESCRIPTION OF LAND PROPOSED TO BE ANNEXED TO THE TOWN OF BERTHOUD, COUNTY OF LARIMER, STATE OF COLORADO, WAS PREPARED UNDER MY PERSONAL SUPERVISION AND CHECKING, AND THAT IT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, BELIEF, AND IN MY PROFESSIONAL OPINION.

I FURTHER STATE THAT NOT LESS THAN ONE-SIXTH OF THE PERIMETER OF THE AREA PROPOSED TO BE ANNEXED IS CONTIGUOUS TO THE BOUNDARY LINE OF THE TOWN OF BERTHOUD, COUNTY OF LARIMER, STATE OF COLORADO.

DRAFT 04/21/2026

_____
MICHAEL MASSEY, #38346
COLORADO REGISTERED PROFESSIONAL LAND SURVEYOR

NOTE:
TOTAL PERIMETER OF ANNEXATION: 1177.25'
CONTIGUOUS LENGTH TO THE EXISTING TOWN BOUNDARY: 288.49'
ONE-SIXTH OF TOTAL ANNEXATION PERIMETER: 196.21'

	SQUARE FEET	ACRES
PARCEL 1	86,588	1.988

PROJECT CONTACTS:

SURVEYOR
RIDGETOP ENGINEERING AND SURVEYING
541 E. GARDEN DRIVE, UNIT N
WINDSOR, CO 80550
(970) 663-4552
CONTACT: MICHAEL MASSEY, P.L.S.

OWNER
PEAK INVESTMENTS, LLC
5805 MANGROVE CT
LOVELAND, CO 80538
(970) 218-1477

LEGEND:

- EASEMENT LINE
- PROPERTY LINE
- RIGHT OF WAY LINE
- TOWN OF BERTHOUD BOUNDARIES
- SECTION LINE
- FOUND MONUMENT AS NOTED

N

30 0 30 60
scale 1"=30' feet

DATE	REVISED	REQUEST BY	CHECK

Project: 21-163-001
Drawing: ANNEXATION
Drafted By: BSA
Date: 11/07/2026
Rev. Date:
Check By: MM

BERTHOUD INDUSTRIAL ANNEXATION
TO THE TOWN OF BERTHOUD, COLORADO
PARCEL 1, BUCKNER NORTH EXEMPTION, BEING A PART OF THE NORTHEAST 1/4 OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 69 WEST OF THE 6TH P.M.
TOWN OF BERTHOUD, COUNTY OF LARIMER, STATE OF COLORADO

541 E. GARDEN DRIVE
UNIT N
WINDSOR, CO 80550
970-663-4552
RIDGETOP ENGINEERING & SURVEYING

Sheet: 1 / 1

DRAWING FILENAME: V:\Projects\21-163-001 Berthoud Lot 3\dgn\Working Files\SWO\Annexation.dwg LAYOUT NAME: 24x36 Landscape DATE: Apr 21, 2026 - 12:09am

Berthoud Industrial – Parcel 1 Buckner North Exemption

PETITION FOR ANNEXATION

We represent that we are the landowners of 100% of the land described in this Petition, excluding public streets, alleys, roads and easements, which is legally described on **Exhibit "A"** and depicted on **Exhibit "B"**, and affirm the following to be true and correct as of April 2026, our petition for annexation is filed with the Town of Berthoud.

CONTIGUITY:

1. The perimeter of the proposed annexation has a distance of 1,177.25 feet of which 577.25 are contiguous to the existing Town Limits of Berthoud.

2. This contiguity results in a minimum of 49% of the perimeter (at least 1/6) of proposed annexation being contiguous to the Town of Berthoud.

3. The proposed annexation contains approximately 1.988 acres.

4. The requirements of §31-12-104 and §31-12-105 C.R.S., exist or have been met.

5. We further allege:

   a. It is desirable and necessary that the territory be annexed to the Town of Berthoud.

   b. A community of interest exists between the territory and the Town of Berthoud.

   c. The territory is integrated or capable of being integrated with the Town of Berthoud.

   d. The territory is urban or will be urbanized in the near future.

   e. No land held in identical ownership is divided into separate parcels unless the owner of said tract has consented in writing or joins in this Petition.

   f. No proceedings for annexation of the land described in this Petition have been commenced for annexation to another municipality.

6. The Petitioners understand that there may be a significant period of time before municipal utilities will be available, but anticipate that urbanization will be able to take place at a pace acceptable to them without immediate access to these utilities. Until urbanization takes place the petitioners intend to maintain their properties in their current uses, which uses are acceptable to the Town of Berthoud.

7. The Petitioners have submitted the petition with the intention that the property will be developed in accordance with Berthoud's Development Code, Comprehensive Plan, Municipal Code, resolutions and ordinances.

8. The Petitioners are aware that Berthoud has enacted fees and policies with the intention that growth should pay its own way and that growth should improve the health, safety and welfare of its citizens. Examples of Berthoud's fees which are acceptable to the petitioners include fees for: building, electric, construction meter, plan review, building permit administration, parks, trails and open space, public facilities infrastructure, streets, drainage, police facility infrastructure, general administration facility infrastructure, water administration, water meter, water tap, sewer tap, raw water, and other supplemental fees as appropriate.

9. The Petitioners understand that Berthoud is required by Colorado Revised Statutes to prepare and file an annexation impact report. The Petitioners will prepare a proposed annexation impact report and provide it to Berthoud for review and consideration six (6) weeks prior to the hearing.

10. The Petitioners agree to dedicate free and clear of all liens and encumbrances of any kind, and at no charge to the Town, all easements and rights-of-way for streets and other public ways and for other public purposes, within the Property.

11. The Petitioners agree to dedicate, with the subdivision of the Property and at no cost to the Town, all required easements and right-of-way for installation and maintenance of infrastructure.

12. The Petitioners agree to design and install transportation infrastructure, utility infrastructure, and stormwater improvements to serve the Property prior to the issuance of any building permits for all or any portion of the property in accordance with Town standards. The Petitioners shall make such other improvements as required by Town ordinances and resolutions, to guarantee construction of all required improvements, and, if requested by Berthoud, to dedicate to Berthoud any or all other required improvements. The Petitioners agrees to enter into a subdivision improvements agreement pertaining to such improvements and other matters at time of final plat.

13. The Petitioners agree that oversizing agreements may exist that the Petitioners may be responsible for his/her fair share for oversizing of infrastructure. Likewise, Petitioners acknowledges that the Town may require the Petitioners to oversize infrastructure, which would be reimbursed by subsequent developers. The Petitioners acknowledge that the Town shall facilitate reimbursement of any financial participation by the Petitioners, over and above the proportionate impact of the development. Such

reimbursement shall come from new development directly connecting to the improvements.

14. The Petitioners agree to satisfy the public land dedication and landscaping requirements specified in the Town's Development Code.

15. The Petitioners agree that future development of the site will comply with any adopted infrastructure plans including but not limited to transportation, drainage, water, sewer, land use, parks, trails, open space and comprehensive plans.

16. The Petitioners agree that the design, improvement, construction, development, and use of the property shall be in conformance with, and that Petitioners shall comply with, all municipal, county, state and federal statutes, ordinances, rules and regulations.

17. The Petitioners agree that all land use approvals and building permits for the development of the Property shall be subject to requirements including, but not limited to, the payment of impact fees and development charges and other land use and development requirements in effect at the time that such proposed development applies for a building permit.

18. The Petitioners agree to convey to the Town, all water rights necessary for development and all irrigation water rights and associated carrying rights and groundwater rights associated with the property, and any related stock certificates evidencing ownership of the water rights, free and clear of all encumbrances and with all taxes and assessments related hereto paid in full, unless the Town in writing rejects any or all such water rights. Water rights may be conveyed on a pro-rata basis as building permits are issued.

19. Berthoud has various enterprise funds through which the utilities provided by Berthoud are financed. Examples of Berthoud's services are its water, wastewater and drainage utilities. Berthoud's Board of Trustees believe that the provision of utilities by Berthoud assists in complying with the *Berthoud Comprehensive Plan* and *Berthoud Development Code* and the petitioners request that Berthoud provide all utility services which are available now or in the future through Berthoud at a cost comparable to that which can be provided by any third party.

20. The Petitioners understand that the R2-J School District forms an integral part of the Berthoud community. Berthoud has enacted fees to support the acquisition of land by this School District. The Petitioners are aware of these fees and agree to financially support the District's land acquisition programs.

The terms of this Petition are binding on the heirs, devisers, successors and assigns of the parties. Therefore, the undersigned hereby request that the Town of Berthoud approve the annexation of the areas described herein.

PETITIONER SIGNATURES

Petitioner 1:

Signature: _____ Date: 4/17/26

Printed Name: Derek Griess

Title: Owner

Ownership Percentage: 50%

Petitioner 2:

Signature: _____ Date: 4/17/26

Printed Name: James Jansma

Title: Owner

Ownership Percentage: 50%

STATE OF COLORADO)
) ss.
COUNTY OF Larimer)

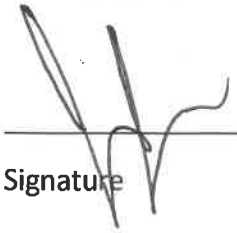
The foregoing instrument was acknowledged before me this 17th day of April, 2026, by Derek Griess and James Jansma.

Witness my hand and official seal.

My commission expires: March 19 2028

Notary Public

AARON J WESTHUIS
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20204000115
MY COMMISSION EXPIRES MARCH 19 2028

Landowner(s) Name(s) and Signature(s	Mailing Address	Date
James Jansma	5651 Neighbors Way Loveland, CO 80537	
Printed Name		
		4/17/26
Signature		
Derek Griess	5805 Mangrove Ct	
Printed Name		
	Loveland CO 80538	4/17/26
Signature		
Printed Name		
Signature		

Board of Trustees Information

Administration Department

Meeting Date:	**April 28, 2026**
Agenda Title/Subject:	**Appointment of Municipal Officers - Resolution 14-2026**
Type of Item:	**Consent Agenda**
Purpose:	**To appoint officers in accordance with Chapters 3, 4, and 5 of the Berthoud Municipal Code and Colorado Revised Statutes § 31-4-304.**
Presented by:	**Christian Samora**

Attachments:

1. Resolution 2026 14 Appointing Officers

Background:

In accordance with Chapters 3, 4, and 5 of the Berthoud Municipal Code and Colorado Revised Statutes § 31-4-304, the Board of Trustees shall appoint a Clerk, Treasurer, Attorney, Town Administrator and offer officers as deemed necessary. Such appointment shall occur within 30 days of the regular election.

Update/Next Steps:

This is a routine item and will not require any further action after approval.

Fiscal Impact and Fund Source:

There will be no fiscal impact in connection with the passage of this Resolution.

Community Touchstones:

This resolution will support all three Touchstones established by the Board of Trustees by providing the officers necessary to do so.
Community Identity, Sustainability, and Resiliency.

Recommended Action(s):

The recommendation for this item is to approve the resolution as part of the Consent Agenda.

Resolution No. 14
Series 2026

A Resolution of the Board of Trustees of the Town of Berthoud Appointing Municipal Officers in Accordance with Chapters 3, 4, and 5 of the Berthoud Municipal Code and C.R.S. § 31-4-304

Whereas, in accordance with C.R.S. § 31-4-304 and Chapters 3, 4, and 5 of the Berthoud Municipal Code, the Board of Trustees must appoint officers to certain positions at the first regular meeting of the Board of Trustees following each biennial election.

Now Therefore be it Resolved by the Board of Trustees of the Town of Berthoud as follows:

Section 1. The following officers are hereby appointed:

a)	Town Administrator	Christopher Kirk
b)	Town Attorney	Kathryn Sellars
c)	Town Attorney	Kendra Carberry
d)	Town Clerk	Christian R. Samora
e)	Town Treasurer	Cindy Leach
f)	Town Clerk Pro Tem	Lexi Weissman
g)	Chief of Police	Justin Williamson
h)	Municipal Judge	Stewart Olive
i)	Alternate Municipal Judge	Sunita Sharma

Introduced, approved and adopted this 28th day of April, 2026.

Town of Berthoud

_____
William Karspeck, Mayor

Attest

_____
Christian R. Samora, CMC, Town Clerk

Board of Trustees Information

Recreation Department

Meeting Date:	**April 28, 2026**
Agenda Title/Subject:	**Berthoud Recreation Center Scheels Sponsorship Contract**
Type of Item:	**Consent Agenda**
Purpose:	**To approve the SCHEELS 2026 sponsorship package with the Recreation Department**
Presented by:	

Attachments:

1. Scheels Sponsorship Agreement

Background:

The Recreation Department offers sponsorship opportunities and associated packages to local and regional businesses to support programs, facilities, and community events. Over the past three (3) years, SCHEELS has served as an MVP-level sponsor, specifically supporting one of the courts at the Recreation Center. This ongoing partnership has contributed to facility improvements, equipment discounts, and overall better user experiences by enabling the recreation center staff to purchase updated equipment.

Update/Next Steps:

No additional action is needed if approved.

Fiscal Impact and Fund Source:

The SCHEELS sponsorship revenue supports ongoing facility improvements and access to discounted equipment from their store for the recreation department. In return, participants benefit from discounts on equipment purchased for use in our programs. This revenue is tracked under the Recreation Center Sponsorship account 52-00-4500-60.

Community Touchstones:

Sustainable partnerships like these allow the Recreation Department to deliver quality programming, provide safe and welcoming facilities, and invest in the long-term health and wellness of Berthoud residents, all while honoring the community identity the Town of Berthoud continues to strive for.

Recommended Action(s):

It is recommended that the Board of Trustees approve the 2026 SCHEELS Sponsorship agreement with the Town of Berthoud Recreation Department.

SPONSORSHIP AGREEMENT

THIS SPONSORSHIP AGREEMENT (the "Agreement") is made and entered into this 22 day of April, 2026, ("Effective Date") by and between the Town of Berthoud, a Colorado municipal corporation with an address of 807 Mountain Avenue, Berthoud, CO 80513 (the "Town"), and SCHEELS All Sports, Inc., a North Dakota Corporation d.b.a SCHEELS, an independent contractor with a principal place of business at 4755 Ronald Reagan Blvd. Johnstown, CO 80534 ("Sponsor") (each a "Party" and collectively the "Parties").

For the consideration hereinafter set forth, the receipt and sufficiency of which are hereby acknowledged, the Parties hereto agree as follows:

I. Sponsorship

Sponsor shall provide the following during the term of this Agreement:

A. Upon execution of this Agreement by both Parties, the Sponsor shall make a one-time payment to the Town of Three Thousand Dollars ($3,000.00) in good funds and deliver to the Town a $500.00 SCHEELS Gift Card. Sponsor's payment obligations are conditioned upon the Town's performance of the advertisement and placement obligations described in Section II below ("Sponsorship Benefits"). In the event the Town fails to deliver the Sponsorship Benefits in the manner described in Section II below, Sponsor shall be entitled to a prorated refund or other mutually agreed remedy.

B. The Town's Recreation Administration will receive a twenty percent (20%) discount at or through Sponsor's business for recreation equipment and apparel for recreational activities conducted by the Town for the benefit of the public. Sponsor will honor a price match for the same equipment and apparel at a different vendor if the reduced price is greater than the discount described in this paragraph.

C. Players and coaching staff participating in the Town's recreational activities and leagues will receive twenty percent (20%) team discount coupons to be distributed by the Town's Recreation Administration.

D. Free meeting space for coaches/parent meetings.

E. Fundraiser opportunities.

II. Advertisement and Placement for Sponsorship

During the term of this Agreement, the Town will provide the following advertisement and name and logo placement in consideration of the sponsorship from Sponsor pursuant to this Agreement. Sponsor will provide the logos and names, as designed by Sponsor, that Sponsor wants the Town to use. The Town will not modify the logo or name designs provided by the Sponsor.

A. South Court Sponsor at Waggener Farm Recreation Center.

B. One TV ad to play on REACH TV at Waggener Farm Recreation Center.

C. Sponsor Logo in seasonal Berthoud Recreation activity guides.

D. Sponsor business spotlight in one Berthoud Recreation activity guide.

E. Sponsor logo on all printed and digital Berthoud Recreation receipts.

F. Sponsor logo and website link on Berthoud.org.

G. Sponsor spotlight in one Berthoud Recreation E-newsletter.

H. Sponsor name and logo placement on the back of all youth sports T-shirts for Strikers, Lombardis, Spikers, Sluggers, and Dribblers. Sponsor name and logo will share space with other sponsor names and logos.

I. One social media post highlighting Sponsor's company and a link to Sponsor's website.

J. Sponsor will have the opportunity to bid on equipment and apparel orders.

III. Indemnification

A. Sponsor shall defend, indemnify and hold harmless the Town, its officers, employees, agents and their insurers, from and against all liability, claims and demands on account of injury, loss or damage, including without limitation, claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage or any other loss of any kind whatsoever, which arises out of or is in any manner connected with this Agreement, to the extent that such injury, loss or damage is attributable to the act, omission, error, professional error, mistake, negligence or other fault of Sponsor, Sponsor's employees, or anyone else employed directly or indirectly by Sponsor. Sponsor shall defend, investigate, handle, respond and provide defense for and defend against any such liability, claims or demands at the sole expense of Sponsor, or at the option of the Town, Sponsor agrees to pay the Town or reimburse the Town for defense costs incurred by the Town in connection with any such liability, claims, or demands. Recipient, to the fullest extent permitted by law, shall defend and bear all other costs and expenses related thereto, including court costs and attorney fees, whether or not such liability, claims or demands alleged are groundless, false, or fraudulent.

B. To the extent permitted by applicable law, each Party shall be responsible for any claims, damages, losses, and expenses arising out of or resulting from its own negligent acts or omissions or willful misconduct in connection with this Agreement.

C. Notwithstanding the foregoing, nothing in this Agreement shall be construed as a waiver of the protections, limitations, or immunities provided to the Town under the Colorado Governmental Immunity Act.

D. In no event shall either Party be responsible for defending or indemnifying the other Party for claims arising from the other Party's acts or omissions.

IV. Insurance

The Town shall maintain, to the extent required by law, general liability coverage or participation in a governmental self-insurance pool. Upon reasonable request, the Town shall provide evidence of such coverage.

V. Intellectual Property

A. All SCHEELS trademarks, logos, trade names, and related intellectual property are and shall remain the exclusive property of Sponsor. Sponsor grants Town a limited, non-exclusive, non-transferable, revocable license to use such intellectual property solely for purposes expressly approved under this Agreement during its term.

B. No modification or alteration of SCHEELS' intellectual property is permitted without prior written approval from Sponsor. All rights not expressly granted are reserved.

C. Any use of SCHEELS' trademarks, logos, trade names, or other intellectual property outside the scope of this Agreement is subject to Sponsor's prior written approval.

VI. Term and Termination

A. The term of this Agreement shall be from the Effective Date above until December 31, 2027, unless terminated as provided herein.

B. Either Party may terminate this Agreement upon 30 days advance written notice.

C. Sponsor may terminate this Agreement immediately upon written notice if: the Town breaches any material term of this Agreement and fails to cure within thirty (30) days after notice of such breach.

VII. Miscellaneous

A. *Governing Law and Venue*. This Agreement shall be governed by the laws of the State of Colorado, and any legal action concerning the provisions hereof shall be brought in Larimer County, Colorado.

B. *No Waiver*. Delays in enforcement or the waiver of any one or more defaults or breaches of this Agreement by the Town shall not constitute a waiver of any of the other terms or obligation of this Agreement.

C. *Integration*. This Agreement constitutes the entire agreement between the Parties, superseding all prior oral or written communications.

D. *Third Parties*. There are no intended third-party beneficiaries to this Agreement.

E. Notices. Any demand, notice or request provided for by this Agreement shall be sent in writing, addressed to the party to whom notice is to be given or to whom a demand or request is to be made, and delivery shall be made by facsimile, or certified mail, by means of which the sender obtains a receipt of delivery from the carrier.

Town of Berthoud
Chris Kirk
807 Mountain Avenue P.O. Box 1229,
Berthoud, CO 80513
970-344-5819
CKirk@berthoud.org

SCHEELS All Sports
Attn: Russ Spicer - Team Sports Coordinator
4755 Ronald Reagan Blvd. Johnstown, CO 80534
970-699-7117
rdspicer@scheels.com

F. *Severability*. If any provision of this Agreement is found by a court of competent jurisdiction to be unlawful or unenforceable for any reason, the remaining provisions hereof shall remain in full force and effect.

G. *Modification*. This Agreement may only be modified upon written agreement of the Parties.

H. *Assignment*. Neither this Agreement nor any of the rights or obligations of the Parties shall be assigned by either Party without the written consent of the other.

I. *Governmental Immunity*. The Town and its officers, attorneys and employees, are relying on, and do not waive or intend to waive by any provision of this Agreement, the monetary limitations or any other rights, immunities or protections provided by the Colorado Governmental Immunity Act, C.R.S. § 24-10-101, *et seq.*, as amended, or otherwise available to the Town and its officers, attorneys or employees.

J. *Rights and Remedies*. The rights and remedies of the Town under this Agreement are in addition to any other rights and remedies provided by law. The expiration of this Agreement shall in no way limit the Town's legal or equitable remedies, or the period in which such remedies may be asserted, for work negligently or defectively performed.

K. *Subject to Annual Appropriation*. Consistent with Article X, § 20 of the Colorado Constitution, any financial obligation of the Town not performed during the current fiscal year is

subject to annual appropriation, shall extend only to monies currently appropriated, and shall not constitute a mandatory charge, requirement, debt or liability beyond the current fiscal year.

L. *Force Majeure*. No Party shall be in breach of this Agreement if such Party's failure to perform any of the duties under this Agreement is due to Force Majeure, which shall be defined as the inability to undertake or perform any of the duties under this Agreement due to acts of God, floods, fires, sabotage, terrorist attack, strikes, riots, war, labor disputes, forces of nature, the authority and orders of government or pandemics.

M. *Electronic Signatures*. The Parties intend that this Agreement be governed by the Uniform Electronic Transactions Act, C.R.S. § 24-71.3-101, *et seq*.

In Witness Whereof, the Parties have executed this Agreement as of the Effective Date.

Town of Berthoud, Colorado

_____
Chris Kirk, Town Administrator

Attest:

_____
Christian R. Samora, CMC, Town Clerk

SCHEELS

By: _____

State of _____)
) ss.
County of _____)

The foregoing instrument was subscribed, sworn to and acknowledged before me this ___ day of _____, 2026, by _____ as _____ of _____.

My commission expires:

(Seal)

_____
Notary Public

Board of Trustees Information

Administration Department

Meeting Date:	**April 28, 2026**
Agenda Title/Subject:	**Open Stage Denver Contract for July 3rd Event Stage, Sounds, and Lighting**
Type of Item:	**Consent Agenda**
Purpose:	**Approval of service contract for the 3rd of July, Vendor for Stage, Sound, & Lighting**
Presented by:	**Amanda Gustafson**

Attachments:

1. Open Stage - Final Contract

Background:

Berthoud's 3rd of July fireworks event has grown into one of the community's most anticipated summer traditions, drawing thousands of residents and families to celebrate together the evening before Independence Day. The Town will need to contract with a qualified vendor to provide the equipment needed for a successful event, including stage, sound, and lighting equipment.

This agreement contains changed language from the previously approved agreement with the staging company to allow 100% compensation if the contractor is on site and set up and the Town cancels the event. In addition, the Town changed the policy to state that there is no compensation if the Town cancels the event before the event, and that the contractor receives only the non-refundable deposit.

Update/Next Steps:

No additional action is needed if approved.

Fiscal Impact and Fund Source:

The cost of contracting these professional services is consistent with the Town's community events budget and would be handled through the general fund community events account, 11-01-5252-01.

Community Touchstones:

Part of Berthoud’s Community Identity is being a great place to visit, live, and recreate. Providing an event of this nature creates an additional way to show a community togetherness and harmony by providing areas for family entertainment and viewing a fireworks show that frequently brings a positive synergy within the Town throughout the event and several months after.

Recommended Action(s):
It is recommended that the Board of Trustees approve the 2026 Open Stage Denver agreement listed under attachments and the associated payments for Stage, Sound, and Lighting.

Agreement for Services
(Fixed Fee)

This Agreement for Services (the "Agreement") is made and entered into this 14th day of April, 2026 (the "Effective Date"), by and between the Town of Berthoud, a Colorado municipal corporation with an address of 807 Mountain Avenue, Berthoud, CO 80513 (the "Town"), and Open Stage Denver, an independent contractor with a principal place of business at 11503 Monroe Street. Thornton, CO 80233 ("Contractor") (each a "Party" and collectively the "Parties").

Whereas, the Town requires services; and

Whereas, Contractor has held itself out to the Town as having the requisite expertise and experience to perform the required services.

Now Therefore, for the consideration hereinafter set forth, the receipt and sufficiency of which are hereby acknowledged, the Parties agree as follows:

1. Scope of Services.

a. Contractor shall furnish all labor and materials required for the complete and prompt execution and performance of all duties, obligations, and responsibilities which are described or reasonably implied from the Scope of Services set forth in **Exhibit A**, attached hereto and incorporated herein by this reference, and known as:

b. A change in the Scope of Services shall not be effective unless authorized as an amendment to this Agreement. If Contractor proceeds without such written authorization, Contractor shall be deemed to have waived any claim for additional compensation, including a claim based on the theory of unjust enrichment, quantum merit or implied contract. Except as expressly provided herein, no agent, employee, or representative of the Town is authorized to modify any term of this Agreement, either directly or implied by a course of action.

2. Term and Termination.

a. This Agreement shall commence on the Effective Date and shall continue until Contractor completes the Scope of Services to the satisfaction of the Town, or until terminated as provided herein.

b. Either Party may terminate this Agreement upon 30 days advance written notice. The Town shall pay Contractor for all work previously authorized and completed prior to the date of termination. If, however, Contractor has substantially or materially breached this Agreement, the Town shall have any remedy or right of set-off available at law and equity.

c. If the Town cancels the event for any reason after contractor is on-site and has set-up equipment, the Town will reimburse the Contractor for 100% of the total compensation, excluding non-refundable deposits. The Contractor shall promptly notify the Town of any concerns or issues related to weather conditions that may affect set-up of the event.

d. The Town may terminate this Agreement for any reason prior to the event. The non-refundable deposit shall be payment.

3. Compensation. In consideration for the completion of the Scope of Services by Contractor, the Town shall pay Contractor $ 5,700.00. This amount shall include all fees, costs and expenses incurred by Contractor, and no additional amounts shall be paid by the Town for such fees, costs and expenses. Upon execution of this Agreement by both Parties, the Town will pay the Contractor a non-refundable deposit of 25% of the total compensation. Contractor shall submit a final invoice for the remainder of the compensation, which shall be paid by the Town within 30 days of receipt.

4. Contractor Responsibilities.

a. Contractor hereby warrants that it is qualified to assume the responsibilities and render the services described herein and has all requisite corporate authority and licenses in good standing, required by law. The work performed by Contractor shall be in accordance with generally accepted practices and the level of competency presently maintained by other contractors in the same or similar type of work in the applicable community.

b. The Town's review, approval or acceptance of, or payment for any services shall not be construed to operate as a waiver of any rights under this Agreement or of any cause of action arising out of the performance of this Agreement.

c. Contractor shall at all times comply with all applicable law, including all federal, state and local statutes, regulations, ordinances, decrees and rules relating to the emission, discharge, release or threatened release of a hazardous material into the air, surface water, groundwater or land, the manufacturing, processing, use, generation, treatment, storage, disposal, transportation, handling, removal, remediation or investigation of a hazardous material, and the protection of human health and safety, including without limitation the following, as amended: the Comprehensive Environmental Response, Compensation and Liability Act; the Hazardous Materials Transportation Act; the Resource Conservation and Recovery Act; the Toxic Substances Control Act; the Clean Water Act; the Clean Air Act; the Occupational Safety and Health Act; the Solid Waste Disposal Act; the Davis Bacon Act; the Copeland Act; the Contract Work Hours and Safety Standards Act; the Byrd Anti-Lobbying Amendment; the Housing and Community Development Act; and the Energy Policy and Conservation Act.

d. Contractor shall comply with the accessibility standards for an individual with a disability adopted by the State Office of Information Technology pursuant to C.R.S. § 24-85-103, and shall indemnify, hold harmless and assume liability on behalf of the Town and its officers, employees, agents and attorneys for all costs, expenses, claims, damages, liabilities, court awards, attorney fees and related costs, and any other amounts incurred by the Town in relation to Contractor's noncompliance with such accessibility standards.

5. Town Responsibilities.

a. The Town will provide reasonable access to the venue for setup, sound checks, and tear down.

b. The Town will provide on-site parking for the Contractor and employees.

6. Independent Contractor. Contractor is an independent contractor. Notwithstanding any other provision of this Agreement, all personnel assigned by Contractor to perform work under the terms of this Agreement shall be, and remain at all times, employees or agents of Contractor for all purposes. Contractor shall make no representation that it is a Town employee for any purposes.

7. Insurance.

a. Contractor agrees to procure and maintain, at its own cost, a policy or policies of insurance sufficient to insure against all liability, claims, demands, and other obligations assumed by Contractor pursuant to this Agreement. At a minimum, Contractor shall procure and maintain, and shall cause any subcontractor to procure and maintain, the insurance coverages listed below, with forms and insurers acceptable to the Town.

i. Worker's Compensation insurance as required by law.

ii. Commercial General Liability insurance with minimum combined single limits of $1,000,000 each occurrence and $2,000,000 general aggregate. The policy shall be applicable to all premises and operations, and shall include coverage for bodily injury, broad form property damage, personal injury (including coverage for contractual and employee acts), blanket contractual, products, and completed operations. The policy shall contain a severability of interests provision, and shall include the Town and the Town's officers, employees, and contractors as additional insureds. No additional insured endorsement shall contain any exclusion for bodily injury or property damage arising from completed operations.

b. Such insurance shall be in addition to any other insurance requirements imposed by law. The coverages afforded under the policies shall not be canceled, terminated or materially changed without at least 30 days prior written notice to the Town. In the case of any claims-made policy, the necessary retroactive dates and extended reporting periods shall be procured to maintain such continuous coverage. Any insurance carried by the Town, its officers, its employees or its contractors shall be excess and not contributory insurance to that provided by Contractor. Contractor shall be solely responsible for any deductible losses under any policy.

c. Contractor shall provide to the Town a certificate of insurance as evidence that the required policies are in full force and effect. The certificate shall identify this Agreement.

8. Indemnification. Contractor agrees to indemnify and hold harmless the Town and its officers, insurers, volunteers, representative, agents, employees, heirs and assigns from and against all claims, liability, damages, losses, expenses and demands, including reasonable attorney fees, on

account of injury, loss, or damage, including without limitation claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage, or any other loss of any kind whatsoever, which arise out of or are in any manner connected with this Agreement if such injury, loss, or damage is caused in whole or in part by, the omission, error, professional error, mistake, negligence, or other fault of Contractor, any subcontractor of Contractor, or any officer, employee, representative, or agent of Contractor, or which arise out of a worker's compensation claim of any employee of Contractor or of any employee of any subcontractor of Contractor; provided that Contractor's liability under this indemnification provision shall be to the fullest extent of, but shall not exceed, that amount represented by the degree or percentage of negligence or fault attributable to Contractor, any subcontractor of Contractor, or any officer, employee, representative, or agent of Contractor or of any subcontractor of Contractor.

9. Miscellaneous.

a. *Governing Law and Venue*. This Agreement shall be governed by the laws of the State of Colorado, and any legal action concerning the provisions hereof shall be brought in Larimer County, Colorado.

b. *No Waiver*. Delays in enforcement or the waiver of any one or more defaults or breaches of this Agreement by the Town shall not constitute a waiver of any of the other terms or obligation of this Agreement.

c. *Integration*. This Agreement constitutes the entire agreement between the Parties, superseding all prior oral or written communications.

d. *Third Parties*. There are no intended third-party beneficiaries to this Agreement.

e. *Notice*. Any notice under this Agreement shall be in writing and shall be deemed sufficient when directly presented or sent pre-paid, first-class U.S. Mail to the Party at the address set forth on the first page of this Agreement.

f. *Severability*. If any provision of this Agreement is found by a court of competent jurisdiction to be unlawful or unenforceable for any reason, the remaining provisions hereof shall remain in full force and effect.

g. *Modification*. This Agreement may only be modified upon written agreement of the Parties.

h. *Assignment*. Neither this Agreement nor any of the rights or obligations of the Parties shall be assigned by either Party without the written consent of the other.

i. *Governmental Immunity*. The Town and its officers, attorneys and employees, are relying on, and do not waive or intend to waive by any provision of this Agreement, the monetary limitations or any other rights, immunities or protections provided by the Colorado Governmental Immunity Act, C.R.S. § 24-10-101, *et seq.*, as amended, or otherwise available to the Town and its officers, attorneys or employees.

j. *Rights and Remedies*. The rights and remedies of the Town under this Agreement are in addition to any other rights and remedies provided by law. The expiration of this Agreement shall in no way limit the Town's legal or equitable remedies, or the period in which such remedies may be asserted, for work negligently or defectively performed.

k. *Subject to Annual Appropriation*. Consistent with Article X, § 20 of the Colorado Constitution, any financial obligation of the Town not performed during the current fiscal year is subject to annual appropriation, shall extend only to monies currently appropriated, and shall not constitute a mandatory charge, requirement, debt or liability beyond the current fiscal year.

l. *Force Majeure*. No Party shall be in breach of this Agreement if such Party's failure to perform any of the duties under this Agreement is due to Force Majeure, which shall be defined as the inability to undertake or perform any of the duties under this Agreement due to acts of God, floods, fires, sabotage, terrorist attack, strikes, riots, war, labor disputes, forces of nature, the authority and orders of government or pandemics.

m. *Electronic Signatures*. The Parties intend that this Agreement be governed by the Uniform Electronic Transactions Act, C.R.S. § 24-71.3-101, *et seq*.

In Witness Whereof, the Parties have executed this Agreement as of the Effective Date.

Town of Berthoud, Colorado

_____
William Karspeck, Mayor

Attest:

_____
Christian R. Samora, CMC, Town Clerk

Contractor

By: _____

State of Colorado)
) ss.
County of _____)

The foregoing instrument was subscribed, sworn to and acknowledged before me this ___ day of _____, 2026, by _____ as _____ of _____.

My commission expires:

(Seal)

_____
Notary Public

Exhibit A
Scope of Services

Contractor's Duties

During the term of this Agreement, Contractor shall perform the following duties, as directed by the Town:

For the Town's July 3rd event, the Contractor will provide a 16’ x 24’ covered stage with drum riser, black skirt and no other banners, lighting, P. A. for performers, 16 RCF HDL6a 1,400 watt line array speakers (7 per side), 4-8 Carvin 2500 watt subwoofer speakers, six (6) 1,000 watt stage monitors (either QSC K10 OR EV ZLX 15),1 Midas x32 channel digital mixing board, All stands, cables and microphones needed for the day.

Contractor will accommodate a musician who brings their own mic, but have at least one dedicated wireless microphone for announcements, Lighting for the stage (Sufficient lighting for the stage including both par lighting and moving lights), 20kw Diesel generator to power the band, p.a. and lighting. The generator will need to be within 50’ of the stage. Crew enough to set up, operate and tear down the stage, p.a., lighting and generator - included for the 3rd of July fireworks show.

Set up shall start at 2 p.m. on July 3, 2026. Tear down and loading out may not start until after the fireworks show.

Board of Trustees Information

Administration Department

Meeting Date:	**April 28, 2026**
Agenda Title/Subject:	**Town Board Committee Liaison Assignments**
Type of Item:	**Regular Item**
Purpose:	**To assign Trustees to act as liaisons on the various committees**
Presented by:	**Christian Samora**

Attachments:
None

Background:
Following each election, Trustees are assigned to the PORT Committee, Tree Advisory Committee, Youth Advisory Commission, and Historic Preservation Advisory Committee to serve as a liaison and be a conduit of communication between the committees and the board. The meeting schedules for each of the committees are as follows:

- Tree Advisory Committee - 3rd Monday of each month @ 5:30 PM
- Historic Preservation Advisory Committee - 2nd Monday of each month @ 5:30 PM
- Parks, Open Space, Recreation, and Trails (PORT) Committee - 1st Wednesday of each month @ 6:00 PM
- Youth Advisory Commission - 1st Wednesday of each month @ 7:30 AM

For more information regarding the committees and their responsibilities, please see the Boards and Commissions web page.

Update/Next Steps:
No additional action is needed after Trustees are assigned to the various committees.

Fiscal Impact and Fund Source:
There is no fiscal impact related to this item.

Community Touchstones:
Supporting the committees ties into all three Touchstones established by the Board of Trustees: Community Identity, Sustainability, and Resiliency.

Recommended Action(s):
Discuss and assign Trustees to the various committees. The discussion is typically started by allowing the Trustees to express interest in serving as liaison on certain

committees.

Board of Trustees Information

Administration Department

Meeting Date:	**April 28, 2026**
Agenda Title/Subject:	**Appointment of Planning Commission Members**
Type of Item:	**Regular Item**
Purpose:	**To appoint two citizens to serve on the Planning Commission, filling two vacancies that currently exist.**
Presented by:	**Christian Samora**

Attachments:

1. Planning Commission Applications

Background:

There are currently two vacancies on the Berthoud Planning Commission. These vacancies were created following a resignation in March of 2026 and when Karen Anderson was elected to the Board or Trustees.

The vacancies were advertised for at least 30 days and five applications were received from the following individuals.

- Brandon Terrazas
- Tim Hardy
- Marleene Buttice
- Kimberly Wilhelm
- Aaron Perry

The Interview Committee was established as follows:

- Two Town Board Members (Murphy/Wing)
- Chair of the Planning Commission
- Community Development Director

Virtual interviews to fill the noted vacancies are scheduled for April 27, 2026. The current members of the Planning Commission are as follows:

- Stacey Sigman - 2027
- David Pond - 2027
- Nick Semedalas - 2026
- Marc Hofmains - 2027

- Bryce Filho - 2028
- Vacancy - 2028
- Vacancy - 2027

Update/Next Steps:
No additional action is needed after two residents are appointed to the Planning Commission.

Fiscal Impact and Fund Source:
There is not any fiscal impact anticipated with this request.

Community Touchstones:
The Planning Commission works to ensure that development applications are in compliance with the Berthoud Municipal Code as part of Berthoud's Community Identity.

Recommended Action(s):
A Board Member may "move to appoint _____ to the Planning Commission for a term to expire September 30, 2027 and to appoint _____to the Planning Commission for a term to expire September 30, 2028" Followed by a second and a roll call vote.

Print

Advisory Committee Application - Submission #9249

Date Submitted: 3/17/2026

Name of Committee or Commission

Planning Commission

First Name

Brandon

Last Name

Terrazas

Address

644 Biscayne Ct

City

Berthoud

State

CO

Zip Code

80513

Email Address

bterrazas131@gmail.com

Phone Number

(505) 903-2100

How long have you resided within the boundaries of the Town of Berthoud?

7 years

Do you currently serve, or have you served previously, on a board, commission or committee? If so, please list.

Not with the town. I am a current metro district board member.

Not with this town. I am a current metro district board member.

What interests you about becoming a member of this committee?

I am passionate about this town and feel strongly about citizens being involved in the decisions that affect future development and infrastructure improvements. These decisions must be carefully deliberated and thoughtful in order to maintain the unique characteristics of this town.

Briefly explain what you believe are the two most important issues facing this committee, and how do you believe this committee should address each issue?

Rapid growth, infrastructure strain, development financing, and environmental protection are the main issues. A thoughtful approach starts with pacing growth to match Berthoud's long-term infrastructure capacity—ensuring roads, utilities, and services can keep up without overextending the town financially. New development should align with the community's character and be phased in a way that supports, rather than disrupts, existing home values. Reducing reliance on metro districts is key to maintaining true housing affordability and transparency for residents. At the same time, preserving and restoring open space—especially along the Little Thompson River corridor—should be treated as essential infrastructure, not an afterthought, recognizing its role in flood resilience, ecological health, and long-term property value.

List any abilities, skills, licenses, certificates, specialized training, past related experience or interests you have which are applicable to this committee.

I have a strong background in agriculture, natural resources, conservation, real estate, finance and business, government affairs and policy, politics, and executive experience. I have a real estate license in Colorado and I am a current Board Member of the Heritage Ridge Metro District. I have extensive experience in stream and wetland restoration and conservation easements. My work in the federal government for over 20+ yrs is rooted in public service and stakeholder collaboration.

Please specify any activities which might create a conflict of interest that would prevent you from official action if you should be appointed to this committee.

None

Have you recently attended a meeting of the committee you are applying to?

- [x] Yes
- [ ] No

If not appointed at this time, would you be interested in serving on any other advisory committees? If so, please list any preferences:

Yes, open space and natural resources.

All applicants are strongly encouraged to attend a regularly scheduled meeting of the committee for which they are applying prior to submitting an application. The Town of Berthoud will make reasonable accommodations for access to Town services, programs, and activities and will make special communication arrangements for persons with disabilities. Please call (970) 532-2643 for assistance. I certify that all statements on this form are true and complete. I further understand that false statements shall be sufficient cause for rejection of this application.

Signature (Please type your name)

Brandon Terrazas

Date

3/17/26

Print

Advisory Committee Application - Submission #9271

Date Submitted: 3/19/2026

Name of Committee or Commission

Planning Commission

First Name

Tim

Last Name

Hardy

Address

740 8th street

City

Berthoud

State

co

Zip Code

80513

Email Address

tshphoto@gmail.com

Phone Number

9706904213

How long have you resided within the boundaries of the Town of Berthoud?

lifetime

Do you currently serve, or have you served previously, on a board, commission or committee? If so, please list.

I have served on both the planning commission, and as town trustee. Liason to the Historic Preservation

committee

What interests you about becoming a member of this committee?

i am a past member

Briefly explain what you believe are the two most important issues facing this committee, and how do you believe this committee should address each issue?

Growth and holding developers accountable. making sure growth follows our growth management plan and having developers pay their way for development.

List any abilities, skills, licenses, certificates, specialized training, past related experience or interests you have which are applicable to this committee.

business management and previous town board and planning commission experience.

Please specify any activities which might create a conflict of interest that would prevent you from official action if you should be appointed to this committee.

none

Have you recently attended a meeting of the committee you are applying to?

- [ ] Yes
- [x] No

If not appointed at this time, would you be interested in serving on any other advisory committees? If so, please list any preferences:

All applicants are strongly encouraged to attend a regularly scheduled meeting of the committee for which they are applying prior to submitting an application. The Town of Berthoud will make reasonable accommodations for access to Town services, programs, and activities and will make special communication arrangements for persons with disabilities. Please call (970) 532-2643 for assistance. I certify that all statements on this form are true and complete. I further understand that false statements shall be sufficient cause for rejection of this application.

Signature (Please type your name)

Timothy S Hardy

Date

04192026

Print

Advisory Committee Application - Submission #9275

Date Submitted: 3/19/2026

Name of Committee or Commission

Planning Commission

First Name

Marleene

Last Name

Buttice

Address

1018 Dutch Peak Dr.

City

Berthoud

State

CO

Zip Code

80513

Email Address

marleene.buttice@gmail.com

Phone Number

530-304-5544

How long have you resided within the boundaries of the Town of Berthoud?

23 months

Do you currently serve, or have you served previously, on a board, commission or committee? If so, please list.

No

What interests you about becoming a member of this committee?

I am intersted in the future of Berthoud as a resident with children and as a small business owner in downtown Berthoud.

Briefly explain what you believe are the two most important issues facing this committee, and how do you believe this committee should address each issue?

One important issue facing this committee is the juxtoposition of the "old" berthoud reconciling with what "new" Berthoud could be as it grows. There is fear amongst some of the community and they are also typically the mst vocal. I would feel comfortable creating a bridge and bringing those in fear along for the ride. Another important issue facing the commission is communication with the community. There are a lot of rumors that get passed along that hurt Berthoud's chances at development. I would feel very comfortable communicating with the public, especially as a small business owner who has created relationships within the community and with other business owners.

List any abilities, skills, licenses, certificates, specialized training, past related experience or interests you have which are applicable to this committee.

I have an MA in HR Management with a specialization in organizational performance and learnnig. I speak Spanish. I own a small business in town, Berthoud Pet Supply. I worked for the State of Colorado as an HR consultant for the State, which gives me experience reading Acts, codes, and statutes for interpretation an dimplementation purposes. I am also part of the Downtown Berthoud Main Street, and the Chamber of Commerce through my HR company, HR Engagement Analytics. I love talking with the community and working collaboratively for the greater good of Berthoud and its community members.

Please specify any activities which might create a conflict of interest that would prevent you from official action if you should be appointed to this committee.

I have worked for the Town of Berthoud as an HR consultant conducting the Town Administrator's annual multi-rater feedback survey.

Have you recently attended a meeting of the committee you are applying to?

- [ ] Yes
- [x] No

If not appointed at this time, would you be interested in serving on any other advisory committees? If so, please list any preferences:

Yes! I would also be interested in serving on the PORT Commission should this position not work out at this time.

All applicants are strongly encouraged to attend a regularly scheduled meeting of the committee for which they are applying prior to submitting an application. The Town of Berthoud will make reasonable accommodations for access to Town services, programs, and activities and will make special communication arrangements for persons with disabilities. Please call (970) 532-2643 for assistance. I certify that all statements on this form are true and complete. I further understand that false statements shall be sufficient cause for rejection of this application.

Signature (Please type your name)

Marleene Buttice

Date

3/19/26

Print

Advisory Committee Application - Submission #9362

Date Submitted: 3/29/2026

Name of Committee or Commission

Planning Commission

First Name

Kimberly

Last Name

Wilhelm

Address

336 Spring Beauty Dr.

City

Berthoud

State

CO

Zip Code

80513

Email Address

klwilhelm13@gmail.com

Phone Number

8312911701

How long have you resided within the boundaries of the Town of Berthoud?

Since June 2021

Do you currently serve, or have you served previously, on a board, commission or committee? If so, please list.

Not in a government setting, only in a private business setting.

Not in a government setting, only in a private business setting.

What interests you about becoming a member of this committee?

I think that Berthoud is at a pivotal juncture when it comes to development and city planning. My goal is to ensure that what Berthoud becomes is alignment with the Master Plan and with resident desires.

Briefly explain what you believe are the two most important issues facing this committee, and how do you believe this committee should address each issue?

I think the main issue facing this committee is balancing residential, commercial growth, and resident desires in relation to growth. I believe that this committee can take the Master Plan, resident feedback, and strategic commercial areas into consideration in order to address this issue. I think the second most important issue facing this committee is maintaining Mountain Ave's charm while enabling business growth. I think that the committee should address this issue by using other successful cities as inspiration. For example, Fort Collins and Longmont have been able to protect the historic aspect of their downtown areas while continuing to grow and attract more businesses to the area.

List any abilities, skills, licenses, certificates, specialized training, past related experience or interests you have which are applicable to this committee.

In my professional roles, I have managed budgets, programs, and was responsible for the strategy for marketing campaigns, programs, events, etc. I currently am a sales program lead and am involved in sales strategy for a billion dollar company. This requires strong planning, collaboration, strategy, and program management skills. These skills are all dependent on the ability to factor in the larger picture and to rely on and value others and their knowledge and expertise.

Please specify any activities which might create a conflict of interest that would prevent you from official action if you should be appointed to this committee.

I do not have any conflicts of interest that I know of.

Have you recently attended a meeting of the committee you are applying to?

- [x] Yes
- [ ] No

If not appointed at this time, would you be interested in serving on any other advisory committees? If so, please list any preferences:

I would also be interested in PORT.

All applicants are strongly encouraged to attend a regularly scheduled meeting of the committee for which they are applying prior to submitting an application. The Town of Berthoud will make reasonable accommodations for access to Town services, programs, and activities and will make special communication arrangements for persons with disabilities. Please call (970) 532-2643 for assistance. I certify that all statements on this form are true and complete. I further understand that false statements shall be sufficient cause for rejection of this application.

Signature (Please type your name)

Kimberly Wilhelm

Date

03/29/2026

Print

Advisory Committee Application - Submission #9555

Date Submitted: 4/14/2026

Name of Committee or Commission

Planning Commission

First Name

Aaron

Last Name

Perry

Address

325 Colorado Avenue

City

Berthoud

State

Co

Zip Code

80513

Email Address

aperryj@aol.com

Phone Number

303-301-5798

How long have you resided within the boundaries of the Town of Berthoud?

Over 50 years

Do you currently serve, or have you served previously, on a board, commission or committee? If so, please list.

No

What interests you about becoming a member of this committee?

I believe you are never too old to be educated. I truly love my town and have concerns about issues of how my town is growing Rather then complain I would like to come along side this committee to look at productive avenues that would be in the best interests of our town to keep it a town rather than a city

Briefly explain what you believe are the two most important issues facing this committee, and how do you believe this committee should address each issue?

1. Growth-What is the best way to have growth to keep our town sustainable yet keep us in the setting of the small town atmosphere. 2. Water-This is the Garden spot of Colorado how do we keep from running out of water

List any abilities, skills, licenses, certificates, specialized training, past related experience or interests you have which are applicable to this committee.

Love for this Town

Please specify any activities which might create a conflict of interest that would prevent you from official action if you should be appointed to this committee.

None

Have you recently attended a meeting of the committee you are applying to?

- [ ] Yes
- [x] No

If not appointed at this time, would you be interested in serving on any other advisory committees? If so, please list any preferences:

No

All applicants are strongly encouraged to attend a regularly scheduled meeting of the committee for which they are applying prior to submitting an application. The Town of Berthoud will make reasonable accommodations for access to Town services, programs, and activities and will make special communication arrangements for persons with disabilities. Please call (970) 532-2643 for assistance. I certify that all statements on this form are true and complete. I further understand that false statements shall be sufficient cause for rejection of this application.

Signature (Please type your name)

Aaron W Perry

Date

4/14/2026

TOWN OF BERTHOUD

Backflow Prevention & Cross-Connection Control

Proposed Update to Municipal Code §6.28 | New §6.29

Presentation to the Board of Trustees

Series 2026

OVERVIEW

Why we are updating the ordinance

Berthoud operates a public water system serving both potable and non-potable customers.

Recent incidents — including illegal cross connections that resulted in illness — have exposed gaps in our current regulatory authority.

This ordinance gives the Town the clear authority, inspection rights, and enforcement tools needed to protect the drinking water supply.

§6.28

Repealed & Reenacted

Modernized backflow program

§6.29

New Section Added

Non-potable cross-connection control

7

HOAs with Non-Potable Water

Effected HOAs effected by this update

LEGAL FRAMEWORK

What authorizes this ordinance

FEDERAL

Safe Drinking Water Act

42 U.S.C. § 300f et seq. Establishes national drinking water protection.

STATE

CDPHE Regulation 11, §11.39

Colorado Primary Drinking Water Regulations require suppliers to adopt backflow prevention standards.

STATE

Title 25, Articles 8 & 10, C.R.S.

Water quality control and cross-connection authority.

CODE

Colorado Plumbing Code

Adopted plumbing standards, plus ASSE and USC-FCCCHR technical specifications.

SECTION 6.28

The Backflow Prevention Program

PURPOSE

Protect the public potable water supply from contamination and back-siphonage.

Identify, control, and eliminate cross connections between potable and non-potable systems.

Ensure every assembly meets the adopted plumbing code, ASSE, and USC standards.

APPLIES TO

- Commercial, industrial, and institutional services
- Multi-family residential (3+ dwellings)
  - Unless served by individual taps
- Irrigation and secondary-water services
- Fire suppression systems

SINGLE-FAMILY EXEMPTION

Generally exempt — unless a cross connection is identified, a separate irrigation tap exists, or a fire suppression system is present.

SECTION 6.28-7

Required backflow assemblies by property type

Property / Use Type	Required Assembly	Hazard Level
Commercial, industrial, institutional	RPZ (Reduced Pressure Zone)	High
Multi-family residential (3+ units)	RPZ	High
Non-single-family irrigation	RPZ	High
Single-family irrigation (no chemicals)	PVB (Pressure Vacuum Breaker)	Low
Fire sprinklers — no chemical additives	DCVA (Double Check Valve)	Medium
Fire sprinklers — with antifreeze / foam / inhibitors	RPZ	High

Customer is responsible for all design, installation, testing, maintenance, and replacement costs.

SECTION 6.28-9 & 6.28-10

Testing, inspection & reporting requirements

When tests are required

- At new installation and after replacement
- After any repair or relocation
- Annually
- More often for high-hazard facilities

Who performs tests

- ASSE- or ABPA-certified testers
- Calibrated test kit, verified annually
- Licensed installer for repair or replace
- Town may restrict unreliable testers

Reporting deadlines

- New install reports: within 7 days
- Failed tests: reported within 7 days
- Repairs re-tested and passed: within 7 days
- Customer shall retain records for 3 years

What each test tag shows

- Test date and pass or fail result
- Assembly serial, make, model, size
- Tester name, signature, and certification
- Customer account information

NEW SECTION

§6.29 — Non-Potable Cross-Connection Control

Why it's needed

Some Berthoud properties receive both potable Town water and non-potable secondary water — often through HOA-run irrigation systems. A cross connection between the two can contaminate the drinking water for an entire neighborhood and potentially the Town. Section 6.29 closes that gap.

01

Strict Prohibition

Cross connections between potable and non-potable systems are flatly prohibited — regardless of whether a backflow device is installed.

02

High-Hazard Class

Any property with access to both water types is classified as High Hazard and may require a Town-specified assembly.

03

HOA Accountability

Owners' associations must maintain a cross-connection plan and file an annual affidavit by March 1 each year.

SECTION 6.29-3

Devices that do NOT justify a cross connection

NOT ACCEPTABLE PROTECTION

- ✕ Single check valves
- ✕ Swing checks
- ✕ Dual check valves
- ✕ Pressure vacuum breakers (PVB) used to justify interconnection
- ✕ Hose bib vacuum breakers

STRICT LIABILITY

A cross connection is a violation,

regardless of intent.

It is not a defense that:

- A device was installed in good faith
- A contractor recommended the device
- The owner believed it prevented backflow
- The condition predated this ordinance

ENFORCEMENT

Penalty structure

Late Test Results — §6.28-14(E)

Days past due	Civil penalty
31 days	**$100**
61 days	**$250**
91 days	**$500**
After 91 days	**Water service may be suspended**

§6.29 — Non-Potable Violations

ADMINISTRATIVE

Up to $1,000

Per violation — failure to comply with inspection or certification requirements.

UNLAWFUL CROSS CONNECTION

Up to $2,650

Per violation (adjusts for inflation). Plus investigation costs. Service may be terminated.

BACKFLOW EVENT

Up to $2,650

Service terminated immediately. Owner also covers flushing, sampling, notification, and regulatory costs.

EMERGENCY AUTHORITY The Town may immediately terminate service, isolate mains, flush, sample, and notify the public when a backflow event is suspected or confirmed.

WHO DOES WHAT

Responsibilities at a glance

Town of Berthoud

- Administer the BPCCCP
- Maintain hazard-survey and inspection database
- Issue notices for install, test, maintenance
- Conduct annual on-site verifications
- Determine hazard classification

Property Owners & Customers

- Pay all design, install, and maintenance costs
- Provide access to Town personnel for on-site surveys.
- Use only licensed plumbers and certified testers
- Ensure annual testing between Feb 1 – Sept 1
- Submit new-install & failed test reports within 7 days

Owners' Associations (HOAs)

- Maintain a cross-connection control plan
- File an annual affidavit by March 1
- Confirm residents receive annual notice
- Keep current management contact on file
- Maintain list of all non-potable addresses

NEXT STEPS

Implementation & path to adoption

1

Board review

Trustees discuss the proposed ordinance at the scheduled meeting.

2

Public hearing

Opportunity for customers, HOAs, and the public to comment.

3

Adoption

Ordinance passes and takes effect per Section 4 repeal clause.

4

Outreach

Town notifies non-single-family customers and HOAs of obligations.

5

Compliance cycle

First annual testing window opens Feb 1 – Sept 1, 2027.

Staff recommendation

Adopt the ordinance — repealing and reenacting §6.28 and adding §6.29 — to give the Town the authority and tools to protect Berthoud's drinking water supply.

DISCUSSION

Questions & Comments

Town of Berthoud | Backflow Prevention & Cross-Connection Control

Thank you

Ordinance No. 1380
Series 2026

An Ordinance of the Town of Berthoud Repealing and Reenacting Section 6.28 of the Berthoud Municipal Code Regarding Backflow Prevention, Adopting a New Section 6.29 Regarding Non-Potable Cross-Connection Control, and Repealing Provisions in Conflict Therewith

Whereas, the Town of Berthoud operates a municipal public water system; and

Whereas, the Colorado Department of Public Health and Environment requires water suppliers in Colorado to adopt standards for backflow prevention.

Whereas, protection of the public potable water system from contamination and pollution is necessary to protect public health and safety; and

Whereas, certain properties within the Town receive non-potable or secondary irrigation water, including systems operated by homeowners' associations; and

Whereas, cross connections between potable and non-potable systems create a risk of backflow contamination of the public drinking water supply; and

Whereas, the Town has identified illegal cross connections between potable and non-potable systems, including prior incidents resulting in illness; and

Whereas, the Board of Trustees finds it necessary to establish clear regulatory authority, inspection rights, enforcement procedures, and penalties to prevent and eliminate cross connections.

Now Therefore be it Ordained by the Board of Trustees of the Town of Berthoud as follows:

Section 1. Section 6.28 of the Berthoud Municipal Code is hereby repealed in its entirety and reenacted as follows:

6.28 Backflow Prevention and Cross-connection Control Program

6.28-1. Purpose and Authority

A. The Town is the supplier of its public water system and maintains a Backflow Prevention and Cross-Connection Control Program (the "BPCCCP") to protect its potable water supply from contamination or pollution caused by backflow or back-siphonage.

B. The purpose of the BPCCCP is to:

1. Prevent contaminants from entering the public water system from private plumbing systems;

2. Identify, control, and eliminate existing or potential cross connections between potable and non-potable systems;

3. Maintain a consistent, effective process for backflow prevention and inspection; and

4. Ensure all assemblies comply with the Town's adopted plumbing code, CDPHE Reg. 11, Section 11.39 and applicable ASSE/USC standards.

C. The BPCCCP is authorized by the Safe Drinking Water Act, 42 U.S.C. § 300f, *et seq*.; the CDPHE Backflow Prevention and Cross Connection Control Regulation 11, Section 11.39; Title 25, Articles 8 and 10, C.R.S.; and the Colorado Plumbing Code.

6.28-2. Applicability

A. The BPCCCP applies to:

1. All commercial, industrial, institutional, multi-family, irrigation, and other non-single residential property type water service connections to the Town's system; and

2. All customers located outside Town limits who receive water from the Town by agreement or otherwise.

B. Single-family residential connections are generally exempt from the BPCCCP unless the Town identifies a cross connection or potential contamination hazard, or the residence has an additional irrigation service not tapped directly off the domestic potable service or a fire suppression system.

C. If a conflict arises between this Section and any plumbing, mechanical, building, electrical, fire or other code adopted by the State, then the most stringent provisions of each respective code shall prevail.

6.28-3. Definitions

For purposes of this Section, the following terms shall have the following meanings:

ABPA – The American Backflow Prevention Association, a national organization that provides training and certification programs for backflow prevention assembly testers and cross connection control specialists.

ASSE – The American Society of Sanitary Engineering (ASSE International), an organization that develops performance standards and certification criteria for plumbing and backflow prevention assemblies.

Backflow – The reverse flow of water or other substances into the public water system from an unintended source.

Backflow Event – The confirmed or reasonably suspected reversal of flow from a non-potable source into the Town's potable water system.

Backflow Prevention Assembly – An approved, testable, lead-free, mechanical device installed on a service line or internal plumbing to prevent backflow into the potable water supply system, meeting the laboratory and field performance specifications of ASSE or the Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California.

Backflow Prevention Method – A method or non-testable device used to prevent backflow for low-hazard conditions, which is not considered acceptable backflow protection where a testable backflow prevention assembly is required by the Town.

CDPHE – The Colorado Department of Public Health and Environment, the state agency responsible for administering and enforcing the Colorado Primary Drinking Water Regulations (5 CCR 1002-11) and overseeing public water system compliance with state and federal drinking water requirements.

Certified Tester – An individual certified by ASSE or ABPA and state-approved program to test backflow prevention assemblies.

Containment – Installation of a backflow prevention assembly at the service connection to prevent backflow from an entire property or facility.

Cross Connection – An actual or potential connection between the potable water system and a source that could cause contamination.

Cross Connection Survey – A systematic on-site inspection or documented questionnaire conducted by the Town to identify and evaluate the physical presence of any actual or potential cross connections at a water service connection or within the plumbing system, to assess the degree of hazard posed by such cross connections, and to determine whether a backflow assembly is required.

Customer – An individual or entity receiving water service from the Town.

Hazard (degree of) – The evaluation of the actual or potential conditions within water system that can be classified as either a health or non-health hazard.

High Hazard Property – Any property that has access to or is served by both potable water and non-potable or secondary water.

Isolation – Backflow prevention protection at each fixture or appliance outlet/connection.

Multi-family residential – Residential housing with three (3) or more dwellings on a single water service connection.

Non-hazard - A potential cross connection involving any pollutant that will not create a health hazard as determined by the public water system.

Non-Potable Water – Water not meeting drinking water standards, including but not limited to secondary irrigation water, ditch water, lake water, well water, or reclaimed water not intended for human consumption.

On-Site Verification Inspection – An inspection of water cross connections, backflow prevention methods and backflow prevention assemblies performed by the Town.

Pressure Vacuum Breaker (PVB) – A breaker used for low-hazard irrigation systems without chemical injection or booster pumps.

Reduced Pressure Zone (RPZ) Assembly – An assembly designed for high-hazard situations.

Secondary Water System – Any distribution system supplying non-potable water for irrigation or other non-drinking purposes.

Single-family residential – A standalone dwelling for a single household that includes its own land, separate utilities, and private entrance.

Testable Double Check Valve Assembly (DCVA) – An assembly used for medium-hazard situations such as non-chemical fire systems.

USC – The Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California (USC-FCCCHR), which evaluates and lists backflow prevention assemblies that meet accepted performance standards.

6.28-4. Authority and Standards

The BPCCCP complies with the following regulatory authorities and technical standards:

1. The Colorado Primary Drinking Water Regulations, 5 CCR 1002-11, including CDPHE Section 11.39 governing backflow prevention and cross connection control;

2. The current plumbing code adopted by the Town;

3. Applicable ASSE standards;

4. Approval listings and performance criteria established by USC; and

5. Additional technical standards adopted by the Town necessary to administer the BPCCCP.

6.28-5. Administration

The Town shall administer the BPCCCP by:

1. Maintaining a database of backflow inspection reports and hazard surveys;

2. Issuing notices for required installation, testing, and maintenance;

3. Ensuring compliance with CDPHE cross connection control requirements;

4. Coordinating with certified testers and property owners to track compliance; and

5. Conducting annual on-site verification inspections of non-residential properties, and when required of residential properties using backflow prevention methods.

6.28-6. General Requirements

A. The Town will inspect each non-single family residential connection to determine if there is a cross connection hazard that requires backflow protection. Inspections will be conducted whenever a property changes ownership or occupancy, or when alterations are made to the water service or internal plumbing system. If a cross connection is found, the Town will determine what type of backflow assembly is required.

B. All commercial, industrial, institutional, individual irrigation systems, and multi-family buildings shall install an RPZ assembly (lead-free) to isolate their private plumbing systems from the Town's distribution system, unless otherwise approved by the Town. Where an RPZ assembly is not feasible, an approved alternative testable backflow assembly shall be provided at all identified cross connections within the plumbing system.

C. Water heating or storage systems that can cause pressure increases shall include an approved expansion or pressure-control device.

D. Building or plumbing plans for new or modified construction shall be approved by the Town prior to issuance of a building permit. Plans shall include:

1. Service type, size, and location;

2. Meter size and location;

3. Backflow assembly type, size and location;

4. Fire sprinkler system(s) service line, size, and type of assembly; and

5. Any necessary thermal expansion control measures.

6.28-7. Backflow Prevention Assemblies

A. *Where Required*.

1. *Non-Single Residential Properties*. All commercial, industrial, institutional, irrigation, and multi-family service connections shall install an approved RPZ assembly at the service connection for containment unless the Town determines that a lesser degree of hazard exists and approves an alternative backflow prevention assembly.

2. *Commercial and Industrial Internal Hazards*. Where internal cross connections or hazardous processes exist, the Town may require isolation protection at specific equipment, processes, or plumbing connections in addition to containment protection.

3. *Fire Protection Systems*.

a. Non-chemical fire protection systems shall include a testable Double Check Valve Assembly (DCVA) unless a greater degree of hazard requires a higher level of protection.

b. Fire protection systems containing antifreeze, foam, corrosion inhibitors, or other chemical additives shall install an RPZ assembly.

4. *Irrigation Service Connections*. Irrigation service connections shall install backflow protection as follows:

a. Non single-family residential irrigation systems shall install an RPZ assembly unless otherwise approved by the Town.

b. Single-family residential irrigation systems with no chemical injection or booster pumps shall install a PVB unless the Town determines that a greater level of protection is required due to site-specific conditions.

5. *Increased Protection*. The Town may require a higher level of backflow protection where the degree of hazard warrants additional protection of the public water system.

B. *Installation Standards*.

1. Each backflow prevention assembly shall be installed by a licensed plumber in accordance with Town's adopted plumbing code and ASSE/USC specifications.

2. Assemblies shall be located on the customer side of the meter in an accessible, non-hazardous location.

3. Branch connections or tees between the meter and the assembly are prohibited.

4. Each assembly shall be installed horizontally unless specifically approved for vertical installation by ASSE or USC standards.

5. An RPZ shall be installed at least twelve (12) inches above finished grade, with adequate drainage and freeze protection.

6. An assembly shall not be submerged, buried, or located in areas subject to flooding or freezing.

7. Each backflow assembly shall be protected from freezing with an outdoor enclosure in accordance with a ASSE 1060 or by method approved by Berthoud Water Utilities.

C. *Responsibility*. The customer is responsible for all design, installation, testing, maintenance, and replacement costs associated with backflow prevention assemblies.

6.28-8. Degree of Hazard Determination

The Town shall determine the degree of hazard presented by a customer's plumbing system or water use practices. The Town may classify a connection as a health hazard or non-health hazard based on cross connection surveys, inspection findings, operational conditions, or other information available to the Town. The Town's determination of hazard classification shall govern the type of backflow prevention assembly required.

6.28-9. Testing and Maintenance

A. Backflow prevention assemblies shall be tested:

1. At installation, both new and replacement;

2. After repair or relocation; and

3. Annually thereafter on a date set by the Town between February 1st and September 1st.

B. Tests shall be performed by a certified backflow assembly tester/technician.

C. Assemblies that fail must be repaired or replaced with re-submission of the passing test results within seven (7) days of the test completion by a licensed installer or certified tester. The failed test result must also be submitted within seven (7) days of failure.

D. Each tester shall use calibrated test equipment verified annually.

E. The Town may require more frequent testing for high-hazard facilities or after suspected contamination events.

F. Non-approved or non-testable assemblies must be replaced with approved assemblies.

6.28-10. Reporting and Recordkeeping

A. Each test report shall include:

1. Customer account information;

2. Assembly type, make, model, serial number, and size;

3. New installation or replacement date, with replaced assembly serial number;

4. Installation location;

5. Test date and results;

6. Technician name, certification agency, number, and expiration; and

7. Test kit make, model, serial number, and calibration date.

B. All records shall be retained by the tester and the customer for a minimum of three (3) years.

C. Newly installed backflow prevention assembly reports and test results shall be submitted within seven (7) days. The Town may reject incomplete, illegible or inaccurate test reports and may restrict testers that submit unreliable data.

D. Each backflow prevention assembly shall display a test tag including the following:

1. Test date;

2. Assembly serial number, make, model, size; and

3. Tester's name, contact, signature, and state certification number; and

4. Pass or fail results.

6.28-11. Right of Entry

A. Authorized representatives of the Town may enter any property served by the public water system, during reasonable hours and upon presentation of proper credentials, to conduct cross connection surveys, inspect backflow prevention assemblies, verify compliance with the BPCCCP, or investigate conditions that may pose a risk to the public potable water system.

B. Right of entry under this Section shall be a condition of water service. Property owners and customers shall provide reasonable access to water service connections, plumbing systems, and backflow prevention assemblies required by this Section.

C. Where security or restricted access exists, the property owner shall arrange reasonable access for Town personnel to inspect required backflow prevention assemblies.

6.28-12. Notice and Order to Correct

The Town shall provide written notice to any customer whose plumbing system has been determined to present a risk to the Town's distribution system. The notice and order shall state that the customer must install an approved backflow prevention assembly at their own cost at the main service connection, or at each service connection as required by the Town, and shall include a deadline for such installation.

6.28-13. Emergency Authority

A. In the event of a suspected or confirmed backflow event, the Town may immediately take any action necessary to protect the public water supply, including without limitation:

1. Termination of water service;

2. Isolation of affected distribution system areas;

3. Flushing of distribution mains;

4. Collection of water quality samples;

5. Public notification; and

6. Coordination with CDPHE.

B. The Town may recover from all responsible parties all costs associated with investigation, mitigation, and regulatory response.

6.28-14. Violation and Penalties

A. *Violation*. It is unlawful to violate any provision of this Section or the BPCCCP. Each day a violation continues shall constitute a separate offense.

B. *Notice of Violation*. If the Town determines that a certified tester or testing company has violated the requirements of the BPCCCP or this Section, the Town shall issue a written notice of violation describing the violation and required corrective action. Notice may be provided by personal delivery, United States mail, or other method permitted by law.

C. *Tester Penalties*. Violations by a testing company or certified tester may result in the following enforcement actions:

1. For the first violation, the Town shall issue a written notice of violation identifying the violation and requiring corrective action.

2. For the second or any subsequent violation, the Town may suspend or revoke authorization for the certified tester or testing company to perform backflow prevention assembly testing within the Town's water service area.

3. The Town may prohibit any certified tester or testing company that fails to comply with the BPCCCP or this Section from performing backflow testing within the Town's water service area.

D. *Tampering Penalty*. The Town shall assess a penalty of one hundred dollars ($100) for the removal or damage to a water service locking device installed by the Town, in addition to assessment for all costs associated with restoring the device.

E. *Testing Results Penalty*. Failure to submit required backflow assembly test results within the required timeframe shall result in the following penalties:

Days Past Due	Civil Penalty
31 days past due	$100
61 days past due	$250
91 days past due	$500
After 91 days past due	Water service may be suspended.

F. *Suspension*.

1. The Town may suspend water service and assess additional fees if:

a. An uncontrolled cross connection exists;

b. A required assembly is defective, bypassed, or removed;

c. Inspection or testing is refused; or

d. Annual inspection or testing is past due.

2. The Town shall provide reasonable notice to the customer prior to suspension.

3. Water service will be restored only after the condition causing the suspension has been corrected and verified by the Town.

4. Notwithstanding the foregoing, the Town may immediately suspend water service without prior notice whenever, in the judgment of the Town, such action is necessary to protect the public health, the public potable water supply, or the integrity of the distribution system due to an actual or suspected cross connection, backflow condition, or other contamination risk.

Section 2. Section 6.29 is hereby added to the Berthoud Municipal Code, to read as follows:

6.29 Non-Potable Water Cross Connection Control Program

6.29-1. Purpose

This Section establishes requirements to prevent cross connections between the Town's potable water system and non-potable or secondary water systems.

6.29-2. Definitions

The definitions set forth in Section 6.28-3 shall apply to this Section.

6.29-3. Cross Connections Prohibited

A. No person shall create, install, maintain, or permit a cross connection between the Town's potable water system and any non-potable water source. Any person who creates or contributes to the creation of a prohibited cross connection shall be considered a responsible party under this Section.

B. A cross connection shall remain a violation regardless of whether a device intended to prevent backflow has been installed unless such device has been expressly approved in writing by the Town.

C. The following shall not be considered acceptable protection against cross connection:

1. Single check valves;

2. Swing checks;

3. Dual check valves;

4. Irrigation pressure vacuum breakers (PVB) used to justify interconnection; or

5. Hose bib vacuum breakers.

D. Any approved backflow prevention assemblies shall be installed and tested in accordance with Town standards, including without limitation applicable ASSE and USC-FCCCHR standards, and maintained in proper working order at all times.

6.29-4. High Hazard Properties

Any property with access to both potable and non-potable water shall be classified as a High Hazard Property. On a High Hazard Property, the Town may require installation or upgrade of a backflow prevention assembly where it determines that site conditions present an increased risk of backpressure, back siphonage, or contamination.

6.29-5. Owners' Association Responsibilities

A. Any owners' association receiving non-potable water service from the Town shall maintain a cross connection control program for its non-potable distribution system.

B. On or before March 1st of each year, each owners' association receiving non-potable water service from the Town shall provide an annual affidavit to the Town stating that the owners' association:

1. Maintains a cross connection control plan acceptable to the Town;

2. Is not aware of any cross connections exists within the non-potable system;

3. Verified that residents have received annual notification that potable and non-potable systems may not be interconnected;

4. Will provide updated management contact information to the Town within thirty (30) days of any change; and

5. Will maintain a list of all addresses receiving non-potable water and a primary contact name and contact information for each property and provide it to the Town upon request.

6.29-6. Right of Entry

A. Authorized representatives of the Town may enter any property served by a non-potable water system, during reasonable hours and upon presentation of proper credentials, to inspect or investigate conditions that may pose a risk to the Town's potable water system.

B. Right of entry under this Section shall be a condition of non-potable water service. Property owners and customers shall provide reasonable access to service connections, plumbing systems and other facilities.

C. Where security or restricted access exists, the property owner shall arrange reasonable access for Town personnel to inspect required backflow prevention assemblies.

6.29-7. Violation and Penalties

A. *Violation*. It is unlawful to violate any provision of this Section. Each day a violation continues shall constitute a separate offense.

B. *Penalty for Administrative Violations*. For failure to comply with inspection, certification, or protective requirements, the following shall apply:

1. The Town shall issue a written notice of violation, which shall include a deadline for compliance

2. The Town may impose a civil penalty not to exceed one thousand dollars ($1,000) per violation.

C. *Penalty for Unlawful Cross Connection*. For creation or maintenance of a prohibited cross connection, the following shall apply:

1. The Town shall issue a written notice of violation, which shall include a deadline for elimination of the cross connection.

2. The Town may impose a civil penalty not to exceed $2,650 per violation, subject to inflationary increases as allowed by law.

3. The Town may recover all costs incurred for investigation and inspection.

4. The Town may terminate water service to the property.

D. *Penalty for Backflow Event*. If a backflow event occurs, the following shall apply:

1. The Town shall immediately terminate water service to the property. Water service shall not be restored until the hazard is eliminated and all costs and penalties are satisfied.

2. The Town shall require installation or upgrade of a Town-specified backflow protection.

3. The Town may impose a civil penalty not to exceed $2,650 per violation, subject to inflationary increases as allowed by law, against the property owner or other person responsible for the backflow event.

4. The Town may recover all costs incurred, including without limitation: investigation; sampling and laboratory testing; system flushing; public notification; consultant and engineering services; and regulatory reporting.

5. The Town’s determination that a backflow event has occurred shall be *prima facie* evidence for purposes of enforcement of this Section.

E. *Responsibility*. The existence of a cross connection or the occurrence of a backflow event shall be strict liability, regardless of intent or negligence, and it shall not be a defense to enforcement that: a device was installed in good faith; a contractor recommended or installed the device; the property owner believed the device prevented backflow; or the condition predated the adoption of this Section.

Section 3. Severability. If any provision of this Ordinance is determined to be invalid for any reason, such determination shall not affect the validity of the remaining provisions of this Ordinance, and the Board of Trustees hereby declares that it would have passed this Ordinance and each provision thereof irrespective of the fact that any one or more provisions may be declared invalid.

Section 4. Repeal. Existing ordinances or provisions thereof inconsistent with the provisions of this Ordinance are hereby repealed, except that this repeal shall not affect or prevent the prosecution or punishment of any person for any act done or committed in violation of any ordinance hereby repealed prior to the effective date of this Ordinance.

Introduced, approved and adopted this ___ day of _____, 2026.

Town of Berthoud

_____
William Karspeck, Mayor

Attest

_____
Christian R. Samora, CMC, Town Clerk

Board of Trustees Information

Utilities Department

Meeting Date:	**April 28, 2026**
Agenda Title/Subject:	**2026 Drought Response Plan Update**
Type of Item:	**Regular Item**
Purpose:	**To Provide an Update on 2026 Drought Conditions and Water Supply**
Presented by:	**Ken Matthews , Alex Tennant**

Attachments:
None

Background:
Colorado is entering the 2026 irrigation season under significant drought conditions driven by historically low snowpack and unusually warm winter temperatures. Statewide snowpack is currently at record or near-record lows, with the South Platte Basin measuring approximately 26% of normal at peak accumulation. These conditions are expected to result in reduced runoff, earlier snowmelt, and below-average water supply across much of the state.

Update/Next Steps:
Despite these regional challenges, the Town of Berthoud is well-positioned for the 2026 irrigation season. The Town's diversified and reliable water portfolio—including senior water rights on the Big Thompson River, an above-average Colorado-Big Thompson (C-BT) quota, and operational flexibility between potable and non-potable systems—provides a stable and sufficient supply to meet projected demands.

Based on current storage levels and supply forecasts, Berthoud's water system is expected to accommodate drought conditions this year without significant operational constraints.

At this time, there are no mandatory water restrictions in place. However, consistent with the Town's public outreach efforts, residents, businesses, and homeowners' associations are encouraged to practice voluntary water conservation, including:

- Limiting irrigation to two days per week during spring and fall
- Limiting irrigation to three days per week during peak summer conditions
- Avoiding irrigation during the hottest parts of the day (10 a.m. to 6 p.m.)
- Maintaining irrigation systems to prevent leaks and overspray

Staff will continue to monitor hydrologic conditions, water demand, and supply availability throughout the season and will provide updates to the Board if conditions change.

Fiscal Impact and Fund Source:
There is no direct fiscal impact associated with this update. Water supply operations and monitoring are managed within the existing Water Utilities budget.

Community Touchstones:
The Town's water supply planning and diversified portfolio provide resilience during drought conditions. Encouraging voluntary conservation promotes responsible water use while maintaining flexibility and avoids mandatory restrictions on the community.

Recommended Action(s):
No formal action is required. This item is provided for informational purposes.

STORM DRAINAGE MASTER PLAN

for the





Town of Berthoud
328 Massachusetts Avenue
Berthoud, CO 80513

Phone: 970 532-2643
Fax: 970 532-0640

TEC Project No.10-053.30

October 2011



TEC THE ENGINEERING COMPANY

Storm Drainage Master Plan

for the

Town of Berthoud
328 Massachusetts Avenue
Berthoud, CO 80513

Prepared by:
The **Engineering** Co.

October 2011

Project No. 10-053.05

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I. EXECUTIVE SUMMARY

I. EXECUTIVE SUMMARY

The goal of this study is to identify drainage basins and develop storm drainage runoff quantities and magnitudes within the Town of Berthoud's (Town) General Management Area (GMA). By developing this information and quantifying the amount of runoff generated within the basins identified, the Town will be able to provide guidance and direction in the development of surrounding areas. This information will also allow for the development of regional drainage conveyance and storage strategies that will provide for the safe and controlled conveyance of storm water runoff throughout the Town's development area.

The Town's GMA consists of approximately 39 square miles extending from Interstate 25 on the east to Welch Reservoir on the west, Highway 60 on the north, and south to County Road 2. The study watershed includes the entire GMA, as well as approximately 10 squares miles of additional area outside the boundary of the GMA. The entire drainage watershed is approximately 50 square miles of area incorporating parts of Weld, Larimer, and Boulder counties. The area and layout of the GMA and the drainage basin are shown on Figure ES-1.

The majority of the watershed is directly tributary to the Little Thompson River (LTR), with a portion located along the northern boundary of the GMA flowing north out of the GMA. The LTR effectively separates the drainage basin into north and south portions, with the northern section flowing south and the southern section flowing predominantly north into the LTR. For the purposes of this study the overall drainage watershed has been divided into 13 individual drainage basins. These basins have been identified and delineated by landmarks, roads, and aerial topography. The 13 basins and the relation to the GMA are shown on Figure ES-1. The drainage basins range in size from 500 to 3,000 acres.

Each drainage basin was further divided into sub-basins which were modeled using the Colorado Urban Hydrograph Procedure (CUHP). The hydrographs generated by CUHP were then used in EPA Storm Water Management Model (EPA SWMM5) to develop a drainage routing model. By identifying the magnitude of storm runoff generated within the different sub-basins it is possible to make recommendations at particular design points to aid with planning of future runoff conveyance and storage infrastructure as development occurs within the various drainage basins. Solutions to existing problems can also be evaluated.

Drainage master planning is essential for any community and promotes smart growth, efficient use of available capital funds, and assures public safety. The Town of Berthoud is at a point where an adopted Storm Drainage Master Plan is necessary.

This Plan is a dynamic document that is the first step taken by the Town for master drainage planning and will change and evolve as development occurs. This study presents an initial look at the drainage watershed in the Berthoud General Management Area (GMA) and the surrounding area, identifies natural major drainageways, and gives an idea of the rainfall runoff magnitudes that will need to be managed within the Town and its GMA.

LARIMER COUNTY

WELD COUNTY

BOULDER COUNTY

Big Thompson River

Dry Creek

Little Thompson River

Saint Vrain Creek

WELCH

287

NEWELL RESERVOIR

LOVELAND RESERVOIR

BACON LAKE

BERTHOUD

56

DRY CREEK

W25

E25

BAXTER RESERVOIR

ISH RESERVOIR

HIGHLANDS

BIG HOLLOW

N

W E

S

0 0.5 1 2 Miles

Legend

- Berthoud Drainage Basin Limit
- Berthoud GMA

Major Basins

- 287
- 56
- BACON LAKE
- BAXTER RESERVOIR
- BIG HOLLOW
- DRY CREEK
- E25
- HIGHLANDS
- ISH RESERVOIR
- LOVELAND RESERVOIR
- NEWELL RESERVOIR
- W25
- WELCH

Figure ES-1
Berthoud Major Drainage Basins

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The information provided in this initial master plan is a useful planning resource for the Town and will be used to develop drainage criteria and guide future drainage infrastructure design. At the initial level of detail presented herein, the following is a list of planning recommendations and uses for this document:

1. The hydrology and hydraulic models developed for the master study can be used by the Town or developers for additional future planning and design. The models presented in the appendix of this study represent the existing drainage conditions within the watershed, and can easily be modified to simulate developed land uses and possible runoff routing or storage and water quality alternatives. The model will continue to be enhanced as development occurs in the area.

2. The design rainfall depths that have been calculated and presented in Section II can be used for any future drainage design or CUHP modeling in Berthoud. These rainfall depths should be implemented in the Town's drainage criteria and used for all analysis within Berthoud for consistency.

3. This study identifies all of the drainage basins within the watershed that affect the Berthoud GMA. In addition, an inventory of existing drainage conveyance facilities has been developed. Peak runoff flows have been identified at key design point locations such as major roadway crossings. Determining existing peak flow rates and runoff volumes at these key areas will help the Town evaluate the planning of major drainage ways, future roadway crossing design, potential regional detention benefits, and required detention release rates.

4. Developers will use the Storm Drainage Master Plan as a due diligence resource since the concepts presented in the master plan will identify possible drainage infrastructure improvements that will be required for development within an identified drainage basin. Developers will know in the beginning stages of project planning the flows that affect a site, what hydraulic structures may be required, or roads that may require improvement. Master plans create a guide for developers to follow, and with a guide, their decision process becomes easier.

5. Initial recommendations based on the results of this study are:

   - Initiation of drainageway planning within the watershed.
   - Identify natural drainageways within each basin.
   - Coordinate drainageways with the Town's future planning map.
   - Design future drainageways to convey 100-year peak flows without credit for detention.

6. In addition, planning should begin on regional detention and water quality facilities within the watershed. Detention release rates should be initially set at the 100-year historic release rates or less. Suggestions should be made for detention requirements related to property immediately adjacent to the river, and further analysis should be completed to support further recommendations.

7. Future planning and development within the Town's GMA will be based on the results of this study. This study is the first step in a long term planning process that can lead to:

- Determination of storm drainage impact fees.
- Formation of a storm water utility.
- Cost sharing agreements with developers and other stakeholders.
- Evaluations of benefit/cost for grant and financial aid monies.
- More detailed engineering analysis.



II. INTRODUCTION

II. INTRODUCTION

General, Purpose and Scope

The *Storm Drainage Master Plan* (Plan) was authorized by the Town of Berthoud's (Town) Board of Trustees as a regional planning study to evaluate and aid in the development of the area surrounding the Town within the General Management Area (GMA). This Plan provides the Town with a tool to aid in the development of its GMA and plan for the safe conveyance of developed runoff within the Town.

The purpose of the Plan is to analyze existing drainage conditions within the study area, determine historical drainage quantities, develop recommendations for drainage improvements, and aid in developing future planning concepts based on the Plan.

Tasks for analyzing the existing drainage conditions include:

1. Meet with the Town to obtain information, present study findings, and discuss results of the analysis.
2. Contact agencies, property owners, or individuals that have knowledge or specific interest in the study area.
3. Inventory and compile data on the existing drainage system.
4. Prepare hydrologic analysis for the existing drainage systems.

Mapping and Surveys

Project mapping was provided by the Town of Berthoud in GIS drawings which were developed in 1999.

Area of Study

The Town's GMA is composed of approximately 40 square miles made up primarily of cultivated agricultural farmland. The watershed is composed of approximately 50 square miles surrounding the Little Thompson River. The Little Thompson River is the main drainage feature through the watershed with most of the GMA being directly tributary to the river. A couple of areas in the northern portion of the GMA drain to the north and exit the GMA without entering the Little Thompson River. The water shed was divided into 13 separate drainage areas which were further divided into sub-basins. The Plan's overall watershed and its relation to the Town's GMA, as well as the different drainage basins, are shown on Figure II-1. The breakdown of the drainage basins into sub-basins and their individual designations are shown on Figure II-2.

LARIMER COUNTY

WELD COUNTY

BOULDER COUNTY

Big Thompson River

Dry Creek

Little Thompson River

WELCH

287

NEWELL RESERVOIR

LOVELAND RESERVOIR

BACON LAKE

BERTHOUD

56

W25

E25

DRY CREEK

BAXTER RESERVOIR

ISH RESERVOIR

HIGHLANDS

BIG HOLLOW

N

W E

S

0 0.5 1 2 Miles

Legend

- Berthoud Drainage Basin Limit
- Berthoud GMA

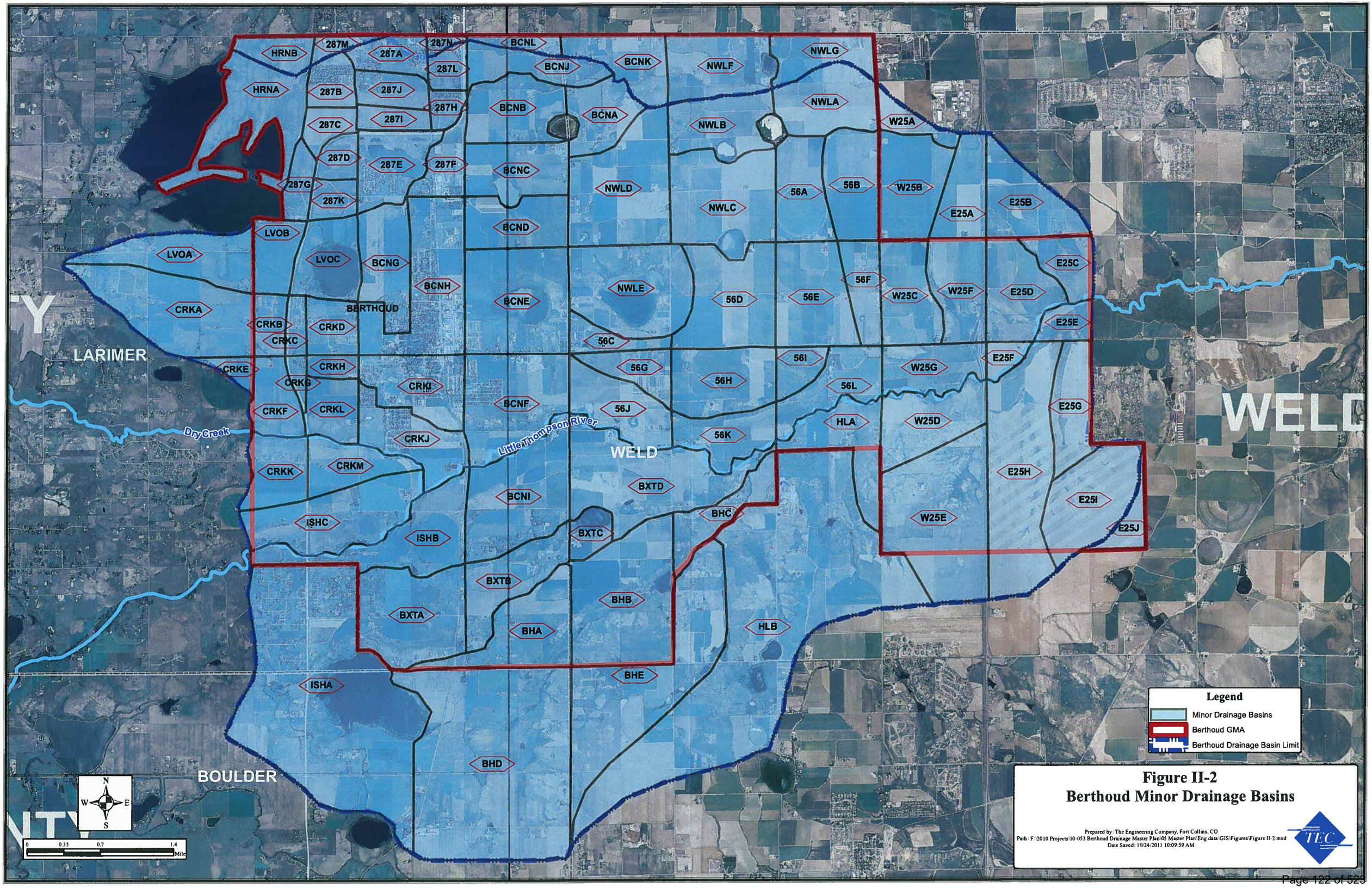
Major Basins

- 287
- 56
- BACON LAKE
- BAXTER RESERVOIR
- BIG HOLLOW
- DRY CREEK
- E25
- HIGHLANDS
- ISH RESERVOIR
- LOVELAND RESERVOIR
- NEWELL RESERVOIR
- W25
- WELCH

Figure II-1
Berthoud Major Drainage Basins

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HRNB
287M
287A
287N
BCNL
BCNJ
BCNK
NWLF
NWLG
HRNA
287B
287J
287L
287H
BCNB
BCNA
NWLA
NWLB
W25A
287C
287I
287D
287E
287F
BCNC
287G
287K
NWLD
56A
56B
W25B
E25B
NWLC
E25A
LVOB
BCND
LVOA
LVOC
BCNG
BCNH
NWLE
56F
E25C
W25C
W25F
E25D
CRKA
BERTHOUD
BCNE
56D
56E
CRKB
CRKD
CRKC
56C
E25E
LARIMER
56I
E25F
CRKE
CRKH
56G
W25G
CRKG
56H
56L
CRKI
CRKF
CRKL
BCNF
56J
E25G
HLA
W25D
Dry Creek
Little Thompson River
CRKJ
56K
WELD
CRKK
CRKM
BXTD
E25H
BCNI
BHC
E25I
ISHC
W25E
E25J
ISHB
BXTC
BXTB
BHB
BXTA
BHA
HLB
BHE
ISHA
BHD
BOULDER
N
W
E
S
0
0.35
0.7
1.4
Miles
Legend
Minor Drainage Basins
Berthoud GMA
Berthoud Drainage Basin Limit
Figure II-2
Berthoud Minor Drainage Basins
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14. Town of Berthoud, *Drainage Facility Inventory and Analysis, Highway 56 from Highway 287 to I-25*, by Ayres Associates dated May 1998.
15. *Colorado Urban Hydrograph Procedure Computer Program*, CUHP 2005 Version 1.3.3, Urban Drainage and Flood Control District, January 2010.
16. *EPA Storm Water Management Model (SWMM) 5.0 Computer Program*, United States Environmental Protection Agency, Revised July 2010.

III. STUDY AREA DESCRIPTION

III. STUDY AREA DESCRIPTION

Watershed Description

The Town of Berthoud, Colorado, is located approximately six miles west of Interstate 25 on Highway 287, about 50 miles north of Denver. The Town is comprised of mostly agricultural development with a developed downtown area of approximately one square mile which includes residential, light commercial and industrial development. For the development of this regional master plan, The Engineering Company (TEC) examined the entire General Management Area (GMA) of the Town.

The GMA is approximately 50 square miles consisting primarily of agricultural farm fields, reservoirs, and the Town. The GMA is located in both Larimer and Weld Counties and is bounded on the north by Highway 60 and on the south by North County Line Road. The eastern extent of the GMA is located approximately one mile east of Interstate 25 with the western boundary located approximately one mile west of State Highway 287. The Little Thompson River, which flows from the western boundary through the GMA and exits the eastern boundary north of County Road 56, effectively splits the GMA into two portions; a northern portion which tends to drain south to the river and a southern portion which drains north to the river.

The northern portion of the GMA consists of mild sloping topography ranging from 0% to 0.50% slopes, while the southern portion has more moderate slopes and gullies as steep as 4% to 5%. The northern section is predominantly agriculture and open fields, with the southern portion having fields on mild sloping plateaus, and native plants and grasses in the gullies and steeper slopes. See Figure II-1 for the general layout of the GMA.

Included within the GMA are several predominant reservoirs and lakes. Most of the reservoirs are used for irrigation of the surrounding farmland with a few notable exceptions; Bacon Lake and Newell Lake are utilized for augmenting the Little Thompson River for water users downstream, and the Berthoud Reservoir is a source of drinking water for the Town. The remaining reservoirs and bodies of water are used to provide irrigation water to the farmlands through a series of ditches and canals that extend throughout the GMA. The elevation within the GMA ranges from 4800 to 5200 ASL with the Little Thompson River occupying the low elevations.

History and Specific Problems

The Town of Berthoud has had issues with drainage and runoff in the past. Most of the issues have been in the developed downtown residential and business district of Berthoud. Localized street and gutter flooding has occurred historically, but these have been attended to by the Town through a series of drainage and storm drain improvements.

Outside of the developed Town the agricultural areas have historically not had many drainage issues. Instead, the fields often drain to nearby roadside ditches that convey the runoff either to a crossing structure, such as a concrete pipe or culvert, or to an intersection where the flow is either conveyed under the intersection

via crossing structures, or the runoff pools until it overflows the road. In the agricultural portion of the watershed the county roads act as low berms in channeling the drainage flows to corners or low spots, and then across the roads. It is at these low spots and concentration points that local improvements will be recommended as part of the development of the GMA.

General

The GMA was divided into 13 separate drainage basins. Each of the major drainage basins was then further divided into sub-basins, shown on Figure II-2. Hydrologic analysis was conducted on each of the drainage sub-basins to determine peak rainfall runoff resulting from the 2-year, 10-year, and 100-year rainfall events. The Colorado Urban Hydrograph Procedure (CUHP) was used to develop runoff hydrographs for each sub-basin. The individual hydrographs were then routed through the existing system using Storm Water Management Model (EPA-SWMM) software to develop peak runoff at key design points.

Input data for the sub-basin CUHP calculations includes: rainfall depth, sub-basin area, impervious percent, sub-basin main flow path length, distance to the sub-basin centroid, flow path slope, soil infiltration rates, and surface storage losses. All of the input data follows the recommendations and information provided in the Urban Drainage manuals and the CUHP user's guide. Hydrologic characteristics and input data, as well as results of the CUHP for each major drainage basin, are located in Appendix B – CUHP results. The results are summarized in Tables located within the description of each one of the drainage basins.

Design Rainfall

For analyzing areas less than ten square miles with the CUHP software, the one hour point rainfall depth is required for each design storm event. Rainfall data for the Berthoud area is not readily available in the Urban Drainage Manual, so the precipitation frequency data was obtained from the on-line database at the NOAA website. From the NOAA Atlas 2, the 2-year 6-hour, 2-year 24-hour, 100-year 6-hour, and 100-year 24-hour rainfall depths were obtained. Using the standard rainfall equations, the one hour rainfall depths for the 2-year, 10-year, and 100-year rainfall events are calculated and shown on Table III-1.

Table III-1: Rainfall

Rainfall Depth (Inches)		
2-Year	10-Year	100-Year
0.97	1.64	2.61

Soils

Soil characteristics for the sub-basins are based on the latest information provided on-line from the Natural Resource Conservation Service web soil survey. Specifically, it is necessary to know what the predominant hydrologic soil group is for each defined sub-basin for CUHP input. The hydrologic soil group determines the correct coefficients to use for the Horton's infiltration equation. Soils are categorized as being in

hydrologic soil group A, B, C, or D with type A soils being those with highest infiltration rates and type D soils being those with lowest infiltration rates (higher runoff potential). Soil maps for each one of the 13 major drainage basins within the watershed are located in Appendix A – NRCS Soils Mapping.

Watershed Imperviousness

The land uses within each defined sub-basin have been verified by field inspection and review of aerial and satellite imagery. Table RO-3 and Figure RO-3 from Urban Drainage Manual Volume 1 (in Appendix D – UDFCD Tables) have been used to determine the sub-basin percent impervious values for use with CUHP. Undeveloped agricultural sub-basins typically have impervious values of 2%, while the residential areas have impervious values in the range of 25% to 60%. Industrial areas have impervious values in the range of 60% to 95%. For the purposes of this study, predominantly agricultural sub-basins are assigned an imperviousness of 3.0% in order to account for the roads and paved areas that tend to surround the agricultural fields.

Depression Storage/Retention Losses

Depression losses for each sub-basin have been estimated in accordance with Table RO-6 (in Appendix D – USFSD Tables) of the Urban Drainage Manual runoff chapter. Depression losses for impervious surfaces are estimated to be 0.07 inches for all sub-basins. Depression losses for pervious surfaces are estimated to be 0.35 inches for developed sub-basins and 0.4 inches for the more agricultural/grassed sub-basins.

Infiltration Rate/Horton's Parameters

The CUHP model uses Horton's infiltration equation to account for infiltration rates of the various hydrologic soil types in the sub-basins. Using the NRCS hydrologic soil group designation, the Horton's parameters have been taken from Table RO-7(in Appendix D – UDFCD Tables) of the Urban Drainage Criteria Manual runoff chapter.

Storage

Irrigation reservoirs and impoundments exist throughout all of the drainage basins. They include Loveland Reservoir, Bacon Lake, Newell Reservoir, and DeFrances Reservoir. Many of these water bodies have varying water levels and are used for a variety of purposes. For this planning study the storage and reservoir bodies were assumed to be full, and thus provide for no storage of the historical storm runoff. Storm water modeled to be entering the impoundment is equal to the amount of water to be modeled exiting the impoundment downstream.

Little Thompson River

The Little Thompson River (LTR) is the primary drainage feature within the watershed. For the development of the models the LTR is the ultimate outfall for most of the watershed. The LTR was not modeled for this planning study. The river is capable of carrying the 100-year historical runoff, and the recommendation of this study requires that detention and release rates remain at the 100-year historical rate. In order to

safely provide for higher than 100-year historical release rates, detailed study and analysis of the LTR would be required to ensure safety downstream.

Irrigation Ditches

Several agricultural irrigation ditches traverse the entire watershed study area. They are utilized to deliver irrigation water from the reservoirs to the agricultural fields. Major irrigation ditches within the study area include the Handy Ditch, Home Supply Ditch north of the LTR, the Ish Ditch, and New Ish Ditch south of the LTR. For the purposes of this planning study the irrigation ditches were not modeled to provide any storm drainage conveyance or storage. Instead, the ditches often act as berms and dikes that channel drainage runoff through the drainage basins. Additional analysis on the ditches and meetings with the ditch companies will be necessary during planning of regional drainageways and greenbelts in the future.

EPA SWMM 5.0 Flow Routing

Individual hydrographs for each sub-basin were calculated using CUHP. Each of those individual hydrographs was then routed through the existing system using an EPA SWMM 5.0 model. The system model is set up as a network of nodes and links. Nodes represent inflow locations within the model and may represent junctions, points of concentration, flow summary point, or crossing structure inlets. Each individual sub-basin has a specific node assigned to it that allows the hydrograph for that sub-basin to enter the SWMM network model. The schematic layout for each existing condition SWMM model is included in Appendix C – SWMM Results. Input parameters for SWMM nodes include invert elevation, depth, and inflow. Links connect the model nodes and may represent pipes, channels, or pumps. Typical input parameters for links include shape, length, depth, and roughness.

Drainage Basin Analysis

The overall study watershed was divided into 13 individual basins using mapping and one-foot contour topography provided by Larimer County. Each basin has been further divided into a number of sub-basins based on the topography and known physical boundaries such as roadways and irrigation ditches. Sub-basin characteristics were verified by several field visits. In general, the sub-basins are named according to a roadway or area that they are tributary to and general location. Physical characteristics such as slope, area, length, and length to centroid are based on GIS files and maps provided by the Town, as well as satellite imagery from Google Earth software. The CUHP Basin Map is shown on Figure III-1. In the following section each drainage basin will be described, along with the characteristics and summary of its sub-basins. A sub-basin data summary will be included and shown for each of the major defined drainage basins.

1. East I-25

East I-25 (E25) is located on the eastern extreme of the GMA. It contains approximately five square miles and is bounded on the north by County Road 48 (CR-48/HWY60) and on the south by County Road 40 (CR-40). The western limit of the basin is Interstate 25 (I-25) and the eastern extent is County Road 11 (CR-11). Refer to Figure III-1 to see the drainage basin in reference to the entire GMA.

LARIMER COUNTY

WELD COUNTY

BOULDER COUNTY

WELCH

287

NEWELL RESERVOIR

LOVELAND RESERVOIR

BACON LAKE

BERTHOUD

56

W25

E25

DRY CREEK

BAXTER RESERVOIR

ISH RESERVOIR

HIGHLANDS

BIG HOLLOW

Dry Creek

Little Thompson River

Big Thompson River

N

W E

S

0 0.5 1 2 Miles

Legend

- Berthoud Drainage Basin Limit
- Berthoud GMA

Major Basins

- 287
- 56
- BACON LAKE
- BAXTER RESERVOIR
- BIG HOLLOW
- DRY CREEK
- E25
- HIGHLANDS
- ISH RESERVOIR
- LOVELAND RESERVOIR
- NEWELL RESERVOIR
- W25
- WELCH

Figure III-1
Berthoud Major Drainage Basins

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The predominant drainage feature within E25 is the Little Thompson River (LTR) which flows from west to east across the basin, and effectively splits the basin into northern and southern portions. Generally, the northern portion of E25 drains south and the southern portion drains to the north where they both flow into the LTR.

The E25 basin is further divided into 10 sub-basins. Figure III-2 shows the E25 and its sub-basin designations, along with the sub-basin areas. These sub-basins are defined primarily by existing drainageways, roads, and local topography. Each of the sub-basins drains to a general point of concentration, an intersection, drainage feature, or road crossing. The peak flows are shown in Table III-2. Table III-2 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

E25A

Sub-basin E25A is located on the west side of I-25, is entirely outside the GMA, and consists of approximately 320 acres. E25A is bounded on the north by CR-48 and the Handy Ditch, and on the south by CR-46. The eastern boundary is I-25 and the western boundary is a topographic rise. E25A consists primarily of cultivated agricultural fields. Rainfall runoff drains to the east and the south where it collects in roadside ditches along CR-46 and I-25. The main point of concentration for E25A is the southeast corner of the sub-basin where CR-46 passes under I-25. The sub-basin is located outside the Town's GMA, but contributes runoff flow to the GMA infrastructure.

E25B

Sub-basin E25B is located on the east side of I-25, is entirely outside the GMA, and consists of approximately 335 acres. E25B is bounded on the south by CR-46 and on the west by I-25. The northern boundary is a topographic high point that traverses from northwest to the southeast across the sub-basin. E25B consists primarily of cultivated agricultural fields. Rainfall runoff drains to the south where it collects in a roadside ditch on the north side of CR-46. Due to the sub-basin being located outside the Town's GMA, the sub-basin analysis is limited to generated runoff and the location of the entry of the runoff into the GMA. A crossing structure located approximately 1,500 feet east of the western boundary of the sub-basin conveys runoff into the GMA and sub-basin E25C, across CR-46. The crossing structure consists of a 48-inch Corrugated Metal Pipe (CMP) culvert (see Photo III-1).



Photo III-1: 48" CMP Culvert at CR-46.

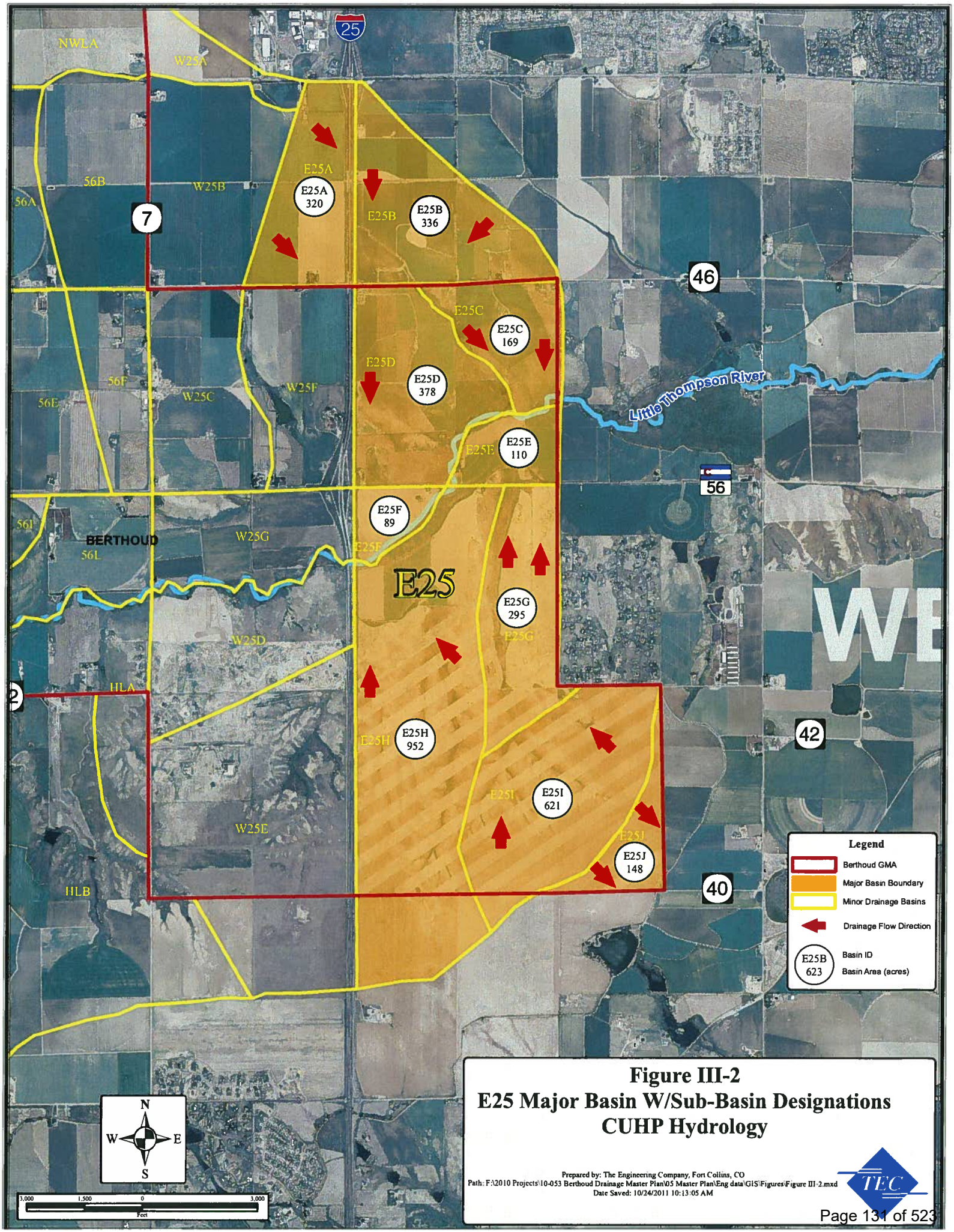


Figure III-2
E25 Major Basin W/Sub-Basin Designations
CUHP Hydrology

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E25C

Sub-basin E25C is located immediately south of CR-46, lies entirely within the GMA, and consists of approximately 169 acres. E25C is bounded on the north by CR-46 and on the south by the LTR. The western boundary is a natural drainage waterway, and the east boundary is Dry Creek Road. E25C consists primarily of cultivated agricultural fields. Rainfall within E25C drains to the south and east directly into the LTR.



Photo III-2: Typical roadside ditch in sub-basin E25E along CR-11.

E25D

Sub-basin E25D is located directly south of CR-46, lies entirely within the GMA, and consists of approximately 378 acres. E25D is bounded on the north by CR-46 and on the south by both CR-44/HWY-56 and the LTR. The western boundary is I-25 and the eastern boundary is the waterway that travels south to the LTR. E25D consists primarily of cultivated agricultural fields. Rainfall within E25D drains primarily south where it collects in a roadside ditch along CR-44/HWY-56, and then flows east into the LTR. Runoff from sub-basins E25A and E25B are routed through E25D. Flows from E25A are conveyed in a roadside ditch south along I-25 to CR-44/HWY-56, and then east to the LTR. Flows generated within sub-basin E25B are conveyed along an overland channel south into the LTR.

E25E

Sub-basin E25E is located north of CR-44, lies entirely within the GMA and consists of approximately 110 acres. E25E is bounded on the south by CR-44 and on the east by CR-11. The northern and western boundary is the LTR. E25E consists primarily of cultivated agricultural fields. Rainfall within E25E flows generally north and directly into the LTR. A roadside ditch along CR-11 conveys runoff from sub-basins E25G and E25I to the LTR. See Photo III-2 for a typical roadside ditch.

E25F

Sub-basin E25F is located south of CR-44, lies entirely within the GMA, and consists of approximately 89 acres. The northern boundary is CR-44 and the western boundary is I-25. The southern and eastern boundaries are the LTR. E25F consists primarily of cultivated agricultural fields. Rainfall within E25F drains south and east directly into the LTR.

E25G

Sub-basin E25G is located south of CR-44, lies entirely within the GMA, and consists of approximately 295 acres. The northern boundary is CR-44 and the southern boundary is a topographic high point. The eastern boundary is CR-11 with the western boundary a topographic high ridge. E25G consists of cultivated fields and natural hillocks and gullies. A natural drainageway conveys runoff from sub-basin E25I north towards CR-44, where it is further conveyed east in a roadside ditch to the intersection of CR-44 and CR-11. At this concentration point the flow is conveyed beneath the intersection north in a 48-inch CMP

culvert. Runoff within E25G drains into the natural drainage or east into a roadside ditch along CR-11. This flow is directed north towards CR-44 and into the culvert at the intersection of CR-11 and CR-44.

E25H

Sub-basin E25H is located east of I-25, lies mostly within the GMA, and consists of approximately 952 acres. The western boundary is I-25 and the eastern boundary is a natural ridge in the topography. The northern boundary consists of both the LTR and CR-44, and the southern boundary, which lies outside the GMA, is a topographical ridge. E25H consists of cultivated agricultural fields and natural gullies. Runoff within E25H flows to the north within natural drainageways and gullies directly to the LTR.

E25I

Sub-basin E25I is located in the southeastern portion of the GMA, lies almost entirely within the GMA, and consists of approximately 621 acres. E25I is an irregular shaped sub-basin and is bounded on all sides by topographic ridges. Runoff drains northward in a series of natural gullies to a concentration point immediately south of sub-basin E25G. Storm flows from E25I are conveyed north through sub-basin E25G by the natural drainageway.

E25J

Sub-basin E25J is located in the southeastern corner of the basin and is bounded on the east and south by the Town's GMA boundary. The sub-basin lies entirely within the GMA and is composed of approximately 148 acres. Runoff drains to the south and east and exits the GMA

Table III-2, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-2: CUHP Sub-Basin Summary
East I-25

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
E25A	320.2	3	2	45	167
E25B	335.6	3	5	96	356
E25C	169.4	3	2	46	171
E25D	378.2	3	56	138	338
E25E	110.1	3	27	64	149
E25F	88.9	3	12	29	71
E25G	294.8	3	55	132	318
E25H	951.8	3	257	608	1,409
E25I	621.2	3	265	599	1,297
E25J	148	3	31	74	174

Hydraulic Analysis

Table III-3 summarizes the peak flows at key routing elements of the East I-25 drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-3 shows location of key junctions and conveyance elements within the drainage basin.

Table III-3: SWMM Element Summary
East I-25 Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	I-25 Crossing Node	2	45	167
102	48" CMP Inlet	5	96	356
103	Outfall to River	257	608	1,409
104	Outfall to River	58	158	358
105	CR-42 Crossing Node	265	598	1,297
106	48" CMP CR-44 Inlet	5	593	1,184
108	Outfall to River	12	29	71
109	Outfall to River	39	75	160
112	Outfall to River	7	78	203
CONVEYANCE ELEMENTS				
201	Roadside Ditch	2	39	39
205	Overland Channel	262	593	1,184
210	Overland Channel	5	32	32
211	Roadside Ditch	11	11	11

Table III-32 summarizes the peak runoff at each element. SWMM results indicate that some of the key elements within the East I-25 drainage basin are currently not sized to convey the 100-year rainfall event runoff. Currently, ponding and overtopping of junction nodes and points of concentration occurs at 101, 102, and 106. These particular points correspond with the road crossings at the underpass at Interstate-25, the culvert crossing at CR-46, and the culvert crossing at CR-44, respectively (see Figure III-3). These are occurrences where the downstream conveyance element is not capable of carrying the peak flow arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, results in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical amounts and rates, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To

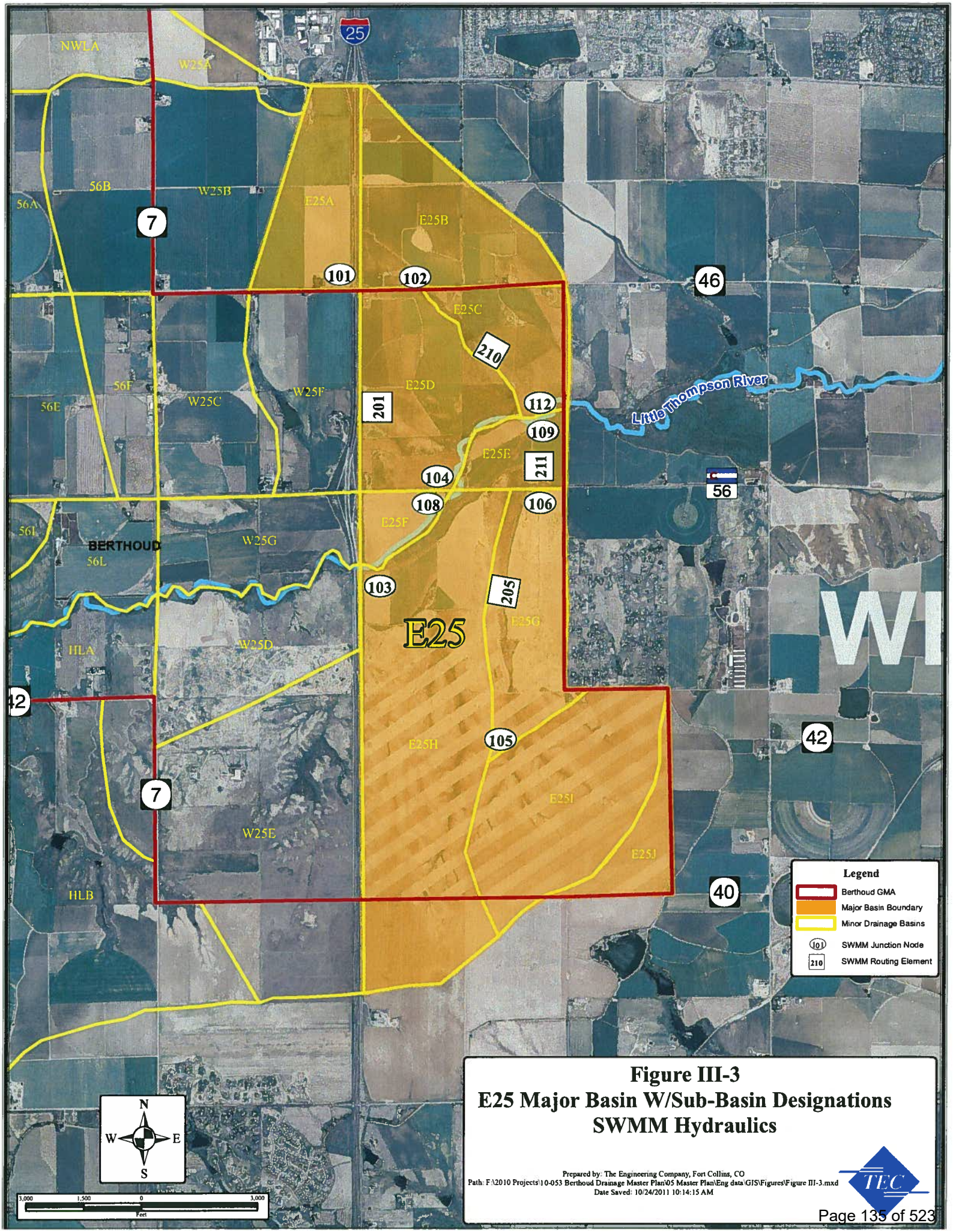


Figure III-3
E25 Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements and can be updated accordingly as improvements are completed.

2. West I-25

The West I-25 (W25) drainage basin is located in the eastern portion of the GMA. W25 contains portions that lie outside the GMA. It consists of approximately 2,530 acres and is bounded on the east by I-25 and on the west by County Road 7(CR-7). The northern and southern boundaries of W25 lie outside the GMA and consist of topographical ridges that define the drainage basin. See Figure II-1 for the relationship of the drainage basin to the GMA. The primary land use within the drainage basin is agricultural with a small amount of single-family, residential development.

The primary drainage feature within W25 is the LTR which flows from west to east across the basin, and effectively splits the basin into northern and southern portions. Generally, the northern portion of W25 drains south and the southern portion drains to the north toward the LTR.

W25 is further divided into 7 sub-basins, shown in Figure III-4. These sub-basins are defined primarily by existing drainageways, roads, and local topography. Each of the sub-basins drains to a point of concentration, often defined by an intersection, drainage structure, or road crossing. The peak runoff for each sub-basin is summarized in Table III-4, as well as the sub-basin area and its percent imperviousness.

The following sections describe the sub-basins and associated drainage features, along with their key points of runoff concentration.

W25A

Sub-basin W25A is located immediately north of CR-48, lies entirely outside the GMA, and consists of approximately 101.9 acres. The western boundary is County Road 7 (CR-7) and the southern extent is the Handy Ditch which parallels CR-46 on the southern side. The northern and eastern boundaries are defined by topographical ridges that define the sub-basin. W25A consists primarily of cultivated agricultural fields. Rainfall within W25A drains to the west and the south where it collects in roadside ditches along CR-48 and CR-7. The main point of concentration for W25A is the southwest corner where CR-48 and CR-7 intersect.

W25B

Sub-basin W25B is located immediately south of CR-48 and east of CR-7, lies entirely outside the GMA, and consists of approximately 354 acres. The north boundary is CR-48 and the southern boundary is CR-46. W25B consists almost entirely of cultivated agricultural fields. Rainfall runoff drains to the west and south within the sub-basin. Roadside ditches along CR-7 and CR-46 convey storm flow to the south and east, respectively. At the intersection of CR-46 and CR-7 the storm runoff collects and crosses south into the GMA via a 42-inch concrete culvert pipe. This crossing structure conveys storm flows into the W25C sub-basin, which are then conveyed within a roadside ditch south along CR-7 where it is further conveyed into sub-basin W25G and finally into LTR.

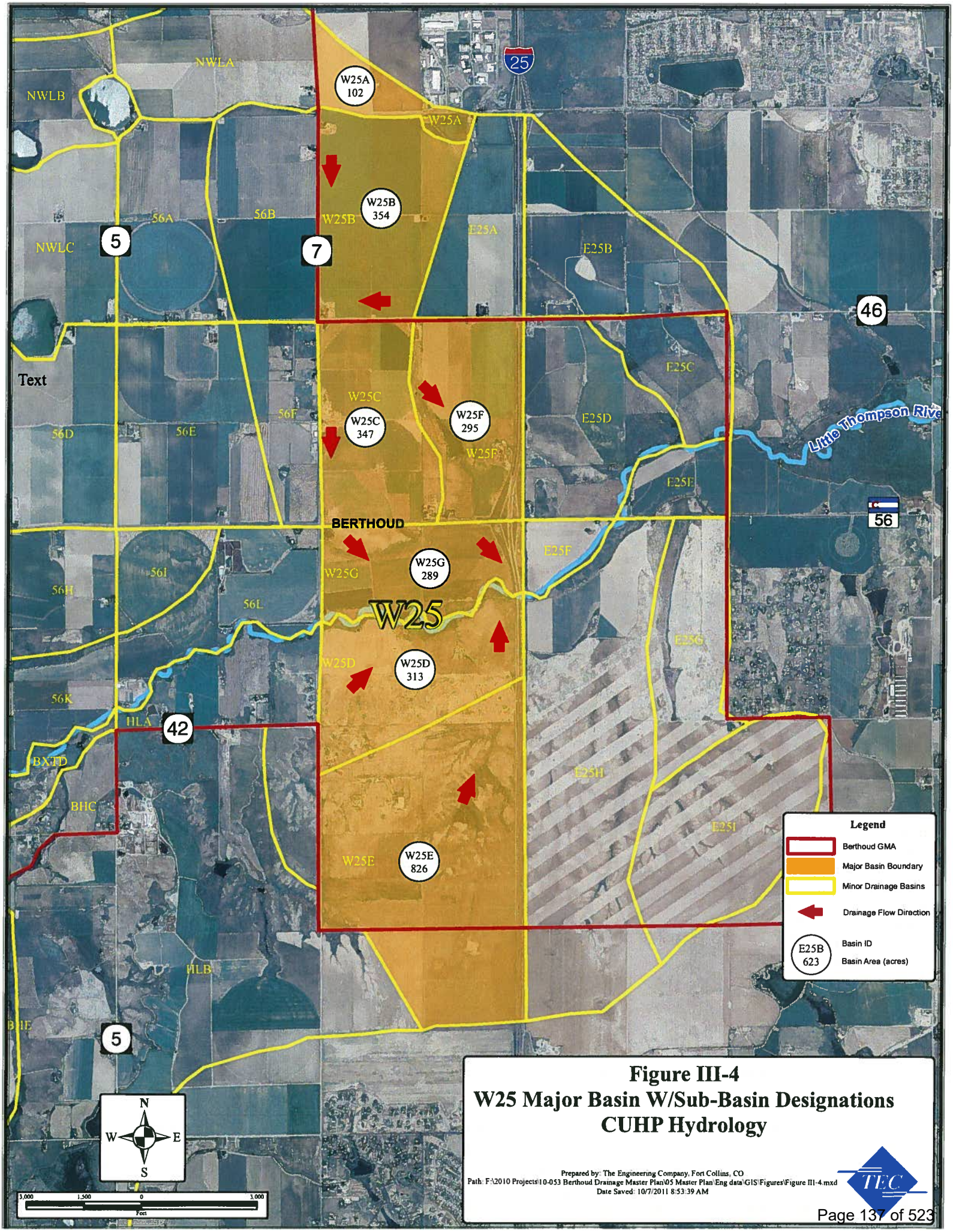


Figure III-4
W25 Major Basin W/Sub-Basin Designations
CUHP Hydrology

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W25C

Sub-basin W25C is located immediately east of CR-7 and north of County Road 44 (CR-44). The sub-basin is located entirely within the Town's GMA and is comprised of approximately 347 acres. The northern boundary is CR-46 and the eastern boundary is a topographical ridge. Runoff drains to the south, and then along CR-44/HWY-56 to a 36-inch diameter CMP culvert where it is conveyed beneath CR-44 and south to sub-basin W25G.

W25D

Sub-basin W25D is located immediately south of the LTR and west of I-25. The sub-basin lies entirely within the Town's GMA and is comprised of approximately 313 acres. The western boundary of the sub-basin is CR-7, and the southern boundary is identified as a topographical ridge. Land-use in the sub-basin includes agriculture, as well as an off-road vehicle facility. Storm runoff drains to the north and east along I-25 and into the LTR.

W25E

Sub-basin W25E is located directly west of I-25 and includes a portion that lies outside the Town's GMA. The east boundary is CR-7 and the north and south boundaries are marked by topographical ridges. The east portion of the sub-basin is dominated by a natural drainage gully that conveys runoff to the northeast corner of the sub-basin. At this point of concentration the runoff is conveyed north into sub-basin W25D.

W25F

Sub-basin W25F is located immediately north of CR-44 and west of I-25. The sub-basin lies entirely within the Town's GMA and is comprised of approximately 295 acres. The northern boundary is CR-46 and the eastern boundary is a topographical ridge. Runoff typically drains to the south and crosses CR-44/HWY-56 through a 36-inch diameter Reinforced Concrete Pipe (RCP) into sub-basin W25G.

W25G

Sub-basin W25G is located between CR-44 on the north and the LTR on the south. I-25 marks the eastern boundary and CR-7 demarks the western boundary. The sub-basin lies entirely within the Town's GMA and is comprised of approximately 289 acres. Overland channels convey flows from across CR-44 south to the LTR.

Table III-4, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-4: CUHP Sub-Basin Summary
West I-25

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
W25A	101.9	3	47	106	234
W25B	354.5	3	118	268	590
W25C	346.6	3	132	298	645
W25D	312.8	3	111	257	567
W25E	825.6	3	324	737	1,621
W25F	295.8	3	95	219	490
W25G	289.0	3	74	189	438

Hydraulic Analysis

Table III-5 summarizes the results of the hydraulic modeling of the West I-25 drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-5 shows location of key junctions and conveyance elements within the drainage basin.

Table III-5: SWMM Element Summary
West I-25 Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	Crossing CR-48	47	106	234
102	Crossing CR-46	150	305	590
103	Crossing CR-44	366	780	1,125
106	Junction	323	737	1,621
107	Outflow to River	94	209	458
109	Outflow to River	349	607	1,163
CONVEYANCE ELEMENTS				
201	Roadside Ditch	32	37	37
202	Overland Channel	148	263	263
204	Overland Channel	20	20	20
206	Roadside Ditch	162	347	820

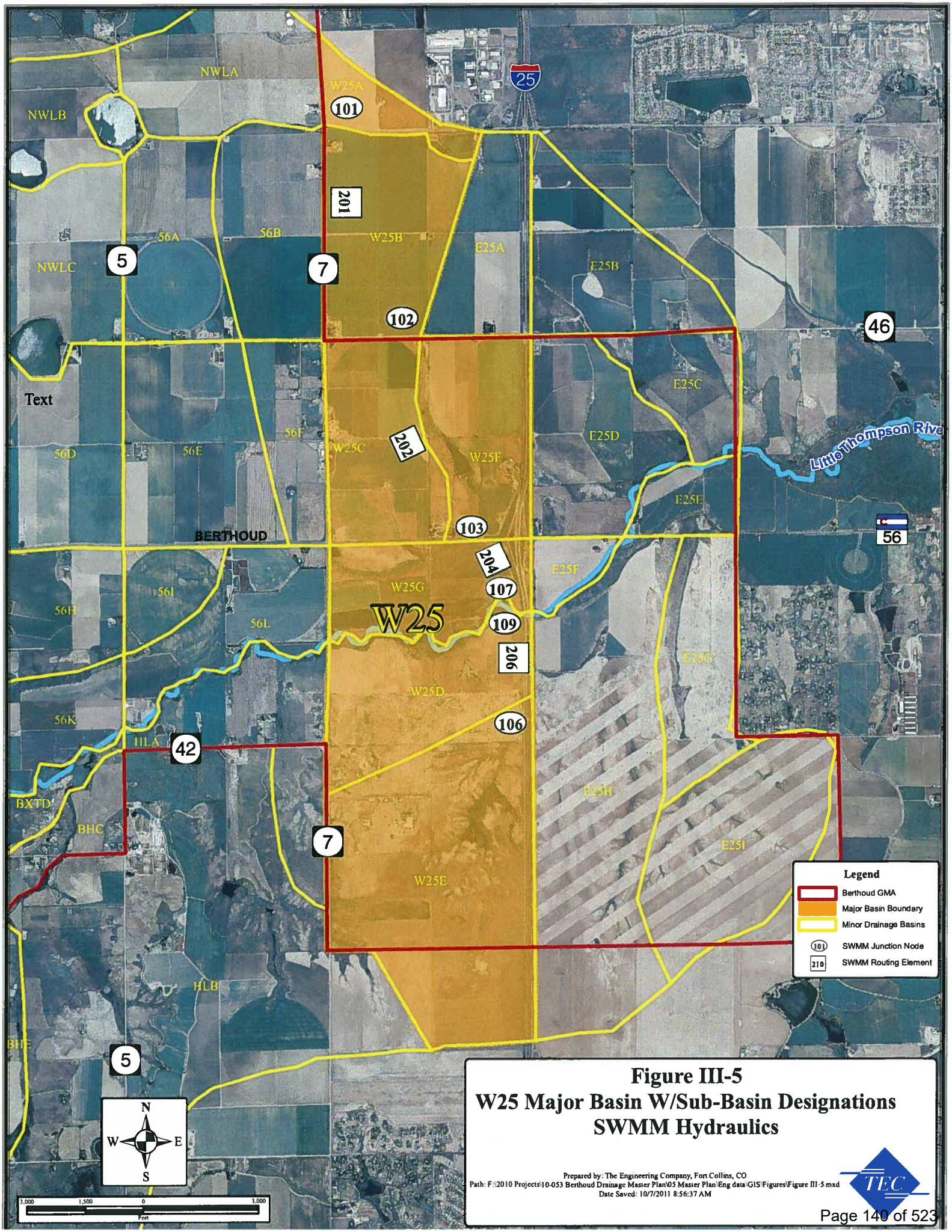


Figure III-5
W25 Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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Table III-5 summarizes the peak runoff at each element. SWMM results indicate that some of the key elements within the West I-25 drainage basin are currently not sized to convey the 100-year rainfall event runoff, as well as the 2-year and 10-year storm events in several instances. Currently, ponding and overtopping of junction nodes and points of concentration occurs at 101, 102, 103, and 106. These particular points correspond with the road crossings at the underpass at CR-48, the culvert crossings at CR-46 and CR-44/HWY-56, and the junction at Interstate-25 and CR-42, respectively. These are occurrences where the downstream conveyance element is not capable of carrying the peak flow arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, can result in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

3. Highway 56

The Highway 56 (56) drainage basin is located in the north central portion of the GMA. The drainage basin lies entirely within the Town's GMA. The location and extent of the drainage basin is shown in Figure III-1. The drainage basin consists of approximately 3,478 acres with a primary land usage of agriculture. The southern boundary of the drainage basin is the LTR and the drainage basin is located on both sides of Highway 56.

The 56 drainage basin is further divided into 12 sub-basins. Figure III-6 shows the layout of the basin and its sub-basins. These sub-basins are defined primarily by existing drainageways, roads, and local topography. Each of the sub-basins drains to a general point of concentration, defined by an intersection, drainage feature, or road crossing. Table III-6 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

56A

Sub-basin 56A is located east of CR-5 and north of CR-46. The north boundary is CR48 and the eastern extent is a topographically high ridge that separates it hydraulically from sub-basin 56B to the east. The sub-basin consists of approximately 309 acres. Runoff typically flows to the south and west, and concentrates in the southwestern corner of the sub-basin. From the corner, runoff is conveyed south along a roadside ditch through sub-basin 56E.

56B

Sub-basin 56B is located west of CR-7 and north of CR-10. The north boundary is CR-48 and the western extent is defined by a topographical high. The sub-basin consists of approximately 330 acres. Runoff typically flows to the south and east and concentrates in the southeastern corner of the sub-basin. Runoff

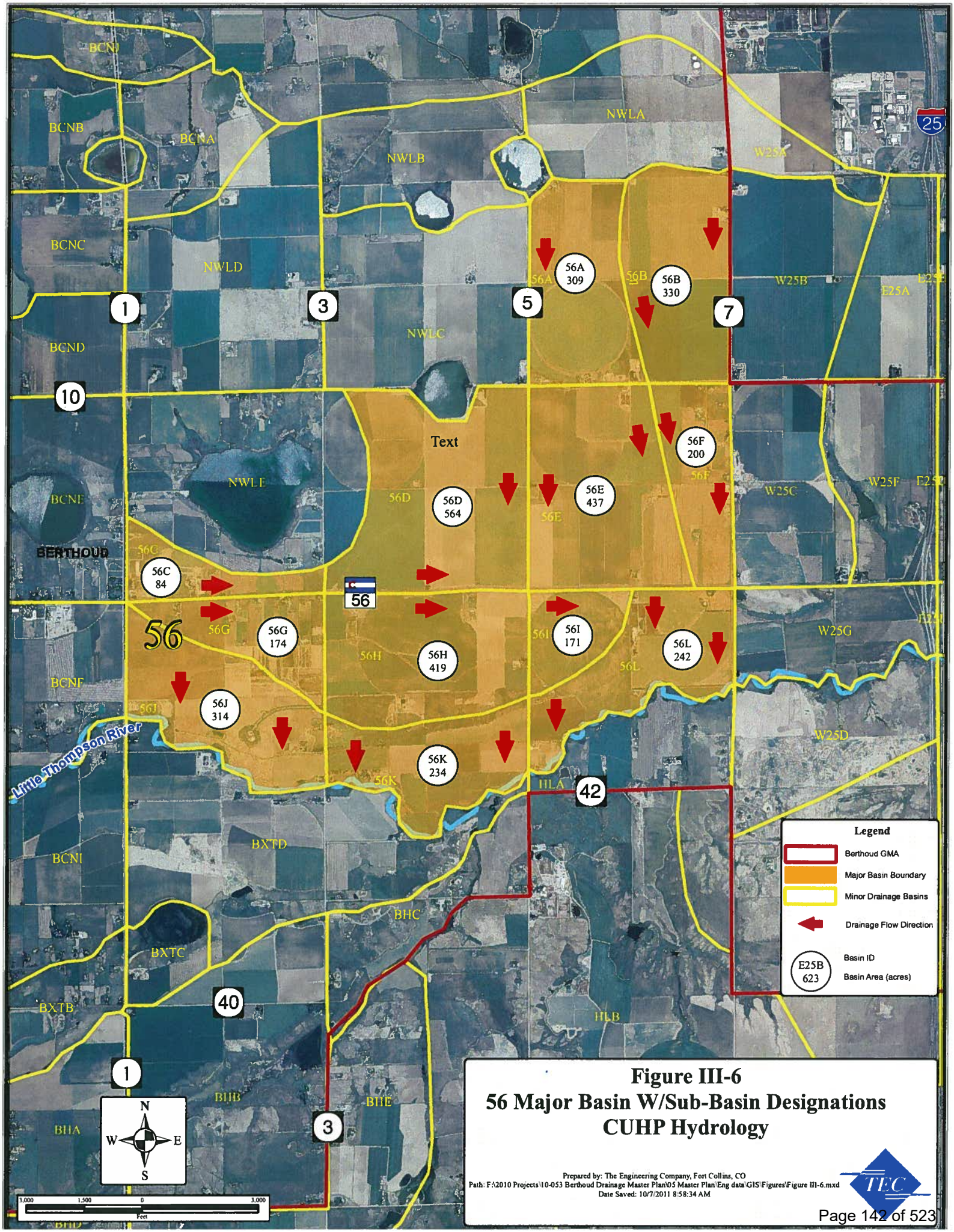


Figure III-6
56 Major Basin W/Sub-Basin Designations
CUHP Hydrology

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crosses the intersection by overtopping the intersection. From that corner, runoff is conveyed south through sub-basin 56F.

56C

Sub-basin 56C is located north of Highway 56, and is bounded on the east and west by CR-3 and N. County Line Road, respectively. The sub-basin consists of approximately 84 acres, and runoff is conveyed south and east to the southeast corner of Highway 56 and CR-3. Runoff is conveyed east under CR-3 through a 36-inch diameter CMP into sub-basin 56D.

56D

Sub-Basin 56D is located north of Highway 56, and is bounded on the west by CR-3 and on the east by CR-5. The sub-basin consists of approximately 564 acres. Runoff generated within the sub-basin drains to the south and east along Highway 56. Runoff from the sub-basin concentrates in the southeast corner of the sub-basin where it is conveyed under CR-5 and into sub-basin 56E by a 36-inch diameter CMP.

56E

Sub-basin 56E is located north of HWY-56 and is bounded on the west by CR-5 and on the east by topographically high ridge. The sub-basin consists of approximately 437 acres, and rainfall runoff drains in a south and east direction. Runoff is conveyed across HWY-56 by a 42-inch diameter CMP into sub-basin 56L.

56F

Sub-basin 56F is located north of Highway 56 and south of CR-46. The eastern boundary is CR-7 and the west is bounded by a topographic high point. The sub-basin consists of approximately 200 acres, and rainfall runoff drains towards the southeast corner of the sub-basin where it is conveyed across Highway 56 by a 42-inch diameter RCP.

56G

Sub-basin 56G is located immediately south of Highway 56 and west of CR-3. The sub-basin consists of approximately 174 acres, and rainfall runoff drains to the north towards Highway 56 and east towards the northeast corner of the sub-basin where it is conveyed under CR-3 by a 36-inch diameter CMP and into sub-basin 56H.

56H

Sub-basin 56H is located immediately south of Highway 56 and west of CR-5. The sub-basin consists of approximately 419 acres, and rainfall runoff drains north towards Highway 56 and east towards the northeast corner of the sub-basin where it is conveyed under CR-5 by a 36-inch diameter CMP and into sub-basin 56I.

56I

Sub-basin 56I is located immediately south of Highway 56 and directly east of CR-5. The sub-basin consists of approximately 170 acres, and rainfall runoff drains north towards Highway 56 where it then is conveyed east and finally into a natural drainageway that conveys the flow south towards the LTR.

56J

Sub-basin 56J is located north of the LTR and east of N. County Line Road. The sub-basin consists of approximately 314 acres, and rainfall runoff drains directly south to the LTR.

56K

Sub-basin 56K is located north of the LTR and east of CR-5. The sub-basin consists of approximately 234 acres, and rainfall runoff drains directly south to the LTR.

56L

Sub-basin 56L is located north of the LTR and east of CR-7. The sub-basin consists of approximately 242 acres, and rainfall runoff drains directly south to the LTR.

Table III-6, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-6: CUHP Sub-Basin Summary
Highway 56 Basin

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
56A	309.3	5	9	107	428
56B	330.2	5	11	134	499
56C	84.5	25	20	66	186
56D	564.2	5	13	138	622
56E	436.8	5	9	106	433
56F	200.1	10	11	75	268
56G	173.8	15	16	75	252
56H	419.4	5	9	106	451
56I	170.7	5	4	44	196
56J	314.2	2	4	99	434
56K	234.0	2	4	120	481
56L	242.4	2	3	81	344

Hydraulic Analysis

Table III-7 summarizes the results of the hydraulic modeling of the Highway 56 drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-7 shows location of key junctions and conveyance elements within the drainage basin.

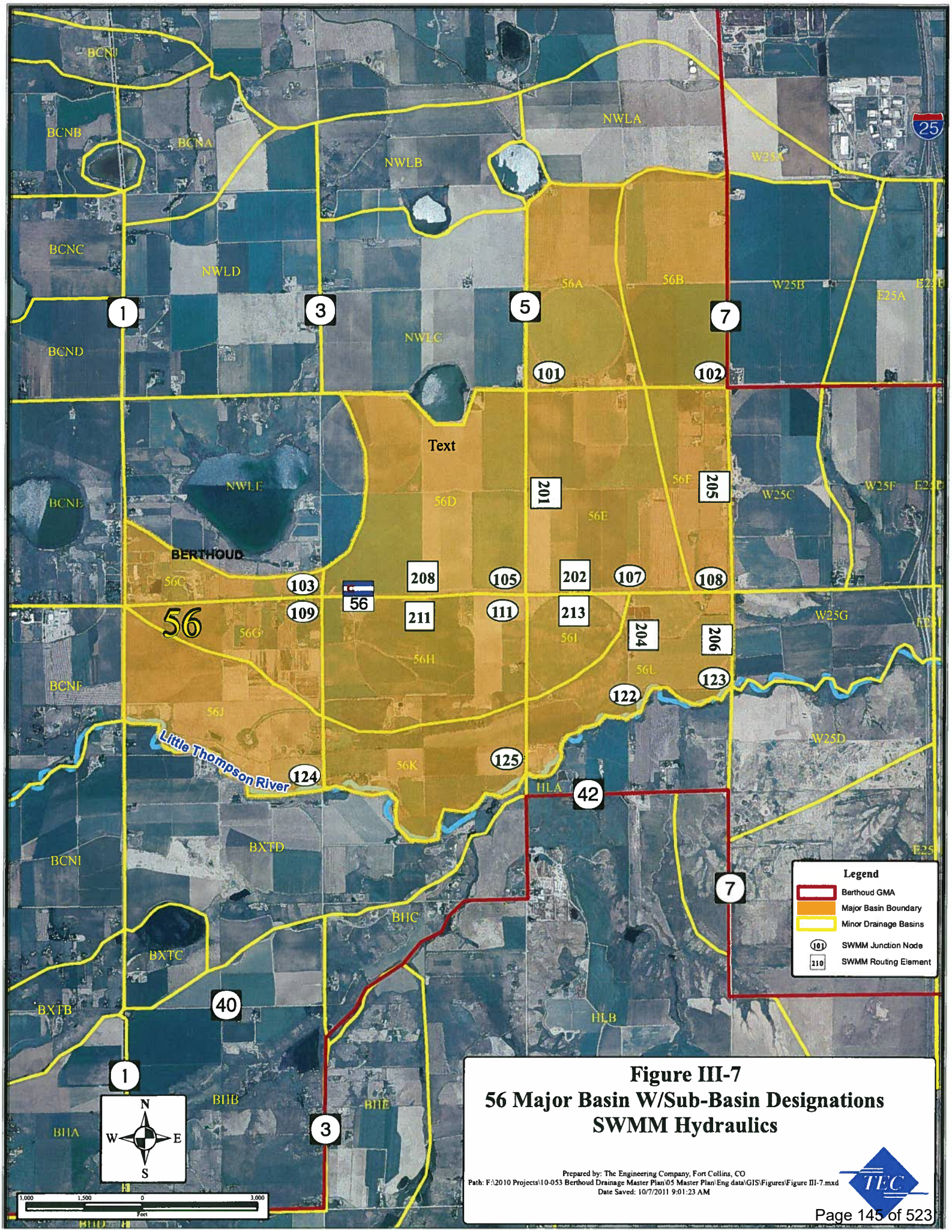


Figure III-7
56 Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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Table III-7: SWMM Element Summary
Highway 56 Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	Crossing CR-46	9	107	428
102	Crossing CR-46	11	134	499
103	Crossing CR-3	20	66	186
105	Crossing CR-5	31	179	643
107	Crossing CR-44	30	125	453
108	Crossing CR-44	22	113	306
109	Crossing CR-3	16	75	252
111	Crossing CR-5	25	128	473
122	Outfall to River	54	261	605
123	Outfall to River	21	64	64
124	Outfall to River	4	99	434
125	Outfall to River	4	120	481
CONVEYANCE ELEMENTS				
201	Roadside Ditch	9	10	10
202	Roadside Ditch	21	21	21
204	Overland Channel	52	186	262
205	Roadside Ditch	11	38	38
206	Overland Channel	21	64	64
208	Roadside Ditch	20	21	21
211	Roadside Ditch	16	21	21
213	Roadside Ditch	19	26	26

Table III-7 summarizes the peak runoff approaching each element. SWMM results indicate that many of the key elements within the Highway 56 drainage basin are currently not sized to convey the 100-year rainfall event runoff. In particular crossings at most of the county roads within the drainage basin are inadequate to convey even the 10-year rainfall runoff. These are occurrences where the downstream conveyance element is not capable of carrying the peak flow arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, can result in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To

determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

4. Newell Reservoir

The Newell Reservoir (NWL) drainage basin is located within the northern portion of the of the Town's GMA. It borders the Highway 56 drainage basin to the east and south, and the Bacon Lake drainage basin on the west. The northern edge of the drainage basin is bounded by a topographic ridge in the landscape. The drainage basin lies entirely within the Town's GMA and is composed of approximately 2,590 acres of cultivated open agricultural fields. Refer to Figure III-1 for the basin's relationship to the Town's GMA.

Newell Reservoir is located in the southwest portion of the drainage basin and is the recipient of the basin's storm runoff. Additional reservoirs are located throughout the drainage basin, most notably DeFrances Reservoir and Hummel Reservoir. These reservoirs are used to hold irrigation water for the surrounding fields and are not included as part of the storm water management plan.

The drainage basin is further divided into seven sub-basins. The basin and its sub-basins are shown on Figure III-8. The sub-basins are defined primarily by existing drainageways, roads, and local topography. Runoff within each sub-basin is collected and concentrated at a particular point. These collection points are often defined by intersections, drainage features, or road crossing structures. These points of concentration become the design points for future storm water management recommendations and improvements. Table III-8 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

The following sections provide a description of each sub-basin and its associated drainage features, along with points of concentration:

NWLA

Sub-basin NWLA is located in the northeastern extent of the drainage basin. The sub-basin is located west of County Road 7 (CR-7) and north of County Road 48 (CR-48). The western extent is defined by the DeFrances Reservoir and County Road 5 (CR-5). The sub-basin consists of approximately 434 acres. Runoff from the sub-basin drains to the south and west collecting at the southwest corner of the sub-basin within the Defrances Reservoir. The Defrances Reservoir is utilized for irrigation purposes, and is not developed for the containment of storm water runoff. For the purposes of future planning and development the reservoir does not provide storage for storm water runoff. From sub-basin NWLA storm water is conveyed south through sub-basin NWLC.

NWLB

Sub-basin NWLB is located in the northern portion of the drainage basin. The sub-basin is located west of CR-5 and west of County Road 3 (CR-3). It is bounded on the south by CR-48. The sub-basin consists of approximately 415 acres of cultivated agricultural fields. Storm water runoff generated within the basin flows to the south and collects along CR-48 and concentrates at the road crossing near the unnamed reservoir. Runoff from this sub-basin is then conveyed south through sub-basin NWLC.

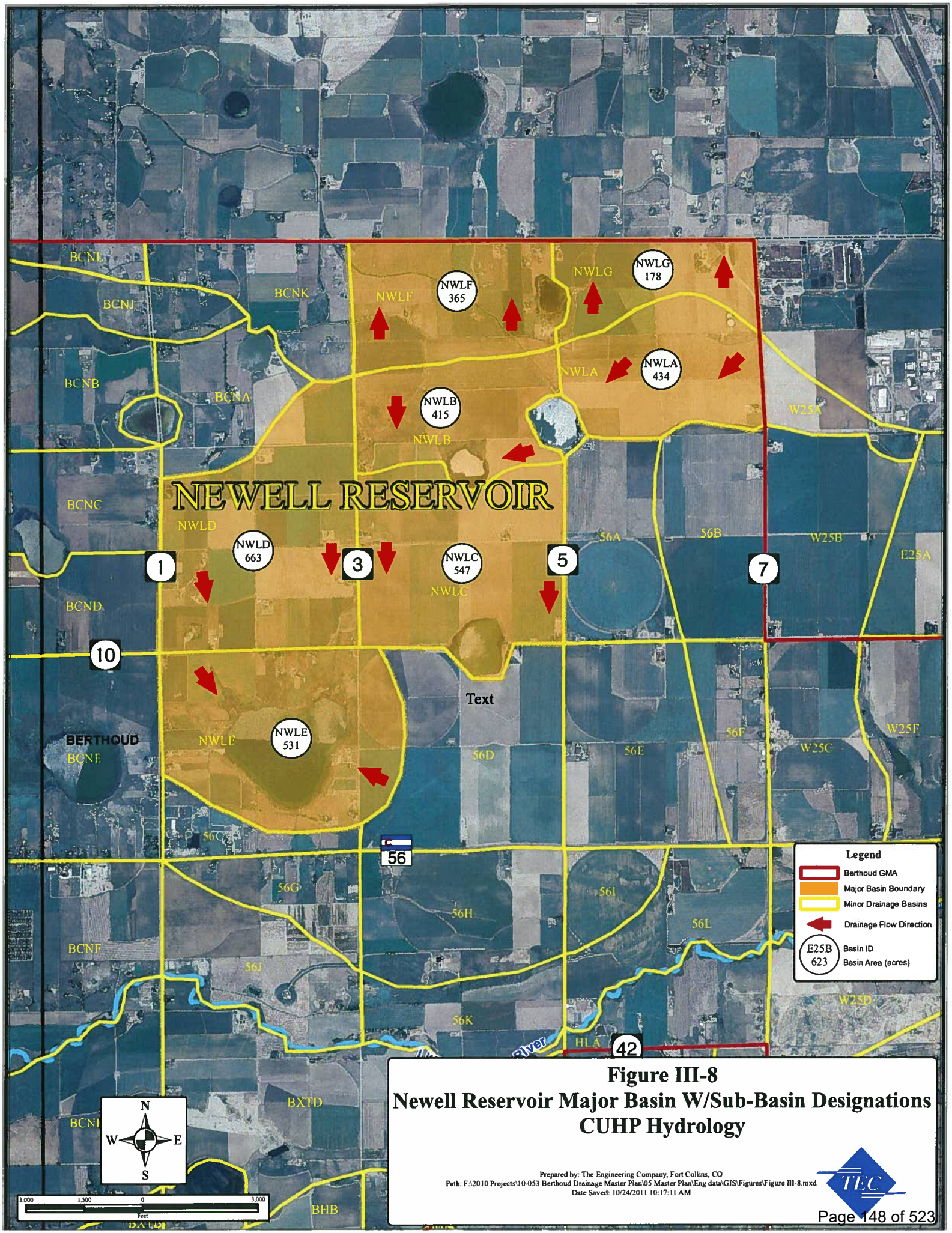


Figure III-8
Newell Reservoir Major Basin W/Sub-Basin Designations
CUHP Hydrology

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NWLC

Sub-basin NWLC is located in the center of the drainage basin, north of County Road 46 (CR-46), and bounded on the east and west by CR-5 and CR-3, respectively. The sub-basin consists of approximately 547 acres of cultivated agricultural fields. Storm water runoff generated within the basin drains to the south and west where it eventually collects at the northeast corner of the intersection of CR-3 and CR-46. Runoff is then conveyed across the intersection and into sub-basin NWLE.

NWLD

Sub-basin NWLD is located along the western edge of the drainage basin. It is bounded on the east and west by CR-3 and County Line Road, respectively, and the southern boundary is defined by CR-46. The sub-basin consists of approximately 663 acres of cultivated agricultural fields and drains to the south where runoff collects along CR-46. Most of the flow along CR-46 is conveyed to the east and collects at the intersection of CR-46 and CR-3. Evidence suggests that storm water runoff has crested CR-46 prior to the intersection and continued south towards Newell Reservoir. Runoff that is collected at the intersection is conveyed across and intersection and south through sub-basin NWLE.

NWLE

Sub-basin NWLE is located in the southwest portion of the drainage basin. The east and west boundaries are defined by CR-3 and County Line Road, respectively; the northern boundary is CR-46. The sub-basin is composed of approximately 532 acres of mostly cultivated agricultural fields with light individual residential development in the sub-basin. The dominant feature within the sub-basin is Newell Reservoir, which has a surface area of approximately 122 acres. The reservoir has no apparent outfall, and is a naturally occurring low spot in the topography. According to discussions with the operators of Newell Reservoir, water is pumped from Newell to Bacon Lake to be used as augmentation water within the LTR. All runoff within sub-basin NWLE, as within the entire drainage basin, flows ultimately into Newell Reservoir.

NWLF

Sub-basin NWLF is located in the northern portion of the GMA. The east and west boundaries are defined by CR-5 and CR-3, respectively. The northern boundary is CR-46/HWY-60 and corresponds with the northern extent of the GMA. The sub-basin is composed of approximately 365 acres of primarily cultivated agricultural fields. Runoff drains to the north and collects along CR-46/HWY-60 and ultimately leaves the GMA to the north.

NWLG

Sub-basin NWLG is located in the northern boundary of the GMA. The east and west boundaries of the sub-basin are defined by CR-7 and CR-5, respectively. The sub-basin is composed of approximately 178 acres of cultivated agricultural fields. Runoff drains to the north and exits the GMA across CR-46/HWY-60.

Table III-8, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-8: CUHP Sub-Basin Summary
Newell Reservoir Basin

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
NWLA	433.7	5	85	193	474
NWLB	415.2	5	98	228	573
NWLC	546.8	5	148	334	797
NWLD	662.7	5	79	191	500
NWLE	531.9	5	331	674	1,401
NWLF	365	3	75	183	414
NWLG	178	3	36	79	180

Hydraulic Analysis

Table III-9 summarizes the results of the hydraulic modeling of the Newell Reservoir drainage basin and its sub-basins for the 2-, 10-, and 100-year rainfall events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-9 shows location of key junctions and conveyance elements within the drainage basin.

Table III-9: SWMM Element Summary
Newell Reservoir Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	DeFrances Reservoir	85	193	474
102	Hummel Reservoir	179	342	686
103	Crossing CR-46	159	365	833
104	Crossing CR-46	83	193	500
107				
108	Newell Reservoir	366	712	1,439
CONVEYANCE ELEMENTS				
201	Roadside Ditch	83	116	119
203	Roadside Ditch	38	38	38
205				
207	Overland Channel	97	227	570

Table III-9 summarizes the peak runoff approaching each element. SWMM routing results indicate that some of the key elements within the Newell Reservoir drainage basin are currently not sized to convey the 100-year rainfall event runoff. In particular, crossings at most of the county roads within the drainage basin

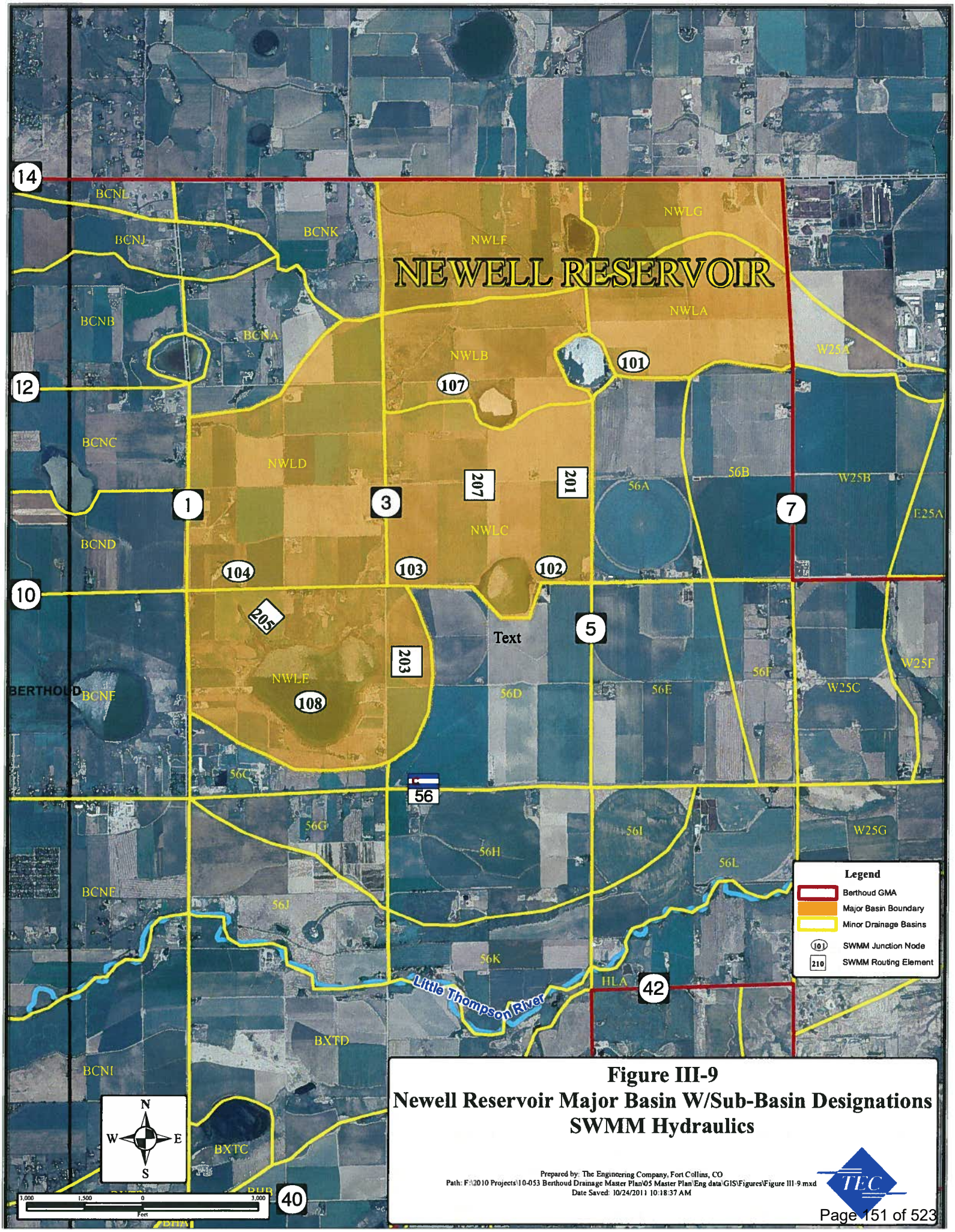


Figure III-9
Newell Reservoir Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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are inadequate to convey the even the 10-year rainfall runoff. These are occurrences where the downstream conveyance element is not capable of carrying the peak flow arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, can result in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

5. Highlands

The Highlands (HL) drainage basin is located south of the LTR and west of sub-basin W25. Most of the drainage basin is located outside of the Town's GMA. The entire drainage basin is comprised of approximately 3,125 acres with approximately 89 percent of the basin located outside the Town's GMA. The basin's runoff generally follows the topography and flows in a north and east direction until it reaches the GMA.

The Highlands drainage basin is further divided into 2 sub-basins as shown on Figure III-10. These sub-basins are defined primarily by existing drainageways, roads, and local topography. Each of the sub-basins drains to a general point of concentration, an intersection, drainage feature, or road crossing. Table III-10 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

The following sections provide a description of each sub-basin and its associated drainage features, along with points of concentration:

HLA

The sub-basin HLA is located directly south of the LTR and is placed in a position where the Town's GMA is very near the LTR. The sub-basin lies mostly in the GMA and is comprised of approximately 344 acres. The eastern boundary is defined by CR7 and the western limit is bounded by CR5. The northern extent is the LTR and the southern extent is mostly CR42, which corresponds with the Town's GMA. A small portion extends south beyond the GMA and is composed of a natural drainageway that drains directly into the GMA. The sub-basin land usage is primarily agricultural fields with very little residential development. All runoff within sub-basin HLA drains north and directly into the LTR.

HLB

Sub-basin HLS is located entirely outside the Town's GMA and is composed of approximately 2,781 acres. Due to the sub-basin's location outside the GMA, its analysis is limited to runoff flows generated and the entry into the GMA, particularly into sub-basin HLA. The runoff flows generated within sub-basin HLB generally flow to the north and east as a topographical high defines the southern boundary and a topographical ridge between HLB, and the Big Hollow drainage basin defines the western boundary. Runoff drains to

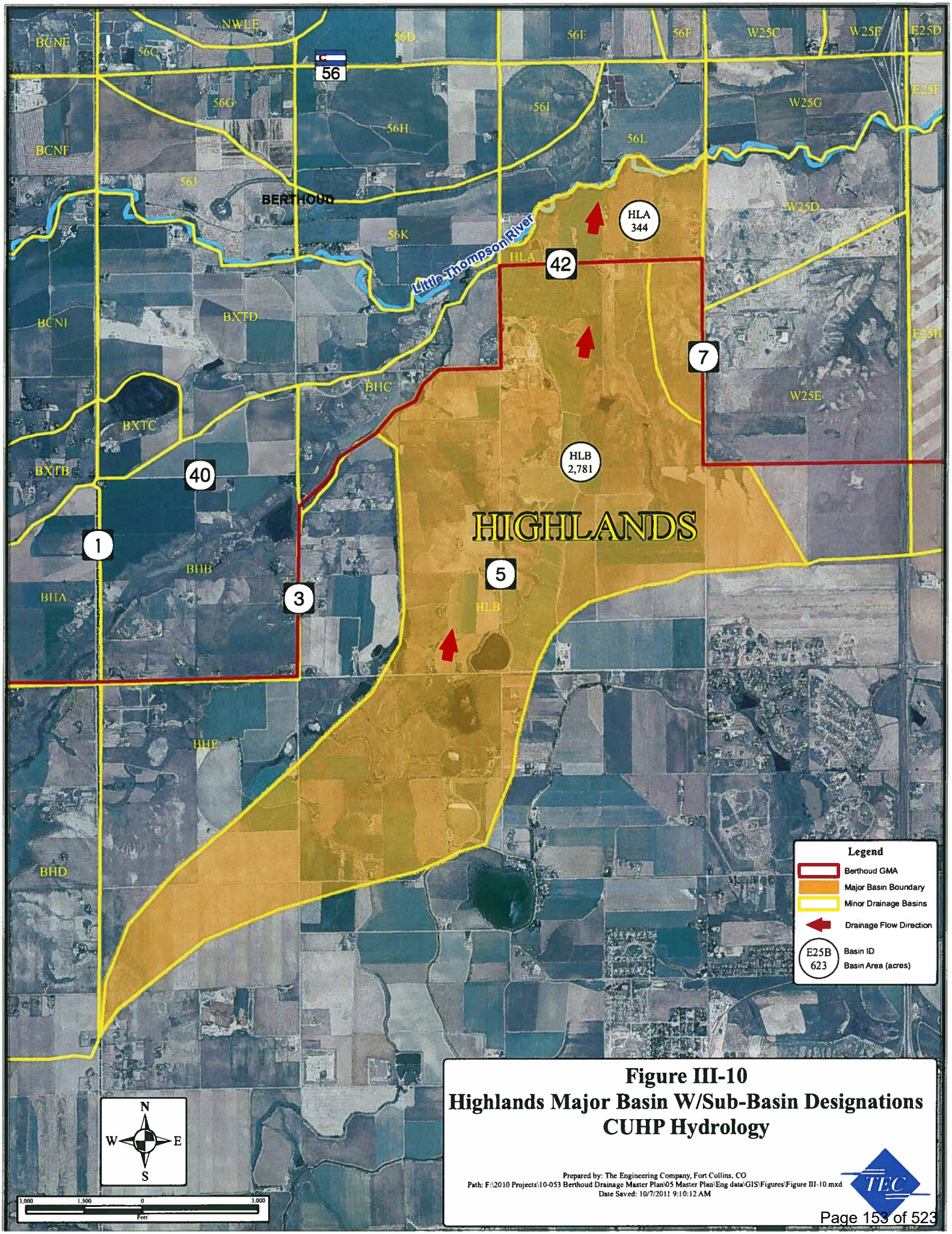


Figure III-10
Highlands Major Basin W/Sub-Basin Designations
CUHP Hydrology

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the north and reaches CR42. The flow is then conveyed via a roadside ditch west where it collects at the southeast corner of the intersection at CR42 and CR5. Here, the pooled drainage eventually crests CR42 and flows northward, entering the GMA and sub-basin HLA. From here the flow continues north and enters the LTR approximately 400 feet north of CR-42.

Table III-10, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-10: CUHP Sub-Basin Summary
Highlands Basin

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
HLA	344.3	3	147	333	718
HLB	2,781.3	3	456	1,109	2,674

Hydraulic Analysis

Table III-11 summarizes the results of the hydraulic modeling of the Highlands drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-11 shows location of key junctions and conveyance elements within the drainage basin.

Table III-11: SWMM Element Summary
Highlands Basin

SWMM Element ID	Sub -Basin	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENT					
101	HLB	GMA Entry	550	1,109	2,674
CONVEYANCE ELEMENT					
201	HLA	Overland Channel	550	1,110	2,673

Table III-11 summarizes the peak runoff approaching each element. SWMM routing results indicate magnitude of the peak flows for each of the modeled elements and rainfall events.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies

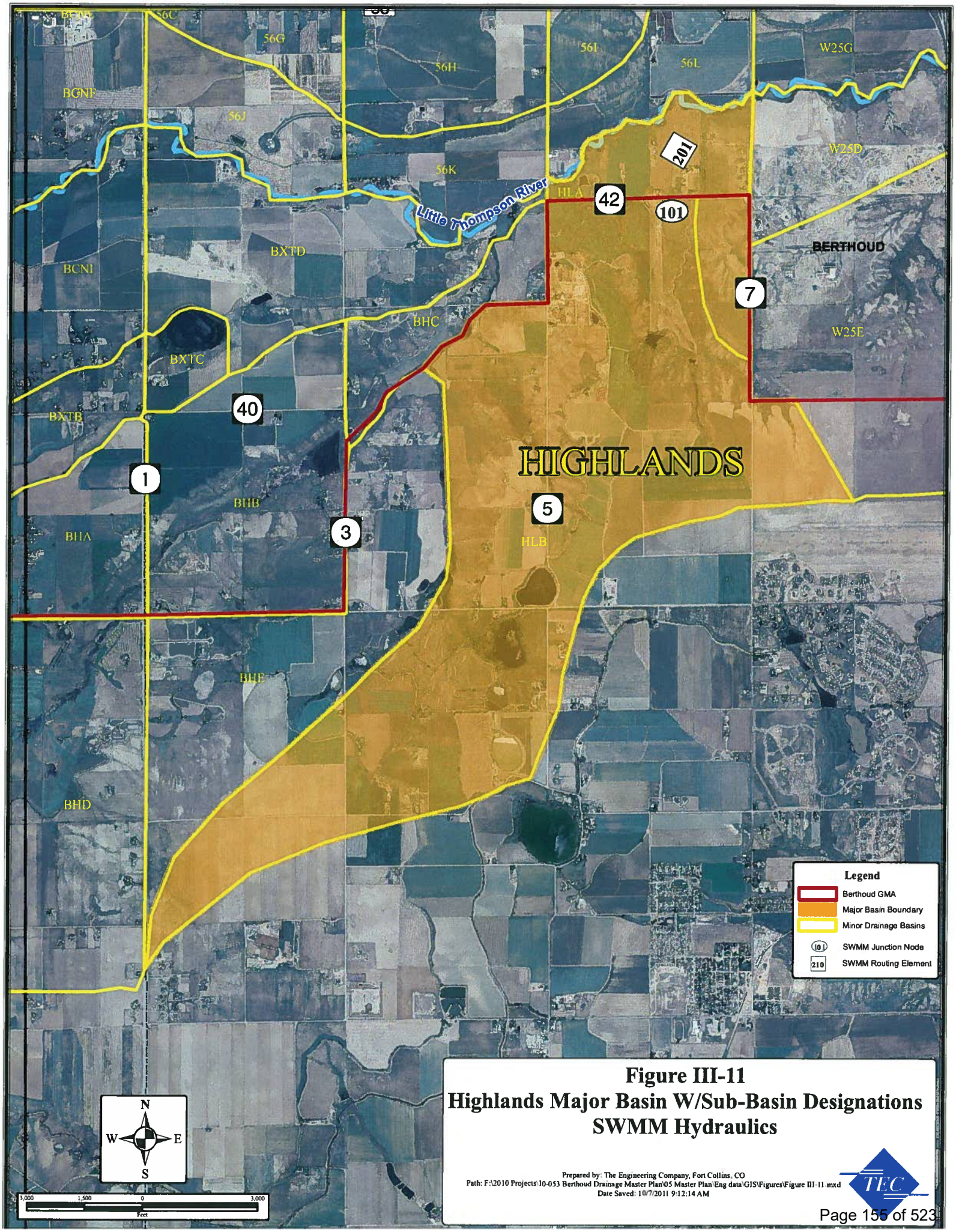


Figure III-11
Highlands Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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are required. The modeling created in this study can be used as the basis for analyzing future improvements and can be updated accordingly as improvements are completed.

6. Baxter Reservoir

The Baxter Reservoir (BXT) drainage basin is located south of the LTR. The basin lies entirely within the Town's GMA and is comprised of approximately 1,676 acres. The basin is irregular in shape and follows a natural drainage swale from the northeast corner of Ish reservoir, northeast to the LTR. The basin is the primary spillway for the Ish Reservoir located to the southwest.

The Baxter Reservoir drainage basin is further divided into four sub-basins as shown on Figure III-12. These sub-basins are defined primarily by existing drainageways, roads, and local topography. Each of the sub-basins drains to a general point of concentration, an intersection, drainage feature, or road crossing. Table III-12 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

The following sections provide a description of each sub-basin and its associated drainage features, along with points of concentration:

BXTA

BXTA is located immediately northeast of the Ish reservoir, is entirely within the GMA, and contains approximately 548 acres. The sub-basin is bounded on the west by CR17 and on the east by CR15. The southern boundary is CR2 and the northern boundary is a topographical ridge. See Figure III-12 for the extents and boundaries of the sub-basin. The sub-basin consists primarily of agricultural fields. The drainage is primarily to the northeast and crosses CR2e. The Ish Canal also crosses the sub-basin in a west to east direction. Runoff in the sub-basin flows in a northeast direction and tends to concentrate along CR15 on the eastern boundary of the sub-basin. The railroad tracks and the county road then channel the flow to the north.

BXTB

Sub-basin BXTB is located immediately east of CR15, is entirely within the GMA, and contains approximately 400 acres. The sub-basin is located between two irrigation canals to the north and south, and between CR157 to the west and S. County Line Road on the east. Flows in the sub-basin travel in a northeast direction and collect in a roadside ditch along S. County Line Road. The flow concentrates at the southwest corner of the intersection of S. County Line Road and E. CR4. From this location the flow crosses the intersection into sub-basin BXTC and Baxter Lake.

BXTC

Sub-basin BXTC is located immediately east of S. County Line Road and east of E. CR40. It is located entirely within the GMA and contains approximately 104 acres. The primary feature of the sub-basin is the presence of Baxter Reservoir. This reservoir is primarily an irrigation reservoir and has a surface area of approximately 41 acres. Runoff generated in the sub-basin flows to the northeast through the reservoir and on to sub-basin BXTD.

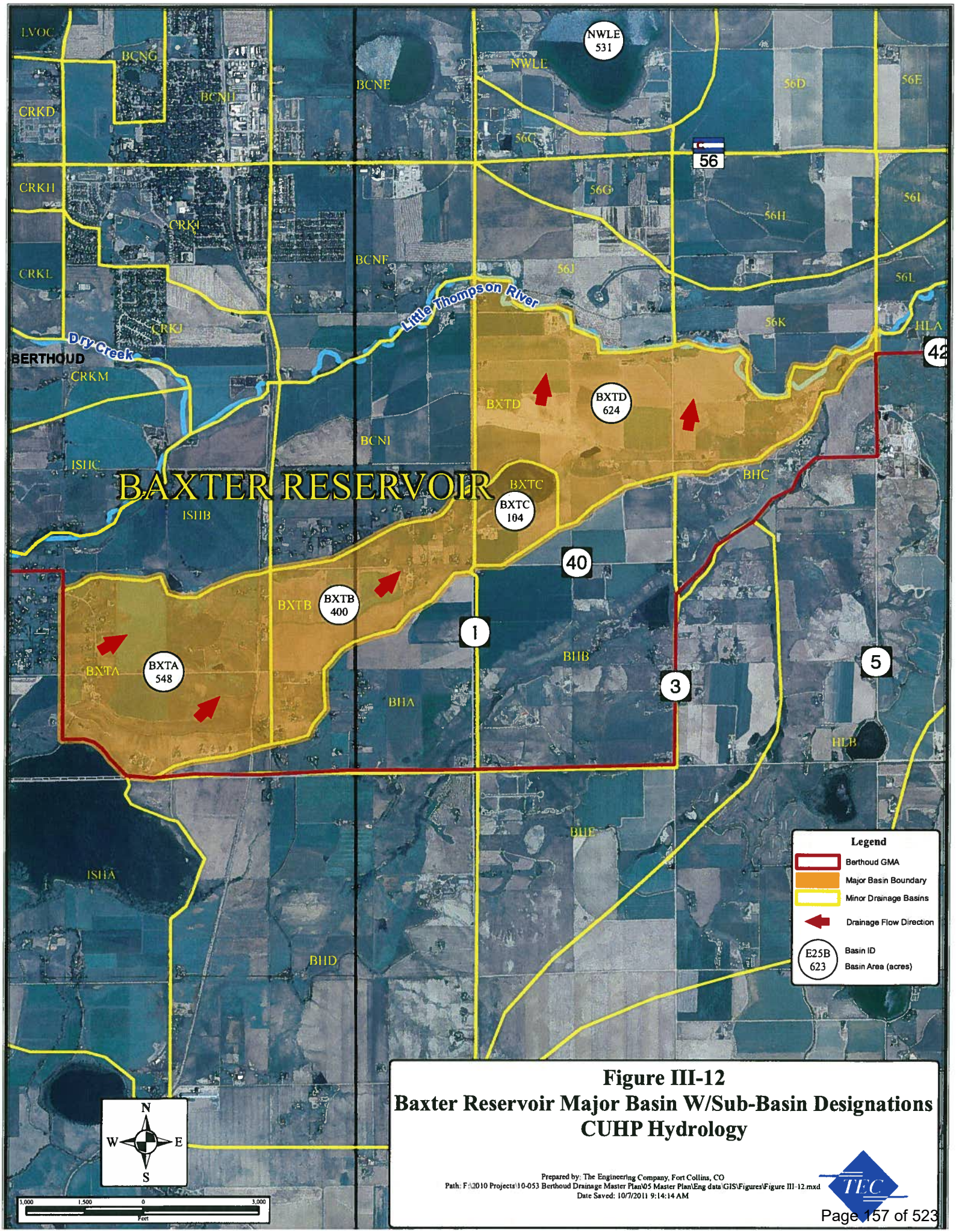


Figure III-12
Baxter Reservoir Major Basin W/Sub-Basin Designations
CUHP Hydrology

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BXTD

Sub-basin BXTD is located immediately south of LTR, is located entirely within the Town's GMA, and contains approximately 624 acres. The north boundary is the LTR and the south is bounded by a topographical ridge that intersects with the LTR to the east. The western boundary is S. County Line Road. The sub-basin consists primarily of agricultural fields and unimproved dirt roads. Runoff generated within the sub-basin flows predominantly to the north and directly into the LTR.

Table III-12, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-12: CUHP Sub-Basin Summary
Baxter Reservoir

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
BXTA	548.3	3	7	150	511
BXTB	399.8	3	5	103	402
BXTC	103.8	3	2	35	145
BXTD	624.5	3	9	164	703

Hydraulic Analysis

Table III-13 summarizes the results of the hydraulic modeling of the Baxter Reservoir drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-13 shows location of key junctions and conveyance elements within the drainage basin.

Table III-13: SWMM Element Summary
Baxter Reservoir Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	WCR-2E	7	150	511
102	Crossing CR-15	11	247	897
103	Crossing County Line Road	12	270	1,013
CONVEYANCE ELEMENTS				
201	Overland Channel	7	150	509
202	Overland Channel	11	247	896
203	Overland Channel	12	270	1,012

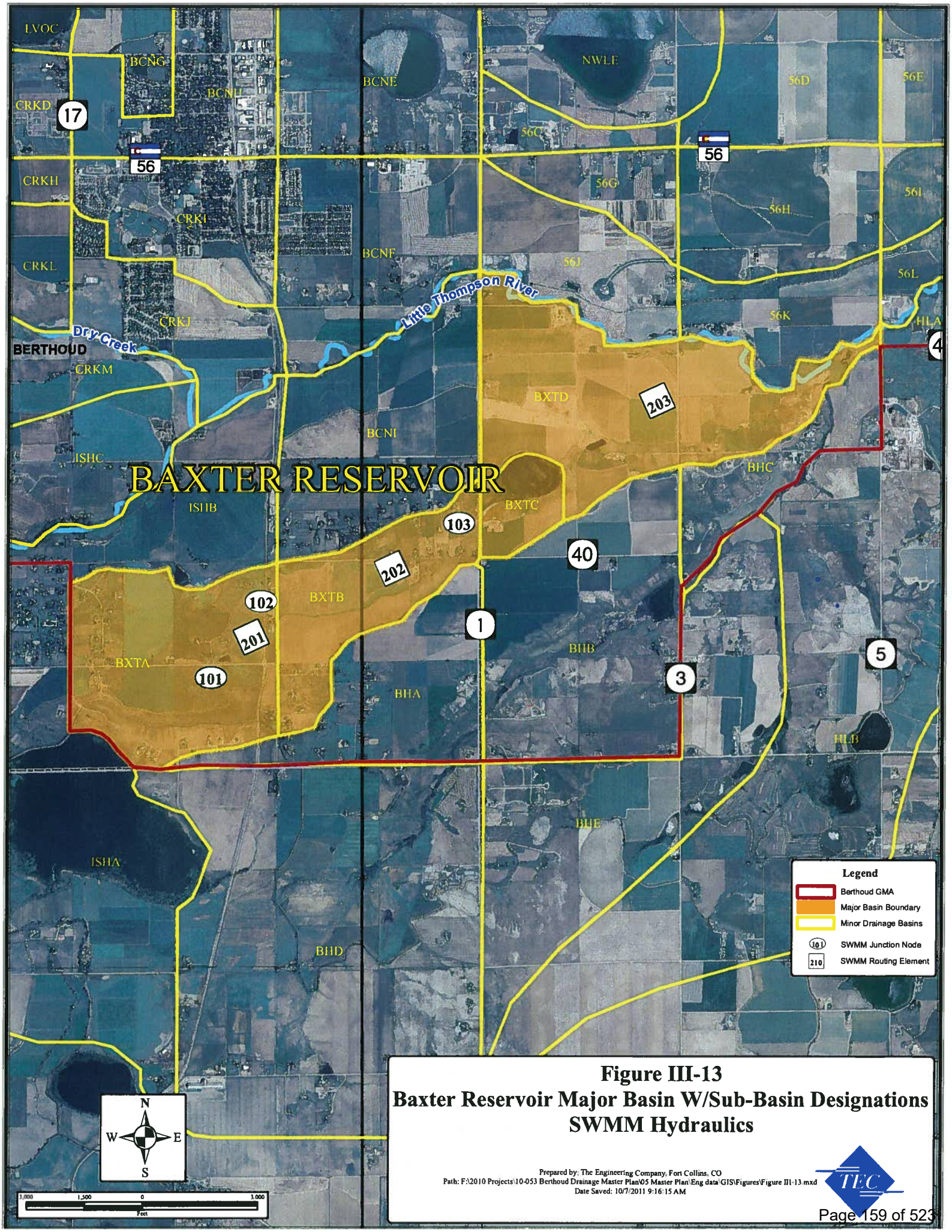


Figure III-13
Baxter Reservoir Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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Table III-13 summarizes the peak runoff approaching each element. SWMM routing results indicate magnitude of the peak flows for each of the modeled elements and rainfall events.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

7. Big Hollow

The Big Hollow (BH) drainage basin is located in the southern portion of the study area. A large amount of the contributing basin lies outside the Town's GMA. The basin runoff flows generally in a north and east direction, eventually reaching the LTR. The basin consists of approximately 4,427 acres and is predominantly agricultural fields with a small amount of light residential development. The basin is further divided into five sub-basins. BH and its sub-basins are shown in Figure III-14. Table III-14 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

The following sections provide a description of each sub-basin and its associated drainage features, along with points of concentration:

BHA

Sub-basin BHA is located north of CR2, lies entirely within the Town's GMA, and consists of approximately 437 acres. The eastern boundary is S. County Line Road and the Ish Ditch constitutes the north and west boundaries. Runoff within the sub-basin flows predominantly to the south and east. Roadside ditches along CR2 and S. County Line Road convey runoff towards the southeast corner of the sub-basin where an overland drainage stream identified as the Big Hollow Stream cuts across the sub-basin and carries flow to the northeast and into sub-basin BHB. The primary land use in the sub-basin is agricultural fields with a small amount of light residential development.

BHB

Sub-basin BHB is located immediately east of S. County Line Road, lies entirely within the Town's GMA, and consists of approximately 769 acres. The Ish Ditch is the northern boundary and CR2 is the southern extent, which is also the boundary for the Town's GMA to the south. CR3 is the eastern boundary and the aforementioned S. County Line Road is the western limit. The primary land use within the sub-basin is agricultural with very little residential development. A stream travels from the western boundary northeast across the sub-basin to exit the eastern boundary. This drainage feature effectively divides the sub-basin into northern and southern portions, with the northern portion draining south and the southern portion draining north. The drainage stream flows into Rockwell Reservoir located along the eastern edge of the sub-basin. Rockwell Reservoir is a small irrigation reservoir occupying approximately 10 acres within the sub-basin. Topography within the basin drains runoff to the east and towards the natural stream.

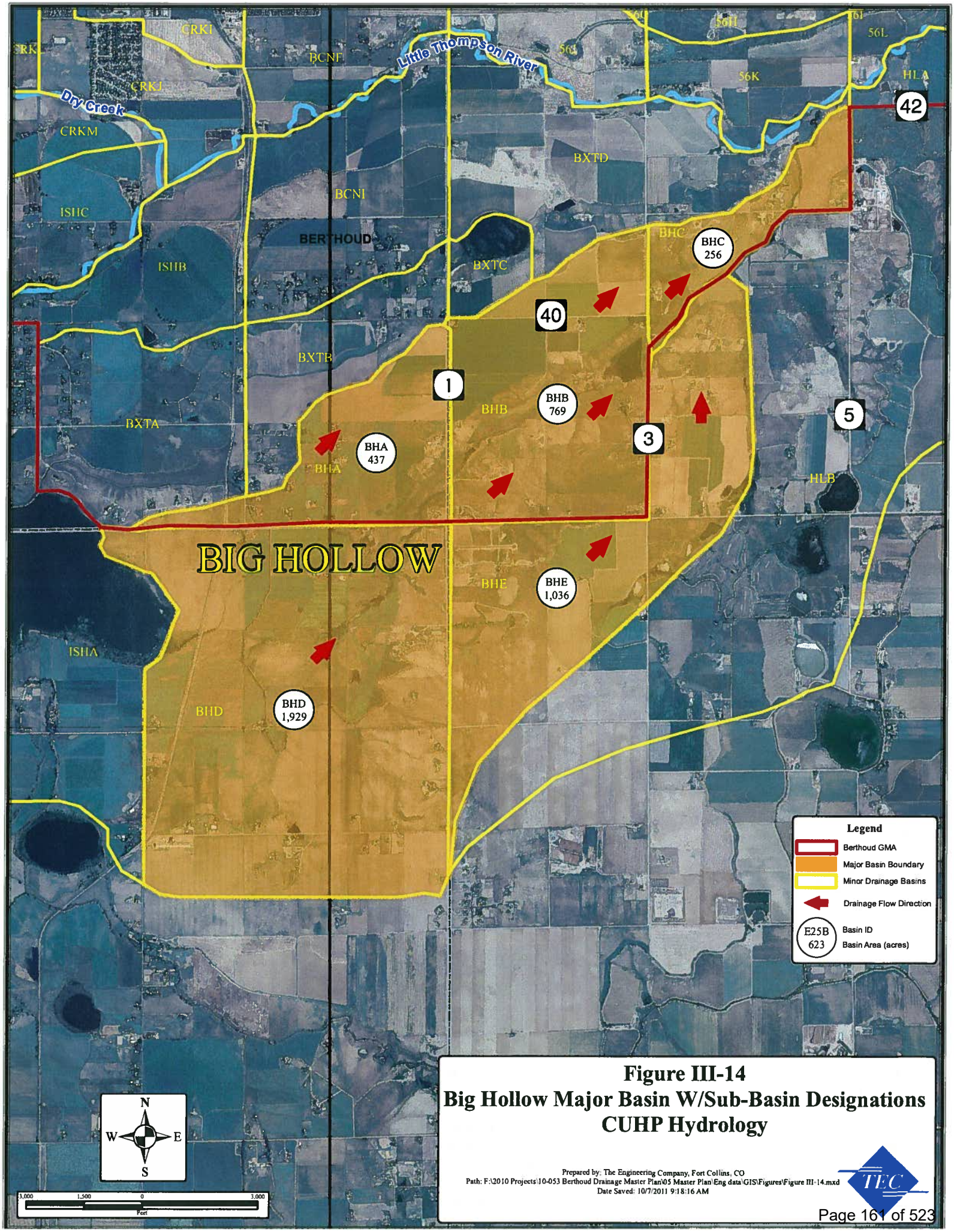


Figure III-14
Big Hollow Major Basin W/Sub-Basin Designations
CUHP Hydrology

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BHC

Sub-basin BHC is located immediately east of CR3, is entirely within the Town's GMA and consists of approximately 256 acres. The north boundary is the Ish Ditch and the south boundary is the Big Hollow Ditch Stream that exits the Rockwell Reservoir in BHB. The drainage stream on the north boundary also denotes the limits of the Town's GMA, and at this point the stream becomes a series of small impoundments that hold back flow as it travels to the northeast towards the LTR.

BHD

Sub-basin BHD is located immediately north of CR2, is entirely outside the Town's GMA, and consists of approximately 1,929acres. Due to its location outside the GMA, the analysis of the sub-basin is limited to the amount of flows generated and where those flows enter into the GMA. In the case of BHD, the flows generated within the basin are shown on Table III-14. In general, the flows generated in BHD drain to the north and east within the basin and enter the GMA within the Big Hollow Ditch Stream located near the southeast corner of sub-basin BHA. The stream then carries these generated flows through BHA and the rest of the Big Hollow drainage basin.

BHE

Sub-basin BHE is located immediately north of CR2, is entirely outside the Town's GMA, and consists of approximately 1,035 acres. Due to the sub-basin's location outside the Town's GMA, the analysis of the sub-basin is limited to the peak flow generated and the entry point into the GMA. The runoff flows must be accounted for when planning drainage and conveyance features in the future. The topography of the sub-basin drains runoff to the east where a series of impoundment reservoirs are located to the east of CR30. These holding reservoirs carry flow to the north in drainage streams where the flow from BHE eventually enters the GMA at sub-basin BHC. The Big Hollow Ditch Stream then carries the runoff flows to the LTR through sub-basin BHC.

Table III-14, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-14: CUHP Sub-Basin Summary
Big Hollow

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
BHA	436.6	3	5	107	367
BHB	769.1	3	9	157	708
BHC	255.6	3	3	55	189
BHD	1,929.4	3	21	443	1,502
BHE	1,035.8	3	8	181	604

Hydraulic Analysis

Table III-15 summarizes the results of the hydraulic modeling of the Big Hollow drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-15 shows location of key junctions and conveyance elements within the drainage basin.

Table III-15: SWMM Element Summary
Big Hollow Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	Crossing CR-2, Enter GMA	21	443	1,502
102	Crossing County Line Road	17	143	385
103	Crossing CR-3	25	288	1,063
CONVEYANCE ELEMENTS				
201	Overland Channel	13	58	139
202	Overland Channel	17	142	356
203	Overland Channel	23	206	236

Table III-15 summarizes the peak runoff approaching each element. SWMM results indicate that some of the key elements within the Big Hollow drainage basin are currently not sized to convey the 100-year rainfall event runoff, as well as the minor storm events in several instances. Currently, ponding and overtopping of junction nodes and points of concentration occurs at 101, 102, and 103. These particular points correspond with the road crossings at CR-2, the culvert crossings at County Line Road and CR-3, respectively. These are occurrences where the downstream conveyance element is not capable of carrying the peak flow arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, results in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements and can be updated accordingly as improvements are completed.

8. Bacon Lake

Bacon Lake (BCN) drainage basin is located in the central portion of the Town's GMA. The basin consists of approximately 4,535 acres, most of which are cultivated agricultural fields. A portion of the drainage

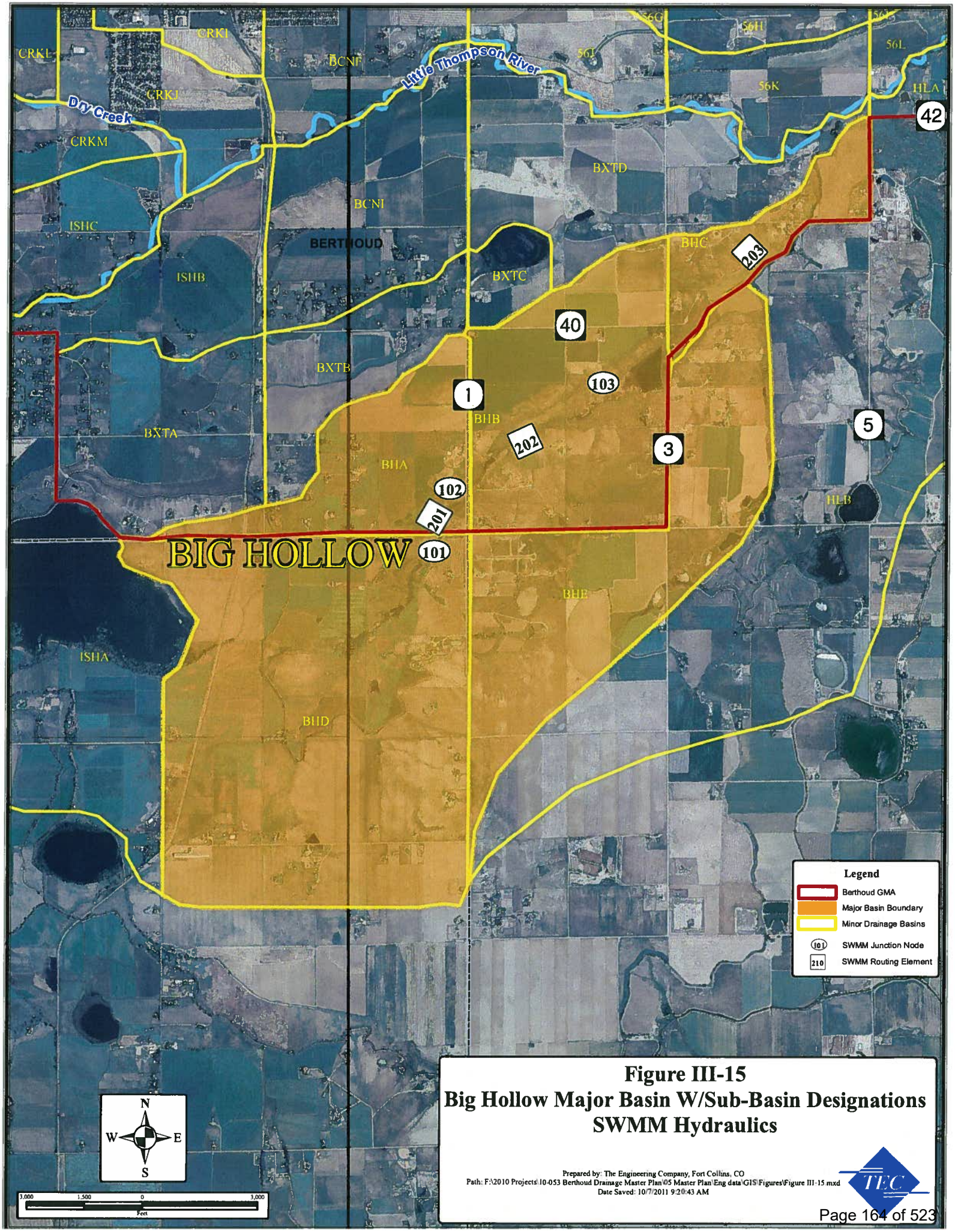


Figure III-15
Big Hollow Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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basin also consists of the developed downtown region of the GMA. This developed portion occupies approximately 600 acres of area mostly within the sub-basin BCNH. For the location and the extent of the drainage basin refer to Figure III-1.

The dominant drainage feature within the basin is Bacon Lake, located centrally to the drainage basin. Bacon Lake is a naturally occurring lake within the basin and occurs in a topographic low area. The lake is approximately 53 acres in area and is utilized to provide augmentation water to the LTR. Bacon Lake has historically been the recipient of the storm water runoff from the Town and the surrounding area.

The Bacon Lake drainage basin is further divided into 12 sub-basins. BCN and its sub-basins are shown in Figure III-16. Table III-16 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

The following sections provide a description of each sub-basin and its associated drainage features, along with points of concentration:

BCNA

Sub-basin BCNA is located in the northeast portion of the drainage basin and consists of approximately 324 acres of cultivated agricultural fields. The sub-basin lies entirely within the Town's GMA. Storm runoff flows to the south and west where it collects at the intersection of CR-48 and South Creek Road. At this point, flow is conveyed across the intersection and into sub-basin BCNC.

BCNB

Sub-basin BCNB is located towards the northern portion of the drainage basin and consists of approximately 538 acres of cultivated agricultural fields. The sub-basin lies entirely within the Town's GMA. Storm water runoff flows to the south where it collects along East County Road 12 (ECR-12). Most runoff collected along ECR-12 flows east to the intersection of ECR-12 and South Creek 13 (SC-13) where it is conveyed south through sub-basin BCNC. Evidence suggests that during heavy rainfall events, flow crests ECR-12 and travels directly south into the Sunnyslope Reservoir located in sub-basin BCNC.

BCNC

Sub-basin BCNC is located in the northern portion of the Bacon Lake drainage basin and is bounded on the east and west by SC-13 and County Road 15 (CR-15), respectively. Sunnyslope Reservoir is located along the southern boundary of the sub-basin. BCNC is composed of approximately 357 acres of cultivated agricultural fields. The Sunnyslope Reservoir located along the southern border has a surface area of approximately 26 acres. Storm runoff generated within the basin flows to the south and collects along the reservoir road and is conveyed toward the reservoir. At the reservoir, sub-basin-generated flows are conveyed south into and through sub-basin BCND.

BCND

Sub-basin BCND is located north of CR-46 and south of the Sunnyslope Reservoir between SC-13 to the east and CR-15 to the west. The sub-basin is composed of approximately 295 acres of cultivated agricultural fields, with light singular residential development. Flow generated within the sub-basin generally travels

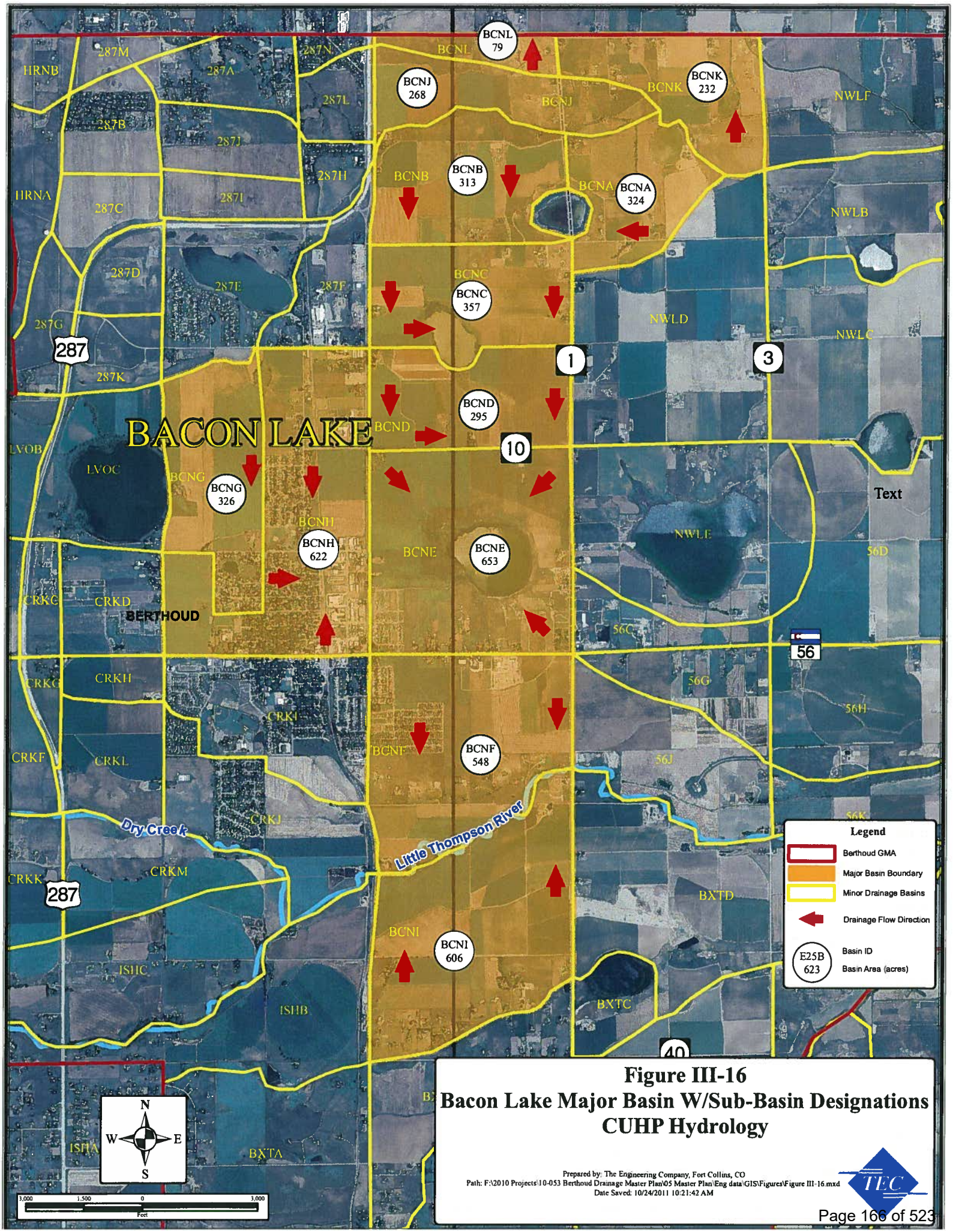


Figure III-16
Bacon Lake Major Basin W/Sub-Basin Designations
CUHP Hydrology

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to the south and east collecting along CR-46, and either crossing over the road at a local low spot, or heading east and concentrating at the northeast intersection of SC-13 and CR46. From this concentration point the flow travels south into sub-basin BCNE.

BCNE

Sub-basin BCNE is located centrally within the drainage basin with east and west borders at SC-13 and CR-15, respectively. BCNE is dominated by the presence of Bacon Lake located in a local low spot topographically. Bacon Lake is a naturally occurring lake with a surface area of approximately 61 acres. Historically, Bacon Lake has been the receiving body of much of the storm water runoff in the area, and particularly the downtown portion of the GMA. The entire sub-basin BCNE drains into Bacon Lake. As a naturally occurring low point topographically, the lake does not have an apparent outfall south towards the LTR. A hand wheel-operated slide gate controls releases of water through a man-made channel into the LTR. This is used to provide augmentation water to the LTR when users downstream put in a water call. Currently, there is no provision for water quality prior to the Town's storm water entering Bacon Lake. The outlet of the Town's storm sewer system is two 60" diameter reinforced concrete pipes, as shown in Photo III-3, above. These storm oulets drain directly into Bacon Lake.



Photo III-3 Storm Drain Outlets to Bacon Lake.

BCNF

Sub-basin BCNF is located on the north bank of the LTR and is bounded on the east by County Line Road and on the west by CR-15. The sub-basin is composed of approximately 548 acres of a mix of cultivated agricultural fields and residential subdivisions. Storm water runoff generated within the sub-basin is conveyed south via overland sheet flow and localized channels into the LTR.

BCNG

Sub-basin BCNG is located on the western extent of the Bacon Lake drainage basin. The western extent is defined by County Road 17 (CR-17), and the south boundary is mostly Bunyan Avenue. The sub-basin is composed of approximately 326 acres of cultivated agricultural fields. Storm water flow is conveyed to the south and collects along Bunyan Avenue where it is conveyed via a 24-inch diameter PVC pipe to the outfall of Robert's Lake. Robert's Lake is a small, 2-acre, wetland area that acts as temporary storage and detention of storm water drainage for the surrounding residential development. The outfall from Robert's



Photo III-4 Roberts Lake Outfall Structure

Lake is a trapezoidal channel that conveys water to the east and into the Town's storm sewer system, as shown in Photo III-4, which, in-turn, conveys the storm flows out to Bacon Lake in sub-basin BCNE.

BCNH

Sub-basin BCNH contains most of the developed downtown portion of the Town's GMA. The northern extent is defined by West County Road 10E (WCR-10E), and the southern boundary is defined by Mountain Avenue/CR-46. The sub-basin is approximately 622 acres and consists of residential, commercial, and light industrial development. Storm flow generated within the sub-basin flows along streets and gutters to the east until it reaches 3rd Street where the flow is directed either north from Mountain Avenue, or south from WCR-10E. Along the eastern portion of the sub-basin, the Town has installed a storm sewer system that collects the generated runoff and conveys it out to Bacon Lake. Two 60-inch diameter reinforced concrete pipes (RCP) convey the final flow out to the lake.

BCNI

Sub-basin BCNI is located in the southern-most portion of the Bacon Lake drainage basin and is on the south bank of the LTR. The eastern extent is bounded by County Line Road, and the western limit is the CR-15. The sub-basin is composed of approximately 605 acres of cultivated agricultural fields with a small amount of singular residential development included. Rainfall runoff is conveyed north via overland sheet flow and localized channel directly into the LTR.

BCNJ

Sub-basin BCNJ is located in the northern-most portion of the Bacon Lake drainage basin, and is bounded on the north by a topographical high ridge and on the west by CR-15. The sub-basin is composed of approximately 268 acres of cultivated agricultural fields. Rainfall is directed to the south and into sub-basin BCNB.

BCNK

Sub-basin BCNK is located along the northern boundary of the GMA, and is bounded on the east and west by CR-3 and CR-1, respectively. The sub-basin is composed of approximately 232 acres that drains to the north towards HWY-60 and exits the GMA.

BCNL

Sub-basin BCNL is located on the northern boundary of the drainage basin along the GMA, and is bounded on the east and west by CR-1 and HWY-287, respectively. The sub-basin is composed of approximately 79 acres of predominantly agricultural fields and open areas. Storm runoff drains to the north and collects along the southern edge of HWY-60 before it continues north and exits the GMA.

Table III-16, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-16: CUHP Sub-Basin Summary
Bacon Lake

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
BCNA	324.3	10	22	154	495
BCNB	313.0	2	2	55	251
BCNC	356.9	5	17	205	714
BCND	294.7	5	7	78	318
BCNE	652.7	10	31	212	728
BCNF	547.5	20	69	249	816
BCNG	325.9	10	16	101	398
BCNH	622.3	40	246	596	1,500
BCNI	605.4	3	8	142	623
BCNJ	267.6	2	4	122	398
BCNK	160.0	3	2	47	157
BCNL	76.8	3	1	19	66

Hydraulic Analysis

Table III-17 summarizes the results of the hydraulic modeling of the Bacon Lake drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included, with a brief description of each. Figure III-17 shows location of key nodes and conveyance elements within the drainage basin.

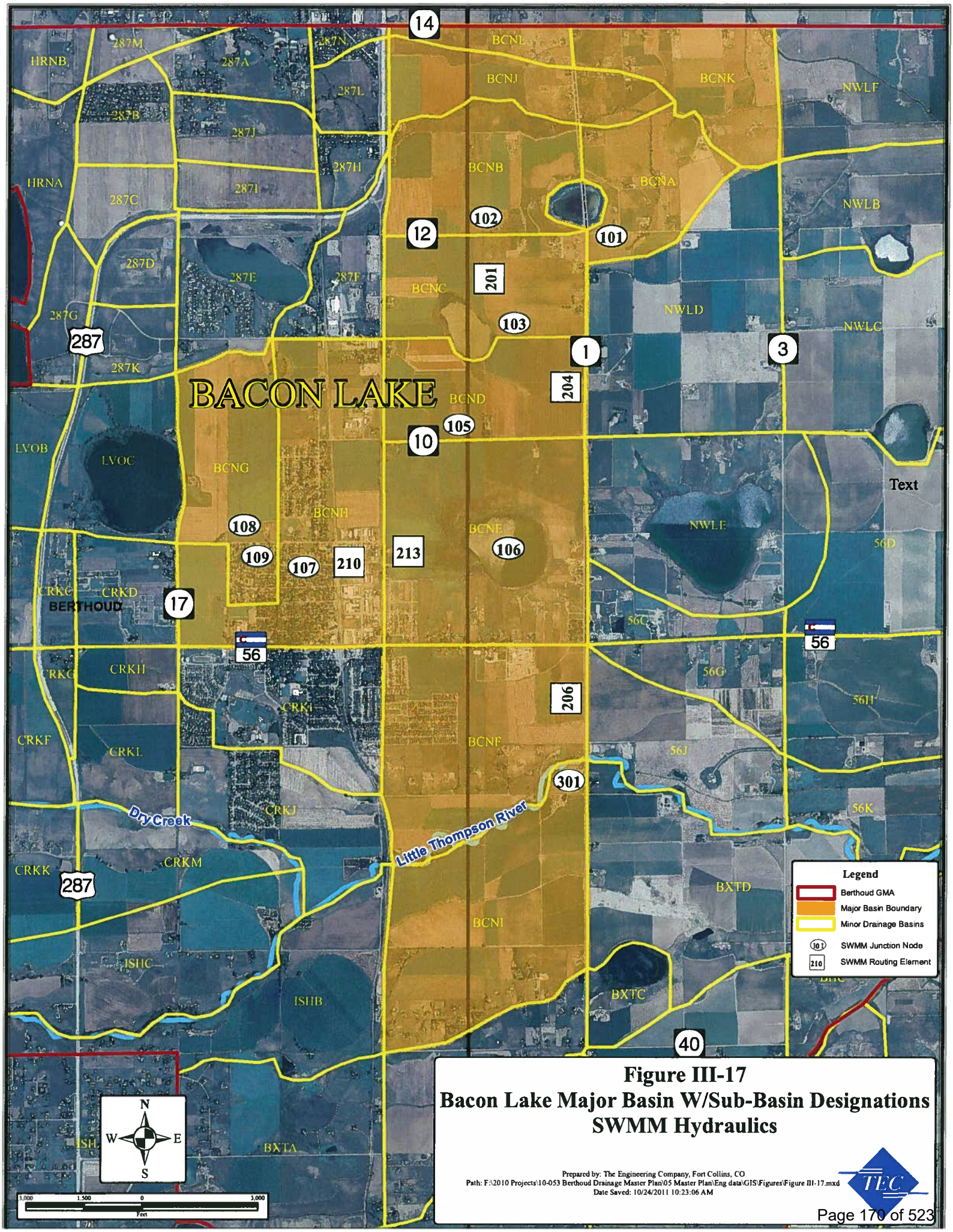


Figure III-17
Bacon Lake Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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Table III-17: SWMM Element Summary
Bacon Lake Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	Crossing CR-48	22	154	495
102	Crossing CR-48	19	77	273
103	Crossing CR-47	33	245	847
105	Crossing CR-46	39	314	657
106	Bacon Lake	315	555	555
107	Storm Inlet	259	626	1,529
108	Crossing Bunyan Avenue	16	101	398
109	Roberts Lake	16	101	109
301	Outfall to River	202	381	948
CONVEYANCE ELEMENTS				
201	Roadside Ditch	19	77	272
204	Roadside Ditch	32	243	339
206	Bacon Outlet	138	138	137
210	Storm Sewer	258	385	385
213	Storm Sewer to Bacon Lake	282	428	429

Table III-17 summarizes the peak runoff approaching each element. SWMM routing results indicate that many of the key elements within the Bacon Lake drainage basin are currently not sized to convey the 100-year rainfall event runoff. In particular, crossings at most of the county roads within the drainage basin are inadequate to convey the even the 10-year rainfall runoff. These are occurrences where the downstream conveyance element is not capable of carrying the peak flow arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, can result in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element. In addition, the amount of flow reaching the Little Thompson River is less than the total amount of flow being generated at each node. This indicates that detention is occurring along the route to the river.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

9. Highway 287

Highway 287 (287) drainage basin is located primarily surrounding the Highway 287 bypass that is located north and west of the Town of Berthoud. The drainage basin is composed of approximately 1,523 acres of a mixture of cultivated agricultural fields and residential subdivision development. The basin is located entirely within the Town's GMA, and is bounded around by topographic high areas.

The Berthoud Reservoir is located within this drainage basin and is utilized as the Town's source of drinking water. The development and construction of the Highway 287 Bypass has created a number of smaller sub-basins within the drainage basin. The drainage basin is further divided into 13 sub-basins as shown on Figure III-18. These sub-basins are defined by existing drainageways, roads, and topography. The sub-basins each generate a rainfall runoff that drains to a local collection or concentration point, usually an intersection, crossing structure, or natural drainageway. The flows generated by each sub-basin are summarized in Table III-18, as well as each sub-basin's area and percent imperviousness.

The following sections provide a description of each sub-basin and its associated drainage features, along with points of concentration:

287A

Sub-basin 287A is located in the northern portion of the drainage basin, and is bounded on the north by County Road 15 and on the east by the railroad tracks. The sub-basin is composed of approximately 174 acres of primarily residential development. Rainfall runoff in the sub-basin flows to the east and collects at the railroad tracks where it is conveyed south into sub-basin 287J.

287B

Sub-basin 287B is located in the northwestern corner of the drainage basin, and is bounded on the east by County Road 17 (CR-17) and on the south, north, and east by topographically high areas. The sub-basin is composed of approximately 151 acres of split evenly between cultivated agricultural fields and residential subdivision development. Rainfall runoff in the sub-basin drains to the north and east where it collects along the northeastern corner of the sub-basin and crosses CR-17 into sub-basin 287A.

287C

Sub-basin 287C is located to the north and west of the Highway 287 bypass. The sub-basin is composed of approximately 103 acres of cultivated agricultural fields. Rainfall runoff within the sub-basin drains to the south and east where it collects along the Highway 287 bypass, and is conveyed beneath the bypass via 48-inch diameter CMP culverts and into sub-basin 287D.

287D

Sub-basin 287 D is located to the south and east of the Highway 287 bypass. The sub-basin is composed of approximately 86 acres of cultivated agricultural fields. The sub-basin is a naturally occurring low area and has acted as natural sump, historically, allowing rainfall runoff to collect and naturally seep into the ground. In the event that this natural low spot is overwhelmed, drainage would occur to the south and east and collect along CR-17.

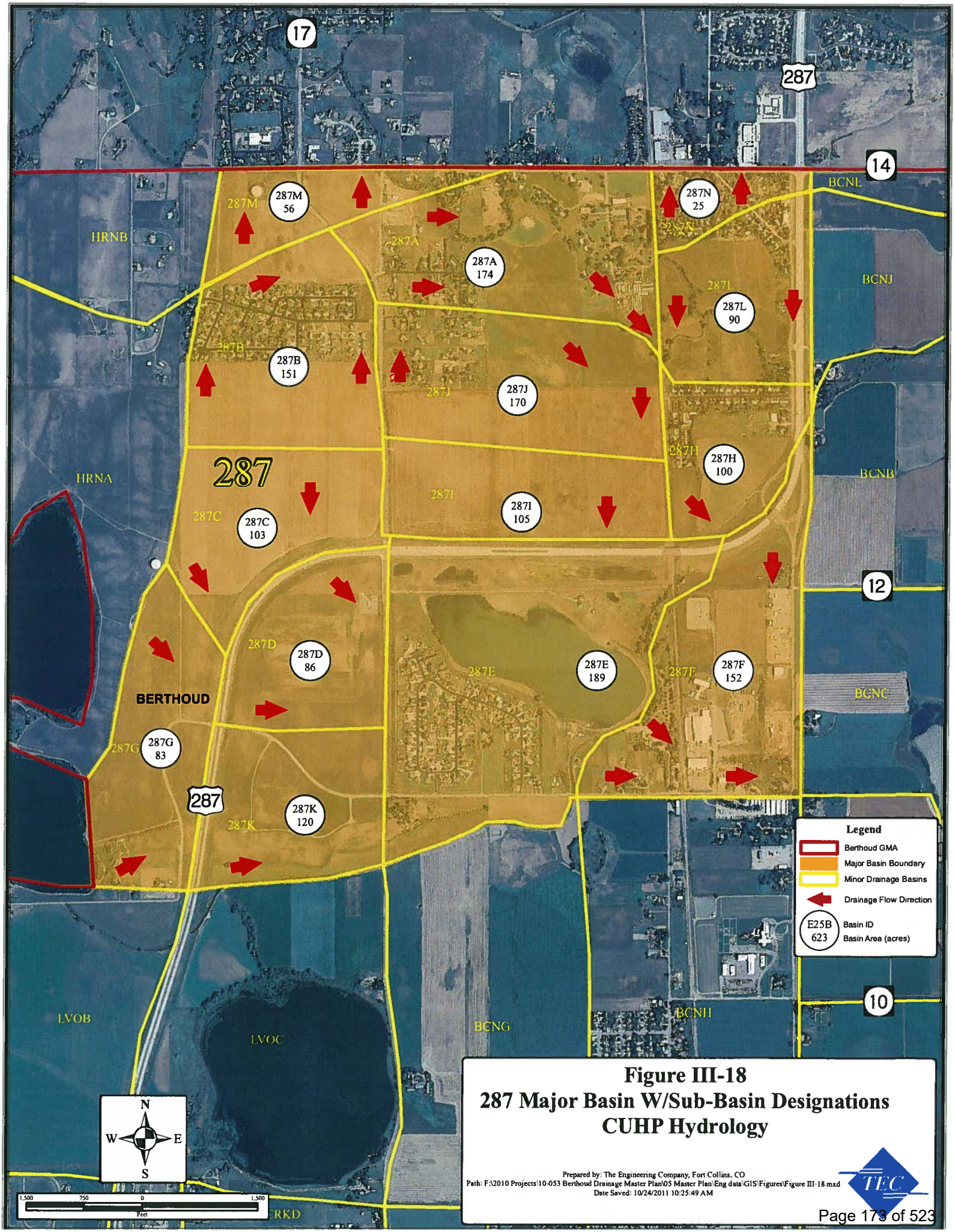


Figure III-18
287 Major Basin W/Sub-Basin Designations
CUHP Hydrology

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287E

Sub-basin 287E surrounds the Berthoud Reservoir. The sub-basin is bounded on the north by the Highway 287 bypass and on the west by CR-17. The sub-basin is composed of approximately 189 acres that contains the Berthoud Reservoir, as well as residential subdivision development. Because the Berthoud Reservoir is used for drinking water within the Town, runoff from the Highway 287 bypass is not permitted to drain directly into the reservoir. Water quality ponds were constructed during the construction of the bypass to collect runoff and prevent it from directly entering into the reservoir. These water quality ponds are located along the northern edge of the sub-basin immediately south of the highway bypass.

287F

Sub-basin 287F is located in the southwest corner of the drainage basin, and is bounded by CR-15 on the east and ECR-10E to the south. The sub-basin consists of approximately 152 acres of a mix of light industrial and commercial development. Rainfall runoff generated within the sub-basin flows to the south and east, collecting in the southeast corner of the sub-basin.

287G

Sub-basin 287G is located in the southeast corner of the drainage basin, and is bounded by Highway 287 to the east and Welch Reservoir to the west. The sub-basin consists of approximately 83 acres of cultivated agricultural fields. Rainfall runoff generated within the basin flows east towards Highway 287 where it collects, and then is conveyed beneath Highway 287 by 48-inch diameter reinforced concrete pipe into sub-basin 287K.

287H

Sub-basin 287H is located in the eastern portion of the drainage basin, and is bounded on the east and south by Highway 287. The sub-basin is approximately 100 acres consisting of a mix of residential subdivision development and cultivated agricultural fields. Rainfall runoff generated within the sub-basin flows to the southeast and collects in a water quality pond located within the bypass off-ramp.

287I

Sub-basin 287I is located immediately north of the Highway 287 bypass. Rainfall runoff generated within the sub-basin flows to the south and collects along the north side of Highway 287. Two 48-inch diameter RCPs convey flow beneath Highway 287 and into water quality ponds located in sub-basin 287E.

287J

Sub-basin 287J is located in the northern portion of the drainage basin, and is approximately 170 acres consisting of a mix of residential subdivision development and cultivated agricultural fields. Rainfall runoff is collected along Crestridge Drive on the northern boundary and flows to the east. Runoff flow is concentrated in the southeast corner of the sub-basin where it is conveyed through sub-basin 287I.

287K

Sub-basin 287K is located in the southwestern portion of the drainage basin, and is approximately 120 acres of cultivated agricultural fields. Rainfall runoff generated within the sub-basin flows toward the interior of the sub-basin into naturally occurring sumps to collect and seep into the ground.

287L

Sub-basin 287L is located in the northeast corner of the drainage basin and is approximately 90 acres of residential subdivision development and open space. Rainfall runoff generated within the sub-basin flows to the south and collects in a natural sump just north of the residential subdivision along 49th St SW.

287M

Sub-basin 287M is located along the northern edge of the drainage basin, and is bounded on the north by HWY-60, which corresponds with the Town's GMA boundary. The sub-basin is composed of approximately 56 acres of agricultural fields and open land. Storm runoff drains to the north and east and collects along HWY-60 before it exits the GMA to the north.

287N

Sub-basin 287N is located in the northeastern portion of the drainage basin, and is bounded on the north by HWY-60, which corresponds with the Town's GMA. The sub-basin is composed of approximately 25 acres of residential development. Storm runoff drains to the north and collects along HWY-60 before continuing north and exiting the GMA.

Table III-18, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-18: CUHP Sub-Basin Summary
Highway 287

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
287A	174.5	30	41	131	317
287B	150.6	12	9	50	167
287C	103.4	2	1	20	90
287D	86.0	2	1	16	74
287E	189.3	40	78	204	458
287F	151.8	75	175	333	613
287G	83.0	3	2	41	130
287H	99.7	30	20	63	154
287I	104.9	5	4	53	164
287J	169.5	20	26	105	283
287K	119.8	5	6	77	232
287L	90.1	45	36	85	194
287M	56.4	20	7	28	83
287N	24.3	75	27	49	92

Hydraulic Analysis

Table III-19 summarizes the results of the hydraulic modeling of the Highway 287 drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-19 shows location of key junctions and conveyance elements within the drainage basin.

Table III-19: SWMM Element Summary
Highway 287 Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	Water Quality Ponds	150	381	708
102	Crossing 287	102	199	314
103	Crossing CR-17	36	110	302
104	Crossing 287	41	119	317
105	Water Quality Pond	77	202	400
106	Berthoud Reservoir	51	132	358
107	Crossing CR-15	85	175	421
108	Crossing 287	150	274	612
110	Crossing 287	70	165	431
111	Crossing @ 49th Street	215	457	650
112	Conveyance along Railroad	141	302	621
113	Crossing 287	192	295	567
CONVEYANCE ELEMENTS				
201	Roadside Ditch	31	31	31
203	Roadside Ditch	74	197	251
204	Overland Channel	28	28	28
206	Roadside Ditch	1	1	1
207	Trackside Ditch	80	80	80
208	Trackside Ditch	109	109	109
209	Roadside Ditch	70	70	70

Table III-19 summarizes the peak runoff approaching each element. SWMM routing results indicate that many of the key elements within the Highway 287 drainage basin are currently not sized to convey the 100-year rainfall event runoff. In particular, road crossings at most of the county roads and Highway 287 within the drainage basin are inadequate to convey the even the 10-year rainfall runoff (see Figure III-19). These are occurrences where the downstream conveyance element is not capable of carrying the peak flow

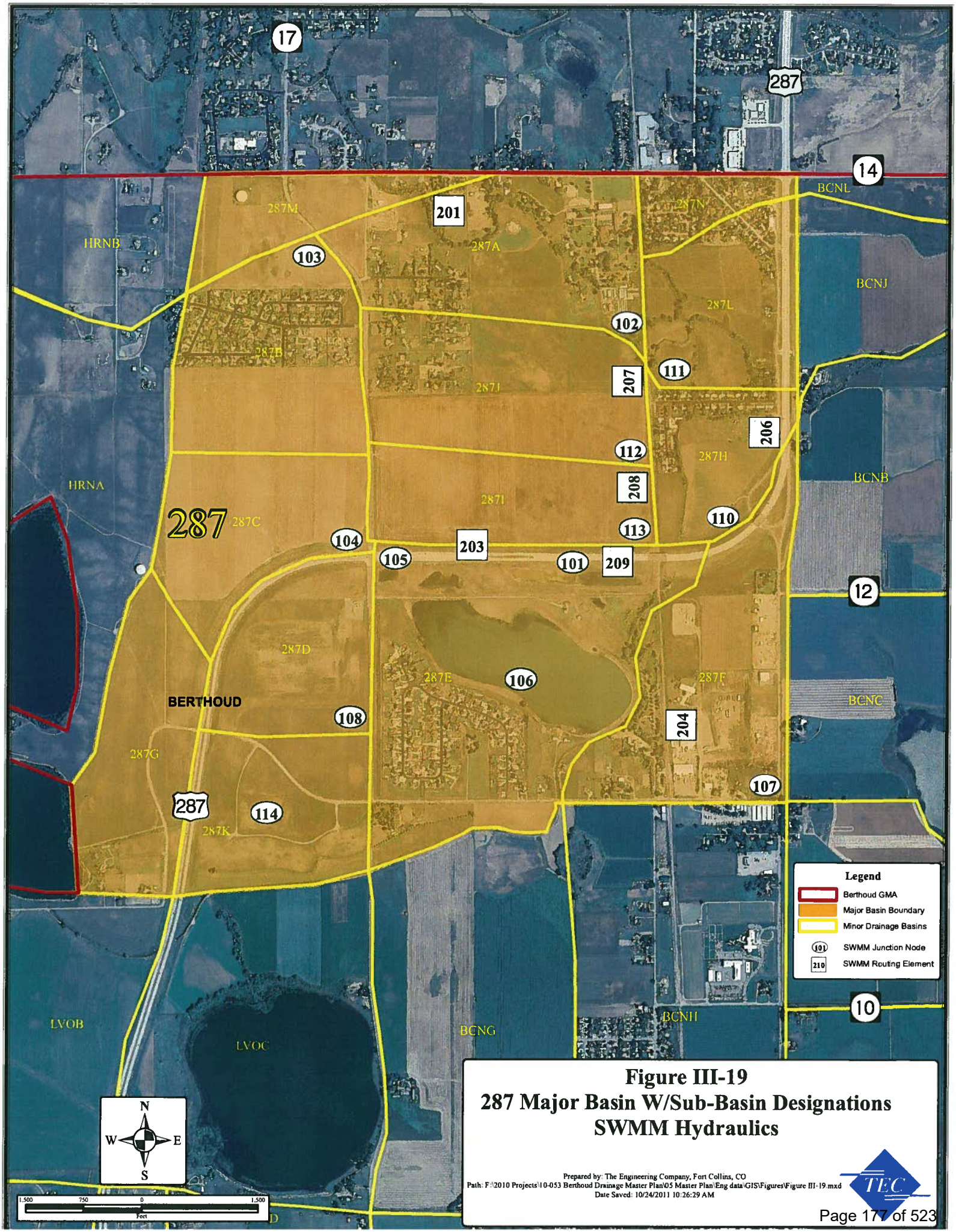


Figure III-19
287 Major Basin W/Sub-Basin Designations
SWMM Hydraulics

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arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, can result in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

10. Dry Creek

The Dry Creek (CRK) drainage basin is located along the western portion of the GMA, and lies partially outside of the Town's GMA. The basin is comprised of approximately 2,372 acres of both residential subdivision development and cultivated agricultural fields. The basin is irregularly shaped, and much of the rainfall runoff drains into Dry Creek. Dry Creek is a tributary of the Little Thompson River with its confluence located within the CRK drainage basin. Refer to Figure III-1 for the relationship of the drainage basin to the Town's GMA.

Rainfall runoff throughout the drainage basin flows predominantly to the east and south to eventually enter either Dry Creek or LTR. No Name Creek is an urban drainageway that collects much of the rainfall runoff within the residentially developed portion of the drainage basin. The No Name Creek is an established green way that exists from CR-46 and conveys flow to the southeast, passing to the north of Berthoud High School, and eventually draining into LTR. Much of the No Name Creek has been developed as a green belt with bike/pedestrian path and controlled culverts passing beneath the city street crossings.

The drainage basin has been further divided into 13 sub-basins as shown on Figure III-20. The sub-basins are defined by existing drainageways, roads, and local topography. Each of the sub-basins drains its generated rainfall runoff to a specific point of concentration defined as an intersection, crossing structure or established drainageway. The sub-basin generated flows, as well as the area and percent imperviousness of each of the sub-basins, are summarized in Table III-20

The following sections describe the sub-basins and their associated drainage features, along with points of concentration:

CRKA

Sub-basin CRKA is located on the western edge of the drainage basin and lies entirely outside of the Town's GMA. The eastern boundary of the sub-basin is North County Road 19 (NCR-19), which corresponds with the western boundary of the Town's GMA. The basin is comprised of approximately 525 acres of cultivated agricultural fields, as well as singular residential development and paved county roads. Rainfall runoff generated within the sub-basin enters the flows to the southeast and collects at the intersection of

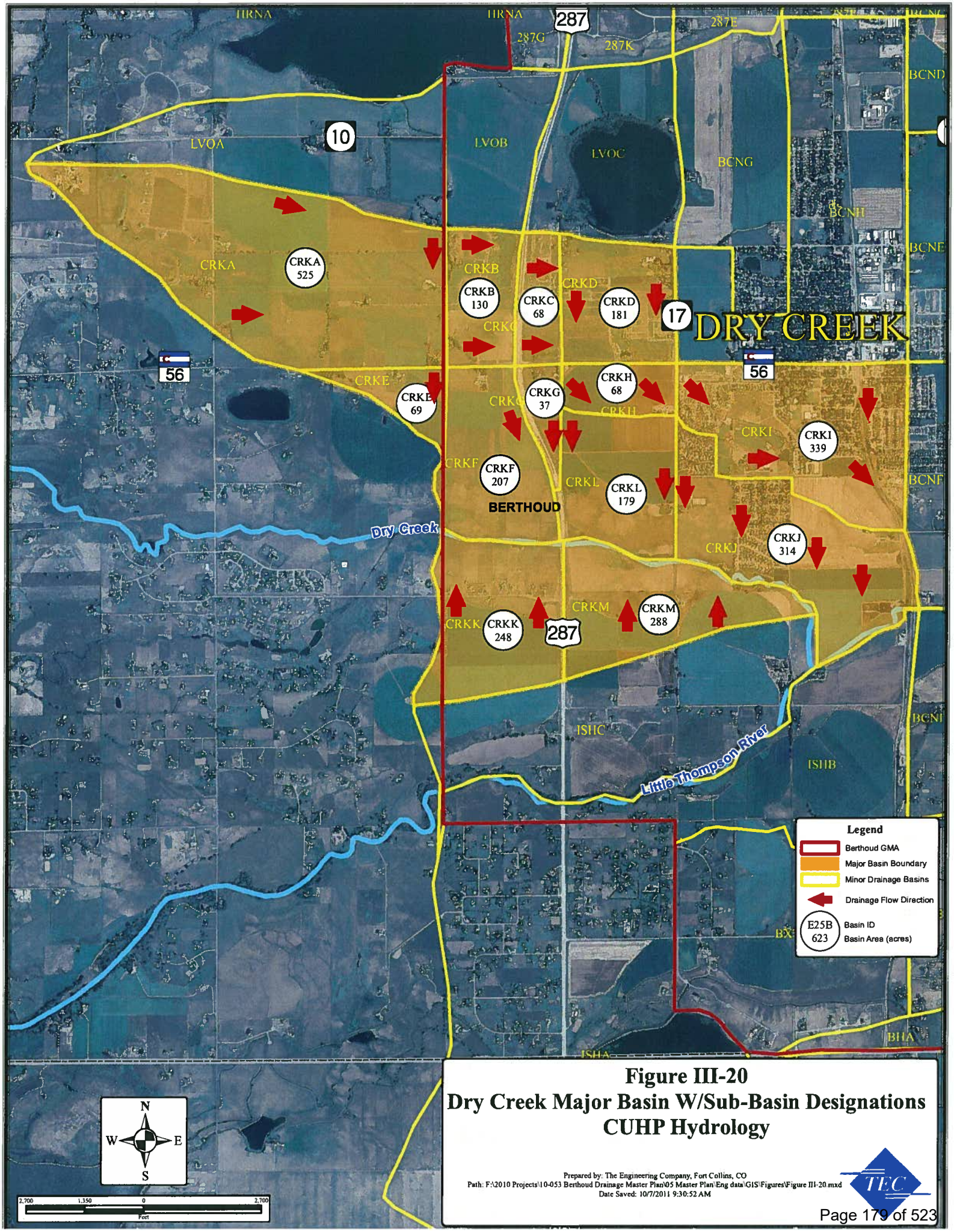


Figure III-20
Dry Creek Major Basin W/Sub-Basin Designations
CUHP Hydrology

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NCR-19 and West County Road 8/CR-56. At this concentration point the flow enters the Town's GMA into sub-basin CRKB.

CRKB

Sub-basin CRKB is located on the eastern edge of the Town's GMA between NCR-19 and Highway 287. The sub-basin is comprised of approximately 130 acres of cultivated agricultural fields, along with singular residential development. Rainfall runoff generated within the sub-basin, as well as flows entering from sub-basin CRKA, flow to the south and east along HWY-56 and concentrate at the intersection of HWY-56 and HWY-287. Flow is then conveyed across HWY-287 into sub-basin CRKD.

CRKC

Sub-basin CRKC is located in the northern portion of the drainage basin between HWY-287 to the west and Meadowlark Drive to the east. The sub-basin is comprised of approximately 68 of light residential development, and rainfall runoff is drained towards the south and east of the sub-basin. Runoff generated within the sub-basin, as well as flow entering from sub-basin CRKB, concentrate at the southeast corner of the sub-basin where it is conveyed across Meadowlark Drive into sub-basin CRKD.

CRKD

Sub-basin CRKD is located in the northeast corner of the drainage basin, immediately south of Loveland Reservoir, between Meadowlark Drive to the west and CR-17 to the east. The sub-basin is comprised of approximately 181 acres of light residential development and open fields. Rainfall runoff drains to the south towards HWY-56 and east where it collects in the southeast corner of the sub-basin. Flow is conveyed southeast into sub-basin CRKH.

CRKE

Sub-basin CRKE is located outside of the GMA and immediately south of WCR-8. The sub-basin is comprised of approximately 69 acres of cultivated agricultural fields. Rainfall runoff generated within the sub-basin flows to the east and south along NCR-19 where it directly enters the Dry Creek drainageway.

CRKF

Sub-basin CRKF is located in the western portion of the drainage basin south of WCR-8 between NCR-19 to the west and HWY-287 to the east. The sub-basin contains approximately 207 acres of cultivated agricultural fields. Rainfall runoff generated within the sub-basin drains to the south and east along HWY 287, and directly enters the Dry Creek drainageway.

CRKG

Sub-basin CRKG is a small sliver of land located south of WCR-8 between HWY-287 west and Meadowlark Drive to the east. The sub-basin contains approximately 37 acres of light residential development and cultivated agricultural fields. Rainfall runoff generated within the sub-basin flows to the south along the east side of HWY-287 and directly enters the Dry Creek drainageway.

CRKH

Sub-basin CRKH is located in the central portion of the drainage basin immediately south of HWY-56 between Meadowlark Drive to west and CR-17 to the east. The sub-basin is comprised of approximately 68 acres of cultivated agricultural fields. Rainfall runoff generated within the sub-basin flows to the east towards CR-17 where it is conveyed by a crossing structure consisting of a 48-inch diameter RCP into sub-basin CRKI and the No Name Creek drainageway.

CRKI

Sub-basin CRKI is located in the northeast corner of the drainage basin immediately south of HWY-56, and between CR-17 to the west and CR-15 to the east. The sub-basin is composed of approximately 339 acres of residential subdivision development. The sub-basin contains a developed greenbelt drainageway called No Name Creek conveying rainfall runoff to the southeastern extent of the drainage basin. No Name Creek has been developed with storm drainage control, in particular. There are developed crossings at the roads as shown in Photo III-5 to the right. In addition, street runoff in the northeastern portion of the sub-basin is currently conveyed east to a point of discharge along the railroad right-of-way.

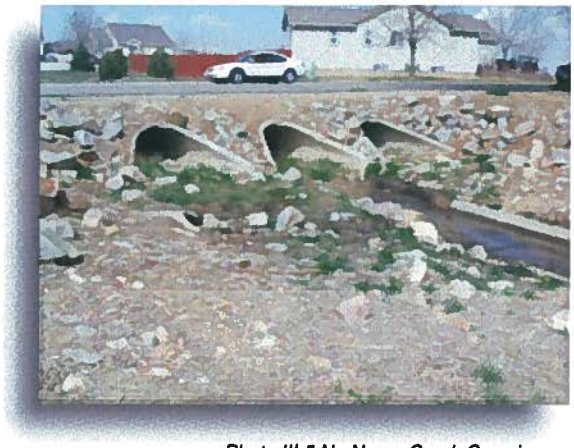


Photo III-5 No Name Creek Crossing Structure at 10th Street.

CRKJ

Sub-basin CRKJ is located in the southeastern portion of the drainage basin immediately north of Dry Creek, and between CR-17 to the west and CR-15 to the east. The sub-basin is comprised of approximately 314 acres of a mix of residential subdivision development and cultivated agricultural fields. Rainfall runoff generated within the basin flows to the south and east on a mix of both overland sheet flow and localized channel flow directly into the Dry Creek and Little Thompson River confluence.

CRKK

Sub-basin CRKK is located in the southwestern corner of the drainage basin on the south bank of Dry Creek, and immediately west of HWY-287. The sub-basin is comprised of approximately 248 acres of cultivated agricultural fields. Rainfall runoff generated within the basin flows to the north through localized channel and overland sheet flow to the Dry Creek drainageway.

CRKL

Sub-basin CRKL is located directly on the north bank of Dry Creek, with CR-17 to the east and HWY-287 to the west. The sub-basin is comprised of approximately 179 acres of cultivated agricultural fields. Rainfall runoff generated within the sub-basin flows to the south and directly into the Dry Creek drainageway.

CRKM

Sub-basin CRKM is located on the south bank of Dry Creek, with HWY-287 to the west. The sub-basin is comprised of approximately 288 acres of cultivated agricultural fields. Rainfall runoff generated within the sub-basin drains to the north via overland sheet flow and localized channels directly into Dry Creek drainageway.

Table III-20, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-20: CUHP Sub-Basin Summary
Dry Creek

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
CRKA	525.1	5	6	70	310
CRKB	130.1	7	3	28	113
CRKC	68.5	10	3	20	63
CRKD	181.2	25	23	74	226
CRKE	68.9	5	1	11	51
CRKF	207.2	4	0	1	1
CRKG	37.3	15	2	9	28
CRKH	68.5	5	1	18	60
CRKI	339.2	80	325	596	1,076
CRKJ	313.6	60	228	458	953
CRKK	247.7	5	6	70	286
CRKL	178.6	2	2	65	216
CRKM	288.0	3	3	58	260

Hydraulic Analysis

Table III-21 summarizes the results of the hydraulic modeling of the Dry Creek drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-21 shows location of key junctions and conveyance elements within the drainage basin.

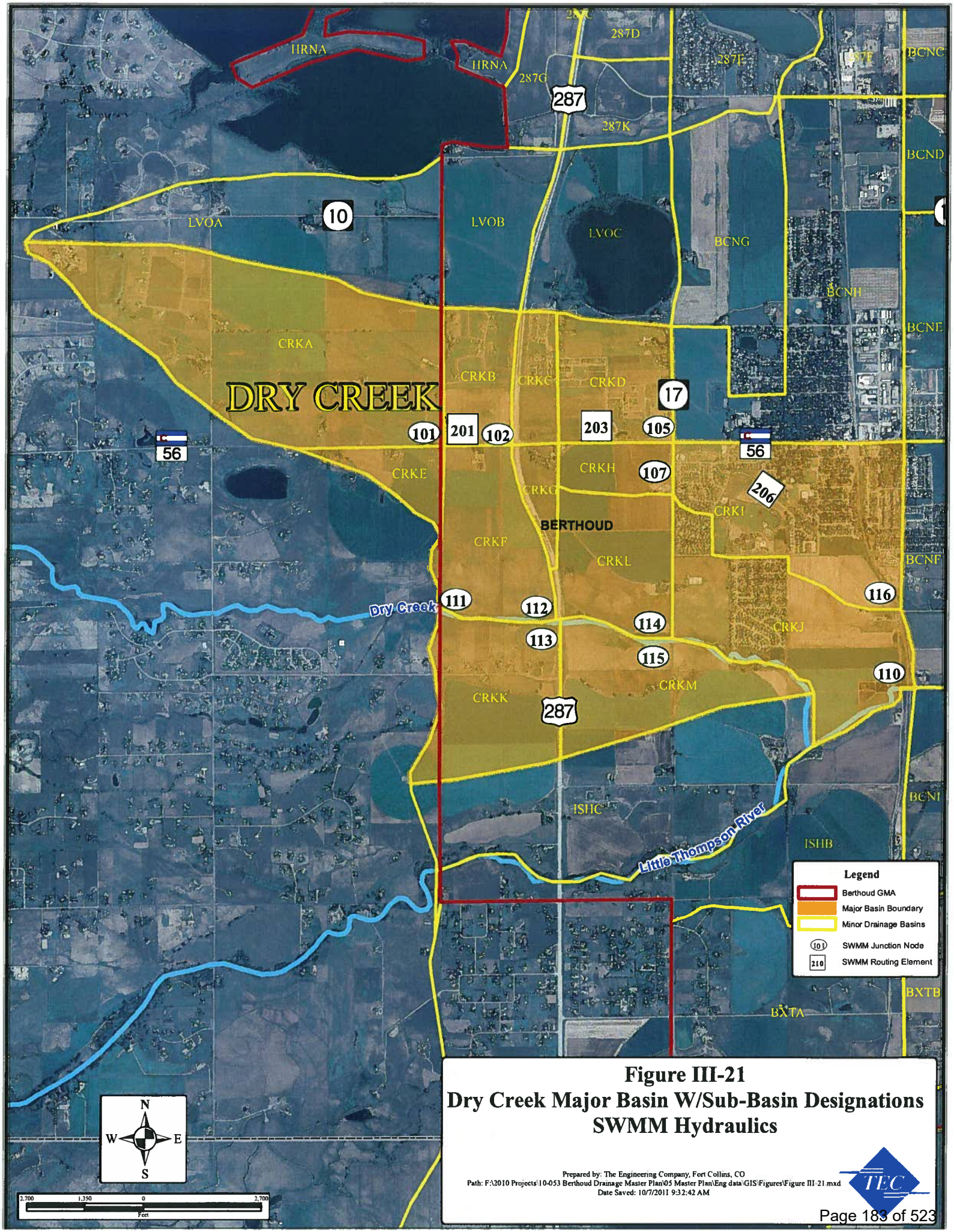


Figure III-21
Dry Creek Major Basin W/Sub-Basin Designations
SWMM Hydraulics

Prepared by: The Engineering Company, Fort Collins, CO
Path: F:\2010 Projects\10-053 Berthoud Drainage Master Plan\05 Master Plan\Eng data\GIS\Figures\Figure III-21.mxd
Date Saved: 10/7/2011 9:32:42 AM

Table III-21: SWMM Element Summary
Dry Creek Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS				
101	Crossing NCR-19	6	70	309
102	Crossing HWY-287	9	93	184
105	Crossing HWY-56	31	172	336
107	Crossing CR-17	1	18	60
110	Outfall to River	519	1,053	2,113
111	Outfall to River	1	11	50
112	Outfall to River	2	10	29
113	Outfall to River	6	70	286
114	Outfall to River	2	65	216
115	Outfall to River	3	58	260
116	Confluence with No Name Creek	341	685	1,230
CONVEYANCE ELEMENTS				
201	Roadside Ditch	6	70	72
203	Roadside Ditch	11	110	110
206	No Name Creek	32	129	171

Table III-21 summarizes the peak runoff approaching each element. Much of the drainage within the basin eventually drains into No Name Creek, and finally into the Little Thompson River. Currently, the outfall of the No Name Creek to Little Thompson River is shown in the junctions 110 and 116, which are summarized in Table III-20, above. The No Name Creek has been developed and appears able to carry the historic flows generated within the basin.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

11. Ish Reservoir

The Ish Reservoir drainage basin is located in the southwest corner of the Town's GMA. Most of the drainage basin is located outside of the Town's GMA. The entire drainage basin is comprised of approximately 2,748 acres, with approximately 70 percent of the overall basin located outside the Town's GMA.

The Ish Reservoir's drainage basin is further divided into three sub-basins as shown on Figure III-22. These sub-basins are defined primarily by existing drainageways, roads, and local topography. Each of the sub-basins drains to a general concentration point, an intersection, drainage feature, or road crossing. Table III-22 summarizes the peak runoff of each sub-basin, along with its area and imperviousness. The following sections describe the sub-basins, drainage features, and concentration points.

ISHA

Sub-basin ISHA is located immediately west of Ish Reservoir, is entirely outside the Town's GMA, and is comprised of approximately 1,940 acres. Due to its location outside the Town's GMA, the analysis of the sub-basin is limited to generated peak runoff and its point of entry into the GMA. A large portion of the sub-basin is occupied by the Ish Reservoir which has a surface area of approximately 250 acres. Much of the surface area drains directly into the reservoir. A portion, particularly in the northwest corner of the sub-basin, drains north into the GMA. The north boundary of the sub-basin is located at WCR4, which corresponds with the Town's GMA. Sub-basin runoff that reaches WCR4 flows east towards Highway 287. At the southwest corner of the intersection of WCR4 and Highway 287, the flow crosses north and enters the Town's GMA. From here, the flow is conveyed north approximately 600 feet and enters the LTR.

ISHB

Sub-basin ISHB is located directly north of WCR4, is located entirely within the Town's GMA, and is comprised of approximately 415 acres. The sub-basin is bounded on the north by the LTR and to the south by a combination of WCR4 and a topographical ridge that separates ISHB from the sub-basin BXTA. Runoff flow from sub-basin ISHB is drained to the north and east flowing directly into the LTR. The LTR flows from the west to the east along the north boundary of the sub-basin.

ISHC

Sub-basin ISHC is located directly north of the LTR, is located entirely within the Town's GMA, and is comprised of approximately 393 acres. The north boundary is a topographical ridge which separates it hydraulically from Dry Creek to the north, and the southern boundary is the LTR. Runoff flows from the sub-basin drain to the south and directly enters the LTR.

Table III-22, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-22: CUHP Sub-Basin Summary
Ish Reservoir

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
ISHA	1,940.2	20	136	565	1,531
ISHB	415.4	5	49	49	218
ISHC	393.4	5	77	77	334

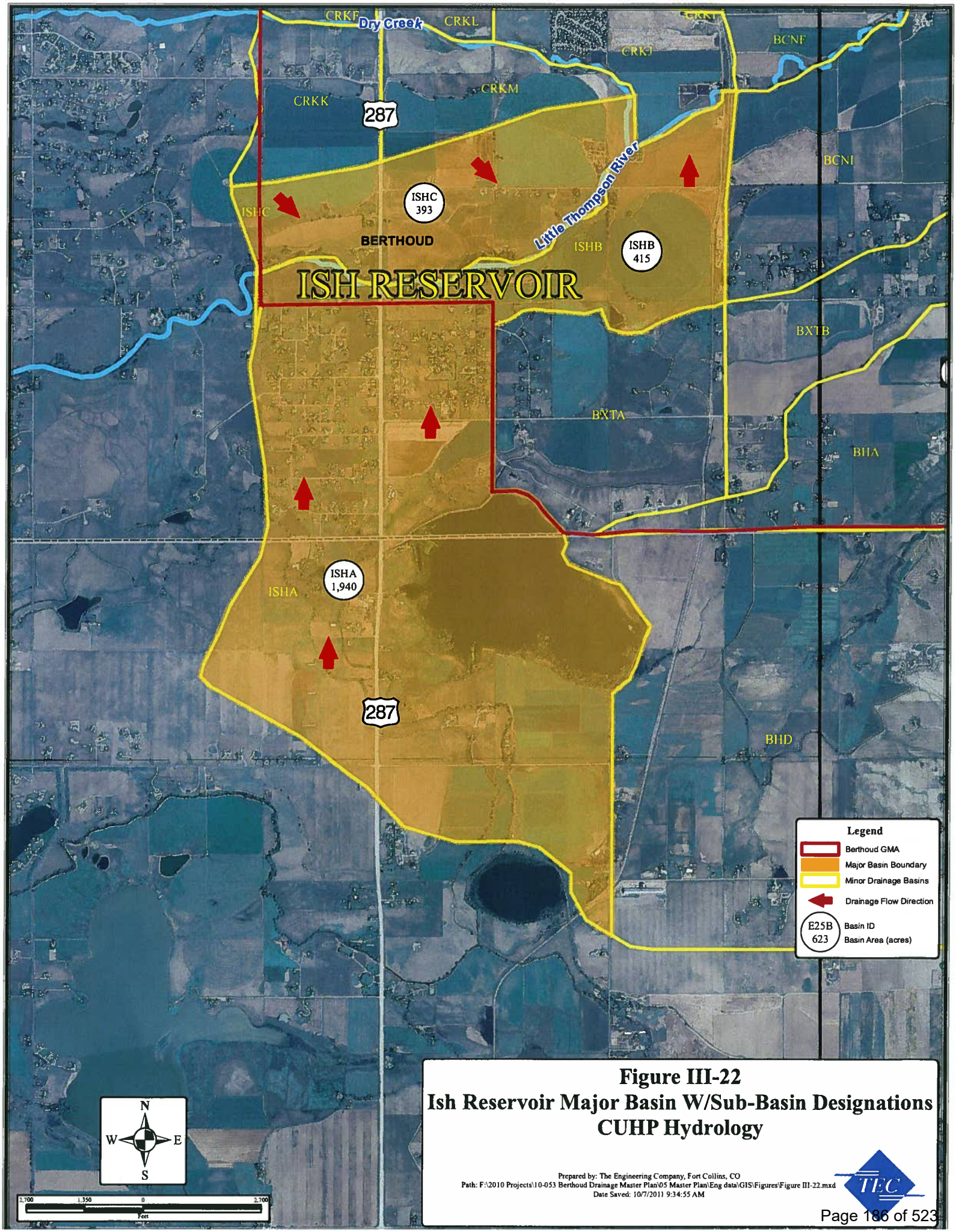


Figure III-22
Ish Reservoir Major Basin W/Sub-Basin Designations
CUHP Hydrology

Prepared by: The Engineering Company, Fort Collins, CO
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Date Saved: 10/7/2011 9:34:55 AM

Hydraulic Analysis

Table III-23 summarizes the results of the hydraulic modeling of the Ish Reservoir drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included, with a brief description of each. Figure III-23 shows the location of key junctions and conveyance elements within the drainage basin.

Table III-23: SWMM Element Summary
Ish Reservoir Basin

SWMM Element ID	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENT				
101	Crossing WCR-4	136	565	1,531
CONVEYANCE ELEMENT				
201	Overland Channel	135	562	1,247

Table III-23 summarizes the peak runoff approaching each element. SWMM routing results indicate magnitude of the peak flows for each of the modeled elements and rainfall events.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

12. Loveland Reservoir

The Loveland Reservoir drainage basin is located along the western most boundary of the Town's GMA. Approximately half of the drainage basin is located outside of the Town's GMA. The entire drainage basin is comprised of approximately 931 acres.

The Loveland Reservoir drainage basin is further divided into three sub-basins as shown on Figure III-24. These sub-basins are defined primarily by existing drainageways, roads, and local topography. Each of the sub-basins drains to a point of concentration which usually consists of an intersection, drainage feature, or road crossing. Table III-24 summarizes the peak runoff of each sub-basin, along with its area and imperviousness.

The following sections describe the sub-basins, drainage features, and points of concentration.

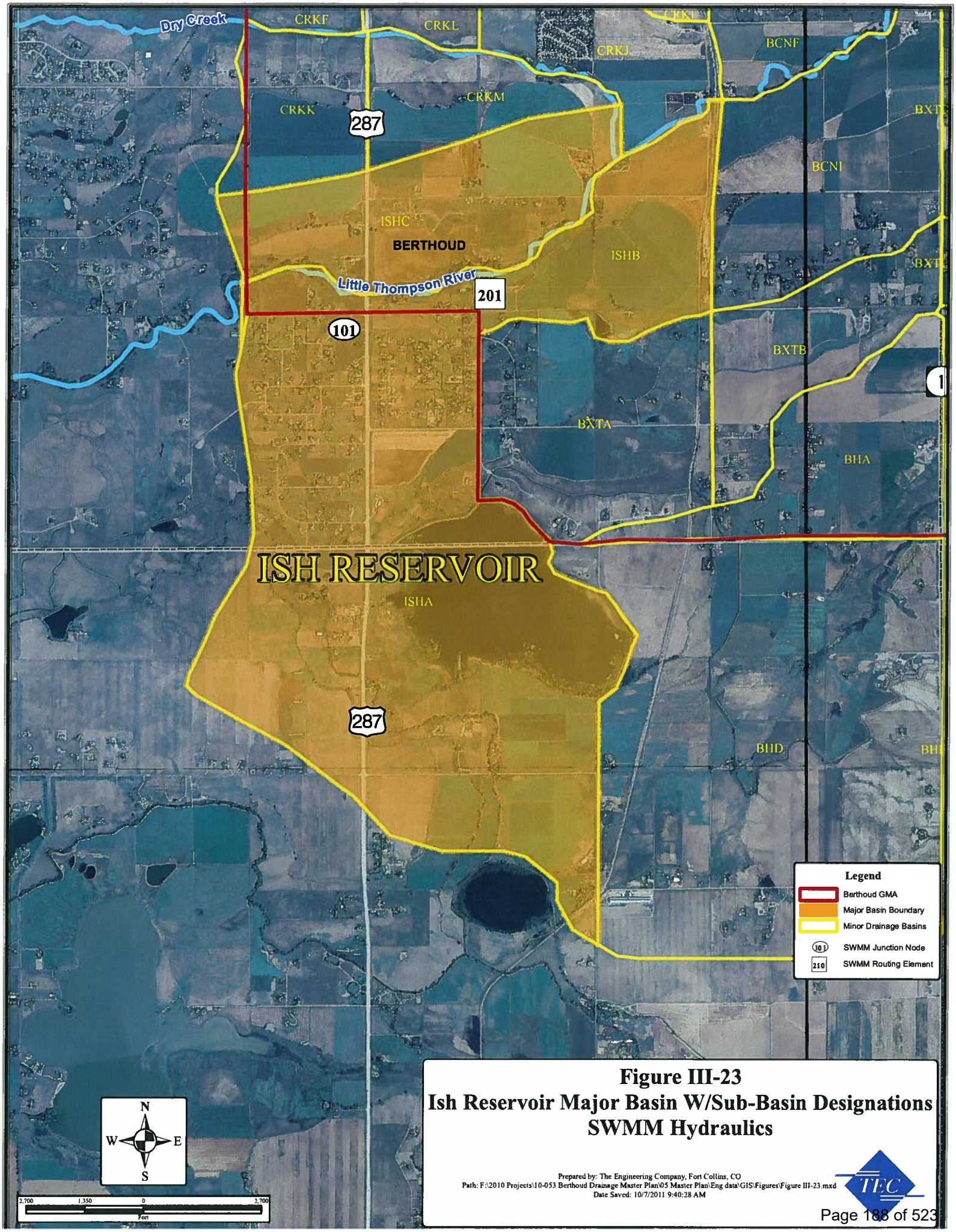


Figure III-23
Ish Reservoir Major Basin W/Sub-Basin Designations
SWMM Hydraulics

Prepared by: The Engineering Company, Fort Collins, CO
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Date Saved: 10/7/2011 9:40:28 AM

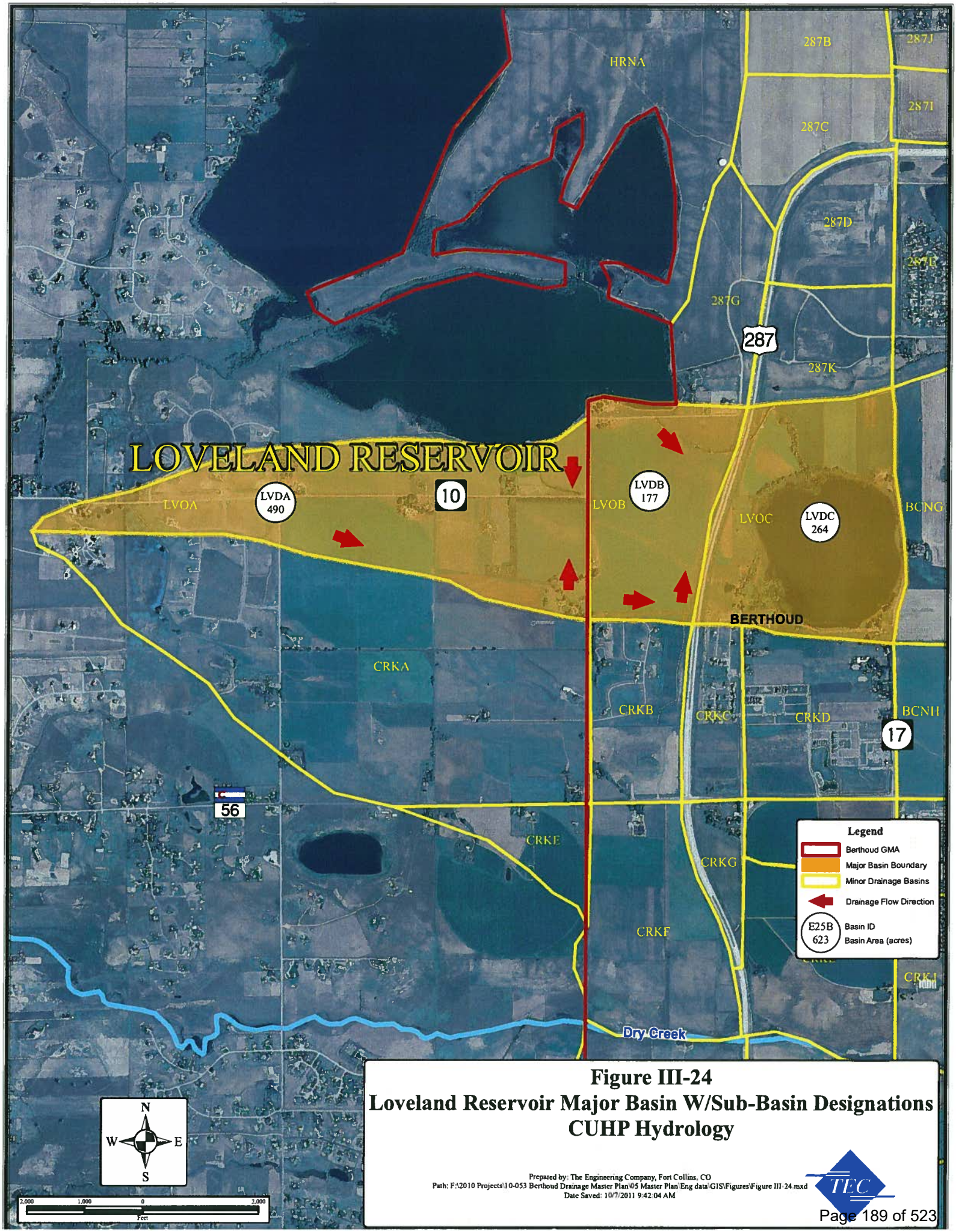


Figure III-24
Loveland Reservoir Major Basin W/Sub-Basin Designations
CUHP Hydrology

Prepared by: The Engineering Company, Fort Collins, CO
Path: F:\2010 Projects\10-053 Berthoud Drainage Master Plan\05 Master Plan\Eng data\GIS\Figures\Figure III-24.mxd
Date Saved: 10/7/2011 9:42:04 AM

LVDA

Sub-basin LVDA is located directly west of NCR19, is located entirely outside the Town's GMA, and is comprised of approximately 450 acres. Welch reservoir is located directly to the north, and a topographical ridge delineates the southern boundary. Due to the basin location outside the GMA, analysis of the sub-basin is limited to peak flows generated and the point of entry into the GMA. The peak flows generated are summarized in Table III-24, below. The point of entry into the GMA is located along NCR19 approximately 1,500 feet south of WCR10. At this location, the flow passes under NCR19 and into sub-basin LVDB.

LVDB

Sub-basin LVDB is located directly east of NCR19 and west of Highway 287. The sub-basin is located entirely within the Town's GMA and is comprised of approximately 178 acres. The northern boundary of the sub-basin is WCR10E, and the southern boundary is a topographical ridge which is denoted by Peak Drive. Flows generated within the sub-basin, as well as flows entering from sub-basin LVDA, are conveyed to the east towards Highway 287. The Highway 287 bypass was recently constructed in 2002 with structures providing for drainage runoff.

LVDC

Sub-basin LVDC is located directly east of the Highway 287 bypass and contains Loveland Reservoir. The sub-basin is entirely within the Town's GMA and is comprised of approximately 264 acres. The reservoir has a surface area of approximately 75 acres. The sub-basin is bounded on the north by the Home Supply Ditch and on the south by a topographic ridge that encompasses Loveland Reservoir. Runoff from the sub-basin flows directly into the reservoir.

Table III-24, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness.

Table III-24: CUHP Sub-Basin Summary
Loveland Reservoir

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
LVDA	490.5	4	109	258	602
LVDB	176.6	3	66	149	319
LVDC	264.0	3	291	563	1,055

Hydraulic Analysis

Table III-25 summarizes the results of the hydraulic modeling of the Loveland Reservoir drainage basin and its sub-basins for the 2-, 10-, and 100-year events. Key existing conveyance elements, as well as points of runoff concentration, are included with a brief description of each. Figure III-25 shows location of key junctions and conveyance elements within the drainage basin.

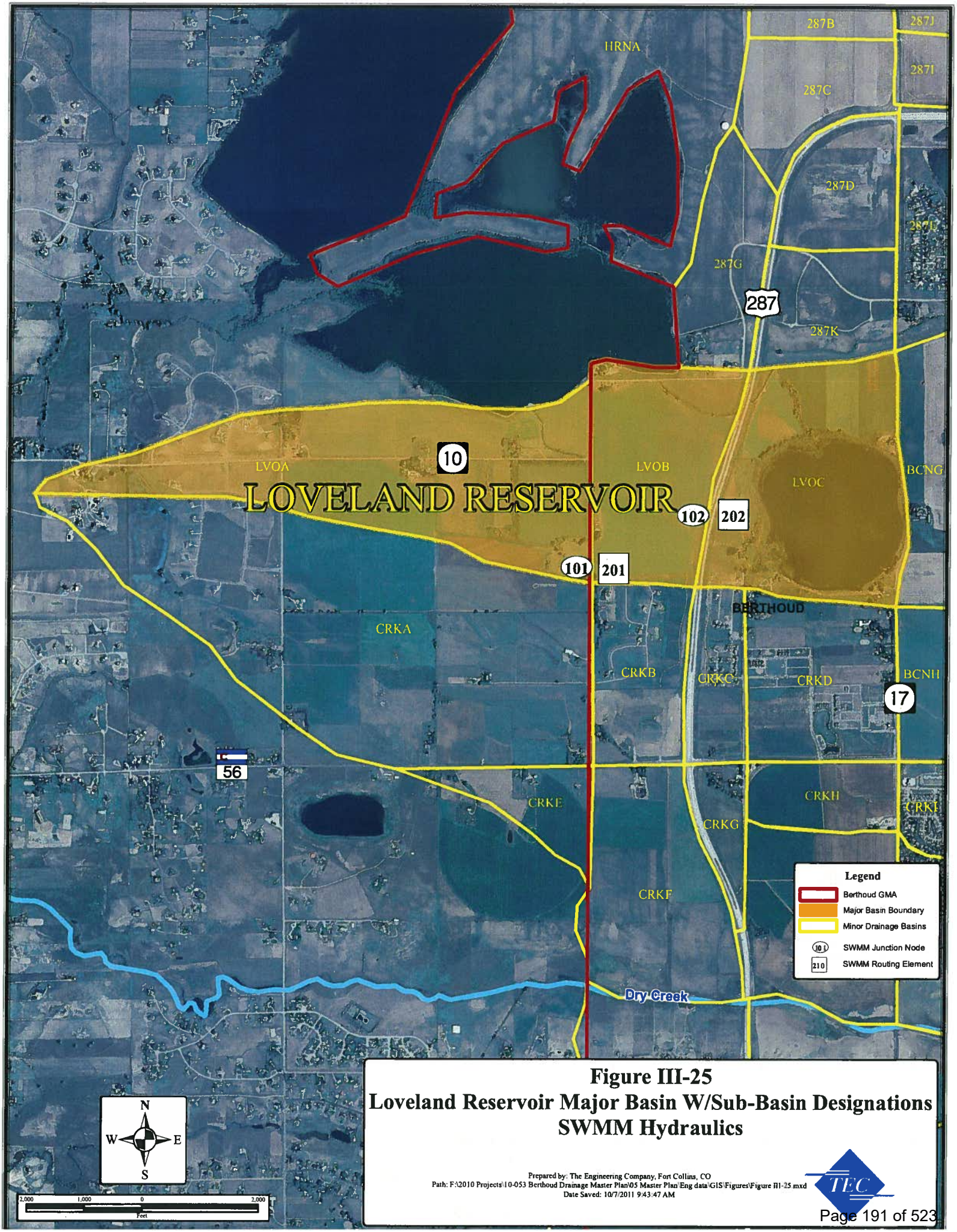


Figure III-25
Loveland Reservoir Major Basin W/Sub-Basin Designations
SWMM Hydraulics

Prepared by: The Engineering Company, Fort Collins, CO
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Table III-25: SWMM Element Summary
Loveland Reservoir Basin

SWMM Element ID	Sub -Basin	Description	2-Year Peak (cfs)	10-Year Peak (cfs)	100-Year Peak (cfs)
NODE ELEMENTS					
101	LVDA	Crossing NCR-19E	109	258	602
102	LVDB	Crossing 287	121	208	384
CONVEYANCE ELEMENTS					
201	LVDB	Roadside Ditch	55	59	65
202	LVDC	Overland Channel	121	207	384

Table III-25 summarizes the peak runoff approaching each element. SWMM results indicate that some of the key elements within the Loveland Reservoir drainage basin are currently not sized to convey the 100-year rainfall event runoff. Currently, ponding and overtopping occurs at junction 101. This point of concentration corresponds with the crossing at North County Road 19E. This occurs where the downstream conveyance element is not capable of carrying the peak flow arriving at the concentration point, which results in ponding at the junction element and, depending on the situation, results in overtopping of roads, localized flooding, and surcharging of the upstream conveyance element.

As development occurs within the drainage basin, runoff should be controlled and released at the 100-year historical rates and amounts, or less. Improvements within the basin should include development of dedicated major drainageways that safely convey the 100-year runoff. The improvements may include open channels, greenways, improved roadway culverts, bridge crossings, and regional detention ponds. To determine all of the components required for future major drainageway improvements, additional studies are required. The modeling created in this study can be used as the basis for analyzing future improvements, and can be updated accordingly as improvements are completed.

13. Welch Reservoir

The Welch Reservoir drainage basin is located in the northwest corner of the Town's GMA, it lies entirely within the GMA, and is comprised of approximately 508 acres. The western border is bounded by the Lonetree Reservoir, and directly south is the Welch Reservoir. The northern boundary is WCR15, which corresponds with the Town's GMA. The eastern boundary is a topographical ridge (see Figure III-26). Runoff drainage within the basin is primarily overland sheet flow to the south and west into either Lonetree or Welch Reservoirs.

The basin has been divided into two sub-basins as shown on Figure III-26. Sub-basin HRNA drains primarily to the Welch and Lonetree Reservoirs, while sub-basin HRNB drains to the north and exits the GMA across CR-14/HWY-60.

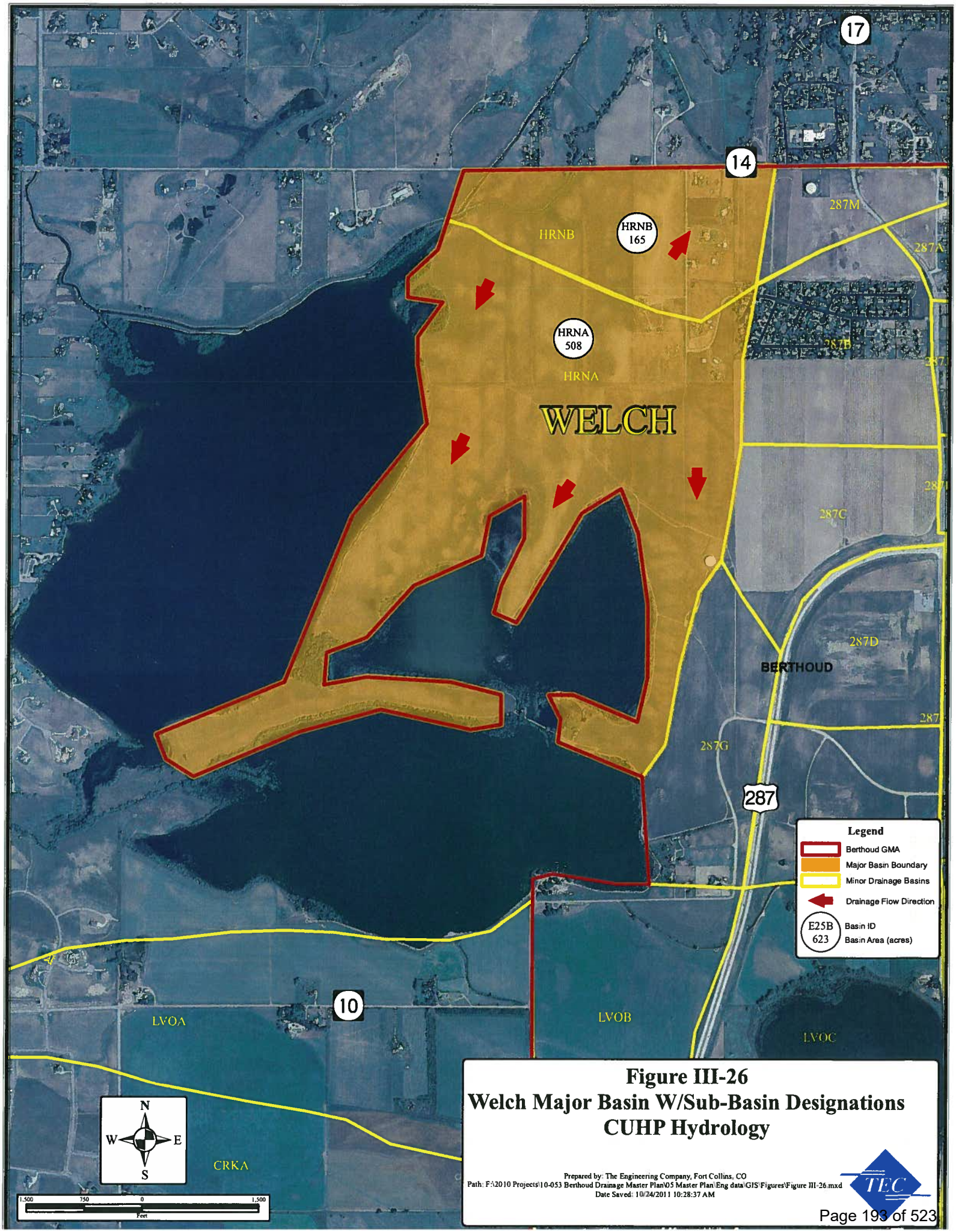


Figure III-26
Welch Major Basin W/Sub-Basin Designations
CUHP Hydrology

Prepared by: The Engineering Company, Fort Collins, CO
Path: F:\2010 Projects\10-053 Berthoud Drainage Master Plan\05 Master Plan\Eng data\GIS\Figures\Figure III-26.mxd
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Table III-26, below, summarizes the peak flows generated for the 2-, 10-, and 100-year rainfall events, as well as sub-basin area and percent imperviousness. A SWMM network model of the Welch Reservoir drainage basin was not developed because the sub-basins drain directly to either the reservoir or out of the GMA, therefore just CUHP data on drainage quantities was developed.

Table III-26: CUHP Sub-Basin Summary
Welch Reservoir

Sub-Basin ID	Area (Acres)	Impervious Percent	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
HRNA	507.6	3	5	124	425
HRNB	165	3	2	50	168

IV. PLANNING RECOMMENDATIONS

IV. PLANNING RECOMMENDATIONS

Future Planning

Drainage master planning is essential for any community and promotes smart growth, efficient use of available capital funds, and assures public safety. The Town of Berthoud is at a point where an adopted Storm Drainage Master Plan is necessary.

This Plan is a dynamic document that is the first step taken by the Town for master drainage planning, and will likely change as development occurs. This study presents an initial look at the drainage watershed in the Berthoud General Management Area (GMA) and the surrounding area, identifies natural major drainageways and gives an idea of the rainfall runoff magnitudes that will need to be managed within the Town and its GMA.

The information provided in this initial master plan is a useful planning resource for the Town and will be used to develop drainage criteria and guide future drainage infrastructure design. At the initial level of detail presented herein, the following is a list of planning recommendations and uses for this document:

1. The hydrology and hydraulic models developed for the master study can be used by the Town or developers for additional future planning and design. The models presented in the appendix of this study represent the existing drainage conditions within the watershed, and can easily be modified to simulate developed land uses and possible runoff routing or storage and water quality alternatives. The model will continue to be enhanced as development occurs in the area.

2. The design rainfall depths that have been calculated and presented in Section II can be used for any future drainage design or CUHP modeling in Berthoud. These rainfall depths should be implemented in the Town's drainage criteria and used for all analysis within Berthoud for consistency.

3. This study identifies all of the drainage basins within the watershed that affect the Berthoud GMA. In addition, an inventory of existing drainage conveyance facilities has been developed. Peak runoff flows have been identified at key design point locations such as major roadway crossings. Determining existing peak flow rates and runoff volumes at these key areas will help the Town evaluate the planning of major drainage ways, future roadway crossing design, potential regional detention benefits, and required detention release rates.

4. Developers will use the Storm Drainage Master Plan as a due diligence resource, since the concepts presented in the master plan will identify possible drainage infrastructure improvements that will be required for development within an identified drainage basin. Developers will know in the beginning stages of project planning the flows that affect a site, what hydraulic structures may be required, or roads that may require improvement. Master plans create a guide for developers to follow, and with a guide, their decision process becomes easier.

5. Initial recommendations based on the results of this study are:

   - Initiation of drainageway planning within the watershed.
   - Identify natural drainageways within each basin.
   - Coordinate drainageways with the Town's future planning map.
   - Design drainageways based on the requirement to convey 100-year historic flows, as identified in this study, without credit for any detention or culvert storage.

6. In addition, planning should begin on regional detention and water quality facilities within the watershed. Detention release rates should be initially set at the 100-year historic release rates. Suggestions should be made for detention requirements related to property immediately adjacent to the river, and further analysis should be completed to support any recommendations.

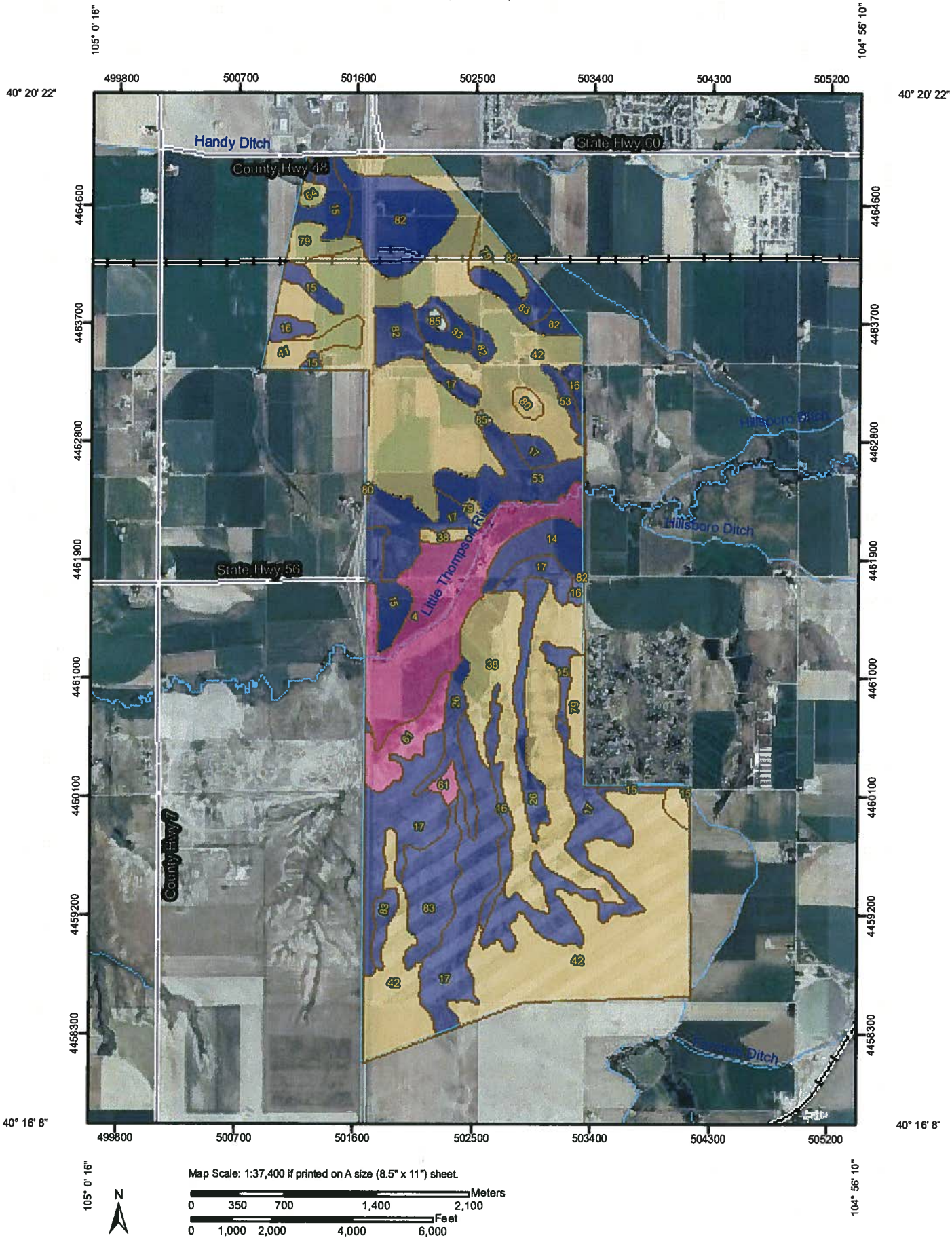
7. Future planning and development within the Town's GMA will be based on the results of this study. This study is the first step in a long term planning process that can lead to:

   - Determination of storm drainage impact fees.
   - Formation of a storm water utility.
   - Cost sharing agreements with developers and other stakeholders.
   - Evaluations of benefit/cost for grant and financial aid monies.
   - More detailed engineering analysis.

APPENDIX A

NRCS Soils Mapping

Hydrologic Soil Group—Weld County, Colorado, Southern Part
(East I-25)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:37,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
4	Aquolls and Aquepts, flooded	D	245.6	8.0%
14	Colby loam, 0 to 1 percent slopes	B	55.7	1.8%
15	Colby loam, 1 to 3 percent slopes	B	119.0	3.9%
16	Colby loam, 3 to 5 percent slopes	B	60.9	2.0%
17	Colby loam, 5 to 9 percent slopes	B	513.0	16.7%
26	Haverson loam, 1 to 3 percent slopes	B	90.7	3.0%
38	Nelson fine sandy loam, 3 to 9 percent slopes	C	319.9	10.4%
41	Nunn clay loam, 0 to 1 percent slopes	C	33.2	1.1%
42	Nunn clay loam, 1 to 3 percent slopes	C	1,028.3	33.6%
53	Otero sandy loam, 5 to 9 percent slopes	B	94.9	3.1%
61	Tassel fine sandy loam, 5 to 20 percent slopes	D	61.6	2.0%
64	Thedalund loam, 1 to 3 percent slopes	C	8.2	0.3%
79	Weld loam, 1 to 3 percent slopes	C	82.9	2.7%
80	Weld loam, 3 to 5 percent slopes	C	10.5	0.3%
82	Wiley-Colby complex, 1 to 3 percent slopes	B	177.9	5.8%
83	Wiley-Colby complex, 3 to 5 percent slopes	B	154.6	5.0%
85	Water		6.8	0.2%
Totals for Area of Interest			**3,063.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

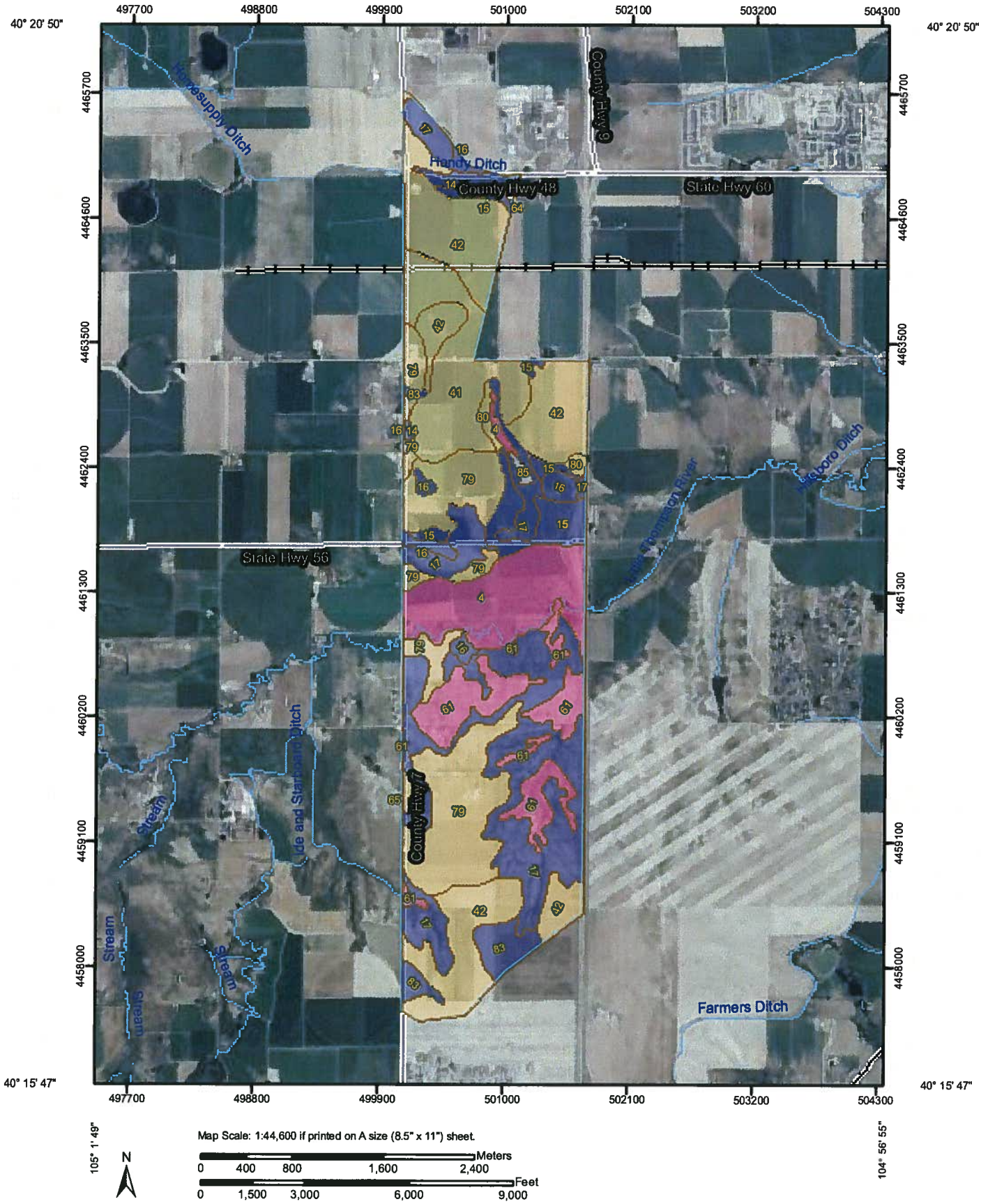
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher


105° 1' 49"
104° 56' 55"
497700
498800
499900
501000
502100
503200
504300
40° 20' 50"
40° 15' 47"
4465700
4464600
4463500
4462400
4461300
4460200
4459100
4458000
Horsesupply Ditch
Handy Ditch
County Hwy 9
County Hwy 48
State Hwy 60
State Hwy 56
Little Thompson River
Hillsboro Ditch
Stream
Side and Starboard Ditch
County Hwy 7
Farmers Ditch
Map Scale: 1:44,600 if printed on A size (8.5" x 11") sheet.
N
Meters
0 400 800 1,600 2,400
Feet
0 1,500 3,000 6,000 9,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:44,600 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Date(s) aerial images were photographed: 8/6/2005

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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
4	Aquolls and Aquepts, flooded	D	259.9	10.1%
14	Colby loam, 0 to 1 percent slopes	B	32.6	1.3%
15	Colby loam, 1 to 3 percent slopes	B	114.3	4.4%
16	Colby loam, 3 to 5 percent slopes	B	56.1	2.2%
17	Colby loam, 5 to 9 percent slopes	B	581.4	22.5%
41	Nunn clay loam, 0 to 1 percent slopes	C	246.7	9.6%
42	Nunn clay loam, 1 to 3 percent slopes	C	546.7	21.2%
61	Tassel fine sandy loam, 5 to 20 percent slopes	D	207.0	8.0%
64	Thedalund loam, 1 to 3 percent slopes	C	1.5	0.1%
65	Thedalund loam, 3 to 9 percent slopes	C	11.2	0.4%
79	Weld loam, 1 to 3 percent slopes	C	430.8	16.7%
80	Weld loam, 3 to 5 percent slopes	C	16.9	0.7%
83	Wiley-Colby complex, 3 to 5 percent slopes	B	68.1	2.6%
85	Water		5.8	0.2%
Totals for Area of Interest			**2,578.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

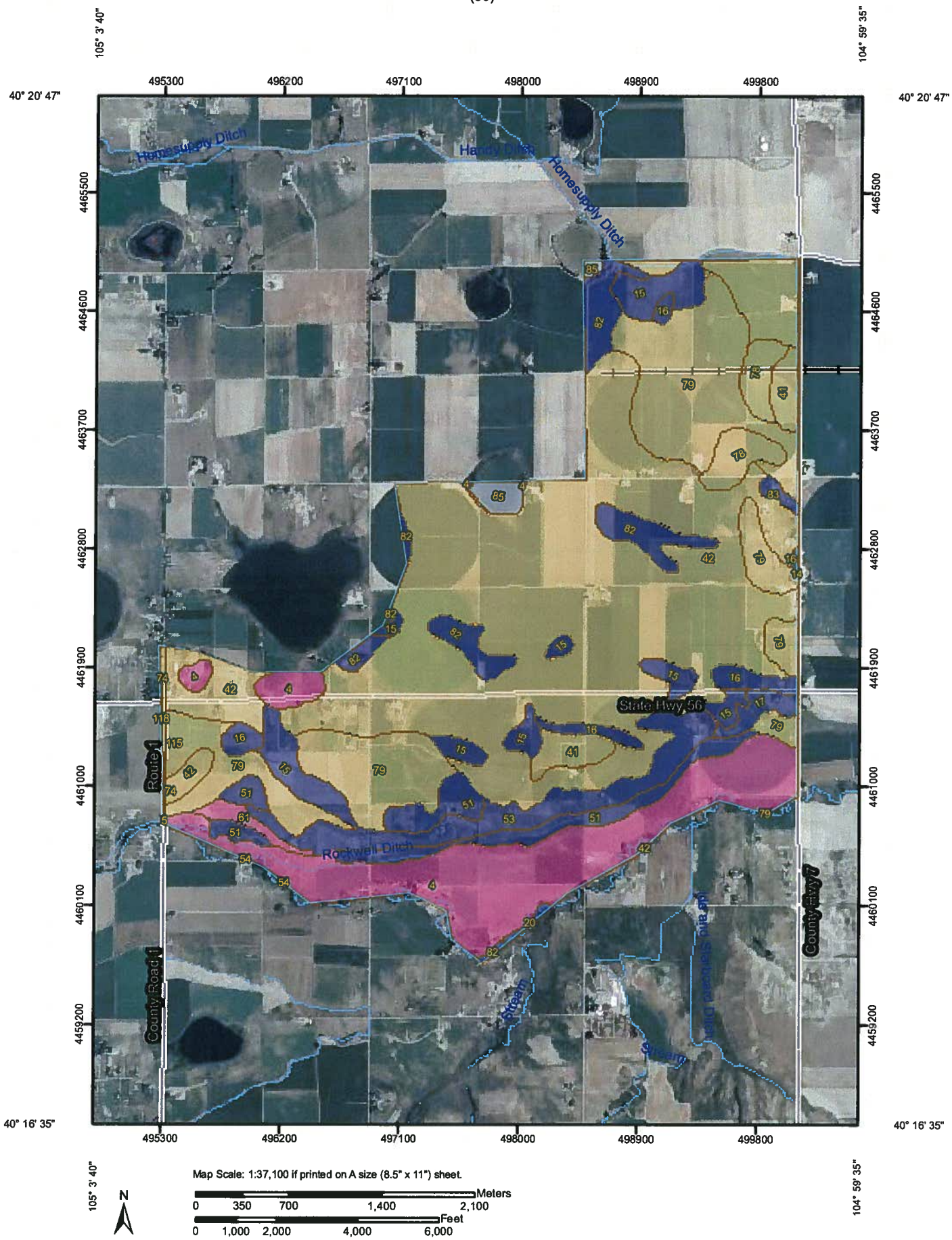
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado; and Weld County, Colorado, Southern Part
(56)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:37,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
5	Aquepts, loamy	D	0.2	0.0%
74	Nunn clay loam, 1 to 3 percent slopes	C	6.7	0.2%
115	Weld silt loam, 0 to 3 percent slopes	C	4.3	0.1%
118	Wiley silt loam, 1 to 3 percent slopes	B	0.0	0.0%
Subtotals for Soil Survey Area			**11.2**	**0.3%**
Totals for Area of Interest			**3,598.3**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
4	Aquolls and Aquepts, flooded	D	491.4	13.7%
14	Colby loam, 0 to 1 percent slopes	B	0.1	0.0%
15	Colby loam, 1 to 3 percent slopes	B	174.3	4.8%
16	Colby loam, 3 to 5 percent slopes	B	62.5	1.7%
17	Colby loam, 5 to 9 percent slopes	B	25.0	0.7%
20	Colombo clay loam, 1 to 3 percent slopes	B	4.8	0.1%
41	Nunn clay loam, 0 to 1 percent slopes	C	64.0	1.8%
42	Nunn clay loam, 1 to 3 percent slopes	C	1,587.1	44.1%
51	Otero sandy loam, 1 to 3 percent slopes	B	147.9	4.1%
53	Otero sandy loam, 5 to 9 percent slopes	B	166.8	4.6%
54	Paoli loam, 0 to 1 percent slopes	B	0.8	0.0%
61	Tassel fine sandy loam, 5 to 20 percent slopes	D	20.6	0.6%
78	Weld loam, 0 to 1 percent slopes	C	76.9	2.1%
79	Weld loam, 1 to 3 percent slopes	C	592.8	16.5%
82	Wiley-Colby complex, 1 to 3 percent slopes	B	139.0	3.9%

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
83	Wiley-Colby complex, 3 to 5 percent slopes	B	9.1	0.3%
85	Water		24.0	0.7%
Subtotals for Soil Survey Area			**3,587.1**	**99.7%**
Totals for Area of Interest			**3,598.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

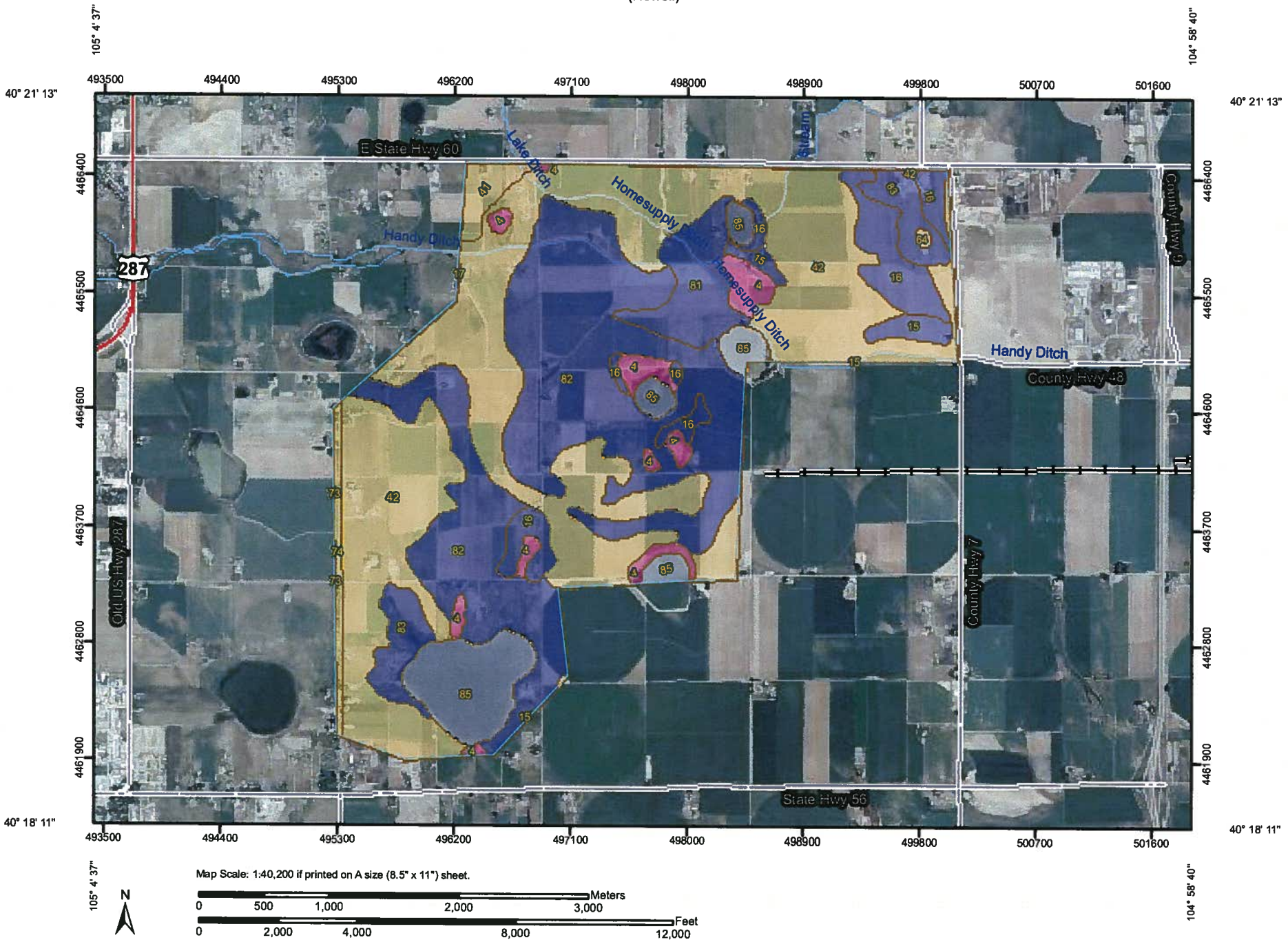
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado; and Weld County, Colorado, Southern Part
(Newell)



Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

9/1/2011
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:40,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
73	Nunn clay loam, 0 to 1 percent slope	C	0.6	0.0%
74	Nunn clay loam, 1 to 3 percent slopes	C	32.1	1.0%
Subtotals for Soil Survey Area			**32.6**	**1.0%**
Totals for Area of Interest			**3,292.5**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
4	Aquolls and Aquepts, flooded	D	105.4	3.2%
15	Colby loam, 1 to 3 percent slopes	B	43.5	1.3%
16	Colby loam, 3 to 5 percent slopes	B	185.5	5.6%
17	Colby loam, 5 to 9 percent slopes	B	0.7	0.0%
41	Nunn clay loam, 0 to 1 percent slopes	C	41.5	1.3%
42	Nunn clay loam, 1 to 3 percent slopes	C	1,391.9	42.3%
64	Thedalund loam, 1 to 3 percent slopes	C	3.5	0.1%
81	Wiley-Colby complex, 0 to 1 percent slopes	B	129.9	3.9%
82	Wiley-Colby complex, 1 to 3 percent slopes	B	1,015.0	30.8%
83	Wiley-Colby complex, 3 to 5 percent slopes	B	119.3	3.6%
85	Water		223.8	6.8%
Subtotals for Soil Survey Area			**3,259.8**	**99.0%**
Totals for Area of Interest			**3,292.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

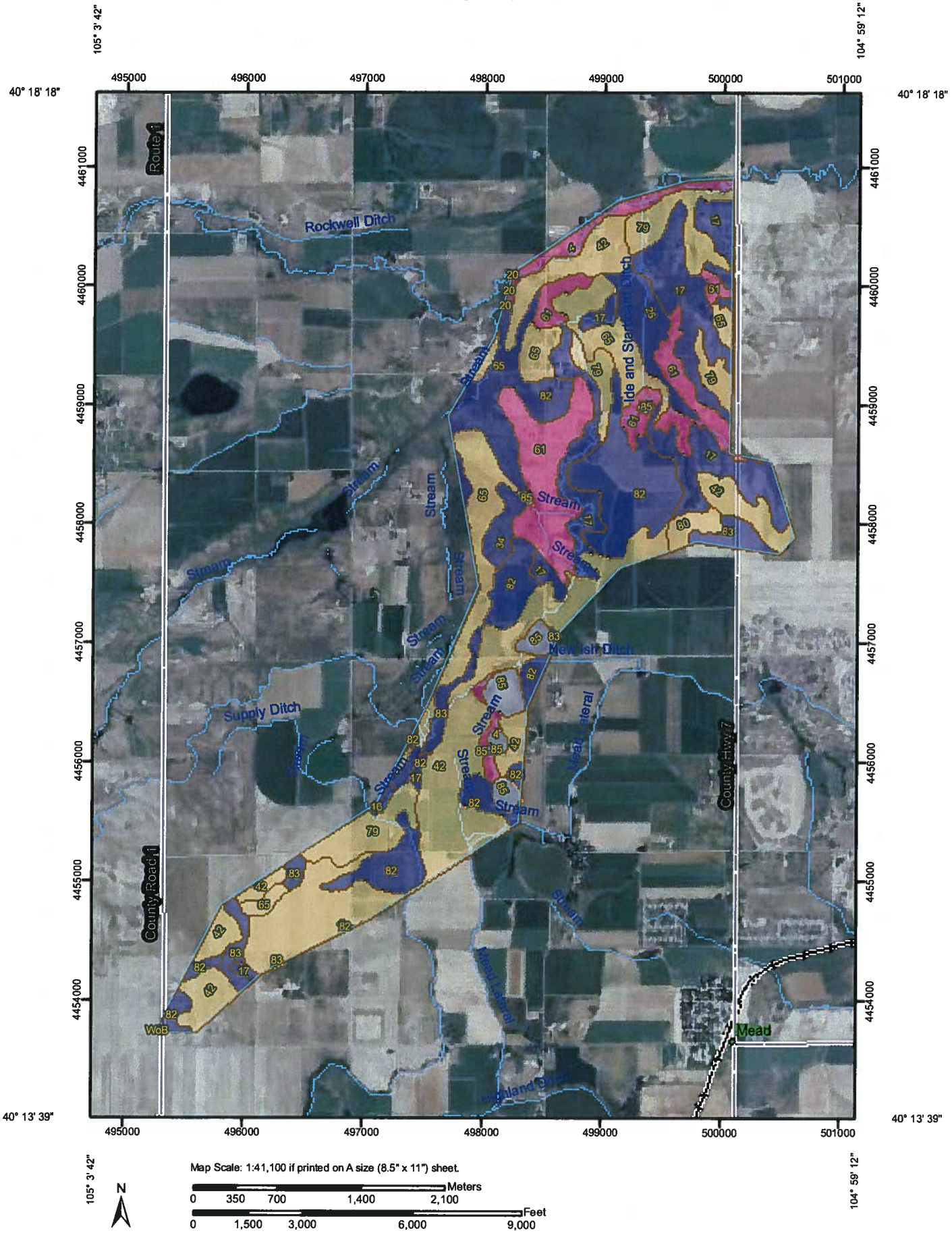
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Boulder County Area, Colorado; and Weld County, Colorado, Southern Part
(Highlands)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:41,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 9, May 1, 2009

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Boulder County Area, Colorado (CO643)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
WoB	Weld-Colby complex, 0 to 3 percent slopes	C	0.4	0.0%
Subtotals for Soil Survey Area			**0.4**	**0.0%**
Totals for Area of Interest			**2,589.8**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
4	Aquolls and Aquepts, flooded	D	66.5	2.6%
16	Colby loam, 3 to 5 percent slopes	B	5.3	0.2%
17	Colby loam, 5 to 9 percent slopes	B	383.1	14.8%
20	Colombo clay loam, 1 to 3 percent slopes	B	0.4	0.0%
26	Haverson loam, 1 to 3 percent slopes	B	70.4	2.7%
34	Kim loam, 5 to 9 percent slopes	B	31.6	1.2%
42	Nunn clay loam, 1 to 3 percent slopes	C	652.4	25.2%
61	Tassel fine sandy loam, 5 to 20 percent slopes	D	262.6	10.1%
65	Thedalund loam, 3 to 9 percent slopes	C	258.8	10.0%
79	Weld loam, 1 to 3 percent slopes	C	196.5	7.6%
80	Weld loam, 3 to 5 percent slopes	C	24.7	1.0%
82	Wiley-Colby complex, 1 to 3 percent slopes	B	481.0	18.6%
83	Wiley-Colby complex, 3 to 5 percent slopes	B	89.0	3.4%
85	Water		67.0	2.6%
Subtotals for Soil Survey Area			**2,589.4**	**100.0%**
Totals for Area of Interest			**2,589.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

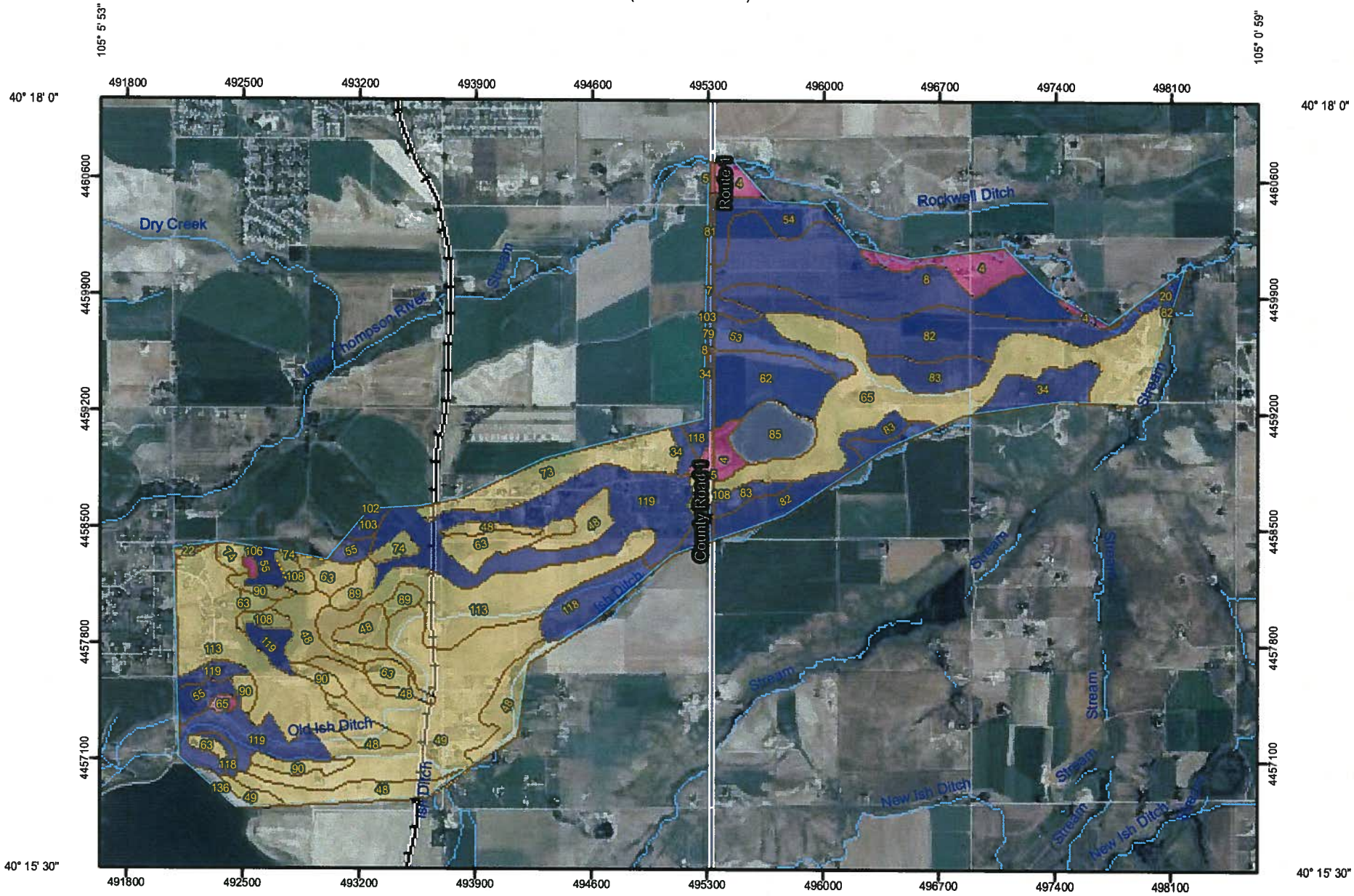
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado; and Weld County, Colorado, Southern Part
(Baxter Reservoir)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

MAP INFORMATION

Map Scale: 1:33,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
5	Aquepts, loamy	D	6.0	0.3%
7	Ascalon sandy loam, 0 to 3 percent slopes	B	2.8	0.1%
8	Ascalon sandy loam, 3 to 5 percent slopes	B	0.0	0.0%
22	Caruso clay loam, 0 to 1 percent slope	C	2.2	0.1%
34	Fort Collins loam, 0 to 1 percent slopes	B	8.0	0.4%
48	Heldt clay loam, 0 to 3 percent slopes	C	146.8	7.7%
49	Heldt clay loam, 3 to 6 percent slopes	C	191.5	10.1%
55	Kim loam, 5 to 9 percent slopes	B	29.2	1.5%
63	Longmont clay, 0 to 3 percent slopes	C	56.5	3.0%
65	Midway clay loam, 5 to 25 percent slopes	D	3.4	0.2%
73	Nunn clay loam, 0 to 1 percent slope	C	62.2	3.3%
74	Nunn clay loam, 1 to 3 percent slopes	C	14.0	0.7%
79	Otero sandy loam, 5 to 9 percent slopes	B	1.8	0.1%
81	Paoli fine sandy loam, 0 to 1 percent slopes	B	3.2	0.2%
89	Renohill clay loam, 0 to 3 percent slopes	C	17.4	0.9%
90	Renohill clay loam, 3 to 9 percent slopes	C	30.7	1.6%
102	Stoneham loam, 3 to 5 percent slopes	B	0.0	0.0%
103	Stoneham loam, 5 to 9 percent slopes	B	6.2	0.3%
106	Tassel sandy loam, 3 to 25 percent slopes	D	2.6	0.1%
108	Thedalund loam, 3 to 9 percent slopes	C	22.7	1.2%
113	Ulm clay loam, 0 to 3 percent slopes	C	221.1	11.6%
118	Wiley silt loam, 1 to 3 percent slopes	B	59.7	3.1%

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
119	Wiley silt loam, 3 to 5 percent slopes	B	212.5	11.2%
136	Water		6.0	0.3%
Subtotals for Soil Survey Area			**1,106.7**	**58.1%**
Totals for Area of Interest			**1,903.6**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
4	Aquolls and Aquepts, flooded	D	57.7	3.0%
8	Ascalon loam, 0 to 1 percent slopes	B	161.5	8.5%
20	Colombo clay loam, 1 to 3 percent slopes	B	5.9	0.3%
34	Kim loam, 5 to 9 percent slopes	B	32.0	1.7%
53	Otero sandy loam, 5 to 9 percent slopes	B	30.0	1.6%
54	Paoli loam, 0 to 1 percent slopes	B	31.5	1.7%
65	Thedalund loam, 3 to 9 percent slopes	C	191.1	10.0%
82	Wiley-Colby complex, 1 to 3 percent slopes	B	199.9	10.5%
83	Wiley-Colby complex, 3 to 5 percent slopes	B	52.2	2.7%
85	Water		35.2	1.8%
Subtotals for Soil Survey Area			**796.9**	**41.9%**
Totals for Area of Interest			**1,903.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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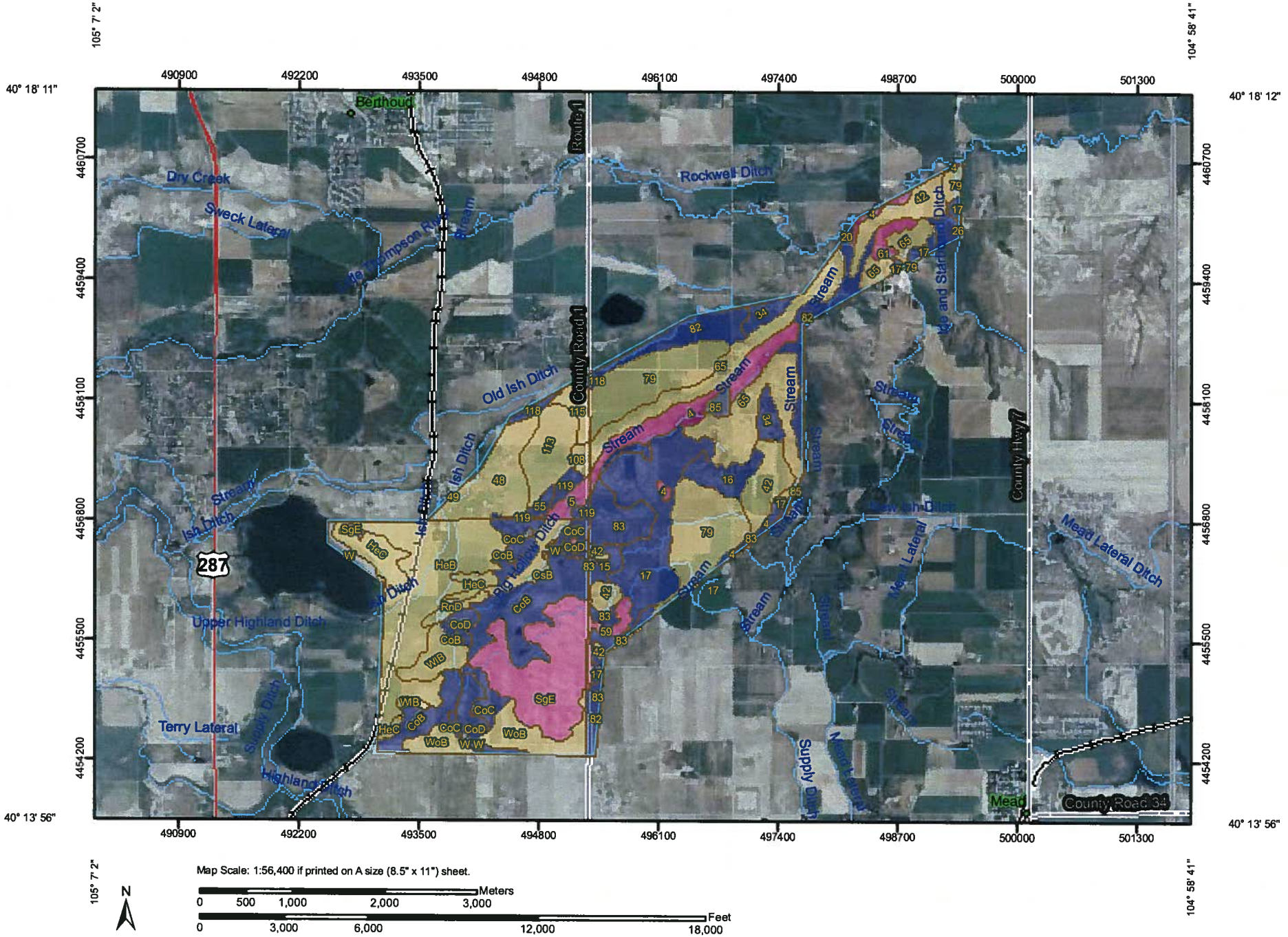
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Boulder County Area, Colorado; Larimer County Area, Colorado; and Weld County, Colorado, Southern Part
(Big Hollow)



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

8/25/2011
Page 1 of 5

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:56,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 9, May 1, 2009

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/6/2005

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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Boulder County Area, Colorado (CO643)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
CoB	Colby silty clay loam, 1 to 3 percent slopes	B	263.0	6.9%
CoC	Colby silty clay loam, 3 to 5 percent slopes	B	97.9	2.6%
CoD	Colby silty clay loam, 5 to 9 percent slopes	B	76.0	2.0%
CsB	Colby silty clay loam, wet, 0 to 3 percent slopes	C	45.4	1.2%
HeB	Heldt clay, 0 to 3 percent slopes	C	367.0	9.6%
HeC	Heldt clay, 3 to 5 percent slopes	C	92.0	2.4%
RnD	Renohill silty clay loam, 3 to 9 percent slopes	C	22.4	0.6%
SgE	Shingle-Gaynor complex, 3 to 20 percent slopes	D	290.7	7.6%
W	Water		24.1	0.6%
WlB	Weld loam, 1 to 3 percent slopes	C	66.9	1.8%
WoB	Weld-Colby complex, 0 to 3 percent slopes	C	124.4	3.3%
Subtotals for Soil Survey Area			**1,469.9**	**38.5%**
Totals for Area of Interest			**3,819.8**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
5	Aquepts, loamy	D	23.4	0.6%
48	Heldt clay loam, 0 to 3 percent slopes	C	152.1	4.0%
49	Heldt clay loam, 3 to 6 percent slopes	C	0.5	0.0%
55	Kim loam, 5 to 9 percent slopes	B	13.8	0.4%
108	Thedalund loam, 3 to 9 percent slopes	C	13.9	0.4%
113	Ulm clay loam, 0 to 3 percent slopes	C	104.7	2.7%
115	Weld silt loam, 0 to 3 percent slopes	C	35.0	0.9%
118	Wiley silt loam, 1 to 3 percent slopes	B	15.1	0.4%
119	Wiley silt loam, 3 to 5 percent slopes	B	31.0	0.8%
Subtotals for Soil Survey Area			**389.5**	**10.2%**
Totals for Area of Interest			**3,819.8**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
4	Aquolls and Aquepts, flooded	D	141.4	3.7%
15	Colby loam, 1 to 3 percent slopes	B	26.2	0.7%
16	Colby loam, 3 to 5 percent slopes	B	58.6	1.5%
17	Colby loam, 5 to 9 percent slopes	B	297.5	7.8%
20	Colombo clay loam, 1 to 3 percent slopes	B	1.6	0.0%
26	Haverson loam, 1 to 3 percent slopes	B	22.0	0.6%
34	Kim loam, 5 to 9 percent slopes	B	56.1	1.5%
42	Nunn clay loam, 1 to 3 percent slopes	C	183.0	4.8%
59	Shingle loam, 3 to 9 percent slopes	D	30.1	0.8%
61	Tassel fine sandy loam, 5 to 20 percent slopes	D	23.9	0.6%
65	Thedalund loam, 3 to 9 percent slopes	C	383.2	10.0%
79	Weld loam, 1 to 3 percent slopes	C	371.1	9.7%
82	Wiley-Colby complex, 1 to 3 percent slopes	B	197.4	5.2%
83	Wiley-Colby complex, 3 to 5 percent slopes	B	151.8	4.0%
85	Water		16.6	0.4%
Subtotals for Soil Survey Area			**1,960.4**	**51.3%**
Totals for Area of Interest			**3,819.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

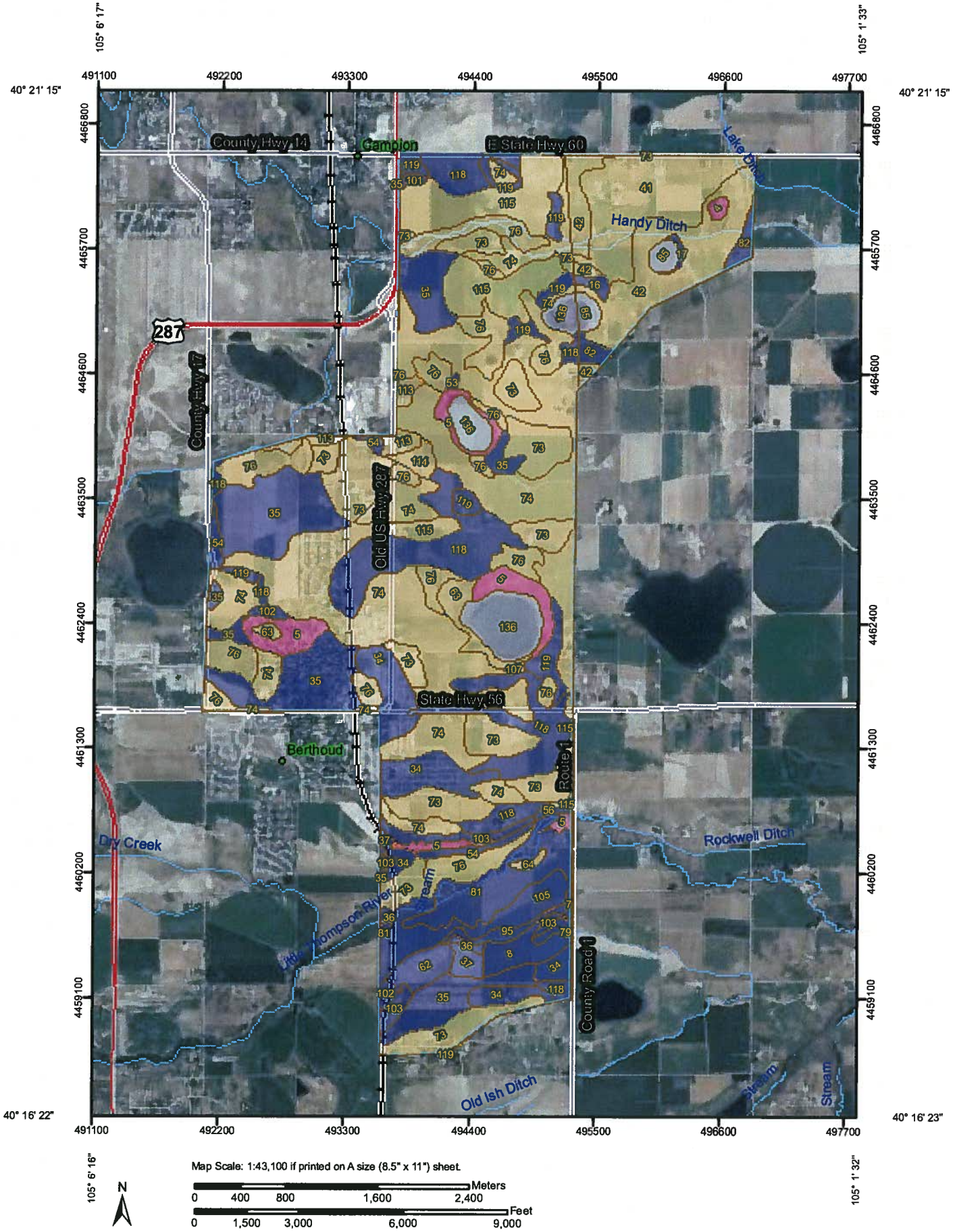
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado; and Weld County, Colorado, Southern Part
(Bacon Lake)



Map Scale: 1:43,100 if printed on A size (8.5" x 11") sheet.

N

Meters
0 400 800 1,600 2,400

Feet
0 1,500 3,000 6,000 9,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
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- D
- Not rated or not available

Political Features
- Cities

Water Features
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Transportation
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- Interstate Highways
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MAP INFORMATION

Map Scale: 1:43,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 11, Aug 27, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
5	Aquepts, loamy	D	122.1	2.7%
7	Ascalon sandy loam, 0 to 3 percent slopes	B	2.7	0.1%
8	Ascalon sandy loam, 3 to 5 percent slopes	B	45.4	1.0%
34	Fort Collins loam, 0 to 1 percent slopes	B	180.8	4.0%
35	Fort Collins loam, 1 to 3 percent slopes	B	450.2	9.9%
36	Fort Collins loam, 3 to 5 percent slopes	B	8.9	0.2%
37	Fort Collins loam, 5 to 9 percent slopes	B	20.8	0.5%
53	Kim loam, 1 to 3 percent slopes	B	2.7	0.1%
54	Kim loam, 3 to 5 percent slopes	B	33.2	0.7%
56	Kim-Thedalund loams, 3 to 15 percent slopes	B	4.9	0.1%
62	Larimer-Stoneham complex, 3 to 10 percent slopes	B	36.5	0.8%
63	Longmont clay, 0 to 3 percent slopes	C	41.4	0.9%
64	Loveland clay loam, 0 to 1 percent slopes	C	5.8	0.1%
73	Nunn clay loam, 0 to 1 percent slope	C	397.1	8.7%
74	Nunn clay loam, 1 to 3 percent slopes	C	1,033.2	22.7%
76	Nunn clay loam, wet, 1 to 3 percent slopes	C	360.3	7.9%
79	Otero sandy loam, 5 to 9 percent slopes	B	6.1	0.1%
81	Paoli fine sandy loam, 0 to 1 percent slopes	B	128.5	2.8%
84	Poudre fine sandy loam, 0 to 1 percent slope	D	0.9	0.0%
95	Satanta loam, 1 to 3 percent slopes	B	19.6	0.4%
101	Stoneham loam, 1 to 3 percent slopes	B	3.6	0.1%
102	Stoneham loam, 3 to 5 percent slopes	B	15.2	0.3%
103	Stoneham loam, 5 to 9 percent slopes	B	49.3	1.1%

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
105	Table Mountain loam, 0 to 1 percent slopes	B	103.7	2.3%
107	Thedalund loam, 0 to 3 percent slopes	C	3.4	0.1%
113	Ulm clay loam, 0 to 3 percent slopes	C	36.1	0.8%
114	Ulm clay loam, 3 to 5 percent slopes	C	18.8	0.4%
115	Weld silt loam, 0 to 3 percent slopes	C	263.5	5.8%
118	Wiley silt loam, 1 to 3 percent slopes	B	386.1	8.5%
119	Wiley silt loam, 3 to 5 percent slopes	B	101.9	2.2%
136	Water		130.9	2.9%
Subtotals for Soil Survey Area			**4,013.5**	**88.1%**
Totals for Area of Interest			**4,555.2**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Weld County, Colorado, Southern Part (CO618)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
4	Aquolls and Aquepts, flooded	D	7.8	0.2%
16	Colby loam, 3 to 5 percent slopes	B	9.5	0.2%
17	Colby loam, 5 to 9 percent slopes	B	4.3	0.1%
41	Nunn clay loam, 0 to 1 percent slopes	C	214.9	4.7%
42	Nunn clay loam, 1 to 3 percent slopes	C	245.8	5.4%
82	Wiley-Colby complex, 1 to 3 percent slopes	B	29.0	0.6%
85	Water		30.4	0.7%
Subtotals for Soil Survey Area			**541.6**	**11.9%**
Totals for Area of Interest			**4,555.2**	**100.0%**

Description

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The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

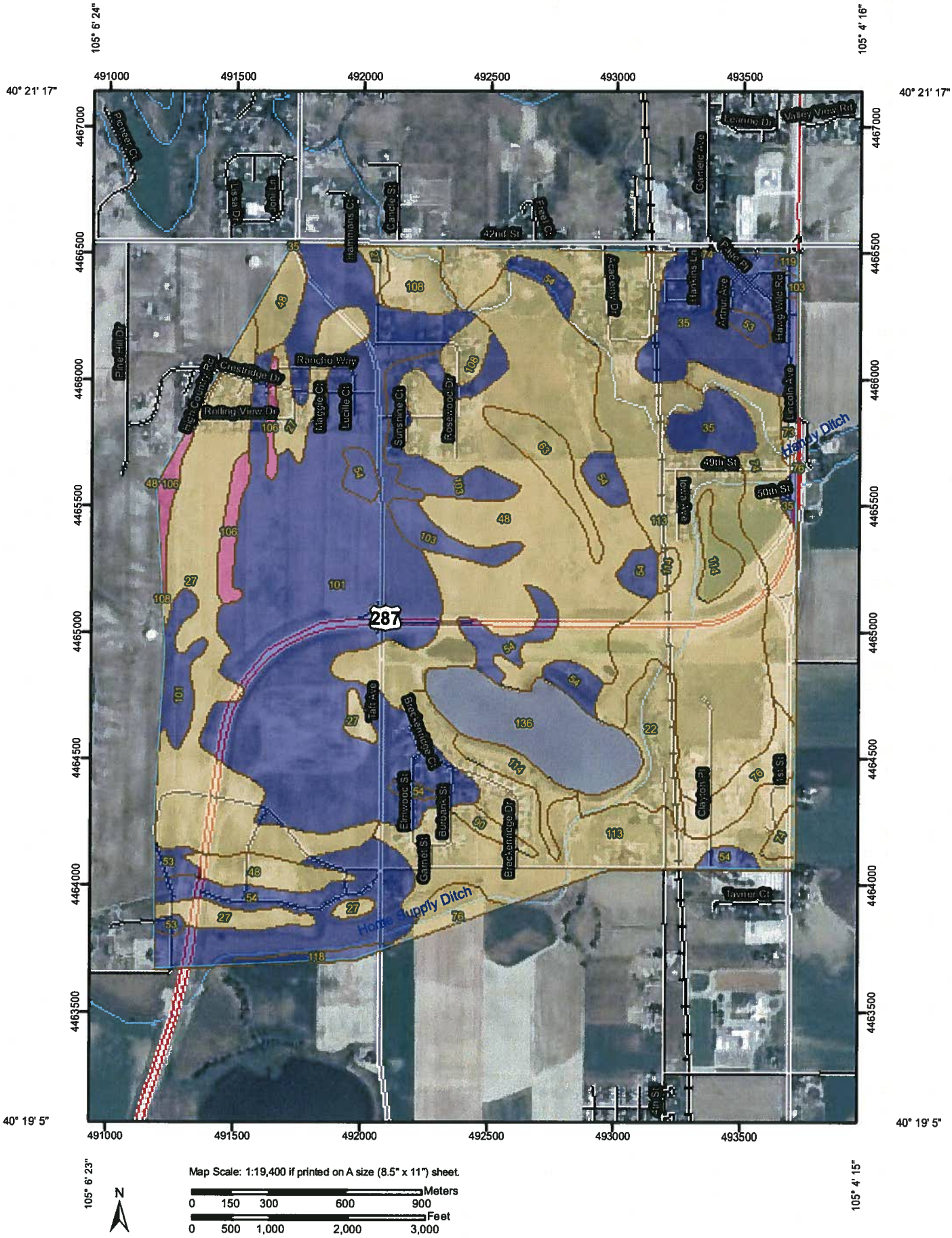
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado
(Highway 287)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:19,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
22	Caruso clay loam, 0 to 1 percent slope	C	28.8	1.8%
27	Cushman fine sandy loam, 3 to 9 percent slopes	C	157.7	10.0%
35	Fort Collins loam, 1 to 3 percent slopes	B	82.5	5.2%
48	Heldt clay loam, 0 to 3 percent slopes	C	243.9	15.4%
53	Kim loam, 1 to 3 percent slopes	B	10.6	0.7%
54	Kim loam, 3 to 5 percent slopes	B	116.9	7.4%
63	Longmont clay, 0 to 3 percent slopes	C	17.4	1.1%
73	Nunn clay loam, 0 to 1 percent slope	C	2.2	0.1%
74	Nunn clay loam, 1 to 3 percent slopes	C	53.0	3.3%
76	Nunn clay loam, wet, 1 to 3 percent slopes	C	31.2	2.0%
90	Renohill clay loam, 3 to 9 percent slopes	C	5.2	0.3%
101	Stoneham loam, 1 to 3 percent slopes	B	338.3	21.4%
103	Stoneham loam, 5 to 9 percent slopes	B	42.2	2.7%
106	Tassel sandy loam, 3 to 25 percent slopes	D	19.3	1.2%
108	Thedalund loam, 3 to 9 percent slopes	C	23.6	1.5%
113	Ulm clay loam, 0 to 3 percent slopes	C	318.6	20.1%
114	Ulm clay loam, 3 to 5 percent slopes	C	26.0	1.6%
115	Weld silt loam, 0 to 3 percent slopes	C	1.8	0.1%
118	Wiley silt loam, 1 to 3 percent slopes	B	5.4	0.3%
119	Wiley silt loam, 3 to 5 percent slopes	B	1.5	0.1%
136	Water		56.2	3.6%
Totals for Area of Interest			**1,582.3**	**100.0%**

Description

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Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

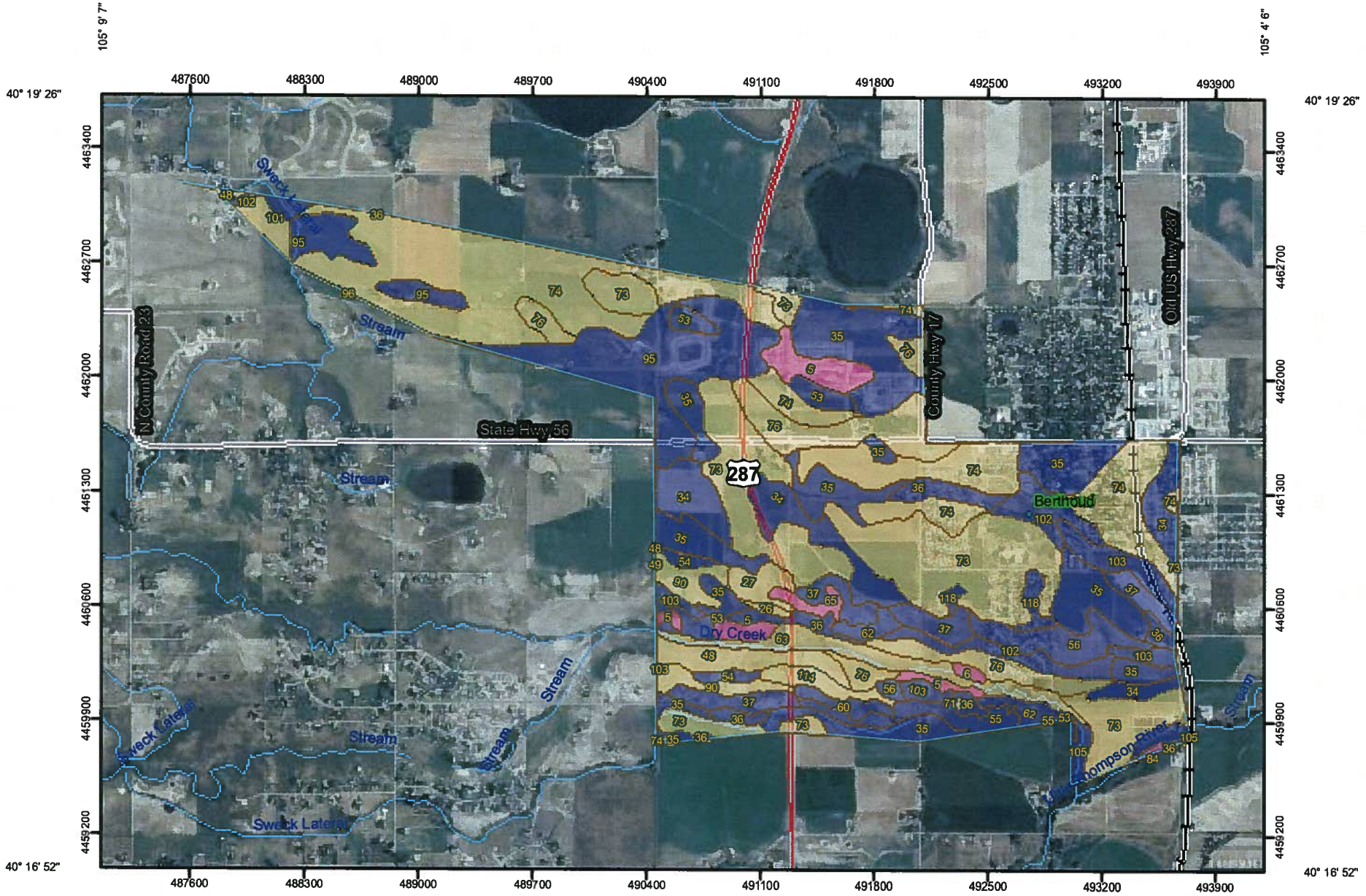
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado
(Dry Creek)



MAP LEGEND

Area of Interest (AOI)
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Survey Area Data: Version 7, May 1, 2009

Date(s) aerial images were photographed: 8/6/2005

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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
5	Aquepts, loamy	D	47.9	2.2%
6	Aquepts, ponded	D	3.6	0.2%
26	Cushman fine sandy loam, 0 to 3 percent slopes	C	3.6	0.2%
27	Cushman fine sandy loam, 3 to 9 percent slopes	C	18.4	0.8%
34	Fort Collins loam, 0 to 1 percent slopes	B	116.4	5.2%
35	Fort Collins loam, 1 to 3 percent slopes	B	300.8	13.5%
36	Fort Collins loam, 3 to 5 percent slopes	B	52.9	2.4%
37	Fort Collins loam, 5 to 9 percent slopes	B	69.3	3.1%
48	Heldt clay loam, 0 to 3 percent slopes	C	39.6	1.8%
49	Heldt clay loam, 3 to 6 percent slopes	C	0.3	0.0%
53	Kim loam, 1 to 3 percent slopes	B	38.1	1.7%
54	Kim loam, 3 to 5 percent slopes	B	12.4	0.6%
55	Kim loam, 5 to 9 percent slopes	B	30.2	1.4%
56	Kim-Thedalund loams, 3 to 15 percent slopes	B	45.9	2.1%
60	Larim gravelly sandy loam, 5 to 40 percent slopes	B	11.7	0.5%
62	Larimer-Stoneham complex, 3 to 10 percent slopes	B	22.5	1.0%
63	Longmont clay, 0 to 3 percent slopes	C	54.0	2.4%
65	Midway clay loam, 5 to 25 percent slopes	D	9.9	0.4%
71	Nelson fine sandy loam, 3 to 9 percent slopes	C	0.6	0.0%
73	Nunn clay loam, 0 to 1 percent slope	C	366.3	16.5%
74	Nunn clay loam, 1 to 3 percent slopes	C	459.3	20.6%
76	Nunn clay loam, wet, 1 to 3 percent slopes	C	132.0	5.9%
81	Paoli fine sandy loam, 0 to 1 percent slopes	B	0.0	0.0%

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
84	Poudre fine sandy loam, 0 to 1 percent slope	D	3.7	0.2%
89	Renohill clay loam, 0 to 3 percent slopes	C	0.3	0.0%
90	Renohill clay loam, 3 to 9 percent slopes	C	35.4	1.6%
95	Satanta loam, 1 to 3 percent slopes	B	192.5	8.7%
96	Satanta loam, 3 to 5 percent slopes	B	0.4	0.0%
101	Stoneham loam, 1 to 3 percent slopes	B	6.0	0.3%
102	Stoneham loam, 3 to 5 percent slopes	B	61.0	2.7%
103	Stoneham loam, 5 to 9 percent slopes	B	49.7	2.2%
105	Table Mountain loam, 0 to 1 percent slopes	B	8.4	0.4%
114	Ulm clay loam, 3 to 5 percent slopes	C	18.4	0.8%
118	Wiley silt loam, 1 to 3 percent slopes	B	13.5	0.6%
Totals for Area of Interest			**2,225.2**	**100.0%**

Description

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Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

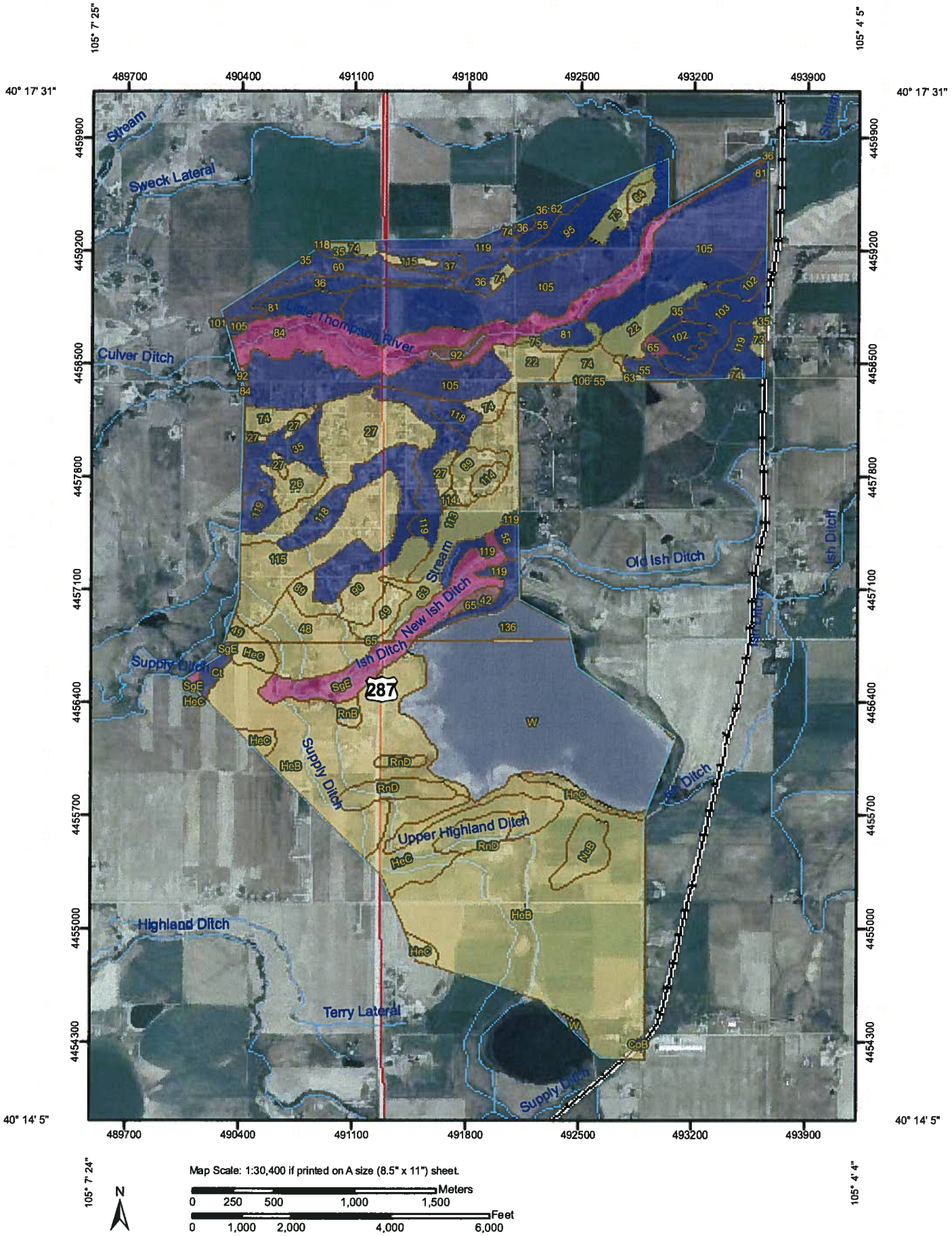
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Boulder County Area, Colorado, and Larimer County Area, Colorado
(Ish Reservoir)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:30,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 9, May 1, 2009

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Boulder County Area, Colorado (CO643)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
CoB	Colby silty clay loam, 1 to 3 percent slopes	B	1.3	0.0%
Ct	Colby-Gaynor association	B	7.1	0.3%
HeB	Heldt clay, 0 to 3 percent slopes	C	589.8	22.5%
HeC	Heldt clay, 3 to 5 percent slopes	C	100.6	3.8%
NuB	Nunn clay loam, 1 to 3 percent slopes	C	23.3	0.9%
RnB	Renohill silty clay loam, 1 to 3 percent slopes	C	5.6	0.2%
RnD	Renohill silty clay loam, 3 to 9 percent slopes	C	46.3	1.8%
SgE	Shingle-Gaynor complex, 3 to 20 percent slopes	D	37.0	1.4%
W	Water		300.6	11.5%
Subtotals for Soil Survey Area			**1,111.6**	**42.4%**
Totals for Area of Interest			**2,622.9**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
22	Caruso clay loam, 0 to 1 percent slope	C	43.3	1.6%
26	Cushman fine sandy loam, 0 to 3 percent slopes	C	16.6	0.6%
27	Cushman fine sandy loam, 3 to 9 percent slopes	C	88.5	3.4%
35	Fort Collins loam, 1 to 3 percent slopes	B	40.3	1.5%
36	Fort Collins loam, 3 to 5 percent slopes	B	28.2	1.1%
37	Fort Collins loam, 5 to 9 percent slopes	B	8.5	0.3%
42	Gravel pits	A	5.9	0.2%
48	Heldt clay loam, 0 to 3 percent slopes	C	27.6	1.1%
49	Heldt clay loam, 3 to 6 percent slopes	C	18.8	0.7%
55	Kim loam, 5 to 9 percent slopes	B	26.8	1.0%
60	Larim gravelly sandy loam, 5 to 40 percent slopes	B	33.0	1.3%
62	Larimer-Stoneham complex, 3 to 10 percent slopes	B	0.4	0.0%
63	Longmont clay, 0 to 3 percent slopes	C	18.8	0.7%
64	Loveland clay loam, 0 to 1 percent slopes	C	6.0	0.2%
65	Midway clay loam, 5 to 25 percent slopes	D	33.6	1.3%

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
73	Nunn clay loam, 0 to 1 percent slope	C	16.7	0.6%
74	Nunn clay loam, 1 to 3 percent slopes	C	49.5	1.9%
75	Nunn clay loam, 3 to 5 percent slopes	C	6.8	0.3%
81	Paoli fine sandy loam, 0 to 1 percent slopes	B	29.2	1.1%
84	Poudre fine sandy loam, 0 to 1 percent slope	D	117.5	4.5%
89	Renohill clay loam, 0 to 3 percent slopes	C	26.5	1.0%
90	Renohill clay loam, 3 to 9 percent slopes	C	27.6	1.1%
92	Riverwash	A	8.1	0.3%
95	Satanta loam, 1 to 3 percent slopes	B	34.0	1.3%
101	Stoneham loam, 1 to 3 percent slopes	B	0.7	0.0%
102	Stoneham loam, 3 to 5 percent slopes	B	23.4	0.9%
103	Stoneham loam, 5 to 9 percent slopes	B	36.4	1.4%
105	Table Mountain loam, 0 to 1 percent slopes	B	351.0	13.4%
106	Tassel sandy loam, 3 to 25 percent slopes	D	0.4	0.0%
113	Ulm clay loam, 0 to 3 percent slopes	C	52.9	2.0%
114	Ulm clay loam, 3 to 5 percent slopes	C	10.5	0.4%
115	Weld silt loam, 0 to 3 percent slopes	C	85.2	3.2%
118	Wiley silt loam, 1 to 3 percent slopes	B	82.2	3.1%
119	Wiley silt loam, 3 to 5 percent slopes	B	122.1	4.7%
136	Water		34.4	1.3%
Subtotals for Soil Survey Area			**1,511.3**	**57.6%**
Totals for Area of Interest			**2,622.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

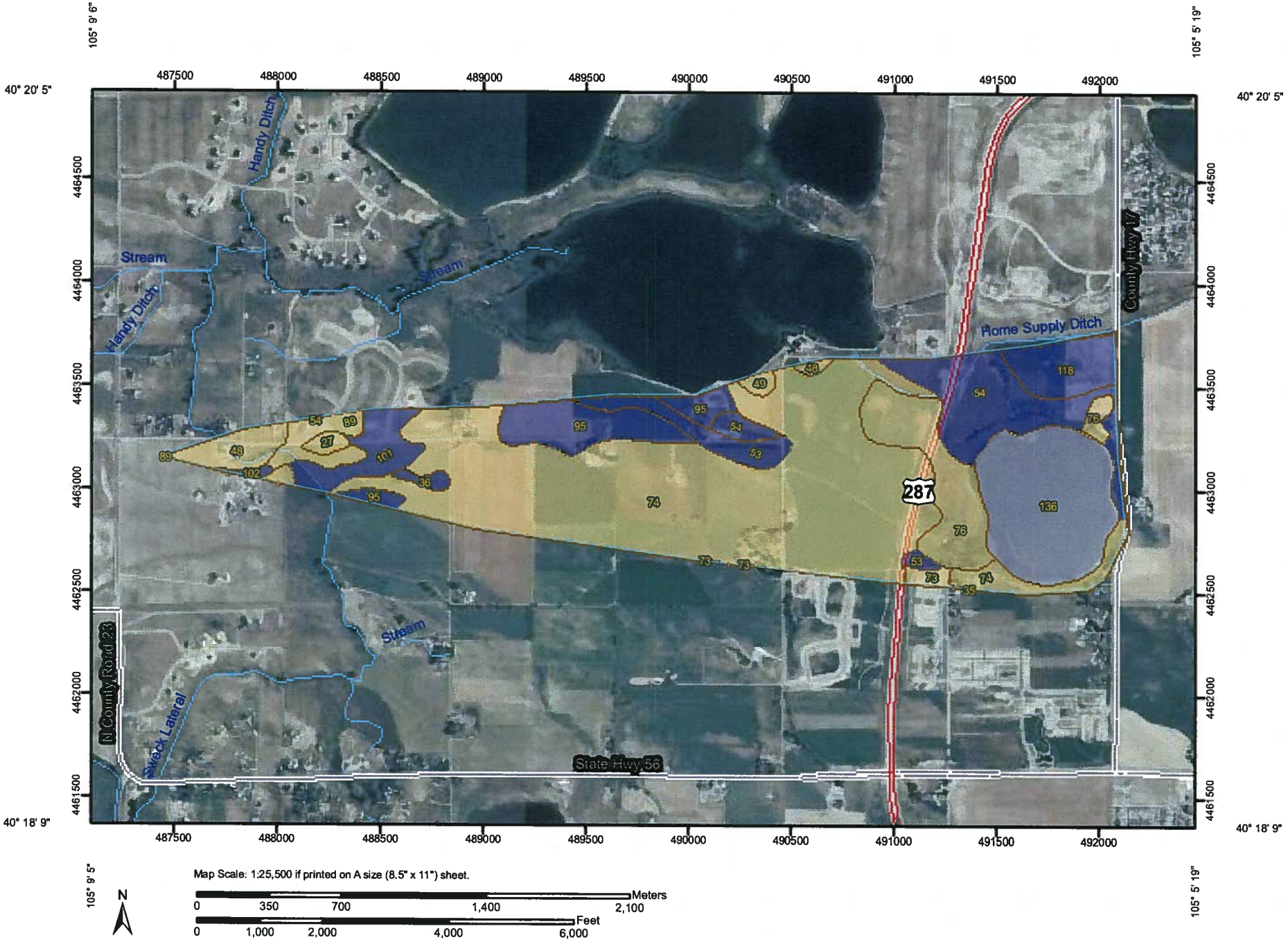
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado
(Loveland)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:25,500 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
27	Cushman fine sandy loam, 3 to 9 percent slopes	C	4.3	0.5%
35	Fort Collins loam, 1 to 3 percent slopes	B	0.0	0.0%
36	Fort Collins loam, 3 to 5 percent slopes	B	3.9	0.5%
48	Heldt clay loam, 0 to 3 percent slopes	C	21.4	2.5%
49	Heldt clay loam, 3 to 6 percent slopes	C	3.6	0.4%
53	Kim loam, 1 to 3 percent slopes	B	26.3	3.0%
54	Kim loam, 3 to 5 percent slopes	B	77.8	9.0%
73	Nunn clay loam, 0 to 1 percent slope	C	5.4	0.6%
74	Nunn clay loam, 1 to 3 percent slopes	C	418.5	48.4%
76	Nunn clay loam, wet, 1 to 3 percent slopes	C	65.0	7.5%
89	Renohill clay loam, 0 to 3 percent slopes	C	17.2	2.0%
95	Satanta loam, 1 to 3 percent slopes	B	53.1	6.1%
101	Stoneham loam, 1 to 3 percent slopes	B	28.0	3.2%
102	Stoneham loam, 3 to 5 percent slopes	B	1.9	0.2%
118	Wiley silt loam, 1 to 3 percent slopes	B	32.1	3.7%
136	Water		106.1	12.3%
Totals for Area of Interest			**864.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

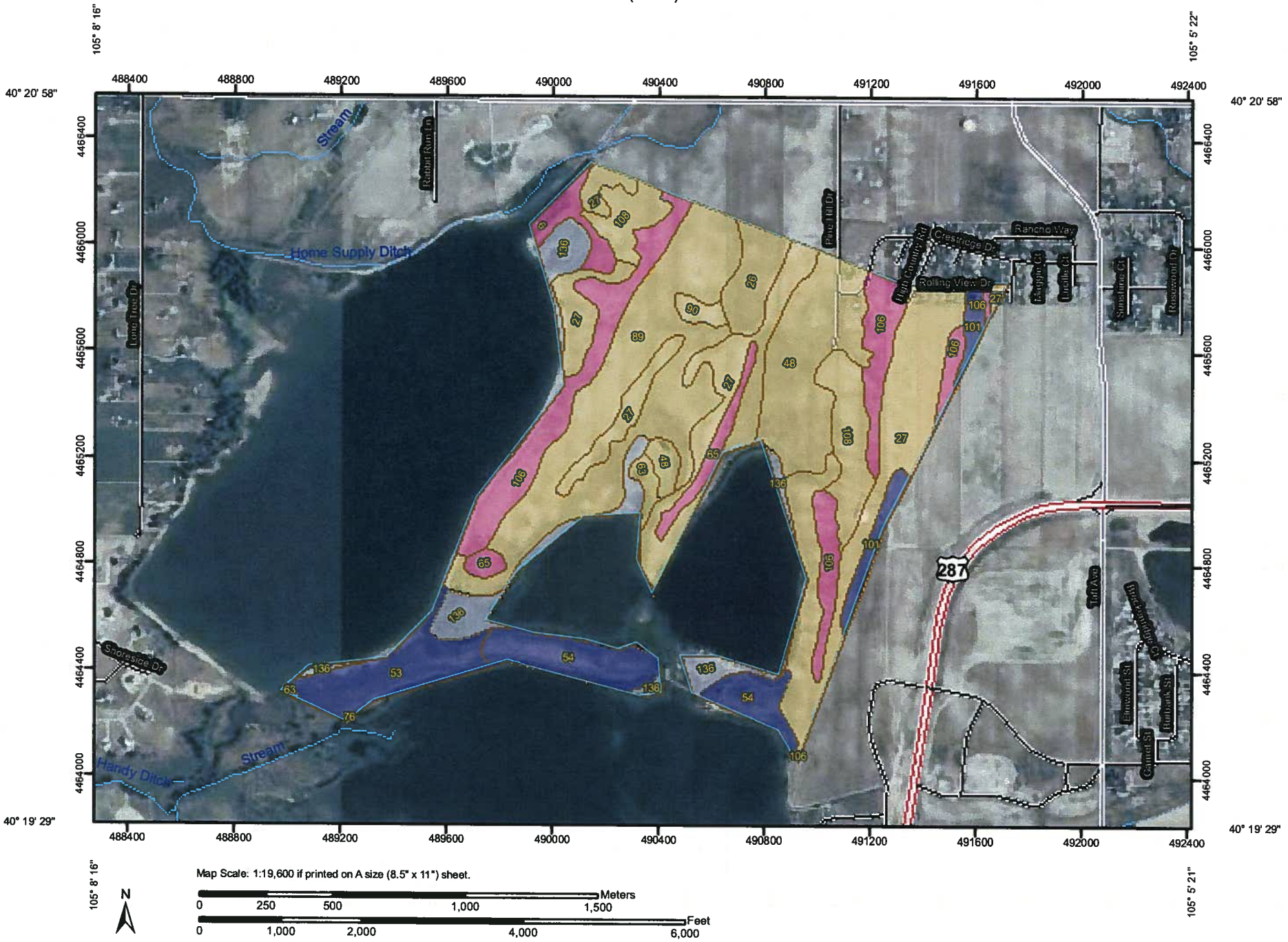
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Larimer County Area, Colorado
(HRNA)



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

8/18/2011
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:19,600 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Larimer County Area, Colorado
Survey Area Data: Version 7, May 1, 2009

Date(s) aerial images were photographed: 8/6/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Larimer County Area, Colorado (CO644)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6	Aquepts, ponded	D	9.4	1.7%
26	Cushman fine sandy loam, 0 to 3 percent slopes	C	16.2	2.9%
27	Cushman fine sandy loam, 3 to 9 percent slopes	C	139.0	24.6%
48	Heldt clay loam, 0 to 3 percent slopes	C	57.0	10.1%
53	Kim loam, 1 to 3 percent slopes	B	29.8	5.3%
54	Kim loam, 3 to 5 percent slopes	B	34.2	6.1%
63	Longmont clay, 0 to 3 percent slopes	C	4.2	0.7%
65	Midway clay loam, 5 to 25 percent slopes	D	11.1	2.0%
76	Nunn clay loam, wet, 1 to 3 percent slopes	C	0.3	0.1%
89	Renohill clay loam, 0 to 3 percent slopes	C	104.2	18.5%
90	Renohill clay loam, 3 to 9 percent slopes	C	3.9	0.7%
101	Stoneham loam, 1 to 3 percent slopes	B	12.7	2.2%
106	Tassel sandy loam, 3 to 25 percent slopes	D	70.4	12.5%
108	Thedalund loam, 3 to 9 percent slopes	C	34.6	6.1%
136	Water		37.0	6.6%
Totals for Area of Interest			**563.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

CUHP Results

East I-25 Drainage Basin

1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

							Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
E25A	Larimer County	0.4	1.21	1.5	0.009	3	0.4	0.1	3.5	0.0018	0.53
E25B	Larimer County	0.524	0.49	1.29	0.012	3	0.4	0.05	3.73	0.0018	0.54
E25C	Larimer County	0.264	0.85	0.8	0.0165	3	0.4	0.05	3.61	0.0018	0.54
E25D	Larimer County	0.591	1.32	1.5	0.015	3	0.05	0.4	3.54	0.0018	0.53
E25E	Larimer County	0.172	0.44	0.57	0.009	3	0.05	0.4	3.86	0.0018	0.56
E25F	Larimer County	0.139	0.42	0.57	0.0007	3	0.05	0.4	3.5	0.0018	0.53
E25G	Larimer County	0.46	0.8	1.18	0.011	3	0.05	0.4	3.56	0.0018	0.54
E25H	Larimer County	1.48	0.64	1.82	0.045	3	0.05	0.4	3.73	0.0018	0.55
E25I	Larimer County	0.97	0.36	0.82	0.025	3	0.05	0.4	3.39	0.0018	0.53
E25J	Larimer County	0.231	0.42	0.91	0.005	3	0.05	0.4	3.5	0.0018	0.53

East I-25 Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
E25A	0.156	0.291	103.3	24.63	53.7	17.40	41.0	116	929,280	0.02	17,520	75.0	2	17,519
E25B	0.156	0.303	55.8	14.51	29.0	10.25	24.2	282	1,217,357	0.02	23,676	50.0	5	23,671
E25C	0.156	0.274	59.4	13.98	30.9	9.88	23.3	133	613,325	0.02	12,043	50.0	2	12,038
E25D	0.156	0.309	89.9	22.83	46.7	16.14	38.1	197	1,373,011	0.29	396,981	60.0	56	396,940
E25E	0.175	0.257	50.9	11.53	26.5	8.15	19.2	101	399,590	0.27	108,362	45.0	27	108,368
E25F	0.187	0.249	101.3	20.85	52.7	14.73	34.7	41	322,925	0.29	93,716	60.0	12	93,703
E25G	0.156	0.298	70.5	17.61	36.6	12.44	29.3	196	1,068,672	0.29	305,088	55.0	55	305,085
E25H	0.156	0.355	46.6	14.20	24.3	10.04	23.7	952	3,438,336	0.28	955,148	45.0	257	955,067
E25I	0.156	0.333	29.6	9.07	15.4	6.41	15.1	983	2,253,504	0.29	660,727	40.0	265	659,646
E25J	0.160	0.268	62.6	14.41	32.6	10.18	24.0	111	536,659	0.29	155,743	50.0	31	155,725

East I-25 Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
E25A	0.154	0.289	103.4	24.42	53.8	17.26	40.7	116	929,280	0.43	399,049	80.0	45	399,027
E25B	0.154	0.301	55.8	14.39	29.0	10.17	24.0	282	1,217,357	0.41	496,111	55.0	96	495,994
E25C	0.154	0.271	59.4	13.87	30.9	9.80	23.1	133	613,325	0.41	253,778	55.0	46	253,672
E25D	0.154	0.306	89.9	22.64	46.8	16.00	37.7	197	1,373,011	0.76	1,041,136	65.0	138	1,041,046
E25E	0.173	0.254	50.9	11.44	26.5	8.09	19.1	101	399,590	0.71	284,147	45.0	64	284,160
E25F	0.185	0.246	101.3	20.68	52.7	14.61	34.5	41	322,925	0.76	245,542	65.0	29	245,506
E25G	0.154	0.295	70.5	17.46	36.7	12.34	29.1	196	1,068,672	0.75	798,367	55.0	132	798,371
E25H	0.154	0.351	46.7	14.09	24.3	9.96	23.5	952	3,438,336	0.73	2,503,243	45.0	608	2,503,066
E25I	0.154	0.330	29.6	9.00	15.4	6.36	15.0	982	2,253,504	0.77	1,726,386	35.0	599	1,723,618
E25J	0.158	0.266	62.8	14.31	32.6	10.11	23.8	110	534,336	0.76	406,292	50.0	74	406,247

East I-25 Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
E25A	0.154	0.287	103.4	24.29	53.8	17.17	40.5	116	929,280	1.53	1,423,818	80.0	167	1,423,741
E25B	0.154	0.299	55.8	14.32	29.0	10.12	23.9	282	1,217,357	1.51	1,838,316	60.0	356	1,837,890
E25C	0.154	0.270	59.4	13.80	30.9	9.75	23.0	133	613,325	1.52	930,003	60.0	171	929,642
E25D	0.154	0.304	89.9	22.52	46.8	15.92	37.5	197	1,373,011	1.86	2,555,394	75.0	338	2,555,211
E25E	0.172	0.253	50.9	11.39	26.5	8.05	19.0	101	399,590	1.81	725,014	55.0	149	725,046
E25F	0.184	0.245	101.3	20.57	52.7	14.53	34.3	41	322,925	1.86	601,687	75.0	71	601,599
E25G	0.154	0.293	70.5	17.37	36.7	12.28	29.0	196	1,068,672	1.85	1,976,951	65.0	318	1,976,981
E25H	0.154	0.349	46.7	14.02	24.3	9.91	23.4	952	3,438,336	1.83	6,295,125	55.0	1,409	6,294,706
E25I	0.154	0.328	29.6	8.96	15.4	6.33	14.9	982	2,253,504	1.87	4,211,716	45.0	1,297	4,205,020
E25J	0.157	0.264	62.8	14.24	32.6	10.06	23.7	110	534,336	1.86	995,597	60.0	174	995,478

West I-25 Drainage Basin

Basin Management
This sheet is used to enter the subcatchment parameters. The user may use all of Excel's cut and paste functions to build the model. The user may also use the Basin management sheet to enter subcatchments one at a time. The user should avoid entering values in columns where the heading is green.

The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
W25A	3	Larimer County	0.159	0.089	0.76	0.016	3	0.05	0.4	4.11	0.0018	0.574
W25B	3	Larimer County	0.553	0.3	1.27	0.015	3	0.05	0.4	3.129	0.0018	0.508
W25C	3	Larimer County	0.541	0.26	1.06	0.016	3	0.05	0.4	3.321	0.0018	0.519
W25D	3	Larimer County	0.489	0.22	1.32	0.018	3	0.05	0.4	3.681	0.0018	0.546
W25E	3	Larimer County	1.29	0.21	1.82	0.025	3	0.05	0.4	3.59	0.0018	0.539
W25F	3	Larimer County	0.462	0.28	1.19	0.014	3	0.05	0.4	3.56	0.0018	0.531
W25G	3	Larimer County	0.451	0.44	0.43	0.003	3	0.1	0.4	3.26	0.0018	0.516

West I-25 Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
W25A	0.179	0.254	24.5	6.27	12.7	4.43	10.5	195	369,389	0.26	96,076	35.0	47	95,995
W25B	0.156	0.306	41.2	11.17	21.4	7.89	18.6	403	1,284,730	0.31	397,156	40.0	118	397,112
W25C	0.156	0.305	34.8	9.65	18.1	6.82	16.1	466	1,256,851	0.30	376,185	40.0	132	376,173
W25D	0.156	0.300	35.2	9.63	18.3	6.80	16.0	416	1,136,045	0.28	318,499	40.0	111	318,536
W25E	0.156	0.347	32.1	10.07	16.7	7.12	16.8	1,205	2,996,928	0.28	854,082	40.0	324	853,415
W25F	0.156	0.298	40.3	10.72	21.0	7.58	17.9	344	1,073,318	0.29	309,418	40.0	95	309,379
W25G	0.156	0.297	44.6	11.67	23.2	8.25	19.5	303	1,047,763	0.25	265,941	45.0	74	265,804

West I-25 Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
W25A	0.178	0.251	24.5	6.23	12.7	4.40	10.4	195	369,389	0.68	252,601	35.0	106	252,396
W25B	0.154	0.303	41.2	11.09	21.4	7.83	18.5	403	1,284,730	0.80	1,030,440	40.0	268	1,030,313
W25C	0.154	0.302	34.8	9.58	18.1	6.77	16.0	466	1,256,851	0.78	981,065	40.0	298	981,021
W25D	0.154	0.298	35.2	9.55	18.3	6.75	15.9	416	1,136,045	0.73	834,608	40.0	257	834,697
W25E	0.154	0.344	32.1	9.99	16.7	7.06	16.7	1,205	2,996,928	0.75	2,237,273	40.0	737	2,235,487
W25F	0.154	0.295	40.3	10.64	21.0	7.52	17.7	344	1,073,318	0.76	811,674	40.0	219	811,517
W25G	0.154	0.294	44.6	11.58	23.2	8.18	19.3	303	1,047,763	0.74	773,885	45.0	189	773,508

West I-25 Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
W25A	0.177	0.250	24.5	6.21	12.7	4.38	10.3	195	369,389	1.79	662,446	40.0	234	661,917
W25B	0.154	0.301	41.2	11.03	21.4	7.80	18.4	403	1,284,730	1.90	2,447,402	50.0	590	2,447,078
W25C	0.154	0.300	34.8	9.53	18.1	6.74	15.9	466	1,256,851	1.88	2,367,245	45.0	645	2,367,102
W25D	0.154	0.296	35.2	9.51	18.3	6.72	15.8	416	1,136,045	1.84	2,087,477	45.0	567	2,087,683
W25E	0.154	0.342	32.1	9.94	16.7	7.03	16.6	1,205	2,996,928	1.85	5,542,439	45.0	1,621	5,539,863
W25F	0.154	0.293	40.3	10.59	21.0	7.48	17.6	344	1,073,318	1.86	1,995,405	50.0	490	1,994,929
W25G	0.154	0.292	44.6	11.52	23.2	8.14	19.2	303	1,047,763	1.84	1,929,471	50.0	438	1,928,568

Highway 56 Drainage Basin

Basin Management
This sheet is used to enter the subcatchment parameters. The user may use all of Excel's cut and paste functions to build the model. The user may also use the Basin management sheet to enter subcatchments one at a time. The user should avoid entering values in columns where the heading is green.

The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
56A	3	Larimer County	0.483	0.27	0.89	0.01	5	0.5	0.04	3.34	0.0018	0.52
56B	3	Larimer County	0.516	0.23	1.03	0.015	5	0.5	0.04	3.03	0.0018	0.5
56C	3	Larimer County	0.132	0.05	1.2	0.005	25	0.5	0.04	3	0.0018	0.5
56D	3	Larimer County	0.881	0.38	0.98	0.004	5	0.5	0.04	3.1	0.0018	0.51
56E	3	Larimer County	0.682	0.43	1.56	0.009	5	0.5	0.04	3.23	0.0018	0.52
56F	3	Larimer County	0.31	0.22	1.39	0.013	10	0.5	0.04	3.14	0.0018	0.51
56G	3	Larimer County	0.27	0.17	0.95	0.004	15	0.5	0.04	3.31	0.0018	0.52
56H	3	Larimer County	0.65	0.37	0.98	0.005	5	0.5	0.04	3.53	0.0018	0.53
56I	3	Larimer County	0.27	0.17	1.2	0.004	5	0.5	0.04	3.73	0.0018	0.55
56J	3	Larimer County	0.49	0.46	0.61	0.016	2	0.5	0.04	3.5	0.0018	0.53
56K	3	Larimer County	0.36	0.09	0.52	0.006	2	0.5	0.04	3.2	0.0018	0.51
56L	3	Larimer County	0.38	0.38	0.51	0.01	2	0.5	0.04	3.41	0.0018	0.52

Highway 56 Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
56A	0.151	0.290	37.1	9.77	19.3	6.90	16.3	391	1,122,106	0.03	33,780	45.0	9	33,757
56B	0.151	0.293	33.1	8.95	17.2	6.33	14.9	468	1,198,771	0.03	38,016	40.0	11	37,969
56C	0.134	0.239	24.3	5.94	12.6	4.20	9.9	163	306,662	0.21	63,437	35.0	20	63,413
56D	0.151	0.318	52.1	14.21	27.1	10.04	23.7	507	2,046,739	0.03	63,703	50.0	13	63,681
56E	0.151	0.306	59.1	15.38	30.7	10.87	25.6	346	1,584,422	0.03	48,141	55.0	9	48,116
56F	0.137	0.253	40.9	9.45	21.3	6.68	15.7	227	720,192	0.07	46,994	45.0	11	46,950
56G	0.124	0.237	38.4	8.49	19.9	6.00	14.1	211	627,264	0.11	67,771	40.0	16	67,723
56H	0.151	0.304	51.0	13.40	26.5	9.47	22.3	382	1,510,080	0.03	44,111	50.0	9	44,081
56I	0.151	0.266	46.6	11.02	24.2	7.79	18.4	174	627,264	0.03	17,490	45.0	4	17,472
56J	0.158	0.306	35.6	9.85	18.5	6.96	16.4	413	1,138,368	0.01	12,873	45.0	4	12,872
56K	0.158	0.292	20.0	5.97	10.4	4.22	10.0	541	836,352	0.01	10,004	35.0	4	9,993
56L	0.158	0.294	34.7	9.33	18.0	6.59	15.5	329	882,816	0.01	10,216	45.0	3	10,212

Highway 56 Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
56A	0.149	0.286	37.0	9.65	19.3	6.82	16.1	391	1,122,106	0.38	423,459	45.0	107	423,190
56B	0.149	0.289	33.0	8.84	17.2	6.25	14.7	469	1,198,771	0.41	495,536	45.0	134	494,824
56C	0.131	0.246	23.1	5.86	12.0	4.14	9.8	171	306,662	0.69	210,711	35.0	66	210,847
56D	0.149	0.313	52.0	14.03	27.1	9.91	23.4	508	2,046,739	0.40	818,092	55.0	158	817,692
56E	0.149	0.302	59.0	15.18	30.7	10.72	25.3	347	1,584,422	0.38	606,807	55.0	106	606,431
56F	0.133	0.248	40.4	9.21	21.0	6.51	15.4	230	720,192	0.46	333,566	45.0	75	333,192
56G	0.122	0.239	37.4	8.36	19.4	5.91	13.9	217	627,264	0.52	323,132	45.0	75	322,966
56H	0.149	0.299	51.0	13.22	26.5	9.34	22.0	383	1,510,080	0.36	540,005	55.0	106	539,741
56I	0.149	0.263	46.5	10.88	24.2	7.69	18.1	174	627,264	0.33	205,249	50.0	44	205,063
56J	0.157	0.304	35.6	9.80	18.5	6.93	16.3	413	1,138,368	0.32	363,765	45.0	99	363,738
56K	0.157	0.290	20.0	5.95	10.4	4.20	9.9	541	836,352	0.36	297,540	35.0	120	297,196
56L	0.157	0.292	34.7	9.28	18.0	6.56	15.5	329	882,816	0.33	295,303	45.0	81	295,196

Highway 56 Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	WS0 (min.)	WS0 Before Peak	W7S (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
56A	0.147	0.284	37.0	9.57	19.2	6.76	16.0	392	1,122,106	1.48	1,659,622	50.0	428	1,658,620
56B	0.147	0.287	33.0	8.77	17.2	6.20	14.6	469	1,198,771	1.52	1,816,253	45.0	499	1,813,484
56C	0.130	0.251	22.4	5.82	11.6	4.11	9.7	177	306,662	1.78	546,245	40.0	186	545,962
56D	0.147	0.311	52.0	13.91	27.0	9.83	23.2	509	2,046,739	1.50	3,072,955	60.0	622	3,071,132
56E	0.147	0.299	59.0	15.05	30.7	10.63	25.1	347	1,584,422	1.48	2,352,280	65.0	433	2,350,614
56F	0.131	0.246	40.1	9.07	20.8	6.41	15.1	232	720,192	1.56	1,125,284	50.0	268	1,124,045
56G	0.120	0.241	36.7	8.28	19.1	5.85	13.8	221	627,264	1.61	1,011,451	50.0	252	1,010,841
56H	0.147	0.297	50.9	13.11	26.5	9.27	21.9	383	1,510,080	1.46	2,203,519	60.0	451	2,202,716
56I	0.147	0.260	46.5	10.80	24.2	7.63	18.0	174	627,264	1.43	896,197	55.0	196	895,451
56J	0.157	0.302	35.6	9.77	18.5	6.90	16.3	413	1,138,368	1.42	1,619,462	50.0	434	1,619,341
56K	0.157	0.289	20.0	5.93	10.4	4.19	9.9	540	836,352	1.46	1,220,121	40.0	481	1,218,637
56L	0.157	0.291	34.7	9.25	18.0	6.54	15.4	329	882,816	1.44	1,269,123	50.0	344	1,268,647

Newell Reservoir Drainage Basin

Basin Management
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The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
NWLA	3	Larimer County	0.68	0.74	1.36	0.008	5	0.05	0.4	3.24	0.0018	0.495
NWLB	3	Larimer County	0.649	0.52	1	0.01	5	0.05	0.4	4.16	0.0018	0.56
NWLC	3	Larimer County	0.854	0.43	1.17	0.009	5	0.05	0.4	3.52	0.0018	0.513
NWLD	3	Larimer County	1.03	1.76	1.76	0.011	5	0.05	0.4	3.64	0.0018	0.543
NWLE	3	Larimer County	0.831	0.56	0.27	0.02	5	0.05	0.4	2.82	0.0018	0.405
NWLF	3	Larimer County	0.57	0.53	1.29	0.005	5	0.05	0.4	3	0.0018	0.5
NWLG	3	Larimer County	0.28	0.68	1.39	0.008	5	0.05	0.4	3	0.0018	0.4

Newell Reservoir Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	WS0 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
NWLA	0.151	0.306	73.9	18.85	38.4	13.32	31.4	276	1,579,776	0.31	496,534	55.0	85	496,511
NWLB	0.151	0.303	51.4	13.48	26.7	9.52	22.5	379	1,507,757	0.27	402,191	45.0	98	401,831
NWLC	0.151	0.316	49.8	13.59	25.9	9.60	22.7	515	1,984,013	0.30	594,288	45.0	148	594,137
NWLD	0.151	0.325	110.4	29.07	57.4	20.54	48.5	280	2,392,896	0.29	683,987	70.0	79	683,879
NWLE	0.151	0.315	23.2	7.11	12.1	5.02	11.8	1,076	1,930,579	0.36	699,263	35.0	331	698,951
NWLF	0.151	0.298	70.6	17.63	36.7	12.46	29.4	242	1,324,224	0.32	422,483	55.0	75	422,472
NWLG	0.151	0.267	81.9	18.34	42.6	12.96	30.6	103	650,496	0.36	233,732	55.0	36	233,677

Newell Reservoir Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
NWLA	0.149	0.302	73.8	18.60	38.4	13.14	31.0	276	1,579,776	0.79	1,251,213	60.0	193	1,251,099
NWLB	0.149	0.300	51.3	13.31	26.7	9.40	22.2	379	1,507,757	0.68	1,024,529	45.0	228	1,023,747
NWLC	0.149	0.312	49.7	13.42	25.9	9.48	22.4	515	1,984,013	0.76	1,507,009	45.0	334	1,506,814
NWLD	0.149	0.321	110.2	28.68	57.3	20.26	47.8	280	2,392,896	0.72	1,730,461	75.0	191	1,730,163
NWLE	0.149	0.311	23.1	7.03	12.0	4.96	11.7	1,077	1,930,579	0.91	1,757,629	35.0	674	1,757,357
NWLF	0.149	0.294	70.5	17.40	36.6	12.30	29.0	243	1,324,224	0.91	1,200,656	55.0	183	1,200,672
NWLG	0.149	0.264	81.8	18.09	42.5	12.79	30.2	103	650,496	0.91	589,796	60.0	79	589,633

Newell Reservoir Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
NWLA	0.147	0.299	73.7	18.43	38.3	13.02	30.7	277	1,579,776	1.95	3,085,537	65.0	474	3,085,091
NWLB	0.147	0.297	51.2	13.19	26.6	9.32	22.0	380	1,507,757	1.85	2,783,221	55.0	573	2,781,391
NWLC	0.147	0.309	49.6	13.30	25.8	9.40	22.2	516	1,984,013	1.92	3,810,562	55.0	797	3,810,369
NWLD	0.147	0.318	110.1	28.40	57.2	20.07	47.3	281	2,392,896	1.88	4,508,467	85.0	500	4,507,924
NWLE	0.147	0.308	23.1	6.97	12.0	4.93	11.6	1,079	1,930,579	2.07	3,988,175	40.0	1,401	3,988,351
NWLF	0.147	0.291	70.4	17.24	36.6	12.18	28.7	243	1,324,224	1.96	2,595,884	65.0	414	2,595,965
NWLG	0.147	0.262	81.7	17.93	42.5	12.67	29.9	103	650,496	1.96	1,275,171	70.0	180	1,274,873

Highlands Drainage Basin

Basin Management
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The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
HLA	3	Larimer County	0.54	0.16	1.34	0.02	3	0.05	0.4	3.56	0.0018	0.54
HLB	3	Larimer County	4.34	0.62	4.08	0.009	3	0.05	0.4	3.55	0.0018	0.5

Highlands Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
HLA	0.156	0.305	29.3	8.35	15.2	5.90	13.9	554	1,254,528	0.29	358,147	35.0	147	357,510
HLB	0.156	0.417	84.8	28.62	44.1	20.23	47.7	1,536	10,082,688	0.30	3,027,837	70.0	456	3,027,768

Highlands Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
HLA	0.154	0.302	29.3	8.29	15.2	5.86	13.8	554	1,254,528	0.75	937,213	35.0	333	935,605
HLB	0.154	0.413	84.8	28.38	44.1	20.06	47.3	1,536	10,082,688	0.79	7,948,315	70.0	1,109	7,948,026

Highlands Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
HLA	0.154	0.300	29.3	8.25	15.2	5.83	13.8	554	1,254,528	1.85	2,320,768	45.0	718	2,316,869
HLB	0.154	0.411	84.8	28.23	44.1	19.95	47.1	1,536	10,082,688	1.89	19,068,977	80.0	2,674	19,068,004

Baxter Reservoir Drainage Basin

Basin Management
This sheet is used to enter the subcatchment parameters. The user may use all of Excel's cut and paste functions to build the model. The user may also use the Basin management sheet to enter subcatchments one at a time. The user should avoid entering values in columns where the heading is green.

The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
BXTA	3	Larimer County	0.856	0.73	1.26	0.007	3	0.4	0.05	3	0.0018	0.5
BXTB	3	Larimer County	0.624	0.62	1.1	0.01	3	0.4	0.05	4	0.0018	0.55
BXTC	3	Larimer County	0.162	0.26	0.4	0.008	3	0.4	0.05	4.5	0.0018	0.6
BXTD	3	Larimer County	0.975	0.72	0.73	0.01	3	0.4	0.05	4.5	0.0018	0.6

Baxter Reservoir Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BXTA	0.156	0.327	70.7	19.23	36.7	13.59	32.0	363	1,988,659	0.02	42,937	60.0	7	42,921
BXTB	0.156	0.312	58.9	15.60	30.6	11.02	26.0	318	1,449,677	0.02	27,221	55.0	5	27,208
BXTC	0.178	0.254	35.3	8.39	18.3	5.93	14.0	138	376,358	0.02	6,301	40.0	2	6,296
BXTD	0.156	0.333	48.6	13.94	25.3	9.85	23.2	602	2,265,120	0.02	37,924	50.0	9	37,910

Baxter Reservoir Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BXTA	0.154	0.324	70.7	19.07	36.8	13.48	31.8	363	1,988,659	0.49	966,953	65.0	150	966,557
BXTB	0.154	0.309	58.9	15.47	30.6	10.93	25.8	318	1,449,677	0.38	555,667	55.0	103	555,373
BXTC	0.176	0.252	35.3	8.33	18.3	5.89	13.9	138	376,358	0.31	116,324	40.0	35	116,229
BXTD	0.154	0.330	48.6	13.83	25.3	9.77	23.0	601	2,265,120	0.31	700,098	50.0	164	699,884

Baxter Reservoir Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BXTA	0.154	0.322	70.7	18.97	36.8	13.41	31.6	363	1,988,659	1.59	3,159,755	70.0	511	3,158,462
BXTB	0.154	0.307	58.9	15.39	30.6	10.88	25.7	318	1,449,677	1.49	2,158,127	65.0	402	2,156,924
BXTC	0.175	0.251	35.3	8.29	18.3	5.86	13.8	138	376,358	1.43	536,332	50.0	145	535,879
BXTD	0.154	0.328	48.6	13.76	25.3	9.72	22.9	601	2,265,120	1.43	3,227,924	55.0	703	3,227,058

Big Hollow Drainage Basin

Basin Management
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2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
BHA	3	Larimer County	0.682	1.01	1.32	0.01	3	0.4	0.05	3	0.0018	0.5
BHB	3	Larimer County	1.24	0.65	1.19	0.005	3	0.4	0.05	4.5	0.0018	0.6
BHC	3	Larimer County	0.399	0.81	1.58	0.007	3	0.4	0.05	3	0.0018	0.5
BHD	3	Larimer County	3.01	1.24	2.09	0.01	3	0.4	0.05	3	0.0018	0.5
BHE	3	Larimer County	1.62	1.4	3.02	0.01	3	0.4	0.05	3	0.0018	0.5

Big Hollow Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BHA	0.156	0.316	80.2	20.95	41.7	14.80	34.9	255	1,584,422	0.02	34,209	65.0	5	34,206
BHB	0.156	0.345	66.7	19.19	34.7	13.56	32.0	558	2,880,768	0.02	48,231	60.0	9	48,230
BHC	0.156	0.291	92.8	22.27	48.3	15.74	37.1	129	926,957	0.02	20,014	70.0	3	20,011
BHD	0.156	0.394	88.3	28.26	45.9	19.97	47.1	1,022	6,992,832	0.02	150,982	75.0	21	150,990
BHE	0.156	0.359	122.6	35.34	63.7	24.98	58.9	396	3,763,584	0.02	81,259	90.0	8	81,260

Big Hollow Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BHA	0.154	0.313	80.2	20.77	41.7	14.68	34.6	255	1,584,422	0.49	770,399	70.0	107	770,313
BHB	0.154	0.342	66.7	19.03	34.7	13.45	31.7	558	2,880,768	0.31	890,381	60.0	157	890,393
BHC	0.154	0.289	92.9	22.09	48.3	15.61	36.8	129	926,957	0.49	450,718	75.0	55	450,671
BHD	0.154	0.391	88.3	28.02	45.9	19.80	46.7	1,022	6,992,832	0.49	3,400,150	75.0	443	3,400,318
BHE	0.154	0.356	122.6	35.04	63.8	24.76	58.4	396	3,763,584	0.49	1,829,981	95.0	181	1,829,999

Big Hollow Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BHA	0.154	0.311	80.2	20.67	41.7	14.60	34.4	255	1,584,422	1.59	2,517,468	75.0	367	2,517,176
BHB	0.154	0.340	66.7	18.93	34.7	13.38	31.5	558	2,880,768	1.43	4,105,257	70.0	708	4,105,387
BHC	0.154	0.287	92.9	21.97	48.3	15.53	36.6	129	926,957	1.59	1,472,830	80.0	189	1,472,701
BHD	0.154	0.389	88.3	27.87	45.9	19.69	46.4	1,022	6,992,832	1.59	11,110,821	80.0	1,502	11,111,312
BHE	0.154	0.354	122.6	34.85	63.8	24.63	58.1	396	3,763,584	1.59	5,979,910	95.0	604	5,979,956

Bacon Lake Drainage Basin

Basin Management
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The possible values for print modes are:

1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
BCNA	3	Larimer County	0.506	0.27	0.78	0.007	10	0.5	0.04	2.67	0.0018	0.431
BCNB	3	Larimer County	0.489	1.07	0.88	0.008	2	0.5	0.04	3.38	0.0018	0.523
BCNC	3	Larimer County	0.56	0.18	0.44	0.007	5	0.5	0.04	2.78	0.0018	0.46
BCND	3	Larimer County	0.46	0.49	0.98	0.01	5	0.5	0.04	3.3	0.0018	0.52
BCNE	3	Larimer County	1.02	0.4	1.32	0.005	10	0.5	0.04	3.02	0.0018	0.46
BCNF	3	Larimer County	0.85	0.44	1.07	0.01	20	0.5	0.04	3.65	0.0018	0.543
BCNG	3	Larimer County	0.51	0.25	1.5	0.01	10	0.5	0.04	3.74	0.0018	0.55
BCNH	3	Larimer County	0.97	0.37	1.28	0.005	40	0.5	0.04	3.63	0.0018	0.54
BCNI	3	Larimer County	0.946	1.32	0.67	0.017	3	0.4	0.05	4.5	0.0018	0.6
BCNJ	3	Larimer County	0.418	0.51	0.35	0.006	2	0.4	0.05	3	0.0018	0.5
BCNK	3	Larimer County	0.25	0.46	0.96	0.005	3	0.4	0.05	3	0.0018	0.5
BCNL	3	Larimer County	0.12	0.34	0.92	0.005	3	0.4	0.05	3	0.0018	0.5

Bacon Lake Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BCNA	0.137	0.272	36.9	9.21	19.2	6.51	15.3	412	1,175,539	0.07	86,583	45.0	22	86,537
BCNB	0.158	0.305	75.2	19.14	39.1	13.52	31.9	195	1,136,045	0.01	13,124	65.0	2	13,125
BCNC	0.151	0.297	23.2	6.79	12.1	4.80	11.3	724	1,300,992	0.03	44,218	40.0	17	44,238
BCND	0.151	0.288	52.1	13.03	27.1	9.21	21.7	265	1,068,672	0.03	32,280	50.0	7	32,264
BCNE	0.137	0.302	55.9	14.49	29.1	10.24	24.1	547	2,369,664	0.07	165,200	55.0	31	165,160
BCNF	0.116	0.293	39.1	10.31	20.4	7.29	17.2	651	1,974,720	0.15	297,925	45.0	69	297,466
BCNG	0.137	0.273	44.6	10.83	23.2	7.66	18.1	343	1,184,832	0.06	70,206	45.0	16	70,183
BCNH	0.095	0.472	23.5	8.22	12.2	5.49	16.7	1,240	2,253,504	0.36	811,995	40.0	246	811,302
BCNI	0.156	0.332	55.2	15.56	28.7	11.00	25.9	514	2,197,747	0.02	36,796	55.0	8	36,786
BCNJ	0.158	0.298	37.1	10.01	19.3	7.07	16.7	338	971,098	0.01	13,880	45.0	4	13,868
BCNK	0.156	0.272	64.8	15.01	33.7	10.61	25.0	116	580,800	0.02	12,540	55.0	2	12,537
BCNL	0.195	0.243	76.9	15.86	40.0	11.21	26.4	47	278,784	0.02	6,019	60.0	1	6,017

Bacon Lake Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BCNA	0.133	0.267	36.4	8.98	18.9	6.35	15.0	417	1,175,539	0.57	667,928	45.0	154	667,761
BCNB	0.157	0.303	75.2	19.03	39.1	13.45	31.7	195	1,136,045	0.33	378,316	65.0	55	378,330
BCNC	0.149	0.293	23.2	6.71	12.0	4.74	11.2	725	1,300,992	0.47	610,127	40.0	205	610,532
BCND	0.149	0.284	52.0	12.86	27.0	9.09	21.4	265	1,068,672	0.38	405,472	55.0	78	405,302
BCNE	0.133	0.297	55.3	14.11	28.7	9.97	23.5	554	2,369,664	0.52	1,233,409	55.0	212	1,233,212
BCNF	0.114	0.299	37.6	10.14	19.6	7.17	16.9	678	1,974,720	0.55	1,087,907	45.0	249	1,086,789
BCNG	0.133	0.268	44.1	10.56	22.9	7.46	17.6	347	1,184,832	0.39	467,693	50.0	101	467,513
BCNH	0.094	0.487	22.6	7.90	11.7	5.28	16.6	1,289	2,253,504	0.85	1,922,965	40.0	596	1,920,426
BCNI	0.154	0.329	55.2	15.43	28.7	10.91	25.7	514	2,197,747	0.31	679,275	55.0	142	679,108
BCNJ	0.157	0.296	37.1	9.95	19.3	7.03	16.6	338	971,098	0.47	460,771	45.0	122	460,405
BCNK	0.154	0.269	64.8	14.89	33.7	10.52	24.8	116	580,800	0.49	282,404	55.0	47	282,339
BCNL	0.194	0.241	76.9	15.74	40.0	11.12	26.2	47	278,784	0.49	135,554	60.0	19	135,505

Bacon Lake Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
BCNA	0.131	0.265	36.1	8.84	18.8	6.25	14.7	420	1,175,539	1.66	1,956,888	50.0	495	1,956,419
BCNB	0.157	0.302	75.2	18.96	39.1	13.40	31.6	195	1,136,045	1.44	1,631,463	70.0	251	1,631,521
BCNC	0.147	0.291	23.1	6.66	12.0	4.71	11.1	726	1,300,992	1.57	2,040,999	40.0	714	2,042,624
BCND	0.147	0.282	51.9	12.75	27.0	9.01	21.3	266	1,068,672	1.48	1,582,770	60.0	318	1,582,143
BCNE	0.131	0.294	54.8	13.87	28.5	9.80	23.1	559	2,369,664	1.62	3,834,073	60.0	728	3,833,805
BCNF	0.113	0.303	36.7	10.04	19.1	7.10	16.7	695	1,974,720	1.65	3,250,539	50.0	816	3,248,011
BCNG	0.131	0.265	43.7	10.39	22.7	7.34	17.3	350	1,184,832	1.49	1,769,840	55.0	398	1,769,055
BCNH	0.094	0.498	22.0	7.71	11.4	5.15	16.5	1,322	2,253,504	1.94	4,371,211	45.0	1,500	4,368,309
BCNI	0.154	0.327	55.2	15.36	28.7	10.85	25.6	514	2,197,747	1.43	3,131,914	60.0	623	3,131,181
BCNJ	0.157	0.295	37.2	9.92	19.3	7.01	16.5	338	971,098	1.58	1,532,005	50.0	398	1,530,834
BCNK	0.154	0.268	64.8	14.82	33.7	10.47	24.7	116	580,800	1.59	922,826	65.0	157	922,615
BCNL	0.193	0.240	76.9	15.66	40.0	11.06	26.1	47	278,784	1.59	442,956	70.0	66	442,781

Highway 287 Drainage Basin

Basin Management
This sheet is used to enter the subcatchment parameters. The user may use all of Excel's cut and paste functions to build the model. The user may also use the Basin management sheet to enter subcatchments one at a time. The user should avoid entering values in columns where the heading is green.

The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
287A	3	Larimer County	0.273	0.47	0.89	0.006	30	0.35	0.07	3	0.0018	0.5
287B	3	Larimer County	0.235	0.65	0.73	0.01	12	0.4	0.05	4	0.0018	0.55
287C	3	Larimer County	0.161	0.59	0.73	0.01	2	0.4	0.1	4.5	0.0018	0.6
287D	3	Larimer County	0.13	0.36	0.72	0.006	2	0.4	0.1	4.5	0.0018	0.6
287E	3	Larimer County	0.295	0.5	0.62	0.003	40	0.35	0.05	3	0.0018	0.5
287F	3	Larimer County	0.235	0.47	0.73	0.007	75	0.35	0.1	3	0.0018	0.5
287G	3	Larimer County	0.129	0.23	0.52	0.02	3	0.4	0.1	3	0.0018	0.5
287H	3	Larimer County	0.15	0.52	0.57	0.004	30	0.35	0.05	3	0.0018	0.5
287I	3	Larimer County	0.163	0.2	0.55	0.01	5	0.4	0.1	3	0.0018	0.5
287J	3	Larimer County	0.265	0.34	0.66	0.006	20	0.4	0.05	3	0.0018	0.5
287K	3	Larimer County	0.187	0.18	0.29	0.006	5	0.4	0.05	3	0.0018	0.5
287L	3	Larimer County	0.141	0.43	0.72	0.003	45	0.35	0.05	4.5	0.0018	0.6
287M	3	Larimer County	0.09	0.27	0.54	0.01	20	0.35	0.05	4.5	0.0018	0.6
287N	3	Larimer County	0.04	0.18	0.52	0.007	75	0.35	0.05	4.5	0.0018	0.6

Highway 287 Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
287A	0.104	0.295	37.1	9.89	19.3	6.99	16.5	221	634,234	0.28	175,103	45.0	41	174,967
287B	0.134	0.236	56.0	11.66	29.1	8.24	19.4	126	545,952	0.08	46,033	50.0	9	46,014
287C	0.181	0.259	66.2	14.65	34.4	10.35	24.4	73	374,035	0.01	3,964	55.0	1	3,963
287D	0.194	0.250	64.7	13.95	33.7	9.86	23.2	60	302,016	0.01	3,201	50.0	1	3,200
287E	0.095	0.395	25.9	9.06	13.5	6.06	15.6	342	685,344	0.39	266,691	40.0	78	266,512
287F	0.081	0.619	12.0	4.21	6.3	2.81	12.0	586	545,952	0.72	390,387	35.0	175	390,106
287G	0.191	0.246	33.6	7.85	17.5	5.55	13.1	115	299,693	0.02	6,109	40.0	2	6,097
287H	0.121	0.270	44.3	10.68	23.1	7.55	17.8	101	348,480	0.28	97,871	45.0	20	97,834
287I	0.172	0.247	34.2	7.98	17.8	5.64	13.3	143	378,682	0.03	13,052	40.0	4	13,026
287J	0.116	0.246	36.9	8.48	19.2	5.99	14.1	215	615,648	0.17	103,422	40.0	26	103,335
287K	0.165	0.252	25.4	6.41	13.2	4.53	10.7	221	434,438	0.04	15,853	35.0	6	15,829
287L	0.110	0.403	29.4	10.30	15.3	6.89	17.7	144	327,571	0.42	136,905	40.0	36	136,834
287M	0.160	0.209	42.8	8.38	22.3	5.92	14.0	63	209,088	0.16	32,589	40.0	7	32,551
287N	0.140	0.475	14.6	5.09	7.6	3.41	11.3	82	92,928	0.74	68,491	35.0	27	68,199

Highway 287 Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
287A	0.102	0.306	35.2	9.76	18.3	6.90	16.3	233	634,234	0.86	543,712	40.0	131	543,776
287B	0.129	0.232	55.0	11.31	28.6	7.99	18.8	128	545,952	0.50	272,497	50.0	50	272,392
287C	0.180	0.257	66.3	14.57	34.5	10.30	24.3	73	374,035	0.30	110,725	55.0	20	110,697
287D	0.192	0.249	64.8	13.87	33.7	9.80	23.1	60	302,016	0.30	89,405	55.0	16	89,391
287E	0.094	0.408	24.9	8.71	12.9	5.82	15.5	356	685,344	0.99	677,441	40.0	204	677,293
287F	0.080	0.622	11.9	4.18	6.2	2.79	12.0	591	545,952	1.40	763,681	35.0	333	762,989
287G	0.189	0.244	33.6	7.79	17.5	5.51	13.0	115	299,693	0.49	145,643	40.0	41	145,368
287H	0.120	0.280	42.1	10.54	21.9	7.45	17.6	107	348,480	0.86	299,935	45.0	63	299,827
287I	0.169	0.243	34.2	7.89	17.8	5.57	13.1	143	378,682	0.51	192,876	40.0	53	192,490
287J	0.114	0.251	35.5	8.35	18.5	5.90	13.9	224	615,648	0.70	428,961	40.0	105	428,645
287K	0.162	0.248	25.4	6.34	13.2	4.48	10.6	221	434,438	0.51	221,499	35.0	77	221,200
287L	0.109	0.412	28.6	10.00	14.9	6.69	17.6	148	327,571	0.94	309,352	40.0	85	308,861
287M	0.157	0.214	41.2	8.25	21.4	5.83	13.8	66	209,088	0.58	122,269	40.0	28	122,144
287N	0.139	0.477	14.4	5.06	7.5	3.38	11.3	83	92,928	1.38	128,426	35.0	49	127,800

Highway 287 Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
287A	0.101	0.313	34.1	9.69	17.7	6.85	16.1	240	634,234	1.95	1,235,821	50.0	317	1,235,011
287B	0.127	0.232	54.3	11.17	28.2	7.90	18.6	130	545,952	1.60	873,395	55.0	167	873,041
287C	0.179	0.256	66.3	14.52	34.5	10.26	24.2	73	374,035	1.41	528,493	65.0	90	528,361
287D	0.192	0.248	64.8	13.83	33.7	9.77	23.0	60	302,016	1.41	426,733	65.0	74	426,672
287E	0.094	0.416	24.3	8.50	12.6	5.68	15.4	365	685,344	2.08	1,422,285	45.0	458	1,421,737
287F	0.080	0.623	11.9	4.16	6.2	2.78	12.0	593	545,952	2.47	1,349,703	40.0	613	1,348,217
287G	0.188	0.242	33.6	7.76	17.5	5.48	12.9	115	299,693	1.59	476,152	45.0	130	475,291
287H	0.118	0.286	40.7	10.45	21.2	7.39	17.4	110	348,480	1.95	680,215	50.0	154	679,978
287I	0.168	0.241	34.1	7.83	17.7	5.53	13.0	143	378,682	1.61	610,184	45.0	164	608,973
287J	0.113	0.255	34.6	8.27	18.0	5.84	13.8	230	615,648	1.79	1,103,241	45.0	283	1,101,384
287K	0.161	0.246	25.3	6.29	13.2	4.45	10.5	222	434,438	1.61	700,131	40.0	232	699,236
287L	0.109	0.418	28.1	9.82	14.6	6.57	17.5	151	327,571	2.03	666,249	45.0	194	664,970
287M	0.155	0.217	40.1	8.17	20.9	5.78	13.6	67	209,088	1.69	353,249	50.0	83	352,919
287N	0.139	0.478	14.4	5.03	7.5	3.36	11.3	83	92,928	2.46	228,280	40.0	92	227,112

Dry Creek Drainage Basin

Basin Management
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The possible values for print modes are:

1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
CRKA		3 Larimer County	0.82	1.24	2.2	0.01	5	0.4	0.05	4.5	0.0018	0.6
CRKB		3 Larimer County	0.203	0.43	0.89	0.004	7	0.4	0.05	4.5	0.0018	0.6
CRKC		3 Larimer County	0.107	0.31	0.7	0.003	10	0.4	0.05	3	0.0018	0.5
CRKD		3 Larimer County	0.283	0.53	1.04	0.004	25	0.4	0.05	4.5	0.0018	0.6
CRKE		3 Larimer County	0.107	0.45	1.03	0.009	5	0.4	0.05	4.5	0.0018	0.6
CRKF		3 Larimer County	0.324	0.4	0.91	0.02	4	0.4	0.05	405	0.0018	0.6
CRKG		3 Larimer County	0.058	0.7	0.92	0.02	15	0.4	0.05	3	0.0018	0.5
CRKH		3 Larimer County	0.107	0.36	0.67	0.004	5	0.4	0.05	3	0.0018	0.5
CRKI		3 Larimer County	0.53	0.98	1.63	0.01	80	0.35	0.075	3	0.0018	0.5
CRKJ		3 Larimer County	0.49	0.6	1.5	0.01	60	0.4	0.05	4.5	0.0018	0.6
CRKK		3 Larimer County	0.387	0.51	0.7	0.009	5	0.4	0.05	4.5	0.0018	0.6
CRKL		3 Larimer County	0.279	0.57	0.85	0.018	2	0.4	0.05	3	0.0018	0.5
CRKM		3 Larimer County	0.45	0.67	1.13	0.01	3	0.4	0.05	4.5	0.0018	0.6

Dry Creek Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
CRKA	0.151	0.314	110.0	28.04	57.2	19.82	46.7	224	1,905,024	0.03	54,440	75.0	6	54,437
CRKB	0.155	0.247	69.8	14.75	36.3	10.43	24.6	87	471,610	0.04	19,312	55.0	3	19,304
CRKC	0.179	0.216	75.2	13.95	39.1	9.86	23.3	43	248,582	0.08	18,771	55.0	3	18,768
CRKD	0.110	0.268	54.3	12.66	28.3	8.95	21.1	156	657,466	0.20	130,297	50.0	23	130,248
CRKE	0.196	0.232	85.0	16.61	44.2	11.74	27.7	38	248,582	0.03	7,104	60.0	1	7,102
CRKF	0.153	0.278	40.7	10.19	21.2	7.20	17.0	239	752,717	0.00	2,454	40.0	0	2,453
CRKG	0.195	0.188	100.2	16.00	52.1	11.30	26.7	17	134,746	0.12	16,264	65.0	2	16,262
CRKH	0.196	0.232	75.4	14.91	39.2	10.54	24.9	43	248,582	0.04	9,071	55.0	1	9,069
CRKI	0.078	0.719	19.1	6.70	10.0	4.48	20.1	831	1,231,296	0.78	965,241	40.0	325	962,131
CRKJ	0.085	0.612	18.7	6.54	9.7	4.37	17.1	787	1,138,368	0.57	653,092	40.0	228	653,699
CRKK	0.151	0.281	47.6	11.76	24.7	8.31	19.6	244	899,078	0.03	25,693	45.0	6	25,683
CRKL	0.158	0.281	48.9	12.05	25.4	8.52	20.1	171	648,173	0.01	9,264	50.0	2	9,264
CRKM	0.156	0.297	65.1	16.32	33.8	11.53	27.2	207	1,045,440	0.02	17,503	55.0	3	17,498

Dry Creek Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
CRKA	0.149	0.310	109.8	27.65	57.1	19.54	46.1	224	1,905,024	0.34	638,232	80.0	70	638,222
CRKB	0.152	0.243	69.4	14.48	36.1	10.23	24.1	88	471,610	0.36	170,341	55.0	28	170,246
CRKC	0.173	0.212	74.3	13.59	38.6	9.60	22.6	43	248,582	0.57	141,592	60.0	20	141,580
CRKD	0.108	0.276	51.8	12.46	26.9	8.81	20.8	164	657,466	0.62	405,947	50.0	74	405,787
CRKE	0.193	0.228	84.8	16.38	44.1	11.58	27.3	38	248,582	0.34	83,282	60.0	11	83,261
CRKF	0.152	0.275	40.7	10.09	21.2	7.13	16.8	239	752,717	0.01	4,228	40.0	1	4,225
CRKG	0.191	0.190	97.6	15.73	50.7	11.12	26.2	18	134,746	0.63	85,266	70.0	9	85,252
CRKH	0.193	0.228	75.3	14.72	39.2	10.40	24.5	43	248,582	0.51	126,740	60.0	18	126,710
CRKI	0.077	0.721	19.0	6.66	9.9	4.45	20.1	836	1,231,296	1.48	1,820,310	40.0	596	1,814,106
CRKJ	0.085	0.618	18.4	6.45	9.6	4.31	17.1	798	1,138,368	1.14	1,302,360	40.0	458	1,303,719
CRKK	0.149	0.277	47.5	11.60	24.7	8.20	19.3	245	899,078	0.34	301,214	45.0	70	301,050
CRKL	0.157	0.279	49.0	11.99	25.5	8.47	20.0	171	648,173	0.47	307,548	50.0	65	307,531
CRKM	0.154	0.294	65.1	16.19	33.8	11.44	27.0	207	1,045,440	0.31	323,122	55.0	58	323,037

Dry Creek Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
CRKA	0.147	0.308	109.6	27.40	57.0	19.36	45.7	224	1,905,024	1.45	2,761,083	85.0	310	2,761,094
CRKB	0.150	0.241	69.2	14.31	36.0	10.11	23.8	88	471,610	1.47	695,111	65.0	113	694,782
CRKC	0.170	0.210	73.6	13.36	38.3	9.44	22.3	44	248,582	1.67	414,881	65.0	63	414,857
CRKD	0.107	0.281	50.2	12.34	26.1	8.72	20.6	169	657,466	1.72	1,130,267	55.0	226	1,130,404
CRKE	0.191	0.227	84.7	16.24	44.0	11.48	27.1	38	248,582	1.45	360,288	70.0	50	360,199
CRKF	0.150	0.273	40.7	10.02	21.2	7.08	16.7	239	752,717	0.01	6,790	50.0	1	6,786
CRKG	0.189	0.191	95.9	15.57	49.8	11.00	25.9	18	134,746	1.73	233,131	75.0	28	233,081
CRKH	0.191	0.227	75.2	14.59	39.1	10.31	24.3	43	248,582	1.61	400,610	65.0	60	400,510
CRKI	0.077	0.723	19.0	6.64	9.9	4.44	20.0	839	1,231,296	2.55	3,139,284	45.0	1,076	3,128,075
CRKJ	0.084	0.621	18.3	6.39	9.5	4.27	17.0	805	1,138,368	2.23	2,533,842	45.0	953	2,536,068
CRKK	0.147	0.275	47.4	11.51	24.7	8.13	19.2	245	899,078	1.45	1,303,096	55.0	286	1,302,256
CRKL	0.157	0.278	49.0	11.95	25.5	8.44	19.9	171	648,173	1.58	1,022,558	55.0	216	1,022,487
CRKM	0.154	0.292	65.1	16.11	33.8	11.38	26.8	207	1,045,440	1.43	1,489,811	65.0	260	1,489,434

Ish Reservoir Drainage Basin

Basin Management
This sheet is used to enter the subcatchment parameters. The user may use all of Excel's cut and paste functions to build the model. The user may also use the Basin management sheet to enter subcatchments one at a time. The user should avoid entering values in columns where the heading is green.

The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
ISHA	3	Larimer County	3.03	1.93	2.6	0.008	20	0.35	0.05	3	0.0018	0.5
ISHB	3	Larimer County	0.648	0.88	2.37	0.004	5	0.4	0.05	4.5	0.0018	0.6
ISHC	3	Larimer County	0.614	0.98	1.04	0.01	5	0.4	0.05	4.5	0.0018	0.6

Ish Reservoir Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
ISHA	0.116	0.355	106.3	30.45	55.3	21.52	50.8	855	7,039,296	0.18	1,277,112	85.0	136	1,276,972
ISHB	0.151	0.303	124.8	30.57	64.9	21.60	50.9	156	1,505,434	0.03	43,021	80.0	4	43,016
ISHC	0.151	0.301	71.6	18.05	37.2	12.75	30.1	257	1,426,445	0.03	40,764	60.0	7	40,754

Ish Reservoir Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
ISHA	0.114	0.362	102.2	29.90	53.1	21.13	49.8	890	7,039,296	0.74	5,186,295	85.0	565	5,186,167
ISHB	0.149	0.299	124.6	30.14	64.8	21.30	50.2	156	1,505,434	0.34	504,359	85.0	49	504,332
ISHC	0.149	0.297	71.5	17.80	37.2	12.58	29.7	258	1,426,445	0.34	477,896	60.0	77	477,798

Ish Reservoir Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
ISHA	0.113	0.367	99.6	29.57	51.8	20.90	49.3	913	7,039,296	1.83	12,895,989	85.0	1,531	12,892,796
ISHB	0.147	0.297	124.4	29.87	64.7	21.11	49.8	156	1,505,434	1.45	2,181,929	90.0	218	2,181,866
ISHC	0.147	0.295	71.4	17.65	37.1	12.47	29.4	258	1,426,445	1.45	2,067,445	70.0	334	2,067,044

Loveland Reservoir Drainage Basin

Basin Management
This sheet is used to enter the subcatchment parameters. The user may use all of Excel's cut and paste functions to build the model. The user may also use the Basin management sheet to enter subcatchments one at a time. The user should avoid entering values in columns where the heading is green.

The possible values for print modes are:

1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
LVDA	3	Larimer County	0.76	0.37	1.94	0.009	4	0.05	0.4	3.42	0.0018	0.53
LVDB	3	Larimer County	0.28	0.18	0.94	0.007	3	0.05	0.4	3.1	0.0018	0.51
LVDC	3	Larimer County	0.41	0.06	0.43	0.02	3	0.05	0.4	2.35	0.0018	0.34

Loveland Reservoir Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
LVDA	0.153	0.316	60.1	16.08	31.3	11.36	26.8	379	1,765,632	0.29	519,110	50.0	109	519,105
LVDB	0.156	0.276	37.1	9.37	19.3	6.62	15.6	227	650,496	0.31	201,122	40.0	66	201,020
LVDC	0.156	0.293	11.0	3.86	5.7	2.58	6.6	1,115	952,512	0.41	388,337	30.0	291	381,332

Loveland Reservoir Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
LVDA	0.152	0.312	60.1	15.91	31.3	11.24	26.5	379	1,765,632	0.77	1,359,883	50.0	258	1,359,784
LVDB	0.154	0.274	37.1	9.30	19.3	6.57	15.5	227	650,496	0.80	521,398	40.0	149	521,142
LVDC	0.154	0.290	11.0	3.86	5.7	2.58	6.6	1,114	952,512	1.04	992,331	30.0	563	974,220

Loveland Reservoir Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
LVDA	0.150	0.310	60.1	15.80	31.2	11.17	26.3	379	1,765,632	1.87	3,306,449	60.0	602	3,306,039
LVDB	0.154	0.272	37.1	9.25	19.3	6.54	15.4	227	650,496	1.90	1,238,844	45.0	319	1,238,237
LVDC	0.154	0.288	11.0	3.86	5.7	2.58	6.6	1,114	952,512	2.14	2,040,457	35.0	1,055	2,002,946

Welch Reservoir Drainage Basin

Basin Management
This sheet is used to enter the subcatchment parameters. The user may use all of Excel's cut and paste functions to build the model. The user may also use the Basin management sheet to enter subcatchments one at a time. The user should avoid entering values in columns where the heading is green.

The possible values for print modes are:
1 Catchment Summary Pages
2 Summary and Unit Hydrograph
3 Summary, Unit Hydrograph, and Storm Hydrograph

								Maximum Depression Storage (Watershed in)		Infiltration		
Catchment Name	Print Mode	Raingage	Area (mi^2)	Distance to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Horton's Decay Coefficient (1/seconds)	Final Rate (in/hr)
HRNA	3	Larimer County	0.79	1.09	0.91	0.005	3	0.4	0.1	3	0.0018	0.5
HRNB	3	Larimer County	0.26	0.25	0.74	0.001	3	0.4	0.1	3	0.0018	0.5

Welch Reservoir Drainage Basin, 2-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
HRNA	0.156	0.323	80.4	21.43	41.8	15.14	35.7	295	1,835,328	0.02	37,414	65.0	5	37,412
HRNB	0.156	0.273	62.4	14.60	32.5	10.31	24.3	125	604,032	0.02	12,314	55.0	2	12,312

Welch Reservoir Drainage Basin, 10-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
HRNA	0.154	0.320	80.4	21.25	41.8	15.02	35.4	295	1,835,328	0.49	891,921	70.0	124	891,842
HRNB	0.154	0.271	62.4	14.48	32.5	10.23	24.1	125	604,032	0.49	293,543	55.0	50	293,501

Welch Reservoir Drainage Basin, 100-Year Rainfall Event

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.3.3)

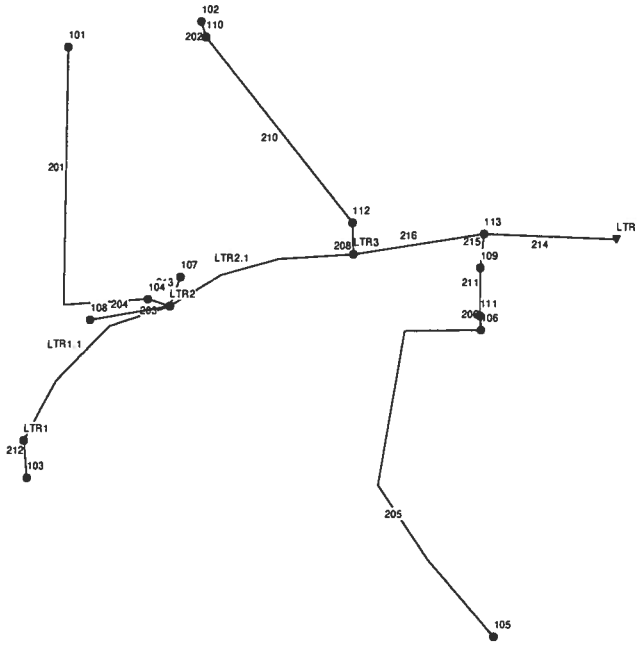
	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph		
Catchment Name/ID	Ct	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)
HRNA	0.154	0.318	80.4	21.14	41.8	14.94	35.2	295	1,835,328	1.59	2,915,972	75.0	425	2,915,687
HRNB	0.154	0.269	62.4	14.41	32.5	10.18	24.0	125	604,032	1.59	959,687	65.0	168	959,535

APPENDIX C

SWMM Results

East I-25 Drainage Basin, Schematic

05/23/2011 00:15:00



East I-25 Drainage Basin, 2-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ MAY-23-2011 00:00:00
Ending Date .............. MAY-23-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 212
WARNING 04: minimum elevation drop used for Conduit 213
WARNING 04: minimum elevation drop used for Conduit 203
WARNING 04: minimum elevation drop used for Conduit 204
WARNING 04: minimum elevation drop used for Conduit 208
WARNING 04: minimum elevation drop used for Conduit 215
WARNING 08: elevation drop exceeds length for Conduit 214

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        59.017        19.231
External Outflow .........        41.882        13.648
Internal Outflow .........        15.404         5.020
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.001         0.000
Final Stored Volume ......         1.652         0.538
Continuity Error (%) .....         0.133


*************************
Highest Continuity Errors
*************************
Node 106 (7.87%)


***************************
Time-Step Critical Elements
***************************
Link 206 (42.39%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 202 (30)
Link 210 (9)
Link 208 (7)
Link 206 (4)
```

****
Routing Time Step Summary
****

Minimum Time Step	:	0.92 sec
Average Time Step	:	19.45 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.81

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	0.47	0.84	4959.84	0 01:25
102	JUNCTION	0.20	0.77	4932.77	0 00:50
105	JUNCTION	0.17	1.25	4932.25	0 00:40
106	JUNCTION	4.19	13.33	4863.33	0 01:15
110	JUNCTION	0.03	0.13	4929.13	0 00:57
111	JUNCTION	6.01	10.00	4857.00	0 00:38
LTR2	JUNCTION	0.35	1.43	4844.43	0 00:52
LTR3	JUNCTION	0.22	0.88	4833.88	0 00:53
LTR1	JUNCTION	0.23	1.28	4854.28	0 00:46
103	JUNCTION	0.00	0.00	4853.00	0 00:00
107	JUNCTION	0.00	0.00	4843.00	0 00:00
104	JUNCTION	0.01	0.02	4843.02	0 01:25
108	JUNCTION	0.00	0.00	4843.00	0 00:00
109	JUNCTION	0.10	0.12	4823.12	0 02:20
112	JUNCTION	0.00	0.00	4833.00	0 00:58
113	JUNCTION	0.02	0.20	4823.20	0 00:54
LTR	OUTFALL	0.00	0.00	4820.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	2.05	2.05	0 01:14	0.129	0.129
102	JUNCTION	4.81	4.81	0 00:50	0.177	0.177
105	JUNCTION	264.66	264.66	0 00:39	4.930	4.934
106	JUNCTION	54.84	306.76	0 00:40	2.281	7.282
110	JUNCTION	0.00	4.83	0 00:50	0.000	0.177
111	JUNCTION	0.00	136.88	0 01:15	0.000	6.709
LTR2	JUNCTION	0.00	316.33	0 00:49	0.000	10.938
LTR3	JUNCTION	0.00	320.55	0 00:53	0.000	11.163
LTR1	JUNCTION	0.00	256.64	0 00:44	0.000	7.144
103	JUNCTION	256.64	256.64	0 00:44	7.139	7.144
107	JUNCTION	0.00	0.00	0 00:00	0.000	0.000
104	JUNCTION	56.29	57.73	0 01:04	2.968	3.096
108	JUNCTION	11.81	11.81	0 00:59	0.695	0.695
109	JUNCTION	26.67	38.67	0 00:44	0.810	2.497
112	JUNCTION	2.31	6.93	0 00:55	0.090	0.267
113	JUNCTION	0.00	355.95	0 00:53	0.000	13.643
LTR	OUTFALL	0.00	355.93	0 00:53	0.000	13.647

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
106	JUNCTION	1.29	10.333	0.000
111	JUNCTION	5.43	8.000	0.000
103	JUNCTION	6.00	0.000	10.000
107	JUNCTION	6.00	0.000	10.000
108	JUNCTION	6.00	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
106	1.67	217.90	0 00:39	1.608	13.33
111	2.14	124.89	0 01:15	5.019	10.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	97.30	62.59	355.93	13.647
System	97.30	62.59	355.93	13.647

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	1.98	0 01:25	14.26	0.05	0.21
202	CONDUIT	4.83	0 00:50	7.88	0.02	0.15
205	CONDUIT	261.26	0 00:40	13.88	0.20	0.71
206	CONDUIT	136.88	0 01:15	26.96	1.45	1.00
210	CONDUIT	4.67	0 00:57	8.41	0.00	0.02
211	CONDUIT	12.00	0 02:20	21.30	0.63	0.53
LTR2.1	CONDUIT	313.71	0 00:53	12.15	0.03	0.12
LTR1.1	CONDUIT	254.90	0 00:46	8.61	0.02	0.14
212	DUMMY	256.64	0 00:44			
213	DUMMY	0.00	0 00:00			
203	DUMMY	57.73	0 01:04			
204	DUMMY	11.81	0 00:59			
208	DUMMY	6.93	0 00:56			
215	DUMMY	38.67	0 00:44			
214	DUMMY	355.93	0 00:53			
216	CONDUIT	320.43	0 00:54	26.60	0.01	0.05

****
Flow Classification Summary

****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.02	0.00	0.00	0.02	0.96	0.00	0.00	4.73	0.0001
202	1.00	0.01	0.34	0.00	0.10	0.55	0.00	0.00	1.08	0.0006
205	1.00	0.03	0.00	0.00	0.88	0.09	0.00	0.00	0.24	0.0004
206	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.10	0.0029
210	1.00	0.01	0.00	0.00	0.00	0.98	0.00	0.00	3.83	0.0000
211	1.00	0.03	0.00	0.00	0.01	0.96	0.00	0.00	4.65	0.0006
LTR2.1	1.00	0.02	0.01	0.00	0.01	0.96	0.00	0.00	1.47	0.0000
LTR1.1	1.00	0.03	0.00	0.00	0.78	0.19	0.00	0.00	0.41	0.0000
216	1.00	0.01	0.01	0.00	0.03	0.95	0.00	0.00	5.61	0.0000

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
206	4.80	4.80	4.81	1.66	1.67
212	6.00	6.00	6.00	6.00	0.01
213	6.00	6.00	6.00	6.00	0.01
203	6.00	6.00	6.00	6.00	0.01
204	6.00	6.00	6.00	6.00	0.01
208	6.00	6.00	6.00	6.00	0.01
215	6.00	6.00	6.00	6.00	0.01
214	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Thu Sep 29 12:58:26 2011
Analysis ended on: Thu Sep 29 12:58:26 2011
Total elapsed time: < 1 sec

East I-25 Drainage Basin, 10-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ MAY-23-2011 00:00:00
Ending Date .............. MAY-23-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 212
WARNING 04: minimum elevation drop used for Conduit 213
WARNING 04: minimum elevation drop used for Conduit 203
WARNING 04: minimum elevation drop used for Conduit 204
WARNING 04: minimum elevation drop used for Conduit 208
WARNING 04: minimum elevation drop used for Conduit 215
WARNING 08: elevation drop exceeds length for Conduit 214

*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       177.553        57.858
External Outflow .........       117.199        38.191
Internal Outflow .........        56.269        18.336
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.001         0.000
Final Stored Volume ......         2.643         0.861
Continuity Error (%) .....         0.812


*************************
Highest Continuity Errors
*************************
Node 106 (6.79%)


***************************
Time-Step Critical Elements
***************************
Link 202 (89.62%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 202 (7)
Link 206 (1)
```

****
Routing Time Step Summary
****

Minimum Time Step	:	0.80 sec
Average Time Step	:	5.95 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.22

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	3.27	4.00	4963.00	0 00:47
102	JUNCTION	2.44	3.00	4935.00	0 00:30
105	JUNCTION	0.75	1.97	4932.97	0 00:40
106	JUNCTION	18.85	25.75	4875.75	0 01:34
110	JUNCTION	0.35	0.42	4929.42	0 01:32
111	JUNCTION	9.41	10.00	4857.00	0 00:31
LTR2	JUNCTION	1.39	2.37	4845.37	0 00:51
LTR3	JUNCTION	0.97	1.61	4834.61	0 00:53
LTR1	JUNCTION	1.09	2.12	4855.12	0 00:47
103	JUNCTION	0.00	0.00	4853.00	0 00:00
107	JUNCTION	0.00	0.00	4843.00	0 00:00
104	JUNCTION	0.01	0.01	4843.01	0 00:47
108	JUNCTION	0.00	0.00	4843.00	0 00:00
109	JUNCTION	0.04	0.05	4823.05	0 00:31
112	JUNCTION	0.00	0.00	4833.00	0 01:33
113	JUNCTION	0.01	0.02	4823.02	0 00:52
LTR	OUTFALL	0.00	0.00	4820.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	45.24	45.24	0 01:19	2.935	2.937
102	JUNCTION	95.72	95.72	0 00:54	3.710	3.710
105	JUNCTION	598.51	598.51	0 00:35	12.923	12.893
106	JUNCTION	132.49	700.24	0 00:40	5.972	18.952
110	JUNCTION	0.00	32.01	0 00:30	0.000	2.187
111	JUNCTION	0.00	235.50	0 01:34	0.000	17.664
LTR2	JUNCTION	0.00	771.63	0 00:50	0.000	30.426
LTR3	JUNCTION	0.00	847.97	0 00:52	0.000	34.414
LTR1	JUNCTION	0.00	608.31	0 00:45	0.000	18.723
103	JUNCTION	608.31	608.31	0 00:45	18.739	18.723
107	JUNCTION	0.00	0.00	0 00:00	0.000	0.000
104	JUNCTION	137.73	157.80	0 01:05	7.778	9.869
108	JUNCTION	28.87	28.87	0 01:05	1.817	1.817
109	JUNCTION	63.83	75.40	0 00:45	2.127	3.805
112	JUNCTION	46.32	78.33	0 00:54	1.897	4.084
113	JUNCTION	0.00	918.06	0 00:52	0.000	38.185
LTR	OUTFALL	0.00	918.06	0 00:52	0.000	38.188

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	2.45	2.000	0.000
102	JUNCTION	1.67	0.000	0.000
106	JUNCTION	0.58	22.746	0.000
111	JUNCTION	5.51	8.000	0.000
103	JUNCTION	6.00	0.000	10.000
107	JUNCTION	6.00	0.000	10.000
108	JUNCTION	6.00	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	2.20	25.18	0 01:19	0.830	4.00
102	1.67	63.71	0 00:54	1.523	3.00
106	3.45	556.95	0 00:40	7.847	25.75
111	3.45	223.93	0 01:35	15.968	10.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	99.20	431.19	918.06	38.188
System	99.20	431.19	918.06	38.188

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	20.06	0 02:20	26.40	0.51	0.50
202	CONDUIT	32.01	0 00:30	9.04	0.16	0.57
205	CONDUIT	593.37	0 00:40	16.14	0.46	0.83
206	CONDUIT	235.50	0 01:34	46.39	2.50	1.00
210	CONDUIT	32.01	0 01:33	17.80	0.02	0.07
211	CONDUIT	11.57	0 02:27	22.12	0.61	0.51
LTR2.1	CONDUIT	769.75	0 00:52	16.13	0.06	0.20
LTR1.1	CONDUIT	604.14	0 00:47	11.19	0.06	0.22
212	DUMMY	608.31	0 00:45			
213	DUMMY	0.00	0 00:00			
203	DUMMY	157.80	0 01:05			
204	DUMMY	28.87	0 01:05			
208	DUMMY	78.33	0 00:54			
215	DUMMY	75.40	0 00:45			
214	DUMMY	918.06	0 00:52			
216	CONDUIT	847.69	0 00:53	44.74	0.02	0.08

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	6.36	0.0003
202	1.00	0.00	0.02	0.00	0.01	0.97	0.00	0.00	1.24	0.0002
205	1.00	0.01	0.00	0.00	0.66	0.33	0.00	0.00	0.74	0.0003
206	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.01	0.0015
210	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	6.68	0.0000
211	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	5.34	0.0002
LTR2.1	1.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00	1.91	0.0000
LTR1.1	1.00	0.01	0.00	0.00	0.37	0.62	0.00	0.00	1.02	0.0000
216	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	8.16	0.0000

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
206	5.51	5.51	5.51	3.44	3.45
212	6.00	6.00	6.00	6.00	0.01
213	6.00	6.00	6.00	6.00	0.01
203	6.00	6.00	6.00	6.00	0.01
204	6.00	6.00	6.00	6.00	0.01
208	6.00	6.00	6.00	6.00	0.01
215	6.00	6.00	6.00	6.00	0.01
214	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Thu Sep 29 13:02:55 2011
Analysis ended on: Thu Sep 29 13:02:55 2011
Total elapsed time: < 1 sec

East I-25 Drainage Basin, 100-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... MAY-23-2011 00:00:00
Ending Date ..... MAY-23-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:15:00
Routing Time Step ..... 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 212
WARNING 04: minimum elevation drop used for Conduit 213
WARNING 04: minimum elevation drop used for Conduit 203
WARNING 04: minimum elevation drop used for Conduit 204
WARNING 04: minimum elevation drop used for Conduit 208
WARNING 04: minimum elevation drop used for Conduit 215
WARNING 08: elevation drop exceeds length for Conduit 214

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       470.900        153.450
External Outflow .........       276.988         90.261
Internal Outflow .........       181.567         59.166
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.001          0.000
Final Stored Volume ......         4.058          1.322
Continuity Error (%) .....         1.760


*************************
Highest Continuity Errors
*************************
Node 106 (8.35%)


***************************
Time-Step Critical Elements
***************************
Link 202 (93.12%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 202 (2)


*************************
```

Routing Time Step Summary
****

Minimum Time Step	:	0.72 sec
Average Time Step	:	4.80 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.10

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days	hr:min
101	JUNCTION	3.76	4.00	4963.00	0	00:39
102	JUNCTION	2.73	3.00	4935.00	0	00:29
105	JUNCTION	1.35	4.52	4935.52	0	01:01
106	JUNCTION	37.09	54.21	4904.21	0	01:43
110	JUNCTION	0.39	0.42	4929.42	0	01:59
111	JUNCTION	9.67	10.00	4857.00	0	00:30
LTR2	JUNCTION	2.07	3.78	4846.78	0	00:58
LTR3	JUNCTION	1.40	2.34	4835.34	0	01:00
LTR1	JUNCTION	1.61	3.41	4856.41	0	00:55
103	JUNCTION	0.00	0.00	4853.00	0	00:00
107	JUNCTION	0.00	0.00	4843.00	0	00:00
104	JUNCTION	0.01	0.01	4843.01	0	00:38
108	JUNCTION	0.00	0.00	4843.00	0	00:00
109	JUNCTION	0.04	0.04	4823.04	0	00:30
112	JUNCTION	0.00	0.00	4833.00	0	03:28
113	JUNCTION	0.01	0.03	4823.03	0	01:00
LTR	OUTFALL	0.00	0.00	4820.00	0	00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	167.24	167.24	0	01:20	10.459	10.461
102	JUNCTION	355.87	355.87	0	00:59	13.748	13.747
105	JUNCTION	1297.25	1297.25	0	00:44	31.485	31.454
106	JUNCTION	318.18	1385.51	0	00:49	14.787	46.340
110	JUNCTION	0.00	32.01	0	00:29	0.000	2.895
111	JUNCTION	0.00	550.29	0	01:43	0.000	42.472
LTR2	JUNCTION	0.00	1770.71	0	00:57	0.000	73.527
LTR3	JUNCTION	0.00	1975.10	0	01:00	0.000	83.184
LTR1	JUNCTION	0.00	1408.72	0	00:55	0.000	47.084
103	JUNCTION	1408.72	1408.72	0	00:55	47.101	47.084
107	JUNCTION	0.00	0.00	0	00:00	0.000	0.000
104	JUNCTION	337.89	357.91	0	01:15	19.082	21.966
108	JUNCTION	71.22	71.22	0	01:15	4.440	4.441
109	JUNCTION	148.90	160.44	0	00:55	5.426	7.128
112	JUNCTION	170.57	202.58	0	01:00	6.953	9.848
113	JUNCTION	0.00	2130.76	0	01:00	0.000	90.249
LTR	OUTFALL	0.00	2130.76	0	01:00	0.000	90.254

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	4.92	2.000	0.000
102	JUNCTION	2.98	0.000	0.000
106	JUNCTION	0.05	51.214	0.000
111	JUNCTION	5.50	8.000	0.000
103	JUNCTION	6.01	0.000	10.000
107	JUNCTION	6.01	0.000	10.000
108	JUNCTION	6.01	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	4.72	147.21	0 01:20	7.535	4.00
102	2.98	323.86	0 01:00	10.852	3.00
105	0.67	145.14	0 00:45	0.807	4.52
106	5.04	1190.46	0 00:41	23.270	54.21
111	5.04	538.75	0 01:43	40.750	10.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	99.36	886.84	2130.76	90.254
System	99.36	886.84	2130.76	90.254

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	20.02	0 03:33	26.45	0.51	0.50
202	CONDUIT	32.01	0 00:29	8.82	0.16	0.57
205	CONDUIT	1174.98	0 00:41	24.48	0.91	1.00
206	CONDUIT	550.29	0 01:43	>50.00	5.84	1.00
210	CONDUIT	32.01	0 01:55	17.83	0.02	0.07
211	CONDUIT	11.54	0 03:28	22.20	0.61	0.51
LTR2.1	CONDUIT	1772.52	0 00:59	22.17	0.14	0.31
LTR1.1	CONDUIT	1403.20	0 00:55	14.49	0.13	0.36
212	DUMMY	1408.72	0 00:55			
213	DUMMY	0.00	0 00:00			
203	DUMMY	357.91	0 01:15			
204	DUMMY	71.22	0 01:15			
208	DUMMY	202.58	0 01:00			
215	DUMMY	160.44	0 00:55			
214	DUMMY	2130.76	0 01:00			
216	CONDUIT	1975.37	0 01:00	>50.00	0.04	0.12

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
		--- Fraction of Time in Flow Class ----								
201	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	6.45	0.0001
202	1.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00	1.18	0.0001
205	1.00	0.01	0.00	0.00	0.57	0.42	0.00	0.00	0.99	0.0004
206	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.01	0.0027
210	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	6.73	0.0000
211	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	5.39	0.0001
LTR2.1	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	2.06	0.0001
LTR1.1	1.00	0.01	0.00	0.00	0.35	0.64	0.00	0.00	1.04	0.0001
216	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	8.56	0.0000

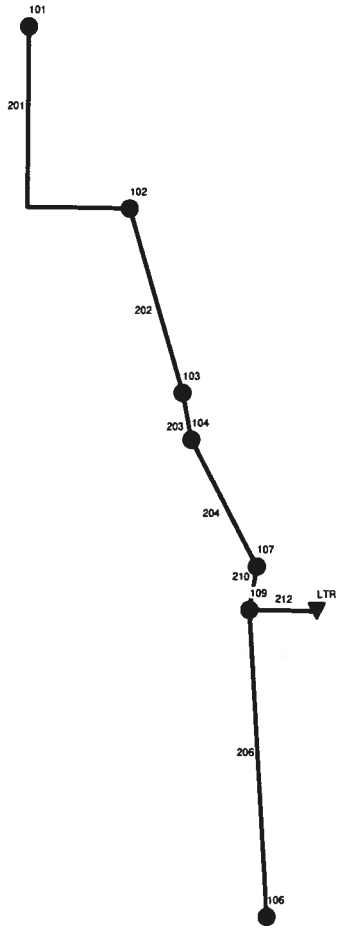
****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
205	0.67	0.67	0.67	0.01	0.01
206	5.50	5.50	5.50	5.03	5.04
212	6.01	6.01	6.01	6.01	0.01
213	6.01	6.01	6.01	6.01	0.01
203	6.01	6.01	6.01	6.01	0.01
204	6.01	6.01	6.01	6.01	0.01
208	6.01	6.01	6.01	6.01	0.01
215	6.01	6.01	6.01	6.01	0.01
214	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Thu Sep 29 13:09:06 2011
Analysis ended on: Thu Sep 29 13:09:06 2011
Total elapsed time: < 1 sec

West I-25 Drainage Basin, Schematic

06/06/2011 00:05:00



West I-25 Drainage Basin, 2-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..............  CFS
Process Models:
  Rainfall/Runoff ........  NO
  Snowmelt ...............  NO
  Groundwater ............  NO
  Flow Routing ...........  YES
  Ponding Allowed ........  YES
  Water Quality ..........  NO
Flow Routing Method ......  DYNWAVE
Starting Date ............  JUN-06-2011 00:00:00
Ending Date ..............  JUN-06-2011 06:00:00
Antecedent Dry Days ......  0.0
Report Time Step .........  00:05:00
Routing Time Step ........  30.00 sec

WARNING 04: minimum elevation drop used for Conduit 210
WARNING 08: elevation drop exceeds length for Conduit 212

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        60.063        19.572
External Outflow .........         0.000         0.000
Internal Outflow .........        59.857        19.505
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.211         0.069
Continuity Error (%) .....        -0.011

***************************
Time-Step Critical Elements
***************************
Link 203 (87.35%)

*******************************
Highest Flow Instability Indexes
*******************************
Link 203 (2)

*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     5.60 sec
Average Time Step           :     9.44 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.03

******************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	0.72	2.00	5072.00	0 00:30
102	JUNCTION	0.51	1.45	4966.45	0 00:45
103	JUNCTION	1.94	2.50	4873.50	0 00:29
104	JUNCTION	0.55	0.70	4870.70	0 01:30
106	JUNCTION	17.51	60.10	4980.10	0 01:07
107	JUNCTION	0.00	0.00	4855.00	0 01:30
108	JUNCTION	0.00	0.00	4855.00	0 00:00
109	JUNCTION	9.81	10.00	4865.00	0 00:23
LTR	OUTFALL	0.00	0.00	4850.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	46.60	46.60	0 00:34	0.720	0.718
102	JUNCTION	118.41	150.01	0 00:40	2.973	3.627
103	JUNCTION	227.35	366.29	0 00:41	5.134	8.752
104	JUNCTION	0.00	19.76	0 00:29	0.000	1.527
106	JUNCTION	323.52	323.52	0 00:39	6.392	6.384
107	JUNCTION	74.12	93.86	0 00:45	1.989	3.514
108	JUNCTION	0.00	0.00	0 00:00	0.000	0.000
109	JUNCTION	111.38	349.49	0 00:39	2.386	12.288
LTR	OUTFALL	0.00	0.00	0 00:00	0.000	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	0.24	0.000	0.000
103	JUNCTION	2.02	0.000	0.000
106	JUNCTION	0.01	57.105	0.000
108	JUNCTION	6.01	0.000	10.000
109	JUNCTION	5.63	7.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	0.24	17.95	0 00:30	0.070	2.00
103	2.01	346.53	0 00:41	7.198	2.50
106	1.51	177.43	0 00:39	1.649	60.10
109	5.63	349.45	0 00:40	12.247	10.00

West I-25 Drainage Basin, 2-Year Rainfall Event

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	0.00	0.00	0.00	0.000
System	0.00	0.00	0.00	0.000

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	32.11	0	00:45	17.02	0.86	0.86
202	CONDUIT	147.79	0	00:45	14.96	0.56	0.86
203	CONDUIT	19.76	0	00:29	7.57	0.38	0.64
204	CONDUIT	19.76	0	01:31	11.98	0.04	0.12
206	CONDUIT	145.93	0	00:28	24.32	1.00	1.00
210	DUMMY	93.86	0	00:45			
212	DUMMY	0.00	0	00:00			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	2.26	0.0008
202	1.00	0.01	0.00	0.00	0.67	0.32	0.00	0.00	0.74	0.0005
203	1.00	0.01	0.00	0.00	0.70	0.29	0.00	0.00	0.98	0.0005
204	1.00	0.01	0.00	0.00	0.00	0.98	0.00	0.00	3.57	0.0000
206	1.00	0.01	0.00	0.00	0.50	0.48	0.00	0.00	1.63	0.0009

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
206	1.52	1.52	1.52	1.50	1.51
210	6.01	6.01	6.01	6.01	0.01
212	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Thu Sep 29 13:28:40 2011
Analysis ended on: Thu Sep 29 13:28:40 2011
Total elapsed time: < 1 sec

West I-25 Drainage Basin, 10-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ..............  CFS
Process Models:
  Rainfall/Runoff ........  NO
  Snowmelt ...............  NO
  Groundwater ............  NO
  Flow Routing ...........  YES
  Ponding Allowed ........  YES
  Water Quality ..........  NO
Flow Routing Method ......  DYNWAVE
Starting Date ............  JUN-06-2011 00:00:00
Ending Date ..............  JUN-06-2011 06:00:00
Antecedent Dry Days ......  0.0
Report Time Step .........  00:05:00
Routing Time Step ........  30.00 sec

WARNING 04: minimum elevation drop used for Conduit 210
WARNING 08: elevation drop exceeds length for Conduit 212

*************************        Volume        Volume
Flow Routing Continuity       acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......          0.000         0.000
Wet Weather Inflow .......          0.000         0.000
Groundwater Inflow .......          0.000         0.000
RDII Inflow ..............          0.000         0.000
External Inflow ..........        158.832        51.758
External Outflow .........          0.000         0.000
Internal Outflow .........        158.625        51.690
Storage Losses ...........          0.000         0.000
Initial Stored Volume ....          0.000         0.000
Final Stored Volume ......          0.223         0.073
Continuity Error (%) .....         -0.010

***************************
Time-Step Critical Elements
***************************
Link 203 (90.54%)

*******************************
Highest Flow Instability Indexes
*******************************
Link 203 (2)

************************
Routing Time Step Summary
************************
Minimum Time Step           :     5.60 sec
Average Time Step           :     8.62 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.03

******************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	0.87	2.00	5072.00	0 00:24
102	JUNCTION	0.81	2.00	4967.00	0 00:36
103	JUNCTION	2.03	2.50	4873.50	0 00:25
104	JUNCTION	0.57	0.70	4870.70	0 01:30
106	JUNCTION	184.60	305.68	5225.68	0 01:44
107	JUNCTION	0.00	0.00	4855.00	0 02:51
109	JUNCTION	9.85	10.00	4865.00	0 00:19
LTR	OUTFALL	0.00	0.00	4850.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	106.37	106.37	0 00:35	1.890	1.888
102	JUNCTION	268.05	305.19	0 00:40	7.710	8.883
103	JUNCTION	517.72	780.43	0 00:40	13.415	22.049
104	JUNCTION	0.00	19.76	0 00:25	0.000	1.741
106	JUNCTION	736.44	736.44	0 00:40	16.732	16.721
107	JUNCTION	189.04	208.80	0 00:45	5.788	7.525
109	JUNCTION	256.71	607.02	0 00:40	6.247	30.489
LTR	OUTFALL	0.00	0.00	0 00:00	0.000	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	0.73	0.000	0.000
102	JUNCTION	0.30	0.000	0.000
103	JUNCTION	2.44	0.000	0.000
106	JUNCTION	0.01	302.680	0.000
109	JUNCTION	5.68	7.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	0.73	70.32	0 00:35	0.725	2.00
102	0.30	42.47	0 00:40	0.235	2.00
103	2.44	760.44	0 00:40	20.277	2.50
106	4.20	590.30	0 00:40	9.732	305.68
109	5.68	606.90	0 00:40	30.448	10.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	0.00	0.00	0.00	0.000
System	0.00	0.00	0.00	0.000

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	37.14	0 00:44	18.96	1.00	1.00
202	CONDUIT	262.71	0 00:48	21.89	1.00	1.00
203	CONDUIT	19.76	0 00:25	7.46	0.38	0.64
204	CONDUIT	19.76	0 01:33	11.98	0.04	0.12
206	CONDUIT	145.93	0 00:23	24.32	1.00	1.00
210	DUMMY	208.80	0 00:45			
212	DUMMY	0.00	0 00:00			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	2.02	0.0008
202	1.00	0.01	0.00	0.00	0.50	0.49	0.00	0.00	1.23	0.0008
203	1.00	0.01	0.00	0.00	0.74	0.25	0.00	0.00	0.97	0.0005
204	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	3.61	0.0000
206	1.00	0.01	0.00	0.00	0.07	0.92	0.00	0.00	3.22	0.0008

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	0.30	0.30	0.30	0.01	0.01
202	0.30	0.30	0.30	0.01	0.01
206	4.21	4.21	4.22	4.19	4.20
210	6.00	6.00	6.00	6.00	0.01
212	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Thu Sep 29 13:33:47 2011
Analysis ended on: Thu Sep 29 13:33:47 2011
Total elapsed time: < 1 sec

West I-25 Drainage Basin, 100-Year Rainfall Event

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-06-2011 00:00:00
Ending Date .............. JUN-06-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 210
WARNING 08: elevation drop exceeds length for Conduit 212

*************************        Volume         Volume
Flow Routing Continuity       acre-feet       10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .......          0.000          0.000
Wet Weather Inflow .......          0.000          0.000
Groundwater Inflow .......          0.000          0.000
RDII Inflow ..............          0.000          0.000
External Inflow ..........        390.875        127.373
External Outflow .........          0.000          0.000
Internal Outflow .........        331.568        108.046
Storage Losses ...........          0.000          0.000
Initial Stored Volume ....          0.000          0.000
Final Stored Volume ......         59.259         19.311
Continuity Error (%) .....          0.012


***************************
Time-Step Critical Elements
***************************
Link 203 (91.83%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 203 (2)


************************
Routing Time Step Summary
************************
Minimum Time Step           :     5.60 sec
Average Time Step           :     8.26 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.02


******************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	0.98	2.00	5072.00	0 00:26
102	JUNCTION	1.04	2.00	4967.00	0 00:33
103	JUNCTION	2.08	2.50	4873.50	0 00:26
104	JUNCTION	0.59	0.70	4870.70	0 01:30
106	JUNCTION	770.26	1017.39	5937.39	0 02:14
107	JUNCTION	0.00	0.00	4855.00	0 02:47
109	JUNCTION	9.85	10.00	4865.00	0 00:20
LTR	OUTFALL	0.00	0.00	4850.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	233.53	233.53	0 00:40	4.954	4.951
102	JUNCTION	589.94	627.08	0 00:50	18.308	19.891
103	JUNCTION	1124.52	1387.23	0 00:49	32.635	45.739
104	JUNCTION	0.00	19.76	0 00:26	0.000	1.860
106	JUNCTION	1621.11	1621.11	0 00:45	41.449	41.438
107	JUNCTION	437.96	457.71	0 00:50	14.427	16.283
109	JUNCTION	566.83	1162.62	0 00:50	15.620	54.096
LTR	OUTFALL	0.00	0.00	0 00:00	0.000	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	1.26	0.000	0.000
102	JUNCTION	1.18	0.000	0.000
103	JUNCTION	2.71	0.000	0.000
106	JUNCTION	0.01	1014.391	0.000
109	JUNCTION	5.67	7.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	1.26	196.28	0 00:40	3.383	2.00
102	1.18	364.29	0 00:50	6.766	2.00
103	2.71	1367.46	0 00:49	43.847	2.50
106	5.61	1474.77	0 00:45	33.155	1017.39
109	5.67	1162.62	0 00:50	54.056	10.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	0.00	0.00	0.00	0.000
System	0.00	0.00	0.00	0.000

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	37.14	0 00:41	17.25	1.00	1.00
202	CONDUIT	262.71	0 00:45	21.90	1.00	1.00
203	CONDUIT	19.76	0 00:26	7.45	0.38	0.64
204	CONDUIT	19.76	0 01:30	11.98	0.04	0.12
206	CONDUIT	145.93	0 00:24	24.32	1.00	1.00
210	DUMMY	457.71	0 00:50			
212	DUMMY	0.00	0 00:00			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.01	0.00	0.00	0.17	0.81	0.00	0.00	1.87	0.0008
202	1.00	0.01	0.00	0.00	0.40	0.58	0.00	0.00	1.61	0.0008
203	1.00	0.01	0.00	0.00	0.76	0.23	0.00	0.00	0.96	0.0004
204	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	3.63	0.0000
206	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	3.45	0.0004

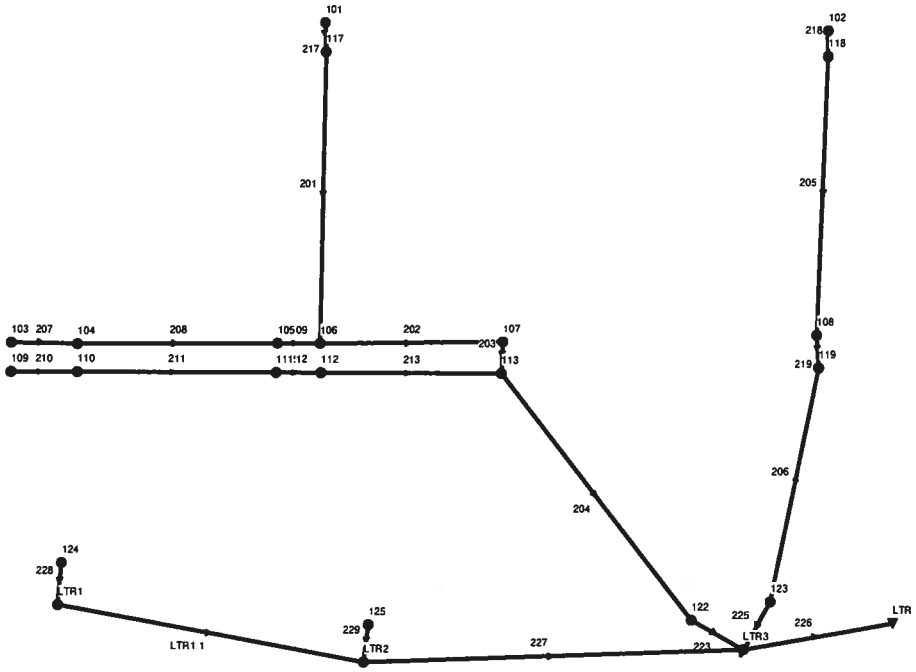
****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	1.14	1.14	1.14	0.01	0.01
202	1.18	1.18	1.18	0.01	0.01
206	5.61	5.61	5.61	5.60	5.61
210	6.01	6.01	6.01	6.01	0.01
212	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Thu Sep 29 13:35:54 2011
Analysis ended on: Thu Sep 29 13:35:54 2011
Total elapsed time: < 1 sec

Highway-56 Drainage Basin, Schematic

06/09/2011 00:15:00



Highway-56 Drainage Basin, 2-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..............  CFS
Process Models:
  Rainfall/Runoff ........  NO
  Snowmelt ...............  NO
  Groundwater ............  NO
  Flow Routing ...........  YES
  Ponding Allowed ........  NO
  Water Quality ..........  NO
Flow Routing Method ......  DYNWAVE
Starting Date ............  JUN-09-2011 00:00:00
Ending Date ..............  JUN-09-2011 06:00:00
Antecedent Dry Days ......  0.0
Report Time Step .........  00:15:00
Routing Time Step ........  30.00 sec

WARNING 04: minimum elevation drop used for Conduit 218
WARNING 04: minimum elevation drop used for Conduit 223
WARNING 04: minimum elevation drop used for Conduit 225
WARNING 04: minimum elevation drop used for Conduit 226
WARNING 04: minimum elevation drop used for Conduit 228
WARNING 04: minimum elevation drop used for Conduit 229
WARNING 02: maximum depth increased for Node 102
WARNING 02: maximum depth increased for Node 107
WARNING 02: maximum depth increased for Node 108
WARNING 02: maximum depth increased for Node 113
WARNING 02: maximum depth increased for Node 118
WARNING 02: maximum depth increased for Node LTR2

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........        10.473          3.413
External Outflow .........        10.148          3.307
Internal Outflow .........         0.144          0.047
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.026          0.008
Final Stored Volume ......         0.228          0.074
Continuity Error (%) .....        -0.191


************************
Highest Continuity Errors
************************
Node LTR2 (35.62%)
Node LTR1 (7.37%)
Node 117 (-2.83%)
Node 104 (-2.56%)
Node 108 (-1.66%)


**************************
Time-Step Critical Elements
**************************
Link 209 (51.26%)
```

Link 217 (27.02%)
Link 210 (4.02%)

****
Highest Flow Instability Indexes
****
Link 203 (34)
Link 210 (25)
Link 207 (22)
Link 219 (21)
Link 209 (8)

****
Routing Time Step Summary
****
Minimum Time Step : 0.50 sec
Average Time Step : 7.91 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 2.39

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	0.78	2.61	5010.61	0 00:44
102	JUNCTION	0.80	1.34	4985.34	0 00:45
103	JUNCTION	1.01	2.22	4967.22	0 00:35
104	JUNCTION	1.16	1.95	4965.95	0 00:38
105	JUNCTION	2.03	4.63	4944.63	0 01:05
106	JUNCTION	2.56	5.00	4944.00	0 01:01
107	JUNCTION	1.57	2.11	4922.11	0 00:55
108	JUNCTION	1.06	1.77	4910.77	0 00:47
109	JUNCTION	1.06	1.93	4966.93	0 00:40
110	JUNCTION	1.20	1.79	4965.79	0 00:46
111	JUNCTION	1.43	2.39	4942.39	0 01:00
112	JUNCTION	1.63	2.70	4941.70	0 01:19
113	JUNCTION	0.76	1.14	4916.14	0 01:03
117	JUNCTION	0.75	1.18	5008.18	0 00:49
118	JUNCTION	0.76	1.25	4985.25	0 00:46
119	JUNCTION	1.35	2.08	4910.08	0 00:51
LTR1	JUNCTION	0.05	0.07	4908.07	0 01:25
LTR2	JUNCTION	0.05	0.07	4888.07	0 02:21
122	JUNCTION	0.00	0.00	4873.00	0 01:12
123	JUNCTION	0.00	0.02	4873.02	0 00:05
LTR3	JUNCTION	0.01	0.01	4873.01	0 01:11
124	JUNCTION	0.00	0.00	4908.00	0 00:00
125	JUNCTION	0.00	0.00	4888.00	0 00:00
LTR	OUTFALL	0.00	0.00	4873.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	9.34	9.34	0 00:44	0.252	0.253
102	JUNCTION	11.34	11.34	0 00:40	0.284	0.284
103	JUNCTION	20.21	20.21	0 00:34	0.475	0.474

104	JUNCTION	0.00	20.18	0	00:35	0.000	0.474
105	JUNCTION	13.23	31.27	0	00:44	0.476	0.963
106	JUNCTION	0.00	36.23	0	00:52	0.000	1.209
107	JUNCTION	9.02	30.15	0	00:52	0.360	1.515
108	JUNCTION	11.43	22.15	0	00:45	0.351	0.637
109	JUNCTION	16.39	16.39	0	00:40	0.507	0.507
110	JUNCTION	0.00	16.39	0	00:40	0.000	0.507
111	JUNCTION	9.39	25.21	0	00:48	0.330	0.843
112	JUNCTION	0.00	22.59	0	01:00	0.000	0.835
113	JUNCTION	4.02	54.01	0	00:58	0.131	2.481
117	JUNCTION	0.00	9.34	0	00:45	0.000	0.253
118	JUNCTION	0.00	11.34	0	00:40	0.000	0.284
119	JUNCTION	0.00	22.00	0	00:47	0.000	0.647
LTR1	JUNCTION	0.00	3.81	0	00:44	0.000	0.096
LTR2	JUNCTION	0.00	4.59	0	00:35	0.000	0.164
122	JUNCTION	3.04	54.44	0	01:02	0.076	2.553
123	JUNCTION	0.00	21.15	0	00:51	0.000	0.646
LTR3	JUNCTION	0.00	73.44	0	01:00	0.000	3.306
124	JUNCTION	3.81	3.81	0	00:44	0.096	0.096
125	JUNCTION	4.50	4.50	0	00:35	0.075	0.075
LTR	OUTFALL	0.00	73.44	0	01:00	0.000	3.307

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	0.64	1.607	0.000
105	JUNCTION	0.48	1.626	0.000
106	JUNCTION	0.92	2.000	0.000
124	JUNCTION	6.01	0.000	10.000
125	JUNCTION	6.01	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
106	0.35	10.88	0 01:05	0.047	5.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	99.96	42.41	73.44	3.307
System	99.96	42.41	73.44	3.307

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	8.84	0	00:49	6.16	0.25	0.80
202	CONDUIT	21.21	0	00:52	7.65	1.01	1.00
203	CONDUIT	31.21	0	00:55	7.09	0.07	0.41
204	CONDUIT	52.30	0	01:03	21.45	0.14	0.19
205	CONDUIT	10.82	0	00:46	7.42	0.29	0.76
206	CONDUIT	21.15	0	00:51	26.42	0.09	0.26
207	CONDUIT	20.18	0	00:35	3.90	0.22	0.69
208	CONDUIT	19.92	0	00:39	7.76	0.93	0.99
209	CONDUIT	27.74	0	00:56	4.71	0.25	1.00
210	CONDUIT	16.39	0	00:40	3.86	0.15	0.62
211	CONDUIT	16.00	0	00:46	6.94	0.75	0.95
212	CONDUIT	22.59	0	01:00	3.89	0.26	0.82
213	CONDUIT	19.48	0	01:08	10.94	0.81	0.78
217	CONDUIT	9.34	0	00:45	11.89	1.56	1.00
218	CONDUIT	11.34	0	00:40	4.19	3.20	0.43
219	CONDUIT	22.00	0	00:47	6.89	0.12	0.48
LTR1.1	CONDUIT	1.66	0	01:29	1.24	0.00	0.01
223	DUMMY	54.44	0	01:02			
225	DUMMY	21.14	0	00:51			
226	DUMMY	73.44	0	01:00			
227	CONDUIT	1.04	0	02:21	1.31	0.00	0.00
228	DUMMY	3.81	0	00:44			
229	DUMMY	4.50	0	00:35			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.00	0.00	0.00	0.85	0.14	0.00	0.00	0.66	0.0002
202	1.00	0.00	0.00	0.00	0.04	0.96	0.00	0.00	1.26	0.0007
203	1.00	0.00	0.00	0.00	0.44	0.55	0.00	0.00	1.17	0.0012
204	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	4.74	0.0001
205	1.00	0.00	0.01	0.00	0.10	0.90	0.00	0.00	1.38	0.0002
206	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	5.70	0.0001
207	1.00	0.00	0.10	0.00	0.89	0.00	0.00	0.00	0.37	0.0011
208	1.00	0.00	0.00	0.00	0.67	0.32	0.00	0.00	0.89	0.0007
209	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.27	0.0007
210	1.00	0.00	0.07	0.00	0.92	0.00	0.00	0.00	0.42	0.0009
211	1.00	0.00	0.00	0.00	0.57	0.43	0.00	0.00	1.05	0.0005
212	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.41	0.0005
213	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	2.13	0.0006
217	1.00	0.00	0.06	0.00	0.41	0.53	0.00	0.00	0.76	0.0012
218	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.45	0.0023
219	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0011
LTR1.1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.66	0.0000
227	1.00	0.00	0.02	0.00	0.28	0.71	0.00	0.00	0.93	0.0000

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
202	1.46	1.46	1.46	1.48	1.45
209	0.48	0.48	0.49	0.01	0.01
217	0.59	0.59	0.59	0.64	0.57
218	0.01	0.01	0.01	1.13	0.01

223	6.01	6.01	6.01	6.01	0.01
225	6.01	6.01	6.01	6.01	0.01
226	6.01	6.01	6.01	6.01	0.01
228	6.01	6.01	6.01	6.01	0.01
229	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Thu Sep 29 13:55:17 2011
Analysis ended on: Thu Sep 29 13:55:18 2011
Total elapsed time: 00:00:01

Highway-56 Drainage Basin, 10-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-09-2011 00:00:00
Ending Date .............. JUN-09-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 218
WARNING 04: minimum elevation drop used for Conduit 223
WARNING 04: minimum elevation drop used for Conduit 225
WARNING 04: minimum elevation drop used for Conduit 226
WARNING 04: minimum elevation drop used for Conduit 228
WARNING 04: minimum elevation drop used for Conduit 229
WARNING 02: maximum depth increased for Node 102
WARNING 02: maximum depth increased for Node 107
WARNING 02: maximum depth increased for Node 108
WARNING 02: maximum depth increased for Node 113
WARNING 02: maximum depth increased for Node 118
WARNING 02: maximum depth increased for Node LTR2

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       112.716         36.730
External Outflow .........        62.825         20.472
Internal Outflow .........        49.419         16.104
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.026          0.008
Final Stored Volume ......         0.545          0.178
Continuity Error (%) .....        -0.043


*************************
Highest Continuity Errors
*************************
Node LTR2 (3.31%)
Node 117 (-1.73%)
Node 104 (-1.55%)


***************************
Time-Step Critical Elements
***************************
Link 203 (33.79%)
Link 209 (17.22%)
Link 218 (16.74%)
```

Link 210 (9.64%)
Link 217 (9.08%)

****
Highest Flow Instability Indexes
****
Link 210 (12)
Link 207 (9)
Link 212 (5)
Link 218 (5)
Link 219 (5)

****
Routing Time Step Summary
****
Minimum Time Step : 0.50 sec
Average Time Step : 4.98 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 2.46

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.96	3.00	5011.00	0 00:24
102	JUNCTION	2.06	4.00	4988.00	0 00:28
103	JUNCTION	1.79	5.00	4970.00	0 00:29
104	JUNCTION	2.22	5.00	4969.00	0 00:30
105	JUNCTION	3.68	5.00	4945.00	0 00:32
106	JUNCTION	3.93	5.00	4944.00	0 00:38
107	JUNCTION	3.77	7.00	4927.00	0 00:48
108	JUNCTION	2.48	4.00	4913.00	0 00:35
109	JUNCTION	2.45	5.00	4970.00	0 00:32
110	JUNCTION	2.91	5.00	4969.00	0 00:33
111	JUNCTION	3.41	5.00	4945.00	0 00:34
112	JUNCTION	3.70	5.00	4944.00	0 00:37
113	JUNCTION	1.53	2.49	4917.49	0 00:53
117	JUNCTION	0.96	1.23	5008.23	0 02:30
118	JUNCTION	1.77	3.00	4987.00	0 00:33
119	JUNCTION	2.16	3.13	4911.13	0 01:45
LTR1	JUNCTION	0.31	0.72	4908.72	0 00:58
LTR2	JUNCTION	0.61	1.13	4889.13	0 01:20
122	JUNCTION	0.00	0.00	4873.00	0 00:52
123	JUNCTION	0.00	0.02	4873.02	0 00:05
LTR3	JUNCTION	0.01	0.01	4873.01	0 01:09
124	JUNCTION	0.00	0.00	4908.00	0 00:00
125	JUNCTION	0.00	0.00	4888.00	0 00:00
LTR	OUTFALL	0.00	0.00	4873.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	107.30	107.30	0 00:44	3.165	3.165
102	JUNCTION	133.79	133.79	0 00:44	3.701	3.701
103	JUNCTION	66.19	66.19	0 00:35	1.577	1.577

104	JUNCTION	0.00	66.20	0	00:35	0.000	1.576
105	JUNCTION	157.59	179.08	0	00:55	6.116	7.142
106	JUNCTION	0.00	121.88	0	01:43	0.000	6.469
107	JUNCTION	105.60	125.47	0	00:55	4.535	6.527
108	JUNCTION	75.40	112.94	0	00:44	2.492	4.440
109	JUNCTION	74.80	74.80	0	00:44	2.416	2.416
110	JUNCTION	0.00	74.80	0	00:44	0.000	2.415
111	JUNCTION	106.29	127.66	0	00:55	4.037	5.363
112	JUNCTION	0.00	86.71	0	01:28	0.000	4.659
113	JUNCTION	44.25	187.19	0	00:50	1.534	10.000
117	JUNCTION	0.00	10.44	0	00:25	0.000	0.654
118	JUNCTION	0.00	111.94	0	00:46	0.000	3.576
119	JUNCTION	0.00	64.00	0	00:35	0.000	3.489
LTR1	JUNCTION	0.00	98.75	0	00:44	0.000	2.721
LTR2	JUNCTION	0.00	162.27	0	00:48	0.000	4.940
122	JUNCTION	80.71	260.85	0	00:50	2.208	12.203
123	JUNCTION	0.00	64.00	0	01:50	0.000	3.488
LTR3	JUNCTION	0.00	402.02	0	01:08	0.000	20.470
124	JUNCTION	98.75	98.75	0	00:44	2.720	2.721
125	JUNCTION	120.28	120.28	0	00:35	2.223	2.223
LTR	OUTFALL	0.00	402.02	0	01:08	0.000	20.471

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	2.30	2.000	0.000
102	JUNCTION	1.41	1.000	0.000
103	JUNCTION	1.10	2.000	0.000
104	JUNCTION	1.12	2.000	0.000
105	JUNCTION	2.73	2.000	0.000
106	JUNCTION	2.89	2.000	0.000
107	JUNCTION	1.54	3.000	0.000
108	JUNCTION	1.30	0.000	0.000
109	JUNCTION	1.60	2.000	0.000
110	JUNCTION	1.63	2.000	0.000
111	JUNCTION	2.39	2.000	0.000
112	JUNCTION	2.67	2.000	0.000
118	JUNCTION	1.28	0.000	0.000
124	JUNCTION	6.00	0.000	10.000
125	JUNCTION	6.00	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days	hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	2.12	97.35	0	00:45	2.511	3.00
102	0.37	21.84	0	00:44	0.128	4.00
103	0.02	2.66	0	00:30	0.001	5.00
104	0.99	44.70	0	00:35	0.575	5.00
105	1.19	75.70	0	00:38	1.313	5.00
106	2.50	102.01	0	01:07	4.465	5.00
107	0.32	6.70	0	00:55	0.038	7.00
108	1.30	48.94	0	00:45	0.949	4.00
109	0.02	4.19	0	00:33	0.001	5.00
110	1.49	53.43	0	00:45	1.107	5.00
111	1.06	40.95	0	00:55	0.685	5.00

112	2.24	63.22	0	00:38	2.693	5.00
118	1.28	74.40	0	00:46	1.634	3.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	99.98	197.27	402.02	20.471
System	99.98	197.27	402.02	20.471

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	9.94	0	02:13	8.91	0.28	0.81
202	CONDUIT	21.01	0	00:39	7.00	1.00	1.00
203	CONDUIT	118.77	0	00:48	10.95	0.28	0.81
204	CONDUIT	186.14	0	00:53	32.27	0.50	0.42
205	CONDUIT	37.73	0	00:33	12.58	1.00	1.00
206	CONDUIT	64.00	0	01:50	34.64	0.27	0.39
207	CONDUIT	66.20	0	00:35	9.36	0.72	1.00
208	CONDUIT	21.49	0	00:29	8.15	1.00	1.00
209	CONDUIT	111.94	0	01:10	15.84	1.00	1.00
210	CONDUIT	74.80	0	00:44	10.58	0.67	1.00
211	CONDUIT	21.37	0	00:31	7.46	1.00	1.00
212	CONDUIT	86.71	0	01:28	12.27	1.00	1.00
213	CONDUIT	25.56	0	01:50	10.38	1.06	1.00
217	CONDUIT	10.44	0	00:25	13.55	1.75	1.00
218	CONDUIT	111.94	0	00:46	15.84	31.62	1.00
219	CONDUIT	64.00	0	00:35	6.89	0.34	0.89
LTR1.1	CONDUIT	81.58	0	00:58	4.70	0.01	0.09
223	DUMMY	260.85	0	00:50			
225	DUMMY	64.00	0	01:50			
226	DUMMY	402.02	0	01:08			
227	CONDUIT	108.76	0	01:20	8.55	0.00	0.03
228	DUMMY	98.75	0	00:44			
229	DUMMY	120.28	0	00:35			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.00	0.00	0.00	0.91	0.09	0.00	0.00	0.83	0.0001
202	1.00	0.00	0.00	0.00	0.10	0.90	0.00	0.00	1.19	0.0005
203	1.00	0.00	0.00	0.00	0.66	0.33	0.00	0.00	1.00	0.0002
204	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	5.09	0.0002
205	1.00	0.00	0.00	0.00	0.24	0.75	0.00	0.00	1.74	0.0005
206	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	6.22	0.0001
207	1.00	0.00	0.11	0.00	0.89	0.00	0.00	0.00	0.17	0.0007
208	1.00	0.00	0.00	0.00	0.46	0.54	0.00	0.00	0.84	0.0005
209	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.15	0.0007
210	1.00	0.00	0.04	0.00	0.95	0.00	0.00	0.00	0.17	0.0006
211	1.00	0.00	0.00	0.00	0.33	0.67	0.00	0.00	1.02	0.0005

212	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.15	0.0006
213	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	1.70	0.0005
217	1.00	0.00	0.03	0.00	0.85	0.12	0.00	0.00	0.27	0.0008
218	1.00	0.00	0.00	0.00	0.95	0.05	0.00	0.00	0.23	0.1011
219	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0004
LTR1.1	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.50	0.0000
227	1.00	0.00	0.01	0.00	0.05	0.94	0.00	0.00	1.73	0.0000

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
202	3.28	3.28	3.28	2.01	2.02
205	1.63	1.63	1.63	0.01	0.01
207	1.00	1.00	1.01	0.01	0.01
208	1.43	1.43	1.43	0.05	0.05
209	2.61	2.61	2.61	0.01	0.01
210	1.50	1.50	1.51	0.01	0.01
211	1.98	1.98	1.98	0.47	0.48
212	2.34	2.34	2.34	0.01	0.01
213	1.13	1.13	1.13	1.53	1.13
217	2.26	2.26	2.26	2.30	2.24
218	1.28	1.28	1.28	2.34	1.28
223	6.00	6.00	6.00	6.00	0.01
225	6.00	6.00	6.00	6.00	0.01
226	6.00	6.00	6.00	6.00	0.01
228	6.00	6.00	6.00	6.00	0.01
229	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Thu Sep 29 13:59:11 2011
Analysis ended on: Thu Sep 29 13:59:11 2011
Total elapsed time: < 1 sec

Highway-56 Drainage Basin, 100-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-09-2011 00:00:00
Ending Date .............. JUN-09-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 218
WARNING 04: minimum elevation drop used for Conduit 223
WARNING 04: minimum elevation drop used for Conduit 225
WARNING 04: minimum elevation drop used for Conduit 226
WARNING 04: minimum elevation drop used for Conduit 228
WARNING 04: minimum elevation drop used for Conduit 229
WARNING 02: maximum depth increased for Node 102
WARNING 02: maximum depth increased for Node 107
WARNING 02: maximum depth increased for Node 108
WARNING 02: maximum depth increased for Node 113
WARNING 02: maximum depth increased for Node 118
WARNING 02: maximum depth increased for Node LTR2

**************************        Volume         Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       431.102        140.481
External Outflow .........       163.507         53.281
Internal Outflow .........       267.354         87.121
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.026          0.008
Final Stored Volume ......         0.658          0.215
Continuity Error (%) .....        -0.091


*************************
Highest Continuity Errors
*************************
Node 117 (-1.49%)
Node LTR2 (1.09%)


**************************
Time-Step Critical Elements
**************************
Link 203 (36.16%)
Link 219 (26.97%)
Link 209 (13.62%)
Link 218 (8.74%)
```

Link 217 (4.83%)

****
Highest Flow Instability Indexes
****
Link 203 (14)
Link 210 (11)
Link 207 (10)
Link 204 (7)
Link 213 (7)

****
Routing Time Step Summary
****

Minimum Time Step	:	0.50 sec
Average Time Step	:	4.86 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.83

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.96	3.00	5011.00	0 00:25
102	JUNCTION	2.24	4.00	4988.00	0 00:27
103	JUNCTION	1.89	5.00	4970.00	0 00:27
104	JUNCTION	2.15	5.00	4969.00	0 00:30
105	JUNCTION	3.98	5.00	4945.00	0 00:30
106	JUNCTION	4.06	5.00	4944.00	0 00:38
107	JUNCTION	4.71	7.00	4927.00	0 00:34
108	JUNCTION	2.56	4.00	4913.00	0 00:32
109	JUNCTION	2.77	5.00	4970.00	0 00:28
110	JUNCTION	3.05	5.00	4969.00	0 00:32
111	JUNCTION	3.81	5.00	4945.00	0 00:31
112	JUNCTION	3.94	5.00	4944.00	0 00:35
113	JUNCTION	2.93	6.00	4921.00	0 00:45
117	JUNCTION	0.94	1.23	5008.23	0 02:49
118	JUNCTION	1.81	3.00	4987.00	0 00:30
119	JUNCTION	2.18	3.13	4911.13	0 02:10
LTR1	JUNCTION	0.63	1.84	4909.84	0 00:57
LTR2	JUNCTION	1.17	3.00	4891.00	0 01:08
122	JUNCTION	0.00	0.00	4873.00	0 02:04
123	JUNCTION	0.00	0.02	4873.02	0 00:05
LTR3	JUNCTION	0.01	0.01	4873.01	0 01:07
124	JUNCTION	0.00	0.00	4908.00	0 00:00
125	JUNCTION	0.00	0.00	4888.00	0 00:00
LTR	OUTFALL	0.00	0.00	4873.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	428.12	428.12	0 00:50	12.404	12.406
102	JUNCTION	499.11	499.11	0 00:45	13.562	13.565
103	JUNCTION	186.37	186.37	0 00:40	4.083	4.084
104	JUNCTION	0.00	91.40	0 00:44	0.000	2.940

105	JUNCTION	621.52	643.01	0	00:59	22.970	24.087
106	JUNCTION	0.00	121.88	0	02:24	0.000	9.143
107	JUNCTION	432.64	452.59	0	01:04	17.581	19.732
108	JUNCTION	268.08	305.62	0	00:50	8.406	10.715
109	JUNCTION	251.86	251.86	0	00:50	7.560	7.561
110	JUNCTION	0.00	111.94	0	00:45	0.000	5.088
111	JUNCTION	451.33	472.70	0	00:59	16.474	17.981
112	JUNCTION	0.00	86.71	0	02:10	0.000	6.564
113	JUNCTION	195.81	663.99	0	01:00	6.697	27.653
117	JUNCTION	0.00	10.44	0	00:27	0.000	0.715
118	JUNCTION	0.00	121.02	0	00:30	0.000	5.624
119	JUNCTION	0.00	64.00	0	00:32	0.000	4.209
LTR1	JUNCTION	0.00	434.46	0	00:50	0.000	12.113
LTR2	JUNCTION	0.00	795.77	0	00:51	0.000	21.255
122	JUNCTION	344.18	605.71	0	00:50	9.487	28.042
123	JUNCTION	0.00	64.00	0	02:12	0.000	4.208
LTR3	JUNCTION	0.00	1254.81	0	01:06	0.000	53.276
124	JUNCTION	434.46	434.46	0	00:50	12.110	12.113
125	JUNCTION	480.86	480.86	0	00:40	9.112	9.115
LTR	OUTFALL	0.00	1254.81	0	01:06	0.000	53.277

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	2.57	2.000	0.000
102	JUNCTION	1.98	1.000	0.000
103	JUNCTION	1.39	2.000	0.000
104	JUNCTION	1.35	2.000	0.000
105	JUNCTION	3.20	2.000	0.000
106	JUNCTION	3.27	2.000	0.000
107	JUNCTION	2.99	3.000	0.000
108	JUNCTION	2.06	0.000	0.000
109	JUNCTION	2.15	2.000	0.000
110	JUNCTION	2.14	2.000	0.000
111	JUNCTION	3.03	2.000	0.000
112	JUNCTION	3.16	2.000	0.000
113	JUNCTION	1.38	2.000	0.000
118	JUNCTION	1.90	0.000	0.000
124	JUNCTION	6.00	0.000	10.000
125	JUNCTION	6.00	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	2.45	418.08	0 00:50	11.692	3.00
102	1.45	387.17	0 00:45	7.943	4.00
103	0.80	94.94	0 00:40	1.144	5.00
104	1.30	69.91	0 00:44	1.848	5.00
105	2.26	531.06	0 01:00	15.642	5.00
106	3.01	102.01	0 02:24	6.979	5.00
107	0.77	218.58	0 00:45	1.176	7.00
108	2.06	241.57	0 00:50	6.499	4.00
109	1.13	139.90	0 00:50	2.473	5.00
110	2.04	90.57	0 00:35	3.603	5.00
111	2.37	385.97	0 00:59	11.397	5.00

112	2.89	63.04	0	00:57	4.307	5.00
113	1.34	402.45	0	01:00	9.073	6.00
118	1.90	79.99	0	00:30	3.324	3.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	99.98	441.39	1254.81	53.277
System	99.98	441.39	1254.81	53.277

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	9.94	0	02:16	8.13	0.28	0.81
202	CONDUIT	21.01	0	00:46	7.00	1.00	1.00
203	CONDUIT	452.58	0	01:04	36.02	1.08	1.00
204	CONDUIT	261.54	0	01:45	36.67	0.70	0.50
205	CONDUIT	37.80	0	00:29	12.60	1.00	1.00
206	CONDUIT	64.00	0	02:12	34.66	0.27	0.39
207	CONDUIT	91.40	0	00:44	12.93	1.00	1.00
208	CONDUIT	21.49	0	00:29	8.05	1.00	1.00
209	CONDUIT	111.94	0	02:24	15.84	1.00	1.00
210	CONDUIT	111.94	0	00:45	15.84	1.00	1.00
211	CONDUIT	21.37	0	00:30	7.22	1.00	1.00
212	CONDUIT	86.71	0	02:10	12.27	1.00	1.00
213	CONDUIT	25.54	0	03:10	9.75	1.06	1.00
217	CONDUIT	10.44	0	00:27	14.49	1.75	1.00
218	CONDUIT	121.02	0	00:30	17.29	34.19	1.00
219	CONDUIT	64.00	0	00:32	6.89	0.34	0.89
LTR1.1	CONDUIT	408.32	0	00:57	7.65	0.04	0.24
223	DUMMY	605.71	0	00:50			
225	DUMMY	64.00	0	02:12			
226	DUMMY	1254.81	0	01:06			
227	CONDUIT	645.54	0	01:09	16.51	0.01	0.08
228	DUMMY	434.46	0	00:50			
229	DUMMY	480.86	0	00:40			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.00	0.00	0.00	0.91	0.08	0.00	0.00	0.80	0.0001
202	1.00	0.00	0.00	0.00	0.09	0.91	0.00	0.00	1.17	0.0005
203	1.00	0.00	0.00	0.00	0.67	0.32	0.00	0.00	0.75	0.0061
204	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	5.24	0.0003
205	1.00	0.00	0.00	0.00	0.23	0.77	0.00	0.00	1.73	0.0004
206	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	6.21	0.0001
207	1.00	0.00	0.19	0.00	0.80	0.00	0.00	0.00	0.14	0.0008
208	1.00	0.00	0.00	0.00	0.53	0.47	0.00	0.00	0.75	0.0004
209	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.13	0.0007
210	1.00	0.00	0.04	0.00	0.95	0.00	0.00	0.00	0.13	0.0006

211	1.00	0.00	0.00	0.00	0.31	0.69	0.00	0.00	1.00	0.0005
212	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.12	0.0006
213	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.52	0.0005
217	1.00	0.00	0.03	0.00	0.89	0.07	0.00	0.00	0.22	0.0008
218	1.00	0.00	0.00	0.00	0.95	0.05	0.00	0.00	0.16	0.0644
219	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.38	0.0003
LTR1.1	1.00	0.00	0.00	0.00	0.96	0.04	0.00	0.00	0.52	0.0000
227	1.00	0.00	0.01	0.00	0.05	0.95	0.00	0.00	1.95	0.0000

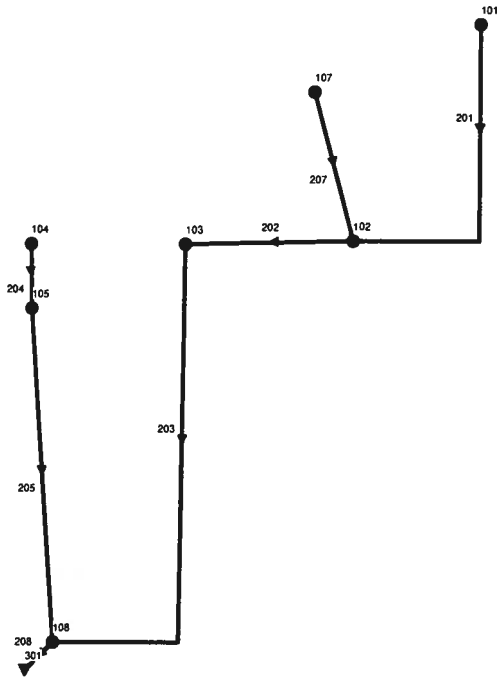
****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
202	3.64	3.64	3.64	1.35	1.38
203	1.34	1.34	1.38	0.39	0.40
205	2.11	2.11	2.11	0.02	0.03
207	1.31	1.31	1.31	0.01	0.01
208	1.66	1.66	1.66	0.03	0.04
209	3.07	3.07	3.08	0.01	0.01
210	2.05	2.05	2.06	0.01	0.01
211	2.40	2.40	2.40	0.01	0.03
212	2.97	2.97	2.97	0.01	0.01
213	2.57	2.57	2.57	1.47	1.20
217	2.52	2.52	2.53	2.56	2.51
218	1.90	1.90	1.90	2.51	1.90
223	6.00	6.00	6.00	6.00	0.01
225	6.00	6.00	6.00	6.00	0.01
226	6.00	6.00	6.00	6.00	0.01
228	6.00	6.00	6.00	6.00	0.01
229	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Thu Sep 29 14:01:23 2011
Analysis ended on: Thu Sep 29 14:01:24 2011
Total elapsed time: 00:00:01

Newell Reservoir Drainage Basin, Schematic

06/13/2011 00:15:00



Newell Reservoir Drainage Basin, 2-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-13-2011 00:00:00
Ending Date .............. JUN-13-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 203
WARNING 04: minimum elevation drop used for Conduit 204
WARNING 08: elevation drop exceeds length for Conduit 205
WARNING 08: elevation drop exceeds length for Conduit 208

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........        65.644         21.391
External Outflow .........        29.316          9.553
Internal Outflow .........        34.398         11.209
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         2.224          0.725
Continuity Error (%) .....        -0.447


*************************
Highest Continuity Errors
*************************
Node 105 (75.03%)
Node 102 (6.72%)


***************************
Time-Step Critical Elements
***************************
Link 204 (44.00%)


*********************************
Highest Flow Instability Indexes
*********************************
Link 204 (12)


************************
Routing Time Step Summary
************************
```

```
Minimum Time Step           :     0.50 sec
Average Time Step           :    18.66 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.14
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.70	2.65	5054.65	0 01:00
102	JUNCTION	2.88	4.00	5003.00	0 00:52
103	JUNCTION	4.17	5.00	5002.00	0 00:33
104	JUNCTION	2.74	3.00	3.00	0 00:38
105	JUNCTION	2.55	3.10	3.10	0 00:49
107	JUNCTION	0.50	1.00	5060.00	0 00:48
108	JUNCTION	0.00	0.00	4997.00	0 00:33
301	OUTFALL	0.00	0.00	4959.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	84.61	84.61	0 00:55	3.707	3.714
102	JUNCTION	0.00	179.13	0 00:47	0.000	6.942
103	JUNCTION	148.26	159.20	0 00:55	4.434	8.057
104	JUNCTION	78.95	83.45	0 01:08	4.993	5.072
105	JUNCTION	0.00	31.62	0 00:38	0.000	0.300
107	JUNCTION	97.98	97.98	0 00:45	2.999	3.006
108	JUNCTION	330.79	365.74	0 00:35	5.220	9.552
301	OUTFALL	0.00	365.75	0 00:35	0.000	9.552

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
102	JUNCTION	1.88	0.000	0.000
103	JUNCTION	3.22	1.000	0.000
104	JUNCTION	5.37	0.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet

102	1.87	163.06	0	00:52	2.850	4.00
103	2.68	120.98	0	00:56	3.567	5.00
104	5.37	83.38	0	01:08	4.770	3.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
301	97.41	127.75	365.75	9.552
System	97.41	127.75	365.75	9.552

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	83.34	0 01:00	11.94	0.72	0.94
202	CONDUIT	36.06	0 02:22	3.28	0.71	1.00
203	CONDUIT	38.22	0 00:40	12.74	35.36	0.50
204	CONDUIT	31.61	0 00:38	6.88	11.53	1.00
205	CONDUIT	0.03	0 00:33	0.01	0.00	0.39
207	CONDUIT	96.60	0 00:48	11.19	0.06	0.62
208	DUMMY	365.75	0 00:35			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.03	0.00	0.00	0.41	0.56	0.00	0.00	1.19	0.0012
202	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.30	0.0018
203	1.00	0.03	0.00	0.00	0.09	0.89	0.00	0.00	1.88	0.0557
204	1.00	0.03	0.00	0.00	0.91	0.06	0.00	0.00	0.20	0.0943
205	1.00	0.03	0.43	0.00	0.54	0.00	0.00	0.00	0.00	0.0000
207	1.00	0.03	0.00	0.00	0.80	0.18	0.00	0.00	0.59	0.0001

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
202	1.88	1.88	1.89	0.01	0.01
203	0.01	0.01	0.01	5.56	0.01
204	2.63	2.63	2.93	0.82	0.01
208	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Thu Sep 29 14:11:14 2011
Analysis ended on: Thu Sep 29 14:11:14 2011
Total elapsed time: < 1 sec

Newell Reservoir Drainage Basin, 2-Year Rainfall Event

Newell Reservoir Drainage Basin, 10-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... JUN-13-2011 00:00:00
Ending Date ..... JUN-13-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:15:00
Routing Time Step ..... 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 203
WARNING 04: minimum elevation drop used for Conduit 204
WARNING 08: elevation drop exceeds length for Conduit 205
WARNING 08: elevation drop exceeds length for Conduit 208

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       165.884         54.056
External Outflow .........        55.758         18.170
Internal Outflow .........       107.759         35.115
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         2.736          0.892
Continuity Error (%) .....        -0.223


*************************
Highest Continuity Errors
*************************
Node 105 (74.92%)
Node 102 (3.98%)


***************************
Time-Step Critical Elements
***************************
Link 204 (42.82%)


*******************************
Highest Flow Instability Indexes
*******************************
Link 204 (13)
Link 202 (1)


************************
Routing Time Step Summary
```

```
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :    18.81 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.18
```

Node Depth Summary

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	4.48	10.00	5062.00	0 00:40
102	JUNCTION	3.17	4.00	5003.00	0 00:41
103	JUNCTION	4.41	5.00	5002.00	0 00:27
104	JUNCTION	2.80	3.00	3.00	0 00:29
105	JUNCTION	2.60	3.10	3.10	0 00:43
107	JUNCTION	0.79	1.58	5060.58	0 00:48
108	JUNCTION	0.00	0.00	4997.00	0 00:28
301	OUTFALL	0.00	0.00	4959.00	0 00:00

Node Inflow Summary

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	193.11	193.11	0 00:59	9.343	9.358
102	JUNCTION	0.00	342.48	0 00:48	0.000	15.783
103	JUNCTION	334.03	364.70	0 00:49	11.245	15.678
104	JUNCTION	190.68	193.29	0 01:19	12.610	12.695
105	JUNCTION	0.00	31.63	0 00:29	0.000	0.300
107	JUNCTION	228.07	228.07	0 00:45	7.640	7.658
108	JUNCTION	673.41	711.63	0 00:34	13.111	18.168
301	OUTFALL	0.00	711.63	0 00:34	0.000	18.168

Node Surcharge Summary

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	1.28	7.000	0.000
102	JUNCTION	2.97	0.000	0.000
103	JUNCTION	4.15	1.000	0.000
104	JUNCTION	5.51	0.000	0.000

Node Flooding Summary

Flooding refers to all water that overflows a node, whether it ponds or not.

Hours	Maximum Rate	Time of Max Occurrence	Total Flood Volume	Maximum Ponded Depth

Node	Flooded	CFS	days	hr:min	10^6 gal	Feet
101	1.15	77.21	0	00:59	1.451	10.00
102	2.96	324.84	0	00:41	10.750	4.00
103	3.26	326.47	0	00:49	10.488	5.00
104	5.51	193.21	0	01:19	12.392	3.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
301	97.39	266.55	711.63	18.168
System	97.39	266.55	711.63	18.168

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	115.89	0	00:40	12.88	1.00	1.00
202	CONDUIT	36.47	0	04:00	3.29	0.72	1.00
203	CONDUIT	38.22	0	00:35	12.74	35.36	0.50
204	CONDUIT	31.61	0	00:29	7.26	11.53	1.00
205	CONDUIT	0.03	0	00:28	0.01	0.00	0.39
207	CONDUIT	226.59	0	00:48	13.02	0.15	0.70
208	DUMMY	711.63	0	00:34			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.03	0.00	0.00	0.28	0.69	0.00	0.00	1.50	0.0017
202	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.32	0.0017
203	1.00	0.03	0.00	0.00	0.07	0.90	0.00	0.00	1.97	0.0527
204	1.00	0.03	0.00	0.00	0.92	0.06	0.00	0.00	0.18	0.0958
205	1.00	0.03	0.41	0.00	0.57	0.00	0.00	0.00	0.00	0.0000
207	1.00	0.03	0.00	0.00	0.70	0.27	0.00	0.00	0.82	0.0003

****
Conduit Surcharge Summary
****

Conduit	--- Hours Full --- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	1.28	1.28	1.28	1.16	1.16
202	2.97	2.97	2.97	0.01	0.01
203	0.01	0.01	0.01	5.62	0.01
204	2.67	2.67	2.98	0.78	0.01
208	6.00	6.00	6.00	6.00	0.01

Newell Reservoir Drainage Basin, 10-Year Rainfall Event

```
Analysis begun on:  Thu Sep 29 14:09:00 2011
Analysis ended on:  Thu Sep 29 14:09:00 2011
Total elapsed time: < 1 sec
```

Newell Reservoir Drainage Basin, 100-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... JUN-13-2011 00:00:00
Ending Date ..... JUN-13-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:15:00
Routing Time Step ..... 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 203
WARNING 04: minimum elevation drop used for Conduit 204
WARNING 08: elevation drop exceeds length for Conduit 205
WARNING 08: elevation drop exceeds length for Conduit 208

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .....           0.000          0.000
Wet Weather Inflow .....           0.000          0.000
Groundwater Inflow .....           0.000          0.000
RDII Inflow ............           0.000          0.000
External Inflow ........         414.223        134.981
External Outflow .......         108.147         35.241
Internal Outflow .......         303.471         98.890
Storage Losses .........           0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         3.421          1.115
Continuity Error (%) .....        -0.197

*************************
Highest Continuity Errors
*************************
Node 105 (74.88%)
Node 102 (2.29%)

***************************
Time-Step Critical Elements
***************************
Link 204 (42.86%)

*********************************
Highest Flow Instability Indexes
*********************************
Link 204 (11)

************************
Routing Time Step Summary
************************
```

```
Minimum Time Step           :     0.50 sec
Average Time Step           :    18.82 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.14
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	6.03	10.00	5062.00	0 00:35
102	JUNCTION	3.32	4.00	5003.00	0 00:39
103	JUNCTION	4.54	5.00	5002.00	0 00:28
104	JUNCTION	2.80	3.00	3.00	0 00:29
105	JUNCTION	2.59	3.10	3.10	0 00:43
107	JUNCTION	1.24	2.51	5061.51	0 00:55
108	JUNCTION	0.00	0.00	4997.00	0 00:29
301	OUTFALL	0.00	0.00	4959.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	473.68	473.68	0 01:05	23.045	23.076
102	JUNCTION	0.00	686.37	0 00:55	0.000	32.229
103	JUNCTION	797.26	833.14	0 00:54	28.442	33.362
104	JUNCTION	499.90	500.03	0 01:27	32.737	32.831
105	JUNCTION	0.00	31.63	0 00:29	0.000	0.300
107	JUNCTION	572.73	572.73	0 00:54	20.762	20.805
108	JUNCTION	1401.08	1439.30	0 00:40	29.732	35.238
301	OUTFALL	0.00	1439.30	0 00:40	0.000	35.239

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	2.47	7.000	0.000
102	JUNCTION	3.87	0.000	0.000
103	JUNCTION	4.80	1.000	0.000
104	JUNCTION	5.51	0.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet

101	2.44	357.77	0	01:05	11.874	10.00
102	3.87	650.43	0	00:55	26.575	4.00
103	3.49	794.91	0	00:55	27.755	5.00
104	5.51	499.97	0	01:27	32.528	3.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
301	97.39	555.31	1439.30	35.239
System	97.39	555.31	1439.30	35.239

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	118.92	0	00:36	13.45	1.03	1.00
202	CONDUIT	37.72	0	04:32	3.29	0.74	1.00
203	CONDUIT	38.22	0	00:36	12.74	35.36	0.50
204	CONDUIT	31.61	0	00:29	7.22	11.53	1.00
205	CONDUIT	0.02	0	00:29	0.01	0.00	0.39
207	CONDUIT	570.48	0	00:55	15.22	0.38	0.81
208	DUMMY	1439.30	0	00:40			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.03	0.00	0.00	0.16	0.81	0.00	0.00	1.68	0.0018
202	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.32	0.0016
203	1.00	0.03	0.00	0.00	0.07	0.90	0.00	0.00	2.00	0.0472
204	1.00	0.03	0.00	0.00	0.92	0.06	0.00	0.00	0.18	0.0943
205	1.00	0.03	0.43	0.00	0.54	0.00	0.00	0.00	0.00	0.0000
207	1.00	0.03	0.00	0.00	0.42	0.55	0.00	0.00	1.20	0.0007

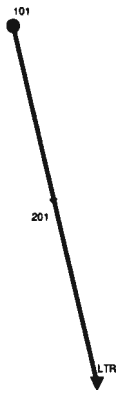
****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	2.44	2.44	2.45	2.43	2.43
202	3.87	3.87	3.88	0.01	0.01
203	0.01	0.01	0.01	5.61	0.01
204	2.67	2.67	2.98	0.78	0.01
208	6.00	6.00	6.00	6.00	0.01

Newell Reservoir Drainage Basin, 100-Year Rainfall Event

```
Analysis begun on:  Thu Sep 29 14:14:17 2011
Analysis ended on:  Thu Sep 29 14:14:17 2011
Total elapsed time: < 1 sec
```

Highlands Drainage Basin



Highland Drainage Basin, 2-Year

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-07-2011 00:00:00
Ending Date .............. JUN-07-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


*************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........        94.572         30.818
External Outflow .........        94.549         30.810
Internal Outflow .........         0.000          0.000
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         0.007          0.002
Continuity Error (%) .....         0.017


***************************
Time-Step Critical Elements
***************************
None


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.10	2.35	4931.35	0 01:10
LTR	OUTFALL	1.10	2.35	4886.35	0 01:10

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	549.99	549.99	0 01:10	27.541	27.541
LTR	OUTFALL	174.90	623.09	0 01:05	3.274	30.808

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	95.84	198.68	623.09	30.808
System	95.84	198.68	623.09	30.808

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	549.78	0 01:10	26.92	0.19	0.47

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change

201	1.00	0.04	0.00	0.00	0.00	0.95	0.00	0.00	3.25	0.0005

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:33:28 2011
Analysis ended on: Mon Aug 22 11:33:28 2011
Total elapsed time: < 1 sec

Highland Drainage Basin, 10-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..............  CFS
Process Models:
  Rainfall/Runoff ........  NO
  Snowmelt ...............  NO
  Groundwater ............  NO
  Flow Routing ...........  YES
  Ponding Allowed ........  NO
  Water Quality ..........  NO
Flow Routing Method ......  DYNWAVE
Starting Date ............  JUN-07-2011 00:00:00
Ending Date ..............  JUN-07-2011 06:00:00
Antecedent Dry Days ......  0.0
Report Time Step .........  00:15:00
Routing Time Step ........  30.00 sec

*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       203.872        66.435
External Outflow .........       203.807        66.414
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.032         0.010
Continuity Error (%) .....         0.017


**************************
Time-Step Critical Elements
**************************
None


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.01


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.64	3.27	4932.27	0 01:10
LTR	OUTFALL	1.64	3.27	4887.27	0 01:11

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	1109.42	1109.42	0 01:10	59.432	59.432
LTR	OUTFALL	333.23	1255.57	0 01:10	6.998	66.409

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	95.84	428.28	1255.57	66.409
System	95.84	428.28	1255.57	66.409

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	1110.06	0 01:11	32.27	0.39	0.65

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change

201	1.00	0.04	0.00	0.00	0.00	0.96	0.00	0.00	3.45	0.0011

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:36:45 2011
Analysis ended on: Mon Aug 22 11:36:45 2011
Total elapsed time: < 1 sec

Highland Drainage Basin, 100-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-07-2011 00:00:00
Ending Date .............. JUN-07-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       490.784       159.929
External Outflow .........       490.590       159.866
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.063         0.021
Continuity Error (%) .....         0.027


***************************
Time-Step Critical Elements
***************************
None


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.06


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	2.50	4.84	4933.84	0 01:20
LTR	OUTFALL	2.49	4.84	4888.84	0 01:20

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	2673.87	2673.87	0 01:20	142.588	142.587
LTR	OUTFALL	717.56	3061.83	0 01:15	17.330	159.854

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	95.84	1030.92	3061.83	159.854
System	95.84	1030.92	3061.83	159.854

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	2673.33	0 01:20	40.33	0.93	0.97

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change

201	1.00	0.04	0.00	0.00	0.00	0.96	0.00	0.00	3.64	0.0026

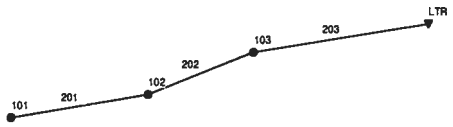
****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:38:20 2011
Analysis ended on: Mon Aug 22 11:38:20 2011
Total elapsed time: < 1 sec

Baxter Reservoir Drainage Basin

08/01/2011 00:15:00



Baxter Reservoir Drainage Basin, 2-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ AUG-01-2011 00:00:00
Ending Date .............. AUG-01-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........         2.625          0.855
External Outflow .........         2.599          0.847
Internal Outflow .........         0.000          0.000
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         0.033          0.011
Continuity Error (%) .....        -0.246

***************************
Time-Step Critical Elements
***************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00

******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	0.15	0.37	5014.37	0 01:11
102	JUNCTION	0.07	0.17	4988.17	0 01:10
103	JUNCTION	0.12	0.30	4970.30	0 01:17
LTR	OUTFALL	0.12	0.30	4915.30	0 01:18

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	7.06	7.06	0 01:00	0.321	0.321
102	JUNCTION	5.30	11.29	0 01:05	0.204	0.523
103	JUNCTION	1.95	12.24	0 01:09	0.047	0.568
LTR	OUTFALL	9.01	17.88	0 01:11	0.284	0.847

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	97.92	5.35	17.88	0.847
System	97.92	5.35	17.88	0.847

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	6.68	0 01:11	5.48	0.00	0.05
202	CONDUIT	11.15	0 01:10	3.24	0.00	0.05
203	CONDUIT	11.80	0 01:18	7.10	0.00	0.06

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.02	0.00	0.00	0.06	0.92	0.00	0.00	1.60	0.0000
202	1.00	0.02	0.00	0.00	0.67	0.31	0.00	0.00	0.87	0.0000
203	1.00	0.02	0.00	0.00	0.01	0.98	0.00	0.00	1.97	0.0000

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:40:44 2011
Analysis ended on: Mon Aug 22 11:40:44 2011
Total elapsed time: < 1 sec

Baxter Reservoir DRainage Basin, 10-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ AUG-01-2011 00:00:00
Ending Date .............. AUG-01-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        53.672        17.490
External Outflow .........        53.603        17.467
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.076         0.025
Continuity Error (%) .....        -0.014

***************************
Time-Step Critical Elements
***************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00

******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	0.86	1.97	5015.97	0 01:06
102	JUNCTION	0.42	1.06	4989.06	0 01:02
103	JUNCTION	0.69	1.70	4971.70	0 01:03
LTR	OUTFALL	0.69	1.70	4916.70	0 01:04

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	149.89	149.89	0 01:05	7.230	7.230
102	JUNCTION	103.50	247.16	0 01:00	4.154	11.378
103	JUNCTION	35.44	270.18	0 01:01	0.869	12.246
LTR	OUTFALL	164.46	413.61	0 00:58	5.235	17.466

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	98.47	109.63	413.61	17.466
System	98.47	109.63	413.61	17.466

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	149.17	0 01:06	14.06	0.11	0.30
202	CONDUIT	246.56	0 01:03	10.04	0.06	0.28
203	CONDUIT	269.51	0 01:04	18.85	0.11	0.34

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.02	0.00	0.00	0.05	0.93	0.00	0.00	2.04	0.0003
202	1.00	0.02	0.00	0.00	0.26	0.73	0.00	0.00	1.20	0.0002
203	1.00	0.02	0.00	0.00	0.01	0.98	0.00	0.00	2.48	0.0003

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:41:51 2011
Analysis ended on: Mon Aug 22 11:41:51 2011
Total elapsed time: < 1 sec

Baxter Reservoir Drainage Basin, 100-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ AUG-01-2011 00:00:00
Ending Date .............. AUG-01-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

*************************       Volume        Volume
Flow Routing Continuity       acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......        0.000         0.000
Wet Weather Inflow .......        0.000         0.000
Groundwater Inflow .......        0.000         0.000
RDII Inflow ..............        0.000         0.000
External Inflow ..........      208.402        67.911
External Outflow .........      208.286        67.873
Internal Outflow .........        0.000         0.000
Storage Losses ...........        0.000         0.000
Initial Stored Volume ....        0.000         0.000
Final Stored Volume ......        0.097         0.032
Continuity Error (%) .....        0.009

***************************
Time-Step Critical Elements
***************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00

******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.53	3.45	5017.45	0 01:11
102	JUNCTION	0.85	2.23	4990.23	0 01:08
103	JUNCTION	1.33	3.27	4973.27	0 01:08
LTR	OUTFALL	1.33	3.27	4918.27	0 01:09

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	510.86	510.86	0 01:10	23.625	23.625
102	JUNCTION	401.75	896.86	0 01:07	16.134	39.746
103	JUNCTION	144.90	1013.07	0 01:07	4.008	43.757
LTR	OUTFALL	703.47	1674.63	0 01:04	24.138	67.868

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	98.47	425.98	1674.63	67.868
System	98.47	425.98	1674.63	67.868

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	508.66	0 01:12	18.58	0.38	0.57
202	CONDUIT	896.11	0 01:09	15.89	0.22	0.55
203	CONDUIT	1012.87	0 01:09	26.81	0.40	0.65

****
Flow Classification Summary
****

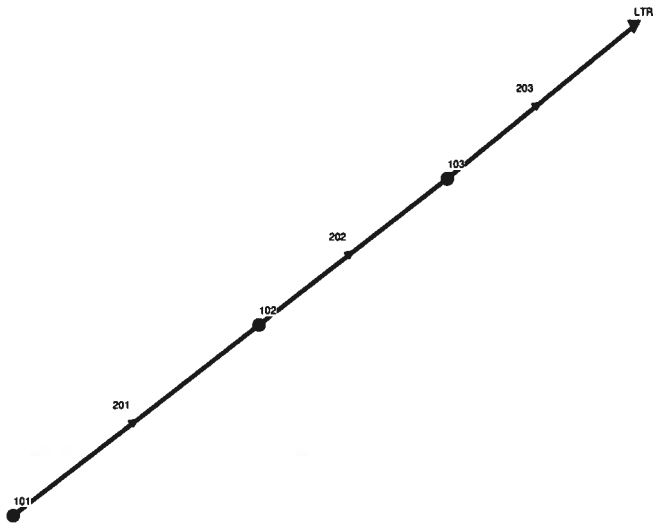
Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.02	0.00	0.00	0.05	0.93	0.00	0.00	2.14	0.0011
202	1.00	0.02	0.00	0.00	0.22	0.76	0.00	0.00	1.37	0.0006
203	1.00	0.02	0.00	0.00	0.01	0.98	0.00	0.00	2.67	0.0011

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:43:17 2011
Analysis ended on: Mon Aug 22 11:43:17 2011
Total elapsed time: < 1 sec

Big Hollow Drainage Basin



Big Hollow Drainage Basin, 2-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-22-2011 00:00:00
Ending Date .............. JUN-22-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 02: maximum depth increased for Node 102
WARNING 02: maximum depth increased for Node 103

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         7.583         2.471
External Outflow .........         7.462         2.432
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.165         0.054
Continuity Error (%) .....        -0.579

*************************
Highest Continuity Errors
*************************
Node 103 (1.45%)

***************************
Time-Step Critical Elements
***************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
```

Percent in Steady State : 0.00
Average Iterations per Step : 2.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	2.14	4.61	5013.61	0 02:03
102	JUNCTION	0.37	0.61	4988.61	0 01:19
103	JUNCTION	0.38	0.67	4952.67	0 01:28
LTR	OUTFALL	0.38	0.66	4888.66	0 01:29

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	20.61	20.61	0 01:15	1.129	1.129
102	JUNCTION	5.03	17.46	0 01:10	0.256	1.379
103	JUNCTION	8.60	24.94	0 01:10	0.361	1.731
LTR	OUTFALL	10.55	33.71	0 01:27	0.726	2.432

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	2.56	8.02	0 01:15	0.154	4.61

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	97.36	15.44	33.71	2.432
System	97.36	15.44	33.71	2.432

****
Link Flow Summary

****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	12.87	0	01:52	10.31	0.71	0.65
202	CONDUIT	17.29	0	01:19	6.71	0.04	0.21
203	CONDUIT	23.22	0	01:29	8.06	0.11	0.33

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.02	0.00	0.00	0.02	0.96	0.00	0.00	2.06	0.0019
202	1.00	0.02	0.02	0.00	0.04	0.92	0.00	0.00	1.42	0.0001
203	1.00	0.02	0.00	0.00	0.06	0.92	0.00	0.00	1.75	0.0003

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:44:47 2011
Analysis ended on: Mon Aug 22 11:44:47 2011
Total elapsed time: < 1 sec

Big Hollow Drainage Basin, 10-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-22-2011 00:00:00
Ending Date .............. JUN-22-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 02: maximum depth increased for Node 102
WARNING 02: maximum depth increased for Node 103

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       166.134        54.137
External Outflow .........       109.549        35.698
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......        57.134        18.618
Continuity Error (%) .....        -0.330

*************************
Highest Continuity Errors
*************************
Node 103 (1.38%)
Node 102 (1.22%)


***************************
Time-Step Critical Elements
***************************
None


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
```

Big Hollow Drainage Basin, 10-Year Event

Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 2.02

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	194.70	279.91	5288.91	0 04:39
102	JUNCTION	1.28	1.80	4989.80	0 01:18
103	JUNCTION	1.96	4.26	4956.26	0 01:55
LTR	OUTFALL	1.42	2.00	4890.00	0 00:55

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	443.23	443.23	0 01:15	25.403	25.402
102	JUNCTION	107.28	143.38	0 01:15	5.761	13.157
103	JUNCTION	157.16	287.84	0 01:05	6.660	19.657
LTR	OUTFALL	231.19	436.86	0 01:30	16.313	35.695

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	5.52	405.21	0 01:15	18.847	279.91
103	1.58	80.07	0 01:10	0.822	4.26

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	98.06	225.05	436.86	35.695
System	98.06	225.05	436.86	35.695

Big Hollow Drainage Basin, 10-Year Event

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	56.77	0	03:35	29.02	3.11	0.95
202	CONDUIT	142.45	0	01:18	10.04	0.33	0.80
203	CONDUIT	206.00	0	01:55	14.71	1.01	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.02	0.00	0.00	0.02	0.97	0.00	0.00	4.20	0.0046
202	1.00	0.02	0.00	0.00	0.19	0.79	0.00	0.00	1.44	0.0007
203	1.00	0.02	0.00	0.00	0.04	0.94	0.00	0.00	2.07	0.0024

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	0.01	0.01	0.01	5.28	0.01
203	0.02	0.02	0.03	2.13	0.02

Analysis begun on: Mon Aug 22 11:46:29 2011
Analysis ended on: Mon Aug 22 11:46:29 2011
Total elapsed time: < 1 sec

Big Hollow Drainage Basin, 100-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-22-2011 00:00:00
Ending Date .............. JUN-22-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 02: maximum depth increased for Node 102
WARNING 02: maximum depth increased for Node 103

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       570.005        185.745
External Outflow .........       264.204         86.095
Internal Outflow .........         0.000          0.000
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......       306.384         99.840
Continuity Error (%) .....        -0.102

*************************
Highest Continuity Errors
*************************
Node 103 (2.45%)
Node 102 (1.70%)


***************************
Time-Step Critical Elements
***************************
None


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
```

```
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.30
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	718.77	1120.64	6129.64	0 05:31
102	JUNCTION	4.60	8.05	4996.05	0 03:05
103	JUNCTION	29.85	41.51	4993.51	0 03:22
LTR	OUTFALL	1.80	2.00	4890.00	0 00:43

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	1502.44	1502.44	0 01:20	83.018	83.016
102	JUNCTION	366.75	385.00	0 01:15	18.827	22.815
103	JUNCTION	707.82	1063.78	0 01:10	30.708	53.135
LTR	OUTFALL	777.50	999.96	0 01:30	53.189	86.088

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	5.52	1483.82	0 01:20	79.602	1120.64
102	3.95	58.06	0 01:25	2.072	8.05
103	5.25	849.28	0 01:10	25.583	41.51

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	98.20	542.07	999.96	86.088
System	98.20	542.07	999.96	86.088

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	138.60	0	05:59	46.31	7.60	1.00
202	CONDUIT	355.96	0	01:10	13.18	0.82	1.00
203	CONDUIT	236.18	0	03:22	16.87	1.16	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.02	0.00	0.00	0.02	0.97	0.00	0.00	1.71	0.3766
202	1.00	0.02	0.00	0.00	0.72	0.26	0.00	0.00	0.80	0.0022
203	1.00	0.02	0.00	0.00	0.05	0.93	0.00	0.00	2.15	0.0058

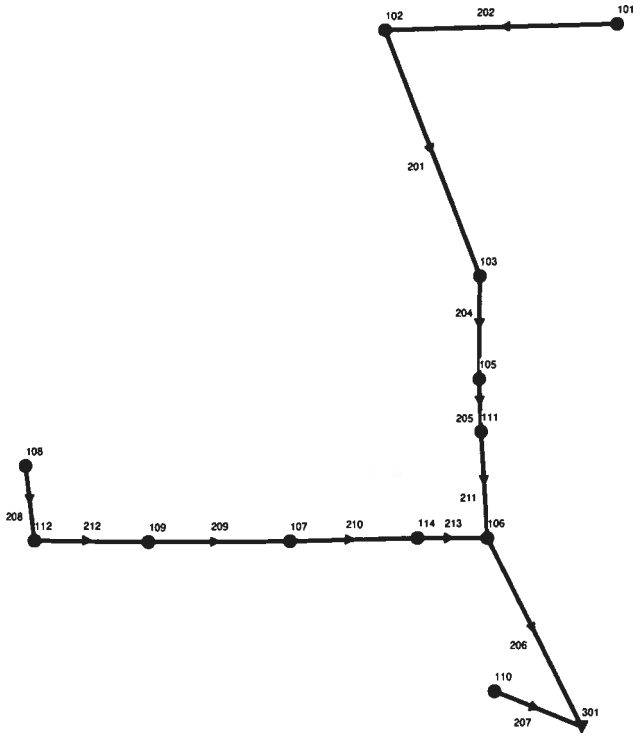
****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	5.07	5.07	5.22	5.36	5.07
202	3.95	3.95	3.96	0.01	0.01
203	0.56	0.56	0.71	5.28	0.56

Analysis begun on: Mon Aug 22 11:49:58 2011
Analysis ended on: Mon Aug 22 11:49:58 2011
Total elapsed time: < 1 sec

Bacon Lake Drainage Basin, Schematic

06/13/2011 00:15:00



Bacon Lake Drainage Basin, 2-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... JUN-13-2011 00:00:00
Ending Date ..... JUN-13-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:05:00
Routing Time Step ..... 30.00 sec

WARNING 08: elevation drop exceeds length for Conduit 214
WARNING 02: maximum depth increased for Node 109

*************************        Volume         Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .....          0.000          0.000
Wet Weather Inflow .....          0.000          0.000
Groundwater Inflow .....          0.000          0.000
RDII Inflow ............          0.000          0.000
External Inflow ........         34.899         11.373
External Outflow .......         28.180          9.183
Internal Outflow .......          6.694          2.181
Storage Losses .........          0.000          0.000
Initial Stored Volume ....        0.000          0.000
Final Stored Volume ......        0.039          0.013
Continuity Error (%) .....       -0.037

**************************
Time-Step Critical Elements
**************************
Link 205 (68.01%)

********************************
Highest Flow Instability Indexes
********************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :     6.61 sec
Average Time Step           :    15.32 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.14

******************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.79	5.00	5089.00	0 00:33
102	JUNCTION	0.36	0.68	5074.68	0 01:02
103	JUNCTION	0.28	0.57	5064.57	0 00:46
105	JUNCTION	0.78	1.45	5033.45	0 00:50
106	JUNCTION	2.85	5.00	4984.00	0 00:40
107	JUNCTION	1.34	3.30	5029.30	0 00:40
108	JUNCTION	0.00	0.00	5049.00	0 00:00
109	JUNCTION	0.44	0.84	5037.84	0 00:49
110	JUNCTION	0.00	0.00	4931.00	0 00:00
111	JUNCTION	0.28	0.55	5030.55	0 00:52
112	JUNCTION	0.30	0.65	5041.65	0 00:45
114	JUNCTION	1.38	3.13	5011.13	0 00:43
301	JUNCTION	0.06	0.08	4933.08	0 01:52
302	OUTFALL	0.00	0.00	4932.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	22.29	22.29	0 00:45	0.648	0.647
102	JUNCTION	2.04	19.49	0 01:01	0.098	0.709
103	JUNCTION	16.72	32.97	0 00:42	0.332	1.037
105	JUNCTION	6.72	39.07	0 00:47	0.242	1.280
106	JUNCTION	0.00	315.28	0 00:44	0.000	9.108
107	JUNCTION	246.43	259.49	0 00:40	6.085	6.590
108	JUNCTION	0.00	0.00	0 00:00	0.000	0.000
109	JUNCTION	0.00	16.05	0 00:45	0.000	0.525
110	JUNCTION	69.38	69.38	0 00:45	2.229	2.225
111	JUNCTION	0.00	38.64	0 00:51	0.000	1.276
112	JUNCTION	16.09	16.09	0 00:45	0.526	0.525
114	JUNCTION	30.73	283.98	0 00:42	1.236	7.833
301	JUNCTION	0.00	202.01	0 00:45	0.000	9.184
302	OUTFALL	0.00	202.01	0 00:45	0.000	9.182

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	0.71	3.000	0.000
106	JUNCTION	0.86	0.000	0.000
110	JUNCTION	6.00	0.000	2.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

	Maximum	Time of Max	Total Flood	Maximum Ponded

Node	Hours Flooded	Rate CFS	Occurrence days hr:min	Volume 10^6 gal	Depth Feet
101	0.47	5.05	0 00:45	0.040	5.00
106	0.86	182.65	0 00:44	2.142	5.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
302	99.22	104.79	202.01	9.182
System	99.22	104.79	202.01	9.182

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	19.33	0 01:02	6.12	0.05	0.20
202	CONDUIT	17.45	0 01:01	14.22	0.80	0.67
204	CONDUIT	32.49	0 00:46	5.69	0.09	0.50
205	CONDUIT	38.64	0 00:51	18.65	0.45	0.33
206	CONDUIT	137.59	0 01:53	24.97	0.78	0.51
207	DUMMY	69.38	0 00:45			
208	CONDUIT	0.00	0 00:00	0.00	0.00	0.11
209	CONDUIT	15.90	0 00:49	2.61	0.06	0.41
210	CONDUIT	258.20	0 00:41	19.45	0.76	0.64
211	CONDUIT	38.58	0 00:52	2.87	0.04	0.59
212	CONDUIT	16.05	0 00:45	7.23	0.54	0.74
213	CONDUIT	282.72	0 00:43	19.29	0.71	0.81
214	DUMMY	202.01	0 00:45			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.01	0.01	0.00	0.12	0.87	0.00	0.00	1.33	0.0001
202	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	2.24	0.0011
204	1.00	0.01	0.00	0.00	0.65	0.34	0.00	0.00	0.80	0.0001
205	1.00	0.01	0.00	0.00	0.02	0.98	0.00	0.00	3.60	0.0006
206	1.00	0.01	0.00	0.00	0.01	0.98	0.00	0.00	3.45	0.0012
208	1.00	0.01	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
209	1.00	0.01	0.00	0.00	0.88	0.11	0.00	0.00	0.57	0.0001
210	1.00	0.01	0.00	0.00	0.24	0.76	0.00	0.00	1.70	0.0011
211	1.00	0.01	0.02	0.00	0.97	0.00	0.00	0.00	0.27	0.0001
212	1.00	0.01	0.00	0.00	0.31	0.68	0.00	0.00	1.01	0.0008
213	1.00	0.01	0.00	0.00	0.46	0.53	0.00	0.00	1.03	0.0010

****
Conduit Surcharge Summary
****

Bacon Lake Drainage Basin, 2-Year Event

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
207	6.00	6.00	6.00	6.00	0.01
214	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Tue Aug 23 06:55:57 2011
Analysis ended on: Tue Aug 23 06:55:57 2011
Total elapsed time: < 1 sec

Bacon Lake Drainage Basin, 10-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..............  CFS
Process Models:
  Rainfall/Runoff ........  NO
  Snowmelt ...............  NO
  Groundwater ............  NO
  Flow Routing ...........  YES
  Ponding Allowed ........  NO
  Water Quality ..........  NO
Flow Routing Method ......  DYNWAVE
Starting Date ............  JUN-13-2011 00:00:00
Ending Date ..............  JUN-13-2011 06:00:00
Antecedent Dry Days ......  0.0
Report Time Step .........  00:05:00
Routing Time Step ........  30.00 sec

WARNING 08: elevation drop exceeds length for Conduit 214
WARNING 02: maximum depth increased for Node 109

**************************        Volume         Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       155.409         50.642
External Outflow .........        59.659         19.441
Internal Outflow .........        95.710         31.189
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         0.098          0.032
Continuity Error (%) .....        -0.037

***************************
Time-Step Critical Elements
***************************
Link 205 (93.13%)

*********************************
Highest Flow Instability Indexes
*********************************
Link 205 (1)

************************
Routing Time Step Summary
************************
Minimum Time Step           :     4.17 sec
Average Time Step           :     7.59 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.31

******************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	3.19	5.00	5089.00	0 00:24
102	JUNCTION	0.92	1.37	5075.37	0 01:10
103	JUNCTION	0.85	1.67	5065.67	0 00:42
105	JUNCTION	2.92	5.00	5037.00	0 00:32
106	JUNCTION	3.85	5.00	4984.00	0 00:32
107	JUNCTION	3.34	10.00	5036.00	0 00:31
108	JUNCTION	0.00	0.00	5049.00	0 00:00
109	JUNCTION	0.79	1.14	5038.14	0 01:09
110	JUNCTION	0.00	0.00	4931.00	0 00:00
111	JUNCTION	0.74	1.06	5031.06	0 01:21
112	JUNCTION	1.69	3.00	5044.00	0 00:32
114	JUNCTION	4.13	10.00	5018.00	0 00:32
301	JUNCTION	0.04	0.04	4933.04	0 03:03
302	OUTFALL	0.00	0.00	4932.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	154.15	154.15	0 00:44	4.998	4.995
102	JUNCTION	55.20	76.60	0 01:06	2.829	4.162
103	JUNCTION	205.33	244.84	0 00:39	4.573	8.714
105	JUNCTION	77.82	314.00	0 00:45	3.032	11.758
106	JUNCTION	0.00	555.19	0 00:53	0.000	28.475
107	JUNCTION	595.89	625.52	0 00:39	14.386	16.223
108	JUNCTION	0.00	0.00	0 00:00	0.000	0.000
109	JUNCTION	0.00	30.11	0 00:29	0.000	1.864
110	JUNCTION	249.26	249.26	0 00:44	8.136	8.129
111	JUNCTION	0.00	126.82	0 01:22	0.000	7.780
112	JUNCTION	101.00	101.00	0 00:49	3.498	3.497
114	JUNCTION	211.80	550.38	0 00:55	9.226	22.801
301	JUNCTION	0.00	381.16	0 00:44	0.000	19.440
302	OUTFALL	0.00	381.16	0 00:44	0.000	19.439

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	2.16	3.000	0.000
105	JUNCTION	1.53	2.000	0.000
106	JUNCTION	2.23	0.000	0.000
107	JUNCTION	0.85	5.000	0.000
110	JUNCTION	6.01	0.000	2.000
112	JUNCTION	1.60	0.000	0.000
114	JUNCTION	1.01	5.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	2.06	134.15	0 00:45	3.668	5.00
105	1.31	187.17	0 00:45	3.972	5.00
106	2.22	423.30	0 00:55	17.154	5.00
107	0.64	286.78	0 00:40	2.655	10.00
112	1.60	71.36	0 00:49	1.633	3.00
114	0.94	121.99	0 00:55	2.106	10.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
302	99.65	188.49	381.16	19.439
System	99.65	188.49	381.16	19.439

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	76.51	0 01:10	8.70	0.20	0.48
202	CONDUIT	21.43	0 01:10	15.18	0.98	0.84
204	CONDUIT	242.64	0 00:42	17.27	0.69	0.92
205	CONDUIT	126.82	0 01:22	25.30	1.46	0.68
206	CONDUIT	136.77	0 03:04	25.22	0.78	0.50
207	DUMMY	249.26	0 00:44			
208	CONDUIT	0.00	0 00:00	0.00	0.00	0.50
209	CONDUIT	29.64	0 01:09	7.03	0.11	0.61
210	CONDUIT	385.85	0 00:32	19.66	1.14	1.00
211	CONDUIT	126.82	0 00:53	7.74	0.12	0.68
212	CONDUIT	30.11	0 00:29	10.08	1.02	1.00
213	CONDUIT	428.37	0 00:44	22.08	1.08	1.00
214	DUMMY	381.16	0 00:44			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.00	0.00	0.00	0.11	0.88	0.00	0.00	1.47	0.0001
202	1.00	0.00	0.00	0.00	0.20	0.80	0.00	0.00	1.68	0.0007
204	1.00	0.00	0.00	0.00	0.43	0.57	0.00	0.00	1.48	0.0005
205	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	3.41	0.0014
206	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	3.36	0.0006
208	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
209	1.00	0.00	0.00	0.00	0.60	0.40	0.00	0.00	0.83	0.0001
210	1.00	0.00	0.00	0.00	0.55	0.45	0.00	0.00	0.83	0.0008
211	1.00	0.00	0.01	0.00	0.53	0.46	0.00	0.00	0.85	0.0001
212	1.00	0.00	0.00	0.00	0.25	0.75	0.00	0.00	1.34	0.0007

213	1.00	0.00	0.00	0.00	0.75	0.24	0.00	0.00	0.64	0.0008

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
205	0.01	0.01	0.01	1.79	0.01
207	6.01	6.01	6.01	6.01	0.01
210	0.83	0.83	0.83	0.10	0.01
212	1.87	1.87	1.87	1.86	1.86
213	1.01	1.01	1.01	1.08	1.01
214	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Tue Aug 23 07:04:42 2011
Analysis ended on: Tue Aug 23 07:04:42 2011
Total elapsed time: < 1 sec

Bacon Lake Drainage Basin, 100-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... JUN-13-2011 00:00:00
Ending Date ..... JUN-13-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:05:00
Routing Time Step ..... 30.00 sec

WARNING 08: elevation drop exceeds length for Conduit 214
WARNING 02: maximum depth increased for Node 109

**************************        Volume         Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       469.035        152.842
External Outflow .........       117.103         38.160
Internal Outflow .........       351.824        114.647
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         0.143          0.047
Continuity Error (%) .....        -0.008

***************************
Time-Step Critical Elements
***************************
Link 205 (96.41%)

*********************************
Highest Flow Instability Indexes
*********************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :     2.53 sec
Average Time Step           :     6.06 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.22

******************
Node Depth Summary
```

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	2.97	5.00	5089.00	0 00:26
102	JUNCTION	1.57	2.57	5076.57	0 01:13
103	JUNCTION	1.53	3.00	5067.00	0 00:34
105	JUNCTION	3.67	5.00	5037.00	0 00:30
106	JUNCTION	4.15	5.00	4984.00	0 00:32
107	JUNCTION	3.60	10.00	5036.00	0 00:30
108	JUNCTION	0.00	0.00	5049.00	0 00:00
109	JUNCTION	0.81	1.16	5038.16	0 03:06
110	JUNCTION	0.00	0.00	4931.00	0 00:00
111	JUNCTION	0.86	1.06	5031.06	0 00:51
112	JUNCTION	1.91	3.00	5044.00	0 00:29
114	JUNCTION	4.87	10.00	5018.00	0 00:30
301	JUNCTION	0.05	0.05	4933.05	0 03:50
302	OUTFALL	0.00	0.00	4932.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	494.67	494.67	0 00:49	14.640	14.634
102	JUNCTION	251.21	272.99	0 01:10	12.204	13.729
103	JUNCTION	714.07	846.64	0 00:47	15.291	28.964
105	JUNCTION	317.93	657.33	0 01:00	11.836	31.259
106	JUNCTION	0.00	555.19	0 00:51	0.000	39.036
107	JUNCTION	1499.61	1529.25	0 00:44	32.702	34.926
108	JUNCTION	0.00	0.00	0 00:00	0.000	0.000
109	JUNCTION	0.00	33.42	0 00:28	0.000	2.258
110	JUNCTION	815.51	815.51	0 00:50	24.306	24.295
111	JUNCTION	0.00	126.82	0 01:43	0.000	11.467
112	JUNCTION	398.44	398.44	0 00:54	13.236	13.233
114	JUNCTION	728.45	1067.03	0 01:00	28.681	44.449
301	JUNCTION	0.00	947.56	0 00:50	0.000	38.158
302	OUTFALL	0.00	947.56	0 00:50	0.000	38.157

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	2.33	3.000	0.000
103	JUNCTION	1.12	0.000	0.000
105	JUNCTION	2.70	2.000	0.000
106	JUNCTION	3.04	0.000	0.000
107	JUNCTION	1.22	5.000	0.000
110	JUNCTION	6.00	0.000	2.000
112	JUNCTION	2.48	0.000	0.000
114	JUNCTION	1.66	5.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	2.27	472.86	0 00:50	13.121	5.00
103	1.11	507.25	0 00:47	9.578	3.00
105	2.49	530.49	0 01:00	19.784	5.00
106	3.03	423.14	0 00:51	25.149	5.00
107	1.15	1190.64	0 00:45	19.159	10.00
112	2.48	368.79	0 00:54	10.976	3.00
114	1.59	638.59	0 01:00	16.874	10.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
302	99.72	325.36	947.56	38.157
System	99.72	325.36	947.56	38.157

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	272.21	0 01:13	12.11	0.72	0.93
202	CONDUIT	24.81	0 02:18	14.99	1.14	1.00
204	CONDUIT	339.40	0 00:45	21.21	0.97	1.00
205	CONDUIT	126.82	0 01:43	25.67	1.46	0.68
206	CONDUIT	136.87	0 03:50	25.23	0.78	0.51
207	DUMMY	815.51	0 00:50			
208	CONDUIT	0.00	0 00:00	0.00	0.00	0.50
209	CONDUIT	29.64	0 01:09	9.35	0.11	0.61
210	CONDUIT	381.86	0 00:30	19.46	1.13	1.00
211	CONDUIT	126.82	0 00:51	7.74	0.12	0.68
212	CONDUIT	33.42	0 00:28	11.16	1.13	1.00
213	CONDUIT	429.31	0 00:31	22.89	1.09	1.00
214	DUMMY	947.56	0 00:50			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.00	0.00	0.00	0.09	0.90	0.00	0.00	1.57	0.0004
202	1.00	0.00	0.00	0.00	0.37	0.63	0.00	0.00	1.02	0.0007
204	1.00	0.00	0.00	0.00	0.09	0.90	0.00	0.00	2.05	0.0005
205	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	3.35	0.0011
206	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	3.25	0.0004
208	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
209	1.00	0.00	0.00	0.00	0.54	0.45	0.00	0.00	0.91	0.0001
210	1.00	0.00	0.00	0.00	0.87	0.12	0.00	0.00	0.54	0.0007

211	1.00	0.00	0.01	0.00	0.34	0.65	0.00	0.00	1.01	0.0001
212	1.00	0.00	0.00	0.00	0.28	0.72	0.00	0.00	1.31	0.0006
213	1.00	0.00	0.00	0.00	0.78	0.22	0.00	0.00	0.46	0.0006

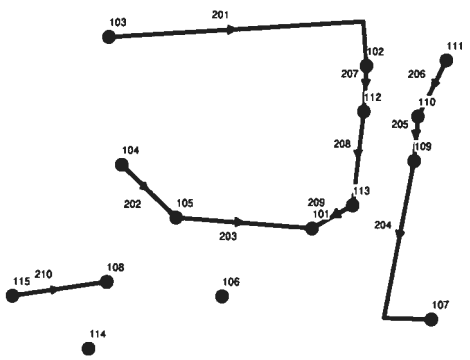
****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
202	1.48	1.48	1.48	2.05	1.48
204	1.35	1.35	1.35	0.01	0.01
205	0.01	0.01	0.01	2.92	0.01
207	6.00	6.00	6.00	6.00	0.01
210	1.20	1.20	1.20	0.09	0.01
212	2.62	2.62	2.63	2.64	2.62
213	1.64	1.64	1.64	1.71	1.64
214	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Tue Aug 23 07:08:10 2011
Analysis ended on: Tue Aug 23 07:08:10 2011
Total elapsed time: < 1 sec

Highway-287 Drainage Basin, Schematic

06/21/2011 00:15:00



Highway-287 Drainage Basin, 2-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ JUN-21-2011 00:00:00
Ending Date .............. JUN-21-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 206

*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        31.230        10.177
External Outflow .........        22.513         7.336
Internal Outflow .........         9.018         2.939
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.034         0.011
Continuity Error (%) .....        -1.074

*******************************
Highest Flow Instability Indexes
*******************************
Link 209 (9)
Link 208 (8)
Link 203 (8)
Link 204 (7)
Link 207 (7)

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.50

******************
Node Depth Summary
******************

-----------------------------------------------------------------------
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	4.77	5.00	5123.00	0 00:15
102	JUNCTION	1.40	5.00	5132.00	0 00:29
103	JUNCTION	0.71	3.00	5151.00	0 00:24
104	JUNCTION	0.13	0.74	5141.74	0 01:15
105	JUNCTION	0.14	0.80	5136.80	0 01:15
106	JUNCTION	0.00	0.00	5115.00	0 00:00
107	JUNCTION	1.92	2.00	5083.00	0 00:15
108	JUNCTION	3.73	5.00	5135.00	0 00:15
109	JUNCTION	0.75	2.00	5104.00	0 00:50
110	JUNCTION	1.81	3.00	5123.00	0 00:29
111	JUNCTION	1.28	2.00	5122.00	0 00:20
112	JUNCTION	1.60	10.00	5134.00	0 00:42
113	JUNCTION	2.08	10.00	5131.00	0 00:33
114	JUNCTION	0.00	0.00	5146.00	0 00:00
115	JUNCTION	0.00	0.00	5149.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	0.00	108.66	0 00:51	0.000	3.380
102	JUNCTION	84.83	100.52	0 00:30	0.877	1.553
103	JUNCTION	36.12	36.12	0 01:20	0.722	0.722
104	JUNCTION	40.81	40.81	0 01:15	0.642	0.642
105	JUNCTION	0.00	40.61	0 01:15	0.000	0.642
106	JUNCTION	50.75	50.75	0 01:05	0.740	0.740
107	JUNCTION	56.71	79.48	0 01:01	0.861	1.575
108	JUNCTION	45.72	45.72	0 01:10	0.647	0.647
109	JUNCTION	0.00	23.79	0 00:50	0.000	0.710
110	JUNCTION	69.86	70.13	0 00:55	0.867	0.901
111	JUNCTION	215.42	215.42	0 00:30	2.099	2.099
112	JUNCTION	118.64	141.17	0 00:45	0.904	2.459
113	JUNCTION	90.05	192.23	0 00:48	0.823	3.247
114	JUNCTION	149.55	149.55	0 00:40	0.994	0.994
115	JUNCTION	0.00	0.00	0 00:00	0.000	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	5.73	1.000	0.000
102	JUNCTION	0.03	0.000	0.000
103	JUNCTION	0.43	1.000	0.000
106	JUNCTION	6.01	0.000	1.000
107	JUNCTION	5.76	0.000	0.000
108	JUNCTION	4.48	0.000	0.000
109	JUNCTION	0.25	0.000	3.000
110	JUNCTION	3.13	1.000	0.000
111	JUNCTION	3.14	0.000	0.000
112	JUNCTION	0.09	5.000	0.000
113	JUNCTION	0.48	6.000	0.000
114	JUNCTION	6.01	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Volume 1000 ft3
102	0.03	9.04	0 00:30	0.005	0.000
103	0.43	14.10	0 01:20	0.088	0.000
110	0.33	46.05	0 00:55	0.219	0.000
111	3.14	213.99	0 00:30	2.075	0.000
112	0.09	29.84	0 00:45	0.036	0.000
113	0.48	121.18	0 00:48	0.516	0.000

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	21.63	0 00:53	15.27	1.00	1.00
202	CONDUIT	40.61	0 01:15	12.43	0.56	0.73
203	CONDUIT	38.51	0 00:51	11.58	0.15	0.39
204	CONDUIT	24.07	0 01:07	28.59	0.86	0.94
205	CONDUIT	23.79	0 00:50	13.17	1.00	1.00
206	CONDUIT	0.27	0 00:24	0.36	1.00	1.00
207	CONDUIT	80.28	0 00:32	9.84	0.92	0.95
208	CONDUIT	109.37	0 00:43	10.17	1.00	1.00
209	CONDUIT	70.15	0 00:40	7.75	1.00	1.00
210	CONDUIT	0.00	0 00:00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	0.11	0.40	0.22	0.22	0.40
205	0.23	0.31	0.25	0.25	0.31
206	2.92	3.13	3.13	0.01	3.13
207	0.01	0.03	0.01	0.01	0.03
208	0.07	0.08	0.08	0.08	0.08
209	0.34	0.46	0.39	0.01	0.46

Analysis begun on: Thu Sep 29 14:48:32 2011
Analysis ended on: Thu Sep 29 14:48:32 2011
Total elapsed time: < 1 sec

Highway-287 Drainage Basin, 10-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ JUN-21-2011 00:00:00
Ending Date .............. JUN-21-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 206

*************************        Volume        Volume
Flow Routing Continuity       acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......        0.000         0.000
Wet Weather Inflow .......        0.000         0.000
Groundwater Inflow .......        0.000         0.000
RDII Inflow ..............        0.000         0.000
External Inflow ..........       97.492        31.769
External Outflow .........       55.373        18.044
Internal Outflow .........       42.656        13.900
Storage Losses ...........        0.000         0.000
Initial Stored Volume ....        0.000         0.000
Final Stored Volume ......        0.040         0.013
Continuity Error (%) .....       -0.591

*******************************
Highest Flow Instability Indexes
*******************************
Link 208 (10)
Link 203 (8)
Link 209 (7)
Link 202 (5)
Link 207 (5)

*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.47

******************
Node Depth Summary
******************

-----------------------------------------------------------------------
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	4.81	5.00	5123.00	0 00:14
102	JUNCTION	2.07	5.00	5132.00	0 00:26
103	JUNCTION	1.19	3.00	5151.00	0 00:21
104	JUNCTION	0.41	3.00	5144.00	0 00:36
105	JUNCTION	0.30	1.09	5137.09	0 00:36
106	JUNCTION	0.00	0.00	5115.00	0 00:00
107	JUNCTION	1.92	2.00	5083.00	0 00:15
108	JUNCTION	3.77	5.00	5135.00	0 00:15
109	JUNCTION	0.99	2.00	5104.00	0 00:29
110	JUNCTION	1.99	3.00	5123.00	0 00:26
111	JUNCTION	1.39	2.00	5122.00	0 00:10
112	JUNCTION	2.80	10.00	5134.00	0 00:36
113	JUNCTION	3.80	10.00	5131.00	0 00:29
114	JUNCTION	0.00	0.00	5146.00	0 00:00
115	JUNCTION	0.00	0.00	5149.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	0.00	143.86	0 00:54	0.000	6.563
102	JUNCTION	168.42	190.05	0 00:30	2.792	4.092
103	JUNCTION	110.13	110.13	0 00:55	2.590	2.590
104	JUNCTION	119.33	119.33	0 00:50	2.360	2.360
105	JUNCTION	0.00	72.90	0 00:36	0.000	2.185
106	JUNCTION	132.21	132.21	0 01:05	2.400	2.400
107	JUNCTION	146.95	170.47	0 00:55	2.571	3.888
108	JUNCTION	128.65	128.65	0 00:45	2.270	2.270
109	JUNCTION	0.00	23.79	0 00:29	0.000	1.310
110	JUNCTION	164.68	164.95	0 00:50	2.550	2.584
111	JUNCTION	457.31	457.31	0 00:30	6.106	6.106
112	JUNCTION	214.53	302.08	0 00:45	2.701	6.425
113	JUNCTION	185.89	295.26	0 00:45	2.506	7.763
114	JUNCTION	274.03	274.03	0 00:40	2.921	2.921
115	JUNCTION	0.00	0.00	0 00:00	0.000	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	5.78	1.000	0.000
102	JUNCTION	0.70	0.000	0.000
103	JUNCTION	1.58	1.000	0.000
104	JUNCTION	0.42	2.000	0.000
106	JUNCTION	6.01	0.000	1.000
107	JUNCTION	5.76	0.000	0.000
108	JUNCTION	4.53	0.000	0.000
109	JUNCTION	1.34	0.000	3.000
110	JUNCTION	3.17	1.000	0.000
111	JUNCTION	3.76	0.000	0.000
112	JUNCTION	0.89	5.000	0.000
113	JUNCTION	1.73	6.000	0.000
114	JUNCTION	6.01	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Volume 1000 ft3
102	0.70	95.39	0 00:30	0.413	0.000
103	1.58	87.02	0 00:55	1.345	0.000
104	0.42	44.69	0 00:50	0.175	0.000
110	1.39	139.58	0 00:50	1.317	0.000
111	3.76	453.53	0 00:30	6.077	0.000
112	0.74	192.20	0 00:45	1.174	0.000
113	1.73	224.18	0 00:45	3.399	0.000

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	21.63	0 00:26	17.53	1.00	1.00
202	CONDUIT	72.90	0 00:36	14.63	1.00	1.00
203	CONDUIT	73.71	0 00:54	13.97	0.29	0.55
204	CONDUIT	24.74	0 01:41	10.66	0.88	0.94
205	CONDUIT	23.79	0 00:29	14.21	1.00	1.00
206	CONDUIT	0.27	0 00:23	0.36	1.00	1.00
207	CONDUIT	87.55	0 00:29	8.06	1.00	1.00
208	CONDUIT	109.37	0 00:36	9.34	1.00	1.00
209	CONDUIT	70.15	0 00:30	7.52	1.00	1.00
210	CONDUIT	0.00	0 00:00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	1.31	1.54	1.43	1.43	1.54
202	0.40	0.40	0.40	0.40	0.40
205	1.23	1.37	1.34	1.34	1.37
206	3.11	3.73	3.17	0.01	3.73
207	0.55	0.68	0.62	0.62	0.68
208	0.68	0.72	0.72	0.72	0.72
209	1.70	1.73	1.73	0.01	1.73

Analysis begun on: Thu Sep 29 14:51:41 2011
Analysis ended on: Thu Sep 29 14:51:41 2011
Total elapsed time: < 1 sec

Highway-287 Drainage Basin, 100-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ JUN-21-2011 00:00:00
Ending Date .............. JUN-21-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 206

*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------      ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        97.492        31.769
External Outflow .........        55.373        18.044
Internal Outflow .........        42.656        13.900
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.040         0.013
Continuity Error (%) .....        -0.591


*******************************
Highest Flow Instability Indexes
*******************************
Link 208 (10)
Link 203 (8)
Link 209 (7)
Link 202 (5)
Link 207 (5)


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.47


******************
Node Depth Summary
******************

-----------------------------------------------------------------------
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	4.81	5.00	5123.00	0 00:14
102	JUNCTION	2.07	5.00	5132.00	0 00:26
103	JUNCTION	1.19	3.00	5151.00	0 00:21
104	JUNCTION	0.41	3.00	5144.00	0 00:36
105	JUNCTION	0.30	1.09	5137.09	0 00:36
106	JUNCTION	0.00	0.00	5115.00	0 00:00
107	JUNCTION	1.92	2.00	5083.00	0 00:15
108	JUNCTION	3.77	5.00	5135.00	0 00:15
109	JUNCTION	0.99	2.00	5104.00	0 00:29
110	JUNCTION	1.99	3.00	5123.00	0 00:26
111	JUNCTION	1.39	2.00	5122.00	0 00:10
112	JUNCTION	2.80	10.00	5134.00	0 00:36
113	JUNCTION	3.80	10.00	5131.00	0 00:29
114	JUNCTION	0.00	0.00	5146.00	0 00:00
115	JUNCTION	0.00	0.00	5149.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	0.00	143.86	0 00:54	0.000	6.563
102	JUNCTION	168.42	190.05	0 00:30	2.792	4.092
103	JUNCTION	110.13	110.13	0 00:55	2.590	2.590
104	JUNCTION	119.33	119.33	0 00:50	2.360	2.360
105	JUNCTION	0.00	72.90	0 00:36	0.000	2.185
106	JUNCTION	132.21	132.21	0 01:05	2.400	2.400
107	JUNCTION	146.95	170.47	0 00:55	2.571	3.888
108	JUNCTION	128.65	128.65	0 00:45	2.270	2.270
109	JUNCTION	0.00	23.79	0 00:29	0.000	1.310
110	JUNCTION	164.68	164.95	0 00:50	2.550	2.584
111	JUNCTION	457.31	457.31	0 00:30	6.106	6.106
112	JUNCTION	214.53	302.08	0 00:45	2.701	6.425
113	JUNCTION	185.89	295.26	0 00:45	2.506	7.763
114	JUNCTION	274.03	274.03	0 00:40	2.921	2.921
115	JUNCTION	0.00	0.00	0 00:00	0.000	0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	5.78	1.000	0.000
102	JUNCTION	0.70	0.000	0.000
103	JUNCTION	1.58	1.000	0.000
104	JUNCTION	0.42	2.000	0.000
106	JUNCTION	6.01	0.000	1.000
107	JUNCTION	5.76	0.000	0.000
108	JUNCTION	4.53	0.000	0.000
109	JUNCTION	1.34	0.000	3.000
110	JUNCTION	3.17	1.000	0.000
111	JUNCTION	3.76	0.000	0.000
112	JUNCTION	0.89	5.000	0.000
113	JUNCTION	1.73	6.000	0.000
114	JUNCTION	6.01	0.000	10.000

110 431
111 650
112 624
113 567

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Volume 1000 ft3
102	0.70	95.39	0 00:30	0.413	0.000
103	1.58	87.02	0 00:55	1.345	0.000
104	0.42	44.69	0 00:50	0.175	0.000
110	1.39	139.58	0 00:50	1.317	0.000
111	3.76	453.53	0 00:30	6.077	0.000
112	0.74	192.20	0 00:45	1.174	0.000
113	1.73	224.18	0 00:45	3.399	0.000

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	21.63	0 00:26	17.53	1.00	1.00
202	CONDUIT	72.90	0 00:36	14.63	1.00	1.00
203	CONDUIT	73.71	0 00:54	13.97	0.29	0.55
204	CONDUIT	24.74	0 01:41	10.66	0.88	0.94
205	CONDUIT	23.79	0 00:29	14.21	1.00	1.00
206	CONDUIT	0.27	0 00:23	0.36	1.00	1.00
207	CONDUIT	87.55	0 00:29	8.06	1.00	1.00
208	CONDUIT	109.37	0 00:36	9.34	1.00	1.00
209	CONDUIT	70.15	0 00:30	7.52	1.00	1.00
210	CONDUIT	0.00	0 00:00	0.00	0.00	0.00

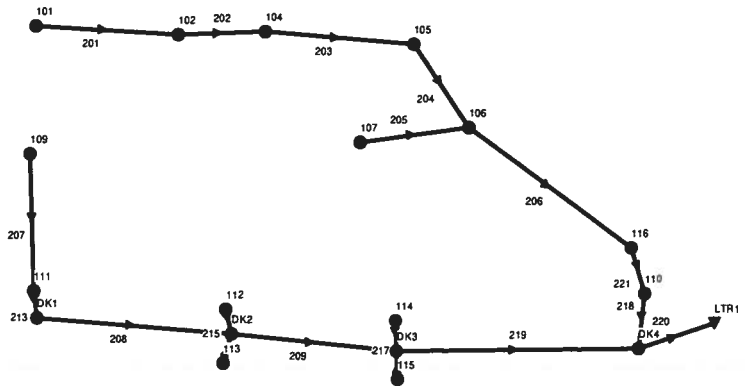
****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	1.31	1.54	1.43	1.43	1.54
202	0.40	0.40	0.40	0.40	0.40
205	1.23	1.37	1.34	1.34	1.37
206	3.11	3.73	3.17	0.01	3.73
207	0.55	0.68	0.62	0.62	0.68
208	0.68	0.72	0.72	0.72	0.72
209	1.70	1.73	1.73	0.01	1.73

Analysis begun on: Thu Sep 29 14:53:56 2011
Analysis ended on: Thu Sep 29 14:53:56 2011
Total elapsed time: < 1 sec

Dry Creek Drainage Basin, Schematic

06/22/2011 00:05:00



Dry Creek Drainage Basin, 2-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... JUN-22-2011 00:00:00
Ending Date ..... JUN-22-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:05:00
Routing Time Step ..... 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 213
WARNING 04: minimum elevation drop used for Conduit 214
WARNING 04: minimum elevation drop used for Conduit 215
WARNING 04: minimum elevation drop used for Conduit 216
WARNING 04: minimum elevation drop used for Conduit 217
WARNING 04: minimum elevation drop used for Conduit 218
WARNING 02: maximum depth increased for Node 106
WARNING 02: maximum depth increased for Node DK1

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........        44.174         14.395
External Outflow .........        43.958         14.324
Internal Outflow .........         0.000          0.000
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.001          0.000
Final Stored Volume ......         0.213          0.070
Continuity Error (%) .....         0.008


*************************
Highest Continuity Errors
*************************
Node DK3 (2.98%)
Node DK1 (2.29%)
Node 106 (1.45%)
Node DK2 (1.40%)


***************************
Time-Step Critical Elements
***************************
Link 204 (45.25%)


*******************************
Highest Flow Instability Indexes
*******************************
```

Link 204 (42)
Link 205 (21)
Link 206 (10)
Link 203 (2)

****
Routing Time Step Summary
****

Minimum Time Step	:	10.43 sec
Average Time Step	:	21.61 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.23

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.54	2.10	5093.10	0 01:21
102	JUNCTION	1.21	1.70	5090.70	0 01:14
104	JUNCTION	1.53	2.11	5081.11	0 01:15
105	JUNCTION	1.27	2.07	5065.07	0 01:06
106	JUNCTION	0.22	0.37	5061.37	0 01:07
107	JUNCTION	0.24	0.40	5062.40	0 00:55
109	JUNCTION	0.50	0.75	5088.75	0 01:00
DK1	JUNCTION	0.03	0.05	5016.05	0 01:19
DK2	JUNCTION	0.08	0.15	5007.15	0 00:59
DK3	JUNCTION	0.11	0.20	4989.20	0 01:23
110	JUNCTION	0.10	0.15	4959.15	0 00:48
111	JUNCTION	0.05	0.08	5016.08	0 01:00
112	JUNCTION	0.00	0.00	5007.00	0 00:00
113	JUNCTION	0.00	0.00	5007.00	0 00:00
114	JUNCTION	0.00	0.00	4989.00	0 00:00
115	JUNCTION	0.00	0.00	4989.00	0 00:00
DK4	JUNCTION	0.01	0.01	4959.01	0 00:48
116	JUNCTION	0.87	2.06	5001.06	0 00:48
LTR1	OUTFALL	0.00	0.00	4958.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	6.01	6.01	0 01:14	0.396	0.397
102	JUNCTION	3.16	8.56	0 01:12	0.144	0.538
104	JUNCTION	2.75	11.04	0 01:10	0.140	0.677
105	JUNCTION	22.96	31.06	0 00:56	0.975	1.644
106	JUNCTION	0.00	32.41	0 01:06	0.000	1.717
107	JUNCTION	1.37	1.37	0 00:55	0.068	0.068
109	JUNCTION	0.98	0.98	0 00:59	0.053	0.053
DK1	JUNCTION	0.00	0.98	0 01:01	0.000	0.053
DK2	JUNCTION	0.00	8.46	0 00:49	0.000	0.382
DK3	JUNCTION	0.00	12.96	0 00:59	0.000	0.577
110	JUNCTION	228.21	519.11	0 00:45	4.903	13.771
111	JUNCTION	0.00	0.98	0 01:00	0.000	0.053
112	JUNCTION	2.18	2.18	0 01:00	0.139	0.138
113	JUNCTION	6.05	6.05	0 00:45	0.192	0.192
114	JUNCTION	2.09	2.09	0 00:49	0.069	0.069
115	JUNCTION	3.18	3.18	0 00:54	0.131	0.131

DK4	JUNCTION	0.00	520.90	0	00:45	0.000	14.325
116	JUNCTION	324.44	341.86	0	00:44	7.214	8.889
LTR1	OUTFALL	0.00	520.86	0	00:45	0.000	14.323

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
112	JUNCTION	6.01	0.000	10.000
113	JUNCTION	6.01	0.000	10.000
114	JUNCTION	6.01	0.000	10.000
115	JUNCTION	6.01	0.000	10.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR1	98.90	145.52	520.86	14.323
System	98.90	145.52	520.86	14.323

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	5.97	0 01:20	3.31	0.08	0.38
202	CONDUIT	8.54	0 01:14	5.86	0.06	0.38
203	CONDUIT	10.98	0 01:16	6.97	0.10	0.42
204	CONDUIT	31.09	0 01:06	9.28	0.09	0.24
205	CONDUIT	1.37	0 00:55	2.53	0.00	0.08
206	CONDUIT	31.72	0 01:07	2.85	0.00	0.15
207	CONDUIT	0.98	0 01:00	19.10	0.00	0.08
208	CONDUIT	0.88	0 01:19	0.61	0.00	0.01
209	CONDUIT	7.99	0 01:00	3.49	0.00	0.02
213	DUMMY	0.98	0 01:01			
214	DUMMY	2.18	0 01:00			
215	DUMMY	6.05	0 00:45			
216	DUMMY	2.09	0 00:49			
217	DUMMY	3.18	0 00:54			
218	DUMMY	519.02	0 00:45			
219	CONDUIT	10.41	0 01:23	5.00	0.00	0.01
220	DUMMY	520.86	0 00:45			
221	CONDUIT	322.69	0 00:48	34.85	0.05	0.18

****

Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.53	0.0002
202	1.00	0.01	0.00	0.00	0.50	0.49	0.00	0.00	0.94	0.0001
203	1.00	0.01	0.00	0.00	0.16	0.83	0.00	0.00	1.18	0.0002
204	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	1.52	0.0012
205	1.00	0.01	0.00	0.00	0.95	0.03	0.00	0.00	0.62	0.0001
206	1.00	0.01	0.00	0.00	0.91	0.08	0.00	0.00	0.74	0.0000
207	1.00	0.01	0.00	0.00	0.02	0.97	0.00	0.00	5.03	0.0000
208	1.00	0.01	0.04	0.00	0.95	0.00	0.00	0.00	0.33	0.0000
209	1.00	0.01	0.00	0.00	0.49	0.50	0.00	0.00	1.08	0.0000
219	1.00	0.02	0.01	0.00	0.03	0.94	0.00	0.00	2.28	0.0000
221	1.00	0.02	0.00	0.00	0.00	0.97	0.00	0.00	4.99	0.0001

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
213	6.01	6.01	6.01	6.01	0.01
214	6.01	6.01	6.01	6.01	0.01
215	6.01	6.01	6.01	6.01	0.01
216	6.01	6.01	6.01	6.01	0.01
217	6.01	6.01	6.01	6.01	0.01
218	6.01	6.01	6.01	6.01	0.01
220	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Thu Sep 29 11:37:53 2011
Analysis ended on: Thu Sep 29 11:37:53 2011
Total elapsed time: < 1 sec

Dry Creek Drainage Basin, 10-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... JUN-22-2011 00:00:00
Ending Date ..... JUN-22-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:05:00
Routing Time Step ..... 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 213
WARNING 04: minimum elevation drop used for Conduit 214
WARNING 04: minimum elevation drop used for Conduit 215
WARNING 04: minimum elevation drop used for Conduit 216
WARNING 04: minimum elevation drop used for Conduit 217
WARNING 04: minimum elevation drop used for Conduit 218
WARNING 02: maximum depth increased for Node 106
WARNING 02: maximum depth increased for Node DK1

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       130.553         42.543
External Outflow .........       125.419         40.870
Internal Outflow .........         4.373          1.425
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.001          0.000
Final Stored Volume ......         0.758          0.247
Continuity Error (%) .....         0.003


**************************
Time-Step Critical Elements
**************************
Link 204 (88.11%)


********************************
Highest Flow Instability Indexes
********************************
Link 205 (44)
Link 204 (12)
Link 206 (7)


************************
Routing Time Step Summary
************************
Minimum Time Step           :     6.63 sec
```

```
Average Time Step           :    10.85 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.80
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days	hr:min
101	JUNCTION	3.84	5.00	5096.00	0	01:20
102	JUNCTION	3.11	4.18	5093.18	0	01:14
104	JUNCTION	3.76	5.00	5084.00	0	01:08
105	JUNCTION	3.59	5.00	5068.00	0	00:43
106	JUNCTION	0.60	0.83	5061.83	0	01:04
107	JUNCTION	0.97	1.47	5063.47	0	01:00
109	JUNCTION	1.32	1.88	5089.88	0	01:00
DK1	JUNCTION	0.14	0.23	5016.23	0	01:07
DK2	JUNCTION	0.31	0.61	5007.61	0	00:54
DK3	JUNCTION	0.57	1.12	4990.12	0	01:00
110	JUNCTION	0.09	0.11	4959.11	0	00:47
111	JUNCTION	0.13	0.16	5016.16	0	01:00
112	JUNCTION	0.00	0.00	5007.00	0	00:00
113	JUNCTION	0.00	0.00	5007.00	0	00:00
114	JUNCTION	0.00	0.00	4989.00	0	00:00
115	JUNCTION	0.00	0.00	4989.00	0	00:00
DK4	JUNCTION	0.01	0.01	4959.01	0	00:50
116	JUNCTION	1.47	2.86	5001.86	0	00:47
LTR1	OUTFALL	0.00	0.00	4958.00	0	00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	70.08	70.08	0	01:19	4.649	4.649
102	JUNCTION	27.61	93.14	0	01:12	1.274	5.906
104	JUNCTION	19.86	111.71	0	01:12	1.059	6.955
105	JUNCTION	74.33	172.77	0	01:07	3.038	9.956
106	JUNCTION	0.00	130.00	0	01:00	0.000	9.488
107	JUNCTION	18.10	18.10	0	00:59	0.948	0.948
109	JUNCTION	11.42	11.42	0	00:59	0.623	0.623
DK1	JUNCTION	0.00	11.40	0	01:00	0.000	0.622
DK2	JUNCTION	0.00	87.55	0	00:50	0.000	3.533
DK3	JUNCTION	0.00	206.11	0	00:53	0.000	8.239
110	JUNCTION	457.47	1053.85	0	00:45	9.773	32.675
111	JUNCTION	0.00	11.40	0	01:00	0.000	0.622
112	JUNCTION	9.94	9.94	0	01:10	0.663	0.663
113	JUNCTION	69.61	69.61	0	00:45	2.254	2.252
114	JUNCTION	64.94	64.94	0	00:50	2.302	2.300
115	JUNCTION	58.04	58.04	0	00:54	2.417	2.416
DK4	JUNCTION	0.00	1185.47	0	00:46	0.000	40.867
116	JUNCTION	596.20	685.48	0	00:44	13.591	22.979
LTR1	OUTFALL	0.00	1185.42	0	00:46	0.000	40.867

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
104	JUNCTION	0.21	0.000	0.000
105	JUNCTION	1.33	0.000	0.000
112	JUNCTION	6.01	0.000	10.000
113	JUNCTION	6.01	0.000	10.000
114	JUNCTION	6.01	0.000	10.000
115	JUNCTION	6.01	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
104	0.21	1.21	0 01:12	0.005	5.00
105	1.33	60.87	0 01:07	1.420	5.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR1	99.50	375.82	1185.42	40.867
System	99.50	375.82	1185.42	40.867

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	70.07	0 01:20	6.69	0.99	0.92
202	CONDUIT	93.08	0 01:14	11.06	0.62	0.92
203	CONDUIT	110.50	0 01:20	11.05	1.00	1.00
204	CONDUIT	111.90	0 00:43	10.39	0.31	0.58
205	CONDUIT	18.10	0 01:00	6.58	0.06	0.23
206	CONDUIT	129.81	0 01:04	6.44	0.01	0.23
207	CONDUIT	11.40	0 01:00	27.32	0.04	0.20
208	CONDUIT	11.25	0 01:07	1.72	0.00	0.04
209	CONDUIT	85.42	0 00:54	5.85	0.00	0.09
213	DUMMY	11.40	0 01:00			
214	DUMMY	9.94	0 01:10			
215	DUMMY	69.61	0 00:45			
216	DUMMY	64.94	0 00:50			
217	DUMMY	58.04	0 00:54			
218	DUMMY	1053.79	0 00:45			
219	CONDUIT	197.38	0 01:01	15.69	0.01	0.06
220	DUMMY	1185.42	0 00:46			
221	CONDUIT	660.09	0 00:47	44.87	0.10	0.25

****

Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
		--- Fraction of Time in Flow Class ----								
201	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.72	0.0009
202	1.00	0.01	0.00	0.00	0.02	0.98	0.00	0.00	1.19	0.0006
203	1.00	0.01	0.00	0.00	0.10	0.89	0.00	0.00	1.24	0.0010
204	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	1.27	0.0007
205	1.00	0.01	0.00	0.00	0.75	0.24	0.00	0.00	0.82	0.0015
206	1.00	0.01	0.00	0.00	0.32	0.67	0.00	0.00	1.05	0.0000
207	1.00	0.01	0.00	0.00	0.01	0.99	0.00	0.00	6.03	0.0000
208	1.00	0.01	0.02	0.00	0.98	0.00	0.00	0.00	0.55	0.0000
209	1.00	0.01	0.00	0.00	0.56	0.43	0.00	0.00	1.01	0.0000
219	1.00	0.01	0.01	0.00	0.01	0.98	0.00	0.00	3.24	0.0000
221	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	6.47	0.0001

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
203	0.21	0.21	0.21	0.01	0.01
213	6.01	6.01	6.01	6.01	0.01
214	6.01	6.01	6.01	6.01	0.01
215	6.01	6.01	6.01	6.01	0.01
216	6.01	6.01	6.01	6.01	0.01
217	6.01	6.01	6.01	6.01	0.01
218	6.01	6.01	6.01	6.01	0.01
220	6.01	6.01	6.01	6.01	0.01

Analysis begun on: Thu Sep 29 11:36:41 2011
Analysis ended on: Thu Sep 29 11:36:42 2011
Total elapsed time: 00:00:01

Dry Creek Drainage Basin, 100-Year Rainfall Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... JUN-22-2011 00:00:00
Ending Date ..... JUN-22-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:05:00
Routing Time Step ..... 30.00 sec

WARNING 04: minimum elevation drop used for Conduit 213
WARNING 04: minimum elevation drop used for Conduit 214
WARNING 04: minimum elevation drop used for Conduit 215
WARNING 04: minimum elevation drop used for Conduit 216
WARNING 04: minimum elevation drop used for Conduit 217
WARNING 04: minimum elevation drop used for Conduit 218
WARNING 02: maximum depth increased for Node 106
WARNING 02: maximum depth increased for Node DK1

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........       353.471        115.184
External Outflow .........       280.906         91.537
Internal Outflow .........        70.710         23.042
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.001          0.000
Final Stored Volume ......         1.864          0.607
Continuity Error (%) .....        -0.002

**************************
Time-Step Critical Elements
**************************
Link 204 (97.94%)

********************************
Highest Flow Instability Indexes
********************************
Link 205 (33)
Link 206 (3)
Link 204 (3)

************************
Routing Time Step Summary
************************
Minimum Time Step           :     6.63 sec
```

```
Average Time Step           :     7.93 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.53
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	4.68	5.00	5096.00	0 00:41
102	JUNCTION	4.09	5.00	5094.00	0 00:44
104	JUNCTION	4.54	5.00	5084.00	0 00:40
105	JUNCTION	4.36	5.00	5068.00	0 00:36
106	JUNCTION	0.75	0.97	5061.97	0 01:10
107	JUNCTION	1.59	3.28	5065.28	0 01:05
109	JUNCTION	2.09	3.30	5091.30	0 01:10
DK1	JUNCTION	0.29	0.55	5016.55	0 01:13
DK2	JUNCTION	0.57	1.35	5008.35	0 00:59
DK3	JUNCTION	1.05	2.48	4991.48	0 01:05
110	JUNCTION	0.09	0.11	4959.11	0 00:50
111	JUNCTION	0.13	0.18	5016.18	0 01:10
112	JUNCTION	0.00	0.00	5007.00	0 00:00
113	JUNCTION	0.00	0.00	5007.00	0 00:00
114	JUNCTION	0.00	0.00	4989.00	0 00:00
115	JUNCTION	0.00	0.00	4989.00	0 00:00
DK4	JUNCTION	0.01	0.01	4959.01	0 00:55
116	JUNCTION	1.69	3.64	5002.64	0 00:50
LTR1	OUTFALL	0.00	0.00	4958.00	0 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	309.60	309.60	0 01:24	20.053	20.052
102	JUNCTION	113.33	184.36	0 01:05	5.198	14.408
104	JUNCTION	62.56	213.06	0 01:05	3.104	16.963
105	JUNCTION	225.68	336.18	0 00:55	8.459	21.479
106	JUNCTION	0.00	172.00	0 01:05	0.000	16.608
107	JUNCTION	60.10	60.10	0 01:05	2.996	2.996
109	JUNCTION	50.05	50.05	0 01:10	2.694	2.693
DK1	JUNCTION	0.00	49.99	0 01:10	0.000	2.693
DK2	JUNCTION	0.00	353.06	0 00:55	0.000	14.203
DK3	JUNCTION	0.00	817.57	0 01:00	0.000	32.981
110	JUNCTION	952.73	2113.56	0 00:48	18.992	58.637
111	JUNCTION	0.00	49.99	0 01:10	0.000	2.693
112	JUNCTION	29.22	29.22	0 01:10	1.781	1.781
113	JUNCTION	286.41	286.41	0 00:55	9.744	9.741
114	JUNCTION	215.98	215.98	0 00:55	7.651	7.648
115	JUNCTION	259.67	259.67	0 01:05	11.142	11.141
DK4	JUNCTION	0.00	2736.66	0 00:51	0.000	91.531
116	JUNCTION	1076.11	1230.81	0 00:49	23.419	39.856
LTR1	OUTFALL	0.00	2736.62	0 00:51	0.000	91.530

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	3.50	0.000	0.000
102	JUNCTION	0.91	0.000	0.000
104	JUNCTION	2.39	0.000	0.000
105	JUNCTION	2.88	0.000	0.000
112	JUNCTION	6.00	0.000	10.000
113	JUNCTION	6.00	0.000	10.000
114	JUNCTION	6.00	0.000	10.000
115	JUNCTION	6.00	0.000	10.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	3.50	238.57	0 01:25	10.799	5.00
102	0.90	33.84	0 01:05	0.515	5.00
104	2.38	102.56	0 01:05	3.872	5.00
105	2.88	224.24	0 00:55	7.853	5.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR1	99.63	661.75	2736.62	91.530
System	99.63	661.75	2736.62	91.530

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	71.69	0 04:11	7.14	1.01	1.00
202	CONDUIT	150.51	0 01:27	15.05	1.00	1.00
203	CONDUIT	110.50	0 01:50	11.17	1.00	1.00
204	CONDUIT	111.90	0 00:36	10.20	0.31	0.60
205	CONDUIT	60.10	0 01:05	7.77	0.20	0.42
206	CONDUIT	171.73	0 01:10	8.18	0.01	0.29
207	CONDUIT	49.99	0 01:10	41.31	0.18	0.35
208	CONDUIT	49.74	0 01:13	2.95	0.00	0.09
209	CONDUIT	350.50	0 00:59	8.46	0.02	0.19
213	DUMMY	49.99	0 01:10			
214	DUMMY	29.22	0 01:10			
215	DUMMY	286.41	0 00:55			
216	DUMMY	215.98	0 00:55			
217	DUMMY	259.67	0 01:05			
218	DUMMY	2113.52	0 00:48			
219	CONDUIT	810.47	0 01:05	26.14	0.04	0.12
220	DUMMY	2736.62	0 00:51			

221	CONDUIT	1225.65	0	00:50	>50.00	0.19	0.31

****
Flow Classification Summary
****

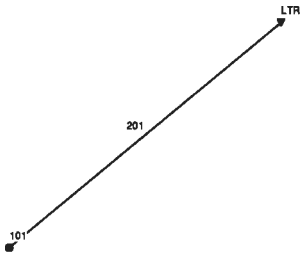
Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
		--- Fraction of Time in Flow Class ----								
201	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.73	0.0006
202	1.00	0.00	0.00	0.00	0.02	0.98	0.00	0.00	1.40	0.0007
203	1.00	0.00	0.00	0.00	0.04	0.95	0.00	0.00	1.25	0.0006
204	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.14	0.0003
205	1.00	0.00	0.00	0.00	0.57	0.42	0.00	0.00	0.83	0.0014
206	1.00	0.00	0.00	0.00	0.25	0.74	0.00	0.00	1.21	0.0000
207	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	6.92	0.0001
208	1.00	0.00	0.01	0.00	0.88	0.11	0.00	0.00	0.73	0.0000
209	1.00	0.00	0.00	0.00	0.24	0.76	0.00	0.00	1.10	0.0000
219	1.00	0.00	0.01	0.00	0.01	0.98	0.00	0.00	3.60	0.0000
221	1.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	6.81	0.0001

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	0.90	0.90	0.91	0.38	0.01
202	0.90	0.90	0.91	0.01	0.01
203	2.38	2.38	2.38	0.01	0.01
213	6.00	6.00	6.00	6.00	0.01
214	6.00	6.00	6.00	6.00	0.01
215	6.00	6.00	6.00	6.00	0.01
216	6.00	6.00	6.00	6.00	0.01
217	6.00	6.00	6.00	6.00	0.01
218	6.00	6.00	6.00	6.00	0.01
220	6.00	6.00	6.00	6.00	0.01

Analysis begun on: Thu Sep 29 11:26:59 2011
Analysis ended on: Thu Sep 29 11:26:59 2011
Total elapsed time: < 1 sec

Ish Reservoir Drainage Basin



Ish Reservoir Drainage Basin, 2-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-22-2011 00:00:00
Ending Date .............. JUN-22-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 02: maximum depth increased for Node 101

*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        30.514         9.943
External Outflow .........        30.133         9.819
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.767         0.250
Continuity Error (%) .....        -1.263


***************************
Time-Step Critical Elements
***************************
None


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	1.04	1.79	5002.79	0 01:30
LTR	OUTFALL	1.04	1.79	4956.79	0 01:30

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	136.42	136.42	0 01:24	9.336	9.334
LTR	OUTFALL	10.39	143.68	0 01:30	0.609	9.818

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	98.47	61.64	143.68	9.818
System	98.47	61.64	143.68	9.818

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	134.71	0 01:30	9.95	0.11	0.36

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change

```
-------------------------------------------------------------------------------------------------
201                    1.00    0.02  0.00  0.00  0.06  0.92  0.00  0.00      1.41    0.0003


*************************
Conduit Surcharge Summary
*************************

No conduits were surcharged.


Analysis begun on:  Mon Aug 22 12:12:00 2011
Analysis ended on:  Mon Aug 22 12:12:00 2011
Total elapsed time: < 1 sec
```

Ish Reservoir Drainage Basin, 10-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-22-2011 00:00:00
Ending Date .............. JUN-22-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 02: maximum depth increased for Node 101

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       138.978        45.288
External Outflow .........       138.064        44.990
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         1.838         0.599
Continuity Error (%) .....        -0.665


***************************
Time-Step Critical Elements
***************************
None


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	2.10	3.53	5004.53	0 01:27
LTR	OUTFALL	2.10	3.53	4958.53	0 01:29

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	564.78	564.78	0 01:25	38.156	38.151
LTR	OUTFALL	120.66	670.52	0 01:27	7.135	44.987

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	98.61	282.00	670.52	44.987
System	98.61	282.00	670.52	44.987

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	562.13	0 01:29	14.43	0.46	0.71

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change

```
-------------------------------------------------------------------------------------------
201                    1.00    0.01  0.00  0.00  0.05  0.93  0.00  0.00      1.54    0.0012


*************************
Conduit Surcharge Summary
*************************

No conduits were surcharged.


Analysis begun on:  Mon Aug 22 12:13:16 2011
Analysis ended on:  Mon Aug 22 12:13:16 2011
Total elapsed time: < 1 sec
```

Ish Reservoir Drainage Basin, 100-Year Event

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ JUN-22-2011 00:00:00
Ending Date .............. JUN-22-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

WARNING 02: maximum depth increased for Node 101

*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       386.780       126.038
External Outflow .........       385.470       125.611
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         3.294         1.074
Continuity Error (%) .....        -0.513


***************************
Time-Step Critical Elements
***************************
None


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	3.80	8.90	5009.90	0 01:55
LTR	OUTFALL	3.18	5.00	4960.00	0 01:11

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	1530.81	1530.81	0 01:25	95.233	95.222
LTR	OUTFALL	529.60	1763.48	0 01:15	30.810	125.602

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	1.52	292.07	0 01:25	4.178	8.90

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
LTR	98.61	787.33	1763.48	125.602
System	98.61	787.33	1763.48	125.602

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
201	CONDUIT	1247.11	0 01:56	17.82	1.01	1.00

****

Flow Classification Summary
****

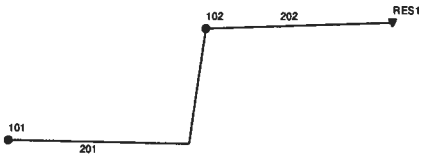
Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.01	0.00	0.00	0.05	0.93	0.00	0.00	1.62	0.0027

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
201	0.01	0.01	0.02	1.45	0.01

Analysis begun on: Mon Aug 22 12:14:32 2011
Analysis ended on: Mon Aug 22 12:14:32 2011
Total elapsed time: < 1 sec

Loveland Reservoir Drainage Basin



Loveland Reservoir Drainage Basin - 2-Year

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Flow Routing Method ..... DYNWAVE
Starting Date ..... AUG-01-2011 00:00:00
Ending Date ..... AUG-01-2011 06:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:15:00
Routing Time Step ..... 30.00 sec

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .....           0.000          0.000
Wet Weather Inflow .....           0.000          0.000
Groundwater Inflow .....           0.000          0.000
RDII Inflow ............           0.000          0.000
External Inflow ........          25.285          8.240
External Outflow .......          22.659          7.384
Internal Outflow .......           2.632          0.858
Storage Losses .........           0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         0.002          0.001
Continuity Error (%) .....        -0.032

***************************
Time-Step Critical Elements
***************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.14

******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	2.25	5.00	5108.00	0 00:35
102	JUNCTION	0.52	1.51	5087.51	0 00:40
RES1	OUTFALL	0.52	1.51	5076.51	0 00:41

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	108.86	108.86	0 00:50	3.883	3.883
102	JUNCTION	66.34	121.48	0 00:40	1.504	4.529
RES1	OUTFALL	291.29	341.41	0 00:30	2.852	7.383

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	1.18	1.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	1.08	54.24	0 00:50	0.858	5.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
RES1	95.84	47.62	341.41	7.383
System	95.84	47.62	341.41	7.383

****
Link Flow Summary
****

	Maximum	Time of Max	Maximum	Max/	Max/

Link	Type	|Flow| CFS	Occurrence days hr:min	|Veloc| ft/sec	Full Flow	Full Depth
201	CONDUIT	55.14	0 00:40	15.85	0.76	0.69
202	CONDUIT	121.24	0 00:41	11.46	0.08	0.30

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.04	0.00	0.00	0.00	0.96	0.00	0.00	2.15	0.0021
202	1.00	0.04	0.00	0.00	0.09	0.86	0.00	0.00	1.50	0.0002

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:28:11 2011
Analysis ended on: Mon Aug 22 11:28:11 2011
Total elapsed time: < 1 sec

Loveland Reservoir Drainage Basin - 10-Year

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ AUG-01-2011 00:00:00
Ending Date .............. AUG-01-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

*************************       Volume        Volume
Flow Routing Continuity       acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......        0.000         0.000
Wet Weather Inflow .......        0.000         0.000
Groundwater Inflow .......        0.000         0.000
RDII Inflow ..............        0.000         0.000
External Inflow ..........       65.543        21.358
External Outflow .........       48.104        15.676
Internal Outflow .........       17.438         5.682
Storage Losses ...........        0.000         0.000
Initial Stored Volume ....        0.000         0.000
Final Stored Volume ......        0.003         0.001
Continuity Error (%) .....       -0.004

***************************
Time-Step Critical Elements
***************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.15

******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	2.91	5.00	5108.00	0 00:28
102	JUNCTION	0.75	1.97	5087.97	0 00:40
RES1	OUTFALL	0.75	1.97	5076.97	0 00:41

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	258.07	258.07	0 00:50	10.171	10.171
102	JUNCTION	148.98	208.07	0 00:40	3.898	8.387
RES1	OUTFALL	562.86	708.56	0 00:30	7.287	15.674

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	2.38	1.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	2.28	199.63	0 00:50	5.682	5.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
RES1	97.23	99.64	708.56	15.674
System	97.23	99.64	708.56	15.674

****
Link Flow Summary
****

	Maximum	Time of Max	Maximum	Max/	Max/

Link	Type	|Flow| CFS	Occurrence days hr:min	|Veloc| ft/sec	Full Flow	Full Depth
201	CONDUIT	59.11	0 00:41	16.29	0.81	0.75
202	CONDUIT	207.41	0 00:41	13.23	0.13	0.39

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.04	0.00	0.00	0.00	0.96	0.00	0.00	2.16	0.0022
202	1.00	0.04	0.00	0.00	0.00	0.96	0.00	0.00	1.60	0.0004

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 11:27:17 2011
Analysis ended on: Mon Aug 22 11:27:17 2011
Total elapsed time: < 1 sec

Loveland Reservoir Drainage Basin - 100-Year

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Starting Date ............ AUG-01-2011 00:00:00
Ending Date .............. AUG-01-2011 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec

*************************       Volume        Volume
Flow Routing Continuity       acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......        0.000         0.000
Wet Weather Inflow .......        0.000         0.000
Groundwater Inflow .......        0.000         0.000
RDII Inflow ..............        0.000         0.000
External Inflow ..........      150.298        48.977
External Outflow .........       91.150        29.703
Internal Outflow .........       59.140        19.272
Storage Losses ...........        0.000         0.000
Initial Stored Volume ....        0.000         0.000
Final Stored Volume ......        0.004         0.001
Continuity Error (%) .....        0.003

***************************
Time-Step Critical Elements
***************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.96 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.14

******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
101	JUNCTION	3.29	5.00	5108.00	0 00:29
102	JUNCTION	0.99	2.66	5088.66	0 00:46
RES1	OUTFALL	0.99	2.66	5077.66	0 00:47

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
101	JUNCTION	601.82	601.82	0 01:00	24.729	24.729
102	JUNCTION	319.27	383.89	0 00:45	9.262	14.722
RES1	OUTFALL	1054.71	1323.50	0 00:35	14.982	29.700

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
101	JUNCTION	3.27	1.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
101	3.21	537.65	0 01:00	19.270	5.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
RES1	95.84	191.54	1323.50	29.700
System	95.84	191.54	1323.50	29.700

****
Link Flow Summary
****

	Maximum	Time of Max	Maximum	Max/	Max/

Link	Type	|Flow| CFS	Occurrence days	Occurrence hr:min	|Veloc| ft/sec	Full Flow	Full Depth
201	CONDUIT	64.74	0	00:47	16.39	0.89	0.83
202	CONDUIT	384.45	0	00:47	15.55	0.25	0.53

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
201	1.00	0.04	0.00	0.00	0.00	0.96	0.00	0.00	2.09	0.0025
202	1.00	0.04	0.00	0.00	0.00	0.96	0.00	0.00	1.67	0.0007

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Aug 22 10:24:34 2011
Analysis ended on: Mon Aug 22 10:24:34 2011
Total elapsed time: < 1 sec



APPENDIX D

UDFCD Tables

Table RO-3—Recommended Percentage Imperviousness Values

Land Use or Surface Characteristics	Percentage Imperviousness
Business:	
Commercial areas	95
Neighborhood areas	85
Residential:	
Single-family	*
Multi-unit (detached)	60
Multi-unit (attached)	75
Half-acre lot or larger	*
Apartments	80
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	5
Playgrounds	10
Schools	50
Railroad yard areas	15
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	0
Lawns, clayey soil	0

* See Figures RO-3 through RO-5 for percentage imperviousness.

$$C_A = K_A + \left(1.31i^3 - 1.44i^2 + 1.135i - 0.12\right) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \qquad \text{(RO-6)}$$

$$C_{CD} = K_{CD} + \left(0.858i^3 - 0.786i^2 + 0.774i + 0.04\right) \qquad \text{(RO-7)}$$

$$C_B = \left(C_A + C_{CD}\right)/2$$

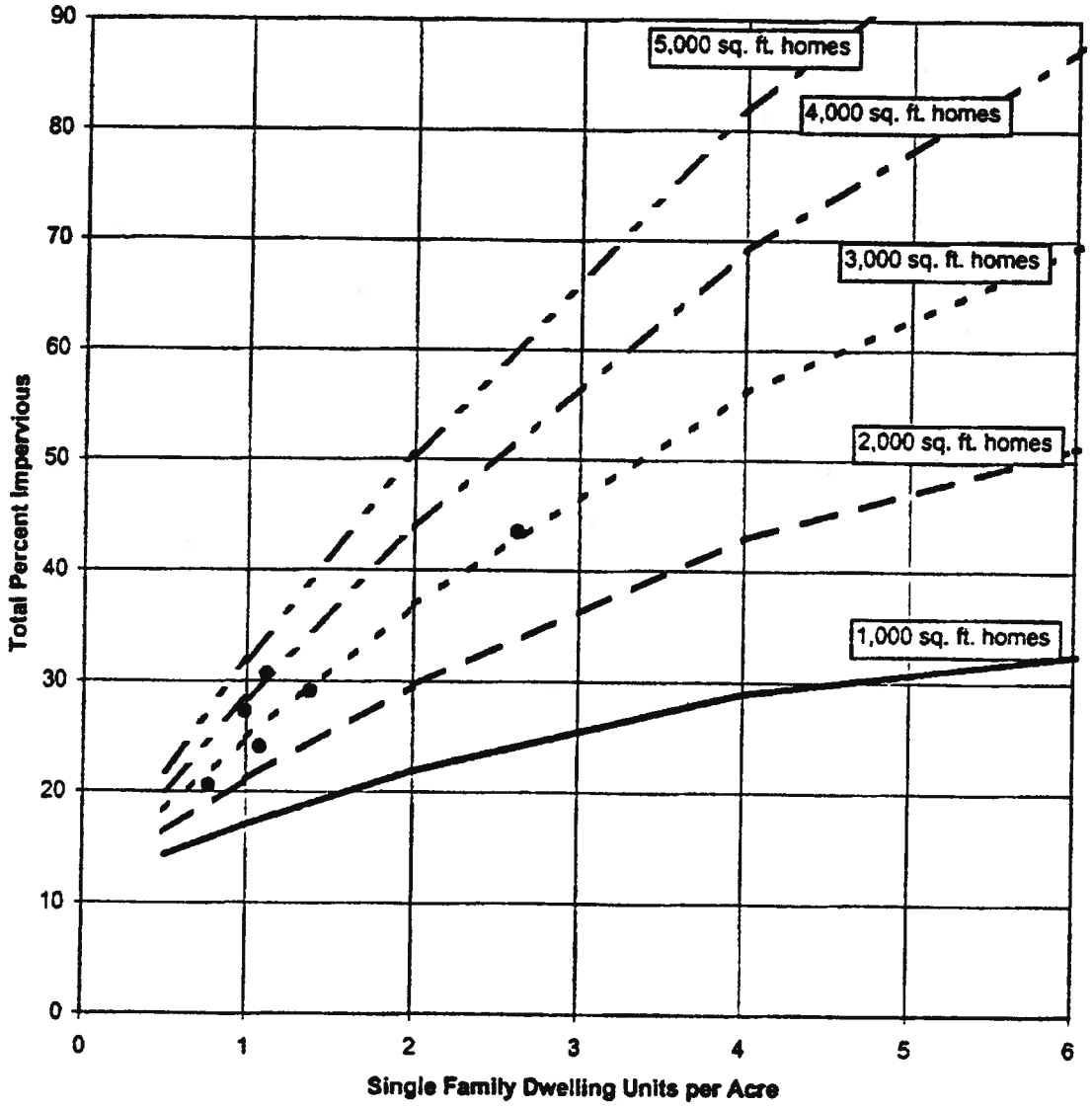


Figure RO-3— Watershed Imperviousness, Single-Family Residential Ranch Style Houses

in Figure RO-A6 in Appendix A at the end of this chapter.

3.2.2 Depression Losses

Rainwater that is collected and held in small depressions and does not become part of the general surface runoff is called depression loss. Most of this water eventually infiltrates or is evaporated. Depression losses also include water intercepted by trees, bushes, other vegetation, and all other surfaces. The CUHP method requires numerical values of depression loss as inputs to calculate the effective rainfall. Table RO-6 can be used as a guide in estimating the amount of depression (retention) losses to be used with CUHP.

Table RO-6—Typical Depression Losses for Various Land Covers

(All Values in Inches. For use with the CUHP Method)

Land Cover	Range in Depression (Retention) Losses	Recommended
Impervious:		
Large paved areas	0.05 - 0.15	0.1
Roofs-flat	0.1 - 0.3	0.1
Roofs-sloped	0.05 - 0.1	0.05
Pervious:		
Lawn grass	0.2 - 0.5	0.35
Wooded areas and open fields	0.2 - 0.6	0.4

When an area is analyzed for depression losses, the pervious and impervious loss values for all parts of the watershed must be considered and accumulated in proportion to the percent of aerial coverage for each type of surface.

3.2.3 Infiltration

The flow of water into the soil surface is called infiltration. In urban hydrology much of the infiltration occurs on areas covered with grass. Urbanization can increase or decrease the total amount of infiltration.

Soil type is the most important factor in determining the infiltration rate. When the soil has a large percentage of well-graded fines, the infiltration rate is low. In some cases of extremely tight soil, there may be, from a practical standpoint, essentially no infiltration. If the soil has several layers or horizons, the least permeable layer near the surface will control the maximum infiltration rate. The soil cover also plays an important role in determining the infiltration rate. Vegetation, lawn grass in particular, tends to increase infiltration by loosening the soil near the surface. Other factors affecting infiltration rates include slope of land, temperature, quality of water, age of lawn and soil compaction.

As rainfall continues, the infiltration rate decreases. When rainfall occurs on an area that has little antecedent moisture and the ground is dry, the infiltration rate is much higher than it is with high

Table RO-7—Recommended Horton's Equation Parameters

NRCS Hydrologic Soil Group	Infiltration (inches per hour)		Decay Coefficient—a
	Initial—f_i	Final—f_o	
A	5.0	1.0	0.0007
B	4.5	0.6	0.0018
C	3.0	0.5	0.0018
D	3.0	0.5	0.0018

To calculate the maximum infiltration depths that may occur at each time increment, it is necessary to integrate Equation RO-8 and calculate the values for each time increment. Very little accuracy is lost if, instead of integrating Equation RO-8, the infiltration rate is calculated at the center of each time increment. This "central" value can then be multiplied by the unit time increment to estimate the infiltration depth. This was done for the four NRCS hydrologic soil groups, and the results are presented in Table RO-8. Although Tables RO-7 and RO-8 provide recommended values for various Horton equation parameters, these recommendations are being made specifically for the urbanized or urbanizing watersheds in the Denver metropolitan area and may not be valid in different meteorologic and climatic regions.

Table RO-8—Incremental Infiltration Depths in Inches*

Time in Minutes**	NRCS Hydrologic Soil Group		
	A	B	C and D
5	0.384	0.298	0.201
10	0.329	0.195	0.134
15	0.284	0.134	0.096
20	0.248	0.099	0.073
25	0.218	0.079	0.060
30	0.194	0.067	0.052
35	0.175	0.060	0.048
40	0.159	0.056	0.045
45	0.146	0.053	0.044
50	0.136	0.052	0.043
55	0.127	0.051	0.042
60	0.121	0.051	0.042
65	0.115	0.050	0.042
70	0.111	0.050	0.042
75	0.107	0.050	0.042
80	0.104	0.050	0.042
85	0.102	0.050	0.042
90	0.100	0.050	0.042
95	0.098	0.050	0.042
100	0.097	0.050	0.042
105	0.096	0.050	0.042
110	0.095	0.050	0.042
115	0.095	0.050	0.042
120	0.094	0.050	0.042

* Based on central value of each time increment in Horton's equation.
** Time at end of the time increment.

APPENDIX E

Technical Memorandum No. 1

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TECHNICAL MEMORANDUM NO. 1

for the

Town of Berthoud

October 2011

STORM DRAINAGE PLANNING MEMORANDUM

Introduction

In October 2011, The Engineering Company (TEC), Fort Collins, CO, completed the "Town of Berthoud Storm Drainage Master Plan". This completed master plan is intended to be an initial step by the Town in preparing a useful guidance document for regional drainage planning within the Berthoud Growth Management Area (GMA).

The Berthoud GMA is approximately 39 square miles in size and is impacted by more than 50 square miles of drainage area, most of which is tributary to the Little Thompson River flowing to the east just south of the Town. Some of the drainage area that is not draining directly to the river is captured in several of the regional lakes such as Welch Reservoir and Bacon Lake. A significant portion of the drainage area near the north end of the GMA drains northward to County Road 14 (42nd Street). The proper downtown area of Berthoud lies near the center of the GMA.

The watershed area studied in the Drainage Master Plan was divided into 13 distinct drainage basins that were each then broken down into many individual sub-basins. Basins are delineated by various physical features such as topography, roadway locations, irrigation ditches, and outfall location. Rainfall runoff hydrographs (flow rate vs. time) were calculated for each sub-basin using Colorado Urban Hydrograph Procedure (CUHP) software. The hydrographs for each sub-basin were then routed together using EPA SWMM software to model the behavior and timing of runoff within the entire watershed for the 2-year, 10-year and 100-year rainfall events.

The results of the Master Drainage Study at this stage of its development present an initial understanding of what existing drainage areas are tributary to the GMA and what amount of rainfall runoff (flow rates and volumes) are impacting key locations within the GMA. The results are a helpful tool for planning future drainage conveyance and infrastructure within the GMA. At this level, the results of the study are useful and represent a broad overall analysis of a large watershed area with many drainage elements.

Evaluation of specific drainage planning alternatives or evaluation of key areas within the GMA, such as new developments or existing drainage problems, will certainly require more detailed engineering analysis and survey on case by case basis.

A wide variety of information was carefully reviewed by TEC while assembling data and evaluating the characteristics of the GMA watershed. Some of the items that were obtained and reviewed include existing drainage reports, aerial images, and subdivision construction plans. A detailed field survey was completed and photographs were documented. In addition, several meetings were conducted with Town engineers and staff, and information from area residents was noted.

While working with the Town on the Master Drainage Plan, several key areas have been identified that have a history of frequent drainage problems and need immediate attention. It is recommended that the Town move forward and identify solution alternatives for these concern areas. A more thorough and detailed engineering investigation that goes beyond the scope of work associated with the regional master drainage plan is needed to address the current drainage problems. A summary of the identified areas of concern are as follows (refer to Figure TM-1 for location of detailed areas):

3rd and Welch

3rd Street at Bimson Avenue, just south of Welch Avenue, there is an existing concrete drainage crosspan. The crosspan carries runoff across 3rd from west to east and discharges into an existing drainage swale that runs south parallel to the railroad tracks. The existing drainage swale continues along the railroad for approximately 1,600 feet at fairly mild slopes until it daylights and tapers out into a grassed field area where runoff then sheet flows to No Name Creek. Continuing south, runoff ultimately drains to the Little Thompson River.

The existing drainage pan at Bimson and 3rd receives runoff from a mostly residential area with paved streets. The tributary area is generally bounded by Welch on the north, Bimson on the south, and extends from 3rd to almost North 8th Street. The basin area is about nine downtown blocks, or approximately 25 acres.

Historically, the intersection of 3rd and Bimson has become flooded during frequent storm events. Runoff water has been known to flood 3rd Street up to Welch Avenue. Ponding water has threatened nearby garages and residences. The drainage pan itself is beginning to be washed out, crumble, and undermine the roadway where runoff flows from the pan into the existing drainage swale. The upper portion of the grassed drainage swale has no positive slope, and in a few places has high points. As a result, water is standing in the swale and does not drain south as intended. Conveyance capacity of the swale is minimal. Runoff that does drain south along the railroad has been eroding the areas of the swale that are exposed and not vegetated.

In general, the drainage basin tributary to 3rd and Bimson at the existing drainage pan is too large to be conveyed only by street curbs and crosspans. In addition, it is not desirable to use railroad right-of-way to convey municipal storm drainage. Alternatives should be evaluated that can intercept the runoff and safely convey it south. Storm sewer options, water quality, and detention options are all possible combinations that can be investigated to mitigate this local problem area. This effort will require detailed survey of existing drainage conditions and determination of the area contributing storm drainage to the area.

Bunyan Avenue at Robert's Lake

Midway between 10th Street and 7th Street, just north of Robert's Lake, there is an existing 24-inch PVC culvert that crosses Bunyan Avenue. The existing culvert conveys runoff from the agricultural area north of Bunyan (Sub-basin BCNG from Master Plan) south into the discharge swale of Robert's Lake. The area of the basin tributary to the existing culvert is about 300 acres and is currently undeveloped. Preliminary development plans for the tributary area have been submitted in the past to the Town for review, and at that time these developments were known as "The Trails at Sugar Creek" and "Westhaven". Progress on these developments has been on hold.

Robert's Lake is a 2 acre stormwater detention area that receives runoff from the surrounding residential area. The discharge swale from the small detention area, which also receives any flows from the Bunyan culvert, continues east and conveys runoff into the Town's existing storm sewer system that ultimately discharges east into Bacon Lake.

Historically, the existing 24-inch culvert crossing Bunyan has not had adequate capacity to convey stormwater resulting from more frequent rainfall events. A significant volume of runoff is being stored against the north side of Bunyan Avenue and flows are overtopping the existing roadway. The roadway overtopping on Bunyan is at a location that has residences fronting the street. In addition, there is no defined and safe overflow path for water that overtops the roadway.

The runoff that is currently impacting the area is from undeveloped agricultural fields, and based on the Master Plan has peak flows of approximately 16 cfs, 101 cfs and 398 cfs for the 2-year, 10-year, and 100-year storm events, respectively. Development of the basin tributary to the existing culvert will increase the peak flows significantly and will make the existing drainage problem worse.

Planning and design should begin now to evaluate alternatives that improve the roadway crossing and incorporate stormwater detention. Roadway overtopping should not be allowed, and design should take into consideration the capacity of the downstream channel and capacity of existing downstream drainage facilities.

Detention Pond at 2nd Street

Recently, there has been interest by the church located on 250 Mountain Avenue to purchase the vacant land located behind the church and between 2nd and 3rd streets from the Town. The parcel is approximately 2.5 acres in size and is currently being used as a detention pond for a portion of downtown storm runoff.

The existing pond receives runoff from about 13 acres of the Berthoud downtown area and has two infall locations and one outlet structure. The tributary area to the pond is bounded on the north by Massachusetts Avenue, and the south by Mountain Avenue, on the east by 2nd Street, and on the west by 6th Street. The outlet structure releases detained flow into an existing 30-inch storm pipe that runs north along 2nd Street and then into an existing 60-inch storm pipe that discharges into Bacon Lake. Bacon Lake is just northeast of downtown and receives most of the rainfall runoff from the downtown area north of Mountain Avenue.

In order for the church to obtain the property, the detention pond and water quality component of the existing pond will need to be relocated/reconfigured. Options need to be looked at for new pond locations, and storm sewer sizing will need to be checked if detention is relocated further downstream in the existing system. Depending on detention pond geometry, a new outlet structure will need to be designed.

Bacon Lake Storm Sewer Infall

Bacon Lake is a naturally occurring lake and occupies a natural topographic low area just northeast of downtown. The lake is approximately 53 acres in area and is used to store and provide augmentation water to the Little Thompson River.

Bacon Lake currently receives most of the rainfall runoff from the downtown area of Berthoud north of Mountain Avenue. Most of the runoff into the lake is direct from the town storm sewer system and has not been treated by any water quality methods such as extended detention. However, recent Mountain Avenue improvements included an upgrade to the existing detention pond discussed above to include water quality capture. This is the only storm water that discharges into Bacon Lake that has gone through any water quality enhancement. Bacon Lake is basically functioning as an impoundment for storm water that has been shed from the town as it does not have an infrastructure that improves water quality.

It is in the Town's interest to look into providing better water quality enhancement to rainfall runoff before discharging into Bacon Lake, especially since the lake discharges directly into the Little Thompson River. In addition, the NPDES stormwater permit requires that stormwater quality be monitored and improved at discharge locations. Several options are available which include various configurations and different water quality methods.

Conclusion

In summary, all of the four drainage concerns mentioned above can be evaluated immediately. With the experience that TEC has with Berthoud's drainage system, alternatives and benefits can be easily determined to develop a capital improvement plan for future stormwater improvements. With solutions to each of the drainage concerns, the Town of Berthoud stormwater system will certainly improve in safety and environmental quality.



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Request for Proposal

Stormwater Master Plan

Town of Berthoud

807 Mountain Avenue

Berthoud, CO 80513

Issued: February 3, 2026

Attachments:

1. **Example – Consulting Services Agreement**

Overview

The Town of Berthoud, Colorado, is soliciting proposals from qualified planning and engineering consulting firms to provide professional services for the development of a comprehensive Stormwater Master Plan. The purpose of this effort is to evaluate existing stormwater and drainage infrastructure and to develop a long-term planning framework that includes cost estimates, feasibility assessments, and maintenance strategies.

The Stormwater Master Plan shall address current conditions and projected growth, with an emphasis on resilience, sustainability, and community benefit. Design concepts should integrate stormwater functionality with opportunities for recreation, cultural engagement, environmental stewardship, and long-term operational efficiency.

Berthoud is a statutory town located within Larimer and Weld Counties, Colorado. With a population of approximately 14,500 residents, the Town is experiencing rapid growth driven primarily by residential development, with continued expansion of commercial and public facilities. This growth necessitates a proactive and coordinated approach to stormwater planning and capital investment.

Background

The incorporated area of the Town of Berthoud encompasses approximately 8,408 acres, with a Growth Management Area (GMA) totaling approximately 24,977 acres. The Town lies within six U.S. Geological Survey (USGS) subbasins: Carter Lake Reservoir-Dry Creek, Mariano Reservoir-Big Thompson River, Boyd Lake-Big Thompson River, Handy Reservoir-Little Thompson River, Ish Reservoir-Little Thompson River, and Outlet Little Thompson River. These are further divided into local subbasins, incorporated Town most notably drains into the Bacon Lake, Dry Creek, and Little Thompson basins.

The Town operates under a Small Municipal Separate Storm Sewer System (MS4) permit and follows the standards and guidance of the Mile High Flood District (MHFD) and Larimer County Stormwater Design Standards, as adopted in Chapter 600 of the Town of Berthoud Engineering and Infrastructure Standards. Minor storm events are defined as 10-year flows and below (Section 602.6), while major storm events correspond to the 100-year runoff condition (Section 602.5). Berthoud does not currently maintain a stormwater Capital Improvements Plan (CIP). The most recent Stormwater Master Plan was completed in 2011.



Project Goals

The primary objective of this project is to develop a comprehensive Stormwater Master Plan that supports Berthoud's existing conditions and anticipated growth while promoting safety, sustainability, and fiscal responsibility. The Plan shall:

- Provide strategic guidance for stormwater infrastructure improvements that address both current deficiencies and anticipate future development demands.
- Identify opportunities for strategic land acquisition to support capital improvements, recreational amenities, and environmental preservation.
- Establish clear guidance for stormwater management practices in commercial, residential, and public development projects.
    - Develop prioritization methodologies and criteria weighting, to evaluate future stormwater projects.
    -
- Identify funding opportunities, including coordination with federal, state, regional, and other external funding entities.
- Maintain consistency in design character, functionality, and performance .
- Incorporate sustainable and resilient infrastructure solutions adaptable to evolving storm patterns and long-term maintenance considerations.
    - Evaluate the cost-effectiveness and benefits of low-impact development (LID), underground detention, and alternative stormwater management strategies.
- Provide Town staff with a comprehensive assessment of constraints, opportunities, and implementation considerations.
    - Coordinate stormwater planning efforts with existing land use plans and proposed developments.
    - Evaluate development capacity, redevelopment potential, and regional water quality facility opportunities.
- Identify opportunities to enhance riparian corridors, improve water quality, and integrate subsurface hydrology into long-term planning.
- Ensure compliance with applicable Town codes, engineering standards, and state regulations.
    - Where appropriate, recommend updates to Town codes and policies to support implementation of the Master Plan.

The Stormwater Master Plan shall also assess existing stormwater funding mechanisms and provide recommendations for establishing sustainable funding strategies to support capital improvements, operations, and maintenance. This includes evaluating development impact fees, maintenance fees, and alternative funding approaches to ensure long-term program solvency.

The Town of Berthoud is committed to providing safe, resilient, and distinctive housing, commercial, and recreational opportunities for its residents. The outcomes of this project should reflect and support these community values while equipping Town staff with the data, tools, and guidance necessary to proactively manage stormwater challenges associated with growth and climate variability.

Scope of Services and Anticipated Deliverables

Task 1: Data Gathering & Site Analysis

- Review existing conditions, prior studies, and background documents.
- Conduct site visits and analysis of topography, watersheds, access, environmental features, and planned development.
- Meet with stakeholders to define constraints.
    - Predict 3 stakeholder group meetings.

Deliverables:

A. Assessment of Constraints and Opportunities for stormwater management within the Berthoud GMA.
    a. Critique of current practices and compliance with small MS4 general permit.
B. Database of existing infrastructure and assessment of current condition.
C. Public Outreach programming.
    a. This may include at least 1 public meeting, 1 presentation to the Town Board of Trustees, guided/sample posting to social media.
    b. Suggested updates to Town codes.
D. Coordination of funding sources.
    a. Grant submissions or samples, table of fund sources and guidance for application.

Task 2: Conceptual Plan Development

- Evaluate hydrology in context of current and planned development.
- Delineate all subbasins and determine stylistic "identity."
- Prepare at least 2 design alternatives for each area/type of concern.
- Provide guidance on MS4 compatibility.
- Identify potential phasing and cost considerations.
- Provide updates to Town Staff on project milestones.

Deliverables:

A. Hydraulic and hydrologic models using appropriate software.
    a. Include all assumptions or justifications for models, provide narrative analysis of the results.
B. Selection of identified strategic corridors for Town staff to review.
    a. Narrative of stylistic "identity" for each subbasin.
C. Minimum 2 design alternatives for each identified area and type of concern.
    a. Assess feasibility of structural and nonstructural controls for each concern.
D. 10-year strategic land acquisition plan.
E. Include cost and implementation strategy for maintenance of existing infrastructure based on included prioritization matrix.

Task 3: Stormwater Management Plan

- Refine all data into conceptual design.

Deliverables:

A. Completed Stormwater Master Plan narrative, include all previous deliverables.
B. Artist renderings for selected strategic corridors ultimate conditions.
C. 10-year Capital Improvement Plan (CIP) for stormwater collection system.
D. Planning level design for 20-year stormwater CIP.
E. Opinion of probable costs for CIP.
F. Management plan for proposed infrastructure by type and ownership.
G. Template for assessing future construction projects.
    a. Include criteria for public and private developments.
H. Framework for designing multi-use stormwater system infrastructure.
I. Guidance and language for implementation of "cash-in-lieu" program for future developments.

Evaluation Criteria

Proposals will be assessed by a team composed of Town staff members with a multi-disciplinary background. Proposals shall be no longer than **15** pages, they will be evaluated based on performance in the following criteria, ordered by prioritization:

A. Project Team Qualification (30 points)
    a. Expertise and experience of personnel assigned to the Project.
B. Relevant Project Examples and References (30 points)
    a. Relevant project experience and performance.
    b. References from at least three past clients for similar projects.
C. Understanding of Project (25 points)
    a. Demonstration of understanding of local and state regulations.
    b. Demonstration of understanding hydrologic and hydraulic modeling and ability to effectively convey information to the public.
    c. Demonstration of knowledge of regional and local hydrology.
D. Fee Proposal (10 points)
    a. Proposed cost of project.
    b. Ability to perform and complete proposed work within the proposed budget.
E. Proposal Accuracy and Completeness (5 points)
    a. Clarity and conciseness in verbiage and exposition.
    b. Adherence to RFP requirements.

Submittal Process/Contact with Town of Berthoud Staff

If your company is interested in responding to this proposal, please send an email to the address listed below containing contact information for your firm, no later than 1:00 PM on February 19th, 2026. This is a non-binding statement, and this will form the list of parties who will receive notification of any questions and their answers. All questions for requests for clarification, or official submittals to this RFP should be made through the following email address:

Daniel Buendia, Town of Berthoud, Public Works Project Engineer
dbuendia@berthoud.org

Responses to any questions will be provided to all interested parties within 3 business days. If a more detailed response is required, you will be informed of a timeline in the initial response. The company that submits a question will not be identified in the public response. A consolidated list of questions and responses will be delivered to all bidding parties on February 25th, 2026.

Submittal Format

An official response submittal must be made by 1:00 PM on March 5th, 2026 and sent to the e-mail address above. Late submissions will not be accepted.

All material submitted regarding this RFP shall become the property of the Town. The Town has the right to use any or all ideas presented in reply to this RFP, regardless of the consultant awarded; disqualification of any consultant does not eliminate this right. The Town reserves the right to reject or accept any or all proposals or waive any formalities, informalities, or information therein.

RFP Timeline and Selection Criteria

All time frames are expected targets, apart from RFP due date of March 5th, 2026. Unless notified in writing, no proposals will be accepted after this date. All time listed is local time.

- Release of Request for Proposal — February 3rd, 2026
- Notice of Interest Email — 1:00 PM, February 19th, 2026
- Deadline for Questions on RFP — 1:00 PM, February 23rd, 2026
- Answers to Questions sent by email — February 25th, 2026
- Bid Reponses Due by Electronic Delivery — 1:00 PM, March 5th, 2026

The Town reserves the right to withdraw or cancel this RFP at any time. The Town also reserves the right to select any consultant that it believes can best perform the work, in its sole discretion, regardless of fee estimate. Any contract negotiated between Town staff, and the selected firm is subject to Town Board approval. The successful candidate will enter into a contract for services with the Town. A copy of the contract is attached.

WILSON & COMPANY
HIGHER RELATIONSHIPS

Town of Berthoud, Colorado

Stormwater Master Plan

Response to RFP
March 5, 2026



WILSON & COMPANY
HIGHER RELATIONSHIPS

4065 Saint Cloud Drive, Suite 100
Loveland, CO 80538
Phone: 970 834 6364
wilsonco.com

March 5, 2026

Mr. Daniel Buendia, Public Works Project Engineer
Town of Berthoud
807 Mountain Avenue
Berthoud, CO 80513

RE: Request for Proposal - Stormwater Master Plan

Wilson & Company, Inc., Engineers & Architects (Wilson & Company) is pleased to submit our proposal for the Town of Berthoud's (Town) Stormwater Master Plan. We view this effort as an opportunity to develop a forward-thinking, transformative framework that strengthens the community's long-term resilience and sustainability. With decades of experience in stormwater management and community-centered planning, our team is committed to helping the Town reduce flood risk, improve water quality, and enhance public well-being.

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Our approach integrates advanced hydrologic and hydraulic (H&H) modeling with meaningful stakeholder engagement, ensuring that recommended solutions are both technically robust and aligned with the Town's priorities. Our work with municipalities across Northern Colorado demonstrates our ability to deliver practical, phased strategies that address today's challenges while accommodating future growth, maximizing return on investment.

By selecting Wilson & Company, the Town will gain a partner that views stormwater not simply as a challenge, but as an opportunity to enhance community resilience, environmental stewardship, and overall quality of life. We are eager to apply our expertise and innovative thinking to support the Town and make a lasting, positive impact on its residents and natural systems.

Our primary point of contact for this project is **Dan Evans, PE, CFM,** who has 34 years of experience in stormwater master planning, stormwater capital project design, and floodplain analysis and permitting. The Wilson & Company team in our Loveland office is familiar with the downtown stormwater system through ongoing work on the 3rd and Massachusetts project and understands the unique challenges and opportunities within this area.

Thank you for the opportunity to submit our proposal for this important project. Please feel free to contact me at 970 420 1134 or Daniel.Evans@Wilsonco.com with any questions. We look forward to the opportunity to work with you on this impactful project.

Sincerely,

Dan Evans, PE, CFM
Project Manager, Water Resources Practice Lead, Northern Colorado

Brian McBride, PE
Vice President/Authorized Principal

We are in receipt of the 2011 Berthoud Storm Drainage Master Plan and the Town's answers to questions, issued February 24, 2026.

A. Project team qualification

a. Expertise and experience of personnel assigned to the project

The Wilson & Company team takes pride in our ability to provide local technical experts and corporate flexibility to address the full range of project and stakeholder requirements, resolve technical challenges, and deliver practical solutions to advance this project. Our core team's vast stormwater master plan experience offers the Town a reliable and knowledgeable team committed to the successful delivery to achieve the envisioned goals.

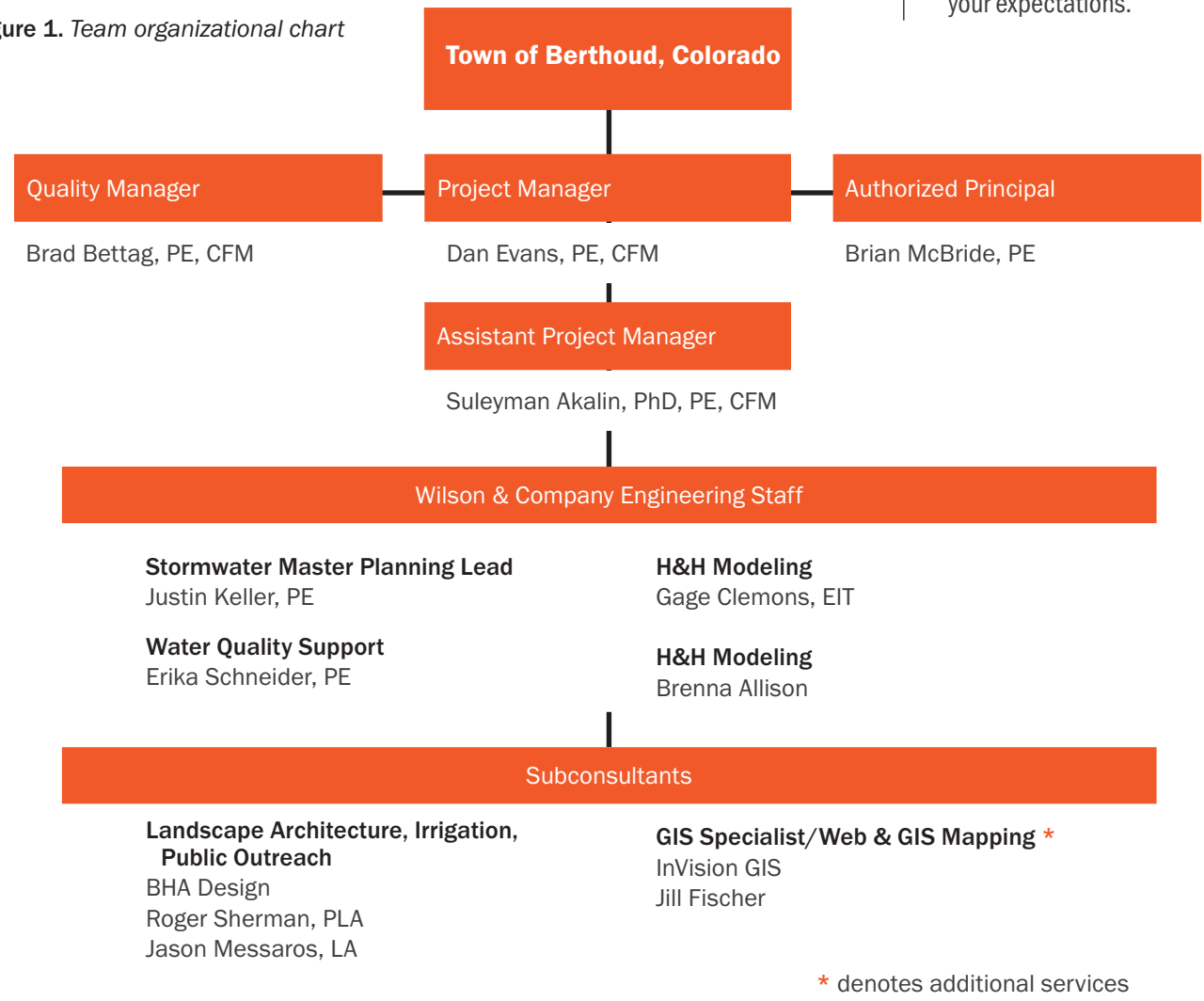
Our project team will be led by our project manager, Dan Evans, PE, CFM. Dan will be supported by a team of highly qualified professionals (**Figure 1**), including assistant project manager, Suleyman Akalin, PhD, PE, CFM; quality manager Brad Bettag, PE, CFM; stormwater master planning lead, Justin Keller, PE; and core experts in the areas of water quality, environmental permitting/cultural resources, H&H modeling, GIS, and survey/right-of-way (ROW).

Biographies for all team members shown in **Figure 1** are included on the following pages. We are happy to provide full resumes upon request.

Highlights of our team:

- Local presence—The majority of our team members are located in our Loveland office. They are supported by a network of multidisciplinary experts throughout Colorado and firmwide.
- Long working history—Our proposed team members have worked together for decades in various capacities, forming solid working relationships that translate to efficient workflow for the Town.
- Deep water resources capacity—Firmwide, our Water Resources Practice has over 50 water resources engineers, including five in our Loveland office and six in our Denver office.
- Recent experience with the Town—Collaborating with the Town over the past four years on the 3rd and Massachusetts Final Design project has given us a grounded understanding of your expectations.

Figure 1. *Team organizational chart*





Dan Evans, PE , CFM | Project Manager

MS, Civil Engineering (Emphasis: Hydrology & Hydraulics)

BA, Geophysics

Professional Engineer (PE): Colorado, #32081

Certified Floodplain Manager (CFM): #US-09-04711

Total Years of Experience: 35

Dan was the Stormwater Master Planning Manager from 2014 to 2022 for the City of Fort Collins Stormwater Utility, where he led a team that completed numerous stormwater master plan updates and reviewed several CLOMRs and LOMRs. This group also designed numerous stormwater projects for the City's in-house construction crew. He is currently the project manager for six stormwater master plan updates: three for the Town of Windsor, two for the City of Greeley, and one in Fort Collins. Dan was the stormwater and floodplain lead for the award-winning Poudre River Whitewater Park. Dan has extensive experience in all aspects of stormwater engineering, including watershed master planning, hydrologic modeling, hydraulic modeling, utility infrastructure design, floodplain permitting, and stream rehabilitation. Dan's public agency work history will provide guidance for delivery of community-accepted, Town-approved drainage solutions, and project deliverables.

Dan has been working with the Town and BHA Design for the past four years on the downtown 3rd and Massachusetts Street enhancements, including design of a storm sewer system. Not only has this effort resulted in improved infrastructure for a densely populated downtown area, it has also fostered excellent working relationships between Dan, the Town, and BHA, which we hope to continue to benefit the Stormwater Master Plan.

Relevant experience

- Sand Creek and Airport Basin Master Plan | City of Greeley | Project Manager
- Oklahoma, Fossil Ridge and River Ridges Basins | Town of Windsor | Project Manager
- City of Evans Master Plan Update | City of Evans | Project Manager
- McClellands Creek Basin | City of Fort Collins | Project Manager
- 3rd and Massachusetts Final Design | Town of Berthoud | Drainage Design Lead



Suleyman Akalin, Ph.D., PE, CFM | Assistant Project Manager

PhD, Civil Engineering (Emphasis: Hydraulics)

MS, Civil Engineering (Emphasis: Hydraulics)

BS, Civil Engineering

PE: Colorado, #41626

CFM: #US-09-04171

Total Years of Experience: 24

Suleyman is an expert in the fields of water resources, H&H, and floodplain studies worldwide, with a strong emphasis on projects throughout Colorado. He has extensive expertise in the design of commonly used hydraulic structures, including storm sewer systems, open channels, detention ponds, spillways, culverts, and energy dissipators. His capabilities also include hydrologic and hydraulic analyses of watersheds, reservoirs, and river basins; storm drainage master planning; stream stabilization and restoration; roadway drainage studies; and sediment transport modeling. Additionally, Suleyman is well-versed in local, state, and federal design standards, regulations, and permitting requirements.

Suleyman and Dan share a rich collaborative history spanning over five years, during which time they have delivered sustainable solutions for challenging stormwater projects. Their synchronized work style and shared commitment to providing excellent products to clients translate into a solid partnership for the Town.

Relevant experience

- Sand Creek and Airport Basin Master Plan | City of Greeley | Assistant Project Manager
- Oklahoma, Fossil Ridge and River Ridges Basins | Town of Windsor | Assistant Project Manager
- City of Evans Master Plan Update | City of Evans | Assistant Project Manager
- McClellands Basin Hydrology Update | City of Fort Collins | Assistant Project Manager



Brad Bettag, PE, CFM | Quality Manager

MS, Hydraulics and Hydrology

BS, Civil Engineering

PE: Colorado, #48334

CFM #US-17-09992

Total Years of Experience: 18

Brad has been focusing on flood hazard mitigation for over 18 years and has served as senior project manager for a wide variety of projects, including: Drainage Master Studies/Plans; flood hazard response planning; regional drainage facility design; and FEMA floodplain mapping. He is skilled in industry-standard H&H modeling platforms (1- and 2-dimensional), assessment and prioritization of areas in need of flood mitigation measures, and development of cost-effective, community-accepted drainage solutions that reduce risk.

> I was extremely impressed with Brad's professionalism, ease of collaboration, knowledge of flood-frequency analysis. His expertise and self-learning of B17C in this study have been most impressive to me...Thank you for the opportunity to collaborate with Brad." –Robert Jarrett, Ph.D. (Retired USGS)

Relevant experience

- Sand Creek and Airport Basin Master Plan | City of Greeley | Quality control
- Todd Creek Major Drainage Plan and FHAD | Mile High Flood District (MFHD) | Project manager
- 52nd/Emerson Water Quality Facility (Heron Pond) | City and County of Denver | Project Manager



Justin Keller, PE | Stormwater Master Planning Lead

BS, Civil Engineering

PE: Colorado, #63417

Total Years of Experience: 9

Justin's water resources and stormwater infrastructure design experience includes master drainage plans and studies, H&H modeling, and resource planning. He has a strong background in conducting large scale modeling efforts, preparing hydraulic reports, and managing project deliverables. Justin's responsibilities include executing design efforts, mentoring junior staff, and assisting with project manager tasks.

Relevant experience

- City of Wheat Ridge Storm Water Master Plan | City of Wheat Ridge, CO | Project Engineer
- City of Louisville Stormwater Master Plan | City of Louisville, CO | Project Engineer
- Southeast Metro Stormwater Authority (SEMSWA) OSP+ Master Plan & Storm Sewer Analysis | Centennial, CO | Project Manager
- North Branch Walnut Creek Culvert Crossing | City and County of Broomfield & Westminster, CO | Project Engineer



Erika Schneider, PE | Water Quality Support

BS, Civil Engineering (Environmental Engineering Option)

B.S., Biology (Aquatic Science Emphasis)

PE: Colorado, #41777

Total Years of Experience: 26

Erika specializes in urban drainage, stormwater, floodplain management, and storm system modeling for municipal, commercial, and residential development and transportation projects. Her technical experience includes watershed analyses, LID and stormwater management, grading and drainage plans, erosion and sedimentation control plans, water quality design, sanitary and water main system design, drainage memos and reports, and floodplain studies (LOMRs/CLOMRs). Erika produces drainage, erosion control, and stormwater management plan reports and provides quality control for construction plans. She is well versed in the MHFD Urban Storm Drainage Criteria Manual.

Relevant experience

- Spring Canyon Dog Park Bioretention | City of Fort Collins | Water Quality Engineer



Gage Clemons, EIT | H&H Modeling

Total Years of Experience: 4 | BS, Civil Engineering | EIT: Colorado, #78495

Gage has over four years of engineering experience in the Northern Colorado area with Wilson & Company, serving on various diverse projects. His experience includes designing storm sewer systems, detention facilities, and water quality devices, master planning, 2D H&H modeling, and civil site design. He has also assisted with small-scale geospatial data processing for numerous projects.



Brenna Allison | H&H Modeling

Total Years of Experience: 4 | BS, Civil Engineering | Fundamentals of Engineering (FE) Exam - Civil #21-752-08

Brenna has four years of engineering experience in the Colorado area. She has assisted in the design of storm sewers and waterline systems, detention facilities, master planning, alternative analysis for projects, plan production and technical report writing. She has demonstrated proficiency in H&H analysis, and has knowledge in AutoDesk Civil 3D, Bentley Design Suite, EPA-SWMM and PC-SWMM, and ArcGIS.

Subconsultants

BHA Design | Landscape Architecture, Irrigation, Public Outreach

For more than 30 years, BHA's work on public and private projects in Northern Colorado has helped shape the area into a world-class community that so many citizens enjoy and expect. They emphasize collaboration, creativity, growth and learning. Excellent communication is inherent in collaboration, and fun and enjoyment are off shoots of their desire for their work to be a rewarding part of their lives. The reward for them is sustainable, smart design for their clients – designs which make communities more beautiful and functional; designs which renew, restore, and artfully enhance the spaces in which we live.

InVision GIS | GIS Specialist/Web & GIS Mapping

InVision GIS is a consulting firm that believes in personal and efficient service. They work with clients to provide powerful GIS solutions that will complement their business processes, developing field forms and logs to transform field observations more efficiently into a working analysis and recordkeeping tool. InVision GIS provides services for small utilities, local governments, and private enterprises. Their areas of expertise include providing services for stormwater, wastewater, and electric utilities, building custom data models unique to each utility. They specialize in secure SQL Server ArcSDE implementations using versioning and archiving. Their custom training provides service support for any level of GIS implementation.

B. Relevant Project Examples and References

a. Relevant project experience and performance

b. References from at least three past clients for similar projects

The examples below demonstrate our experience in successfully delivering solutions for projects with similar challenges. We pride ourselves on having gone above and beyond for each project to deliver excellent products. Through these projects, we have gained valuable insights that we will apply to the Stormwater Master Plan project to achieve similar success. We encourage you to reach out to the references provided to inquire about our qualifications, performance, and the quality of our results.

Sand Creek and Airport Basin Master Plan (2 Basins)

Wilson & Company is working with the City of Greeley to produce a comprehensive stormwater master plan for two drainage basins in eastern Greeley. This plan will be used to guide development within the Sand Creek and Airport Basins, identify and prioritize capital improvement projects, and improve water quality within the basins and in the Cache la Poudre River. The project will produce a feasible, economical, and implementable conceptual design plan to stabilize drainageways, reduce flood losses, and improve water quality within both basins. The hydrologic model used for this master plan was CUHP-SWMM [Colorado Unit Hydrograph Procedure-Stormwater Management Model]. HEC-RAS 2D was used to analyze the 100-year floodplain for Sand Creek and Airport Basin.



Client contact

Mary Mateo, Stormwater Engineer II
City of Greeley
p: 970.371.9700
e: mary.mateo@greeleygov.com

Start: 1/2025
End: Ongoing

Similar elements to Berthoud Stormwater Master Plan:

- Stormwater master plan
- Cost estimate
- H&H modeling
- Alternative analysis
- Stakeholder engagement
- Survey

Similar team members:

- Dan Evans - Project manager
- Suleyman Akalin - Project engineer/ Assistant project manager
- Brad Bettag - QA/QC
- Erika Schnider - Stormwater Engineer
- Gage Clemons - EIT/Design
- Brenna Allison - EIT/Design



Oklahoma, Fossil Creek and River Ridge Basin Master Plan Updates

Wilson & Company updated the stormwater master plan for three basins in the Town of Windsor: Oklahoma, Fossil Ridge, and River Ridge basins. This included updating the hydrologic model, EPA-SWMM, to the most current version using PC-SWMM. This update utilized current LIDAR topographic data to delineate basins and identify conveyance elements. It also included updating the previous model with any new developments in the basins. The runoff information from these models was used to evaluate stormwater improvements to problem areas. The peak flows from the hydrologic modeling were used to identify problem areas in the basins. From the problem areas, various alternatives were evaluated based on cost and performance. These alternatives were presented to the Town using a decision making matrix and providing a selected alternative. A conceptual design and cost estimate was provided in the final report.

Client contact

Doug Roth, Civil Engineer IV
Town of Windsor
p: 970.674.2435
e: droth@windsorgov.com

Start: 1/2024
End: Ongoing

Similar elements to Berthoud Stormwater Master Plan:

- H&H modeling
- Alternative analysis
- Cost estimates
- Conceptual design

Similar team members:

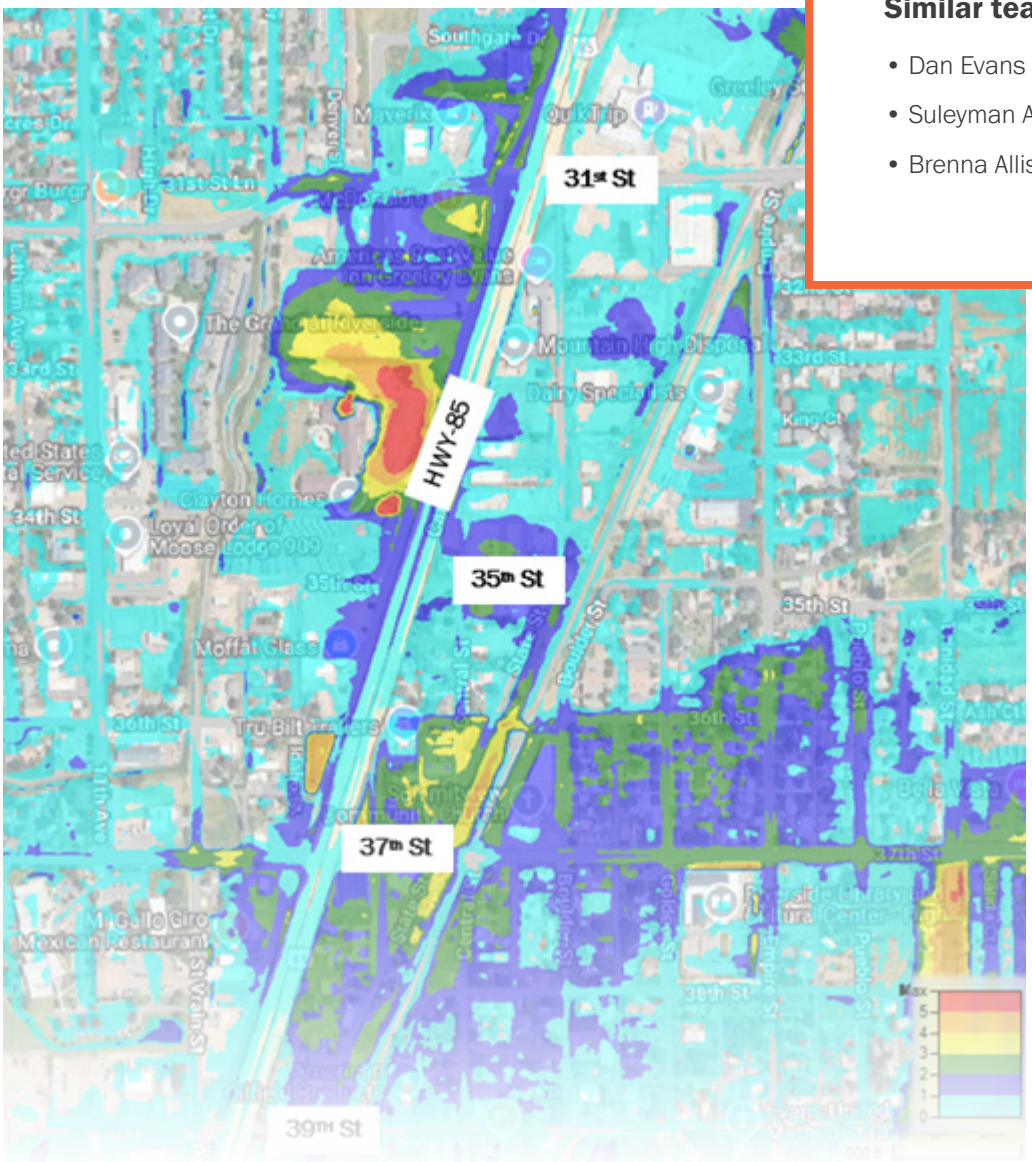
- Dan Evans - Project manager
- Suleyman Akalin - Assistant project manager
- Gage Clemons - Project engineer
- Brad Bettag - QA/QC





City of Evans Stormwater Master Plan Update

Wilson & Company provided the City of Evans with a Rain-On-Grid (ROG) two-dimensional (2D) hydraulic model that indicated 100-year flood depths throughout the City. We also provided the City with an updated prioritization list of stormwater capital projects based on ROG 2D modeling results, citizen complaints, City-identified problem areas, and the existing Stormwater Utility Master Plan. The update was used to support City planning and funding decisions for the next phase of stormwater improvements aimed at mitigating current and potential future flooding issues. In addition, we updated the cost estimate for their highest priority project (23rd Ave Outfall) that Wilson & Company is currently advancing to preliminary design.



Client contact

Shantanu Tiwari, Director of Engineering
City of Evans
p: 970-475-1170
e: Stiwari@EvansColorado.gov

Start: 9/2025
End: Ongoing

Similar elements to Berthoud Stormwater Master Plan:

- H&H modeling
- Cost estimates
- Capital Improvement Plans (CIPs)
- Conceptual design

Similar team members:

- Dan Evans - Project manager
- Suleyman Akalin - Assistant project manager
- Brenna Allison - H&H modeler

C. Understanding of project

a. Demonstration of understanding of local and state regulations
b. Demonstration of understanding hydrologic and hydraulic modeling and ability to effectively convey information to the public
c. Demonstration of knowledge of regional and local hydrology

Berthoud is growing rapidly, and its current town limits and Growth Management Area (GMA) create a hydrologically complex setting. Wilson & Company is passionate about stormwater planning and would be excited to help the Town prepare a stormwater master plan that protects public safety, supports responsible development, and streamlines capital investment decisions.

The 2011 Storm Drainage Master Plan (2011 SDMP) analyzed 13 major basins across ~20 square miles. Since then, Berthoud's incorporated limits have expanded and are non-compact, and the GMA spans ~39 square miles. Wilson & Company recommends updating and expanding the study area to the entire GMA to ensure consistent, basin-wide planning and equitable, defensible decision-making in terms of flood risks and development of regional solutions.

Development has tended to initiate upstream near I-25 and US 287, often preceding downstream improvements. Without an integrated strategy, downstream properties face increased flood risk. Wilson & Company will help the Town prioritize basin-wide improvements, identify strategic drainage corridors, and equitably distribute costs—ensuring effective, defensible, and resilient outcomes.

> Our recent work with Town staff on 3rd Street and Massachusetts (including the 2nd Street pond analysis) gives us strong operational knowledge of the downtown stormwater system, which informs this project.

Wilson & Company will review the 2011 SDMP, evaluate which recommendations remain viable, and incorporate them into a comprehensive plan for the full GMA. Our recent work with Town staff on 3rd Street and Massachusetts (including the 2nd Street pond analysis) gives us strong operational knowledge of the downtown stormwater system, which informs this project.

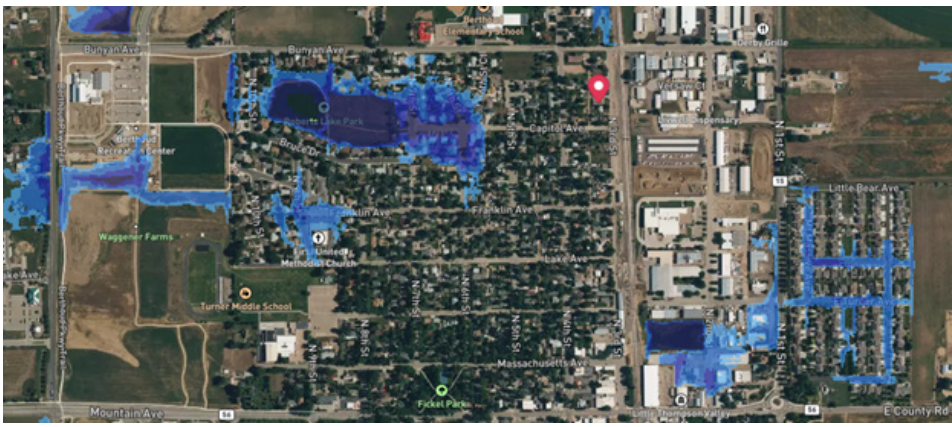
Critical Issue: Despite having an SDMP since 2011, portions of the Town have developed without maintaining historic regional flow patterns. Reestablishing and protecting historic drainageways is often the most effective way to reduce flood risk, protect public infrastructure, and enhance environmental corridors across the community.

To accelerate the master planning effort, Wilson & Company has already:

- Compiled available LiDAR data for the GMA and created a ROG HEC-RAS 2D model using 100-year, 2-hour rainfall to screen flood-prone areas (see **Figure 2**).
- Completed a high-level basin delineation with mapped concentrated flow and major flow paths.

These early insights focus on the work where it will have the greatest impact.

Figure 2. *ROG HEC-RAS 2D Flooding Extents*



Opportunities and constraints

BNSF Railroad (north–south through Town) – Acts as a drainage barrier to eastward flow. Multiple culverts convey stormwater under the tracks; a full inventory is needed. Improvements within the BNSF ROW will require railroad permits. **Wilson & Company's railroad division includes former BNSF staff who will guide permitting and coordination.**

Downtown / Old Town Systems (Mountain, Turner, Franklin Avenues) – These systems convey flow west-to-east under BNSF to Bacon Lake. The Bacon Lake Outfall (constructed in the early 1990s) was designed by Chris Carlson (now Loveland Stormwater Manager). Wilson & Company's recent assessments indicate Turner conveys approximately the 10-year event, while Mountain conveys roughly the 5-year event. **Wilson & Company is currently working with the Town to upgrade the 2nd Street Pond** (see **Figure 3**).

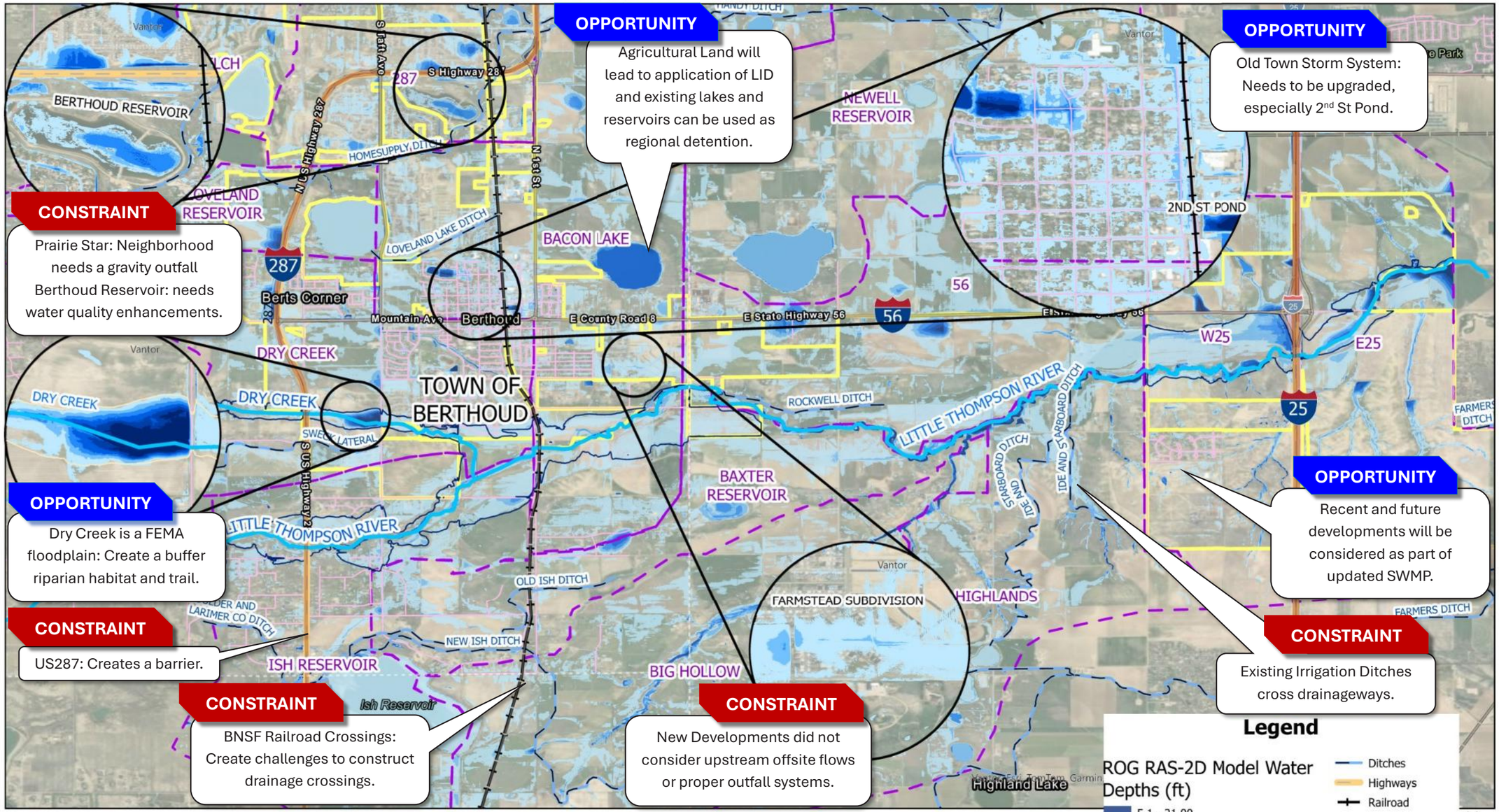
Prairie Star/US 287 Interface – Prairie Star was constructed without a gravity outfall. The detention outfall reportedly pumps under US 287 to downstream facilities that pass through Berthoud Reservoir, the Town's drinking water supply—a risk factor requiring strategic planning. The reservoir lacks a defined outfall and is treated in the 2011 SDMP as confined Basin 287.

Dry Creek – There is ongoing development being constructed around Dry Creek that requires that drainageway to be preserved since it is in the FEMA floodplain. **Wilson & Company staff are working with the developer on a LOMR to make sure no structures are impacted by this floodplain.**

July 18, 2023, Flood Event – Town Staff's memo, "Roadway Drainage Systems in Berthoud – Differentiating Functional Efficiency from Flooding Risks," provides critical context for system performance and community expectations (see Town's document center link: https://berthoud.org/DocumentCenter/View/4340/Roadway-Water-During-Rain-Event-2023-07-17. Farmstead Subdivision experienced street flooding along Nebraska Ave from the July 18th storm event.

Figure 3. *Detention Pond on 2nd Street*





Berthoud Master Plan Opportunities and Constraints Map

Scope of services

We have taken the tasks presented in the RFP and integrated them with our experience on master plans prepared for other communities to give the Town a robust, structured approach for a comprehensive stormwater master plan that will include a framework for a capital improvement plan to help guide the Town to a resilient and sustainable future.

Wilson & Company proposes slightly adjusting the tasks described in the RFP to match the typical workflow for stormwater master planning based on the proven process used for similar Northern Colorado and MHFD studies, as listed below:



Task 1: Data gathering and site analysis

A kickoff meeting will be held at Town Hall to compile all existing conditions information that the Town has, including GIS data, prior studies, drainage reports, and other relevant background information, and visit various problem areas that the Town staff are aware of. We can also visit major drainageways and structures in the Town, including the Little Thompson River, Dry Creek, Bacon Lake outfall, and the 8th Street drainageway. It is our understanding that the Town does not have any of the electronic information from the 2011 SDMP. However, Wilson & Company will use any pertinent information from the report to help progress this SWMP update.

A key aspect of our management approach will be one of routine collaboration. This means confirming that Town staff and Wilson & Company have a common understanding of project goals and the process required to provide the deliverables needed. It also means checking in routinely as the project progresses and at key milestones will be an essential way to keep the project on track.

It is our understanding that the Town was recently listed as a co-permittee for a Phase 2 Municipal Separate Storm Sewer System (MS4) through the Colorado Department of Public Health and Environment (CDPHE). This designation brings various regulatory obligations. Wilson & Company will review the Town's current practices regarding your MS4 permit and make recommendations in the SWMP for ways to improve compliance with your permit. We will also review the Town's stormwater code and recommend any changes that seem pertinent to meet the goals of this SWMP.

We will identify key stakeholders and schedule meetings. Wilson & Company will lead public outreach, including one public meeting and a presentation to the Board of Trustees. BHA will provide artistic renderings for the public meetings to help convey the conceptual design components of the SWMP. We will also leverage the Town website and social channels to gather resident input on drainage concerns.

Wilson & Company has a vast amount of experience with grant funding and is keeping a pulse on the ever-changing landscape in federal funding. We will provide the Town with recommendations for grants, including a table of resources and guidance on how to apply for the right grant or loan.

Task 2: Baseline Hydrology and Hydraulics

The baseline hydrology in the 2011 SDMP was performed using the Colorado Urban Hydrograph Procedure (CUHP) distributed by the MHFD and Storm Water Management Model (SWMM) distributed by the U.S. Environmental Protection Agency (EPA). This also aligns with the Larimer County Stormwater Criteria Manual adopted by the Town. This provides the most compatibility for future users, such as Town staff who may not have access to expensive proprietary hydrology and hydraulics software. MHFD updated impervious values will be used to provide accurate runoff results. For hydraulic calculations, we recommend HEC-RAS software distributed by the U.S. Army Corps of Engineers and the HY-8 culvert analysis tool created by the Federal Highway Administration (FHWA). For detention

pond sizing, we use MHFD-Detention worksheets. We will create a CUHP-SWMM model in PC-SWMM, which is a graphical user interface (GUI) for EPA-SWMM that has auto-delineation tools that help expedite the hydrologic model process.

We will also refine the ROG HEC-RAS 2D model that we created for this proposal. The refinement will occur in areas the Town deems necessary. The results of this model will provide 100-year flood depths and, if they fall within developed areas or existing street ROWs, will help identify problem areas. We will meet with Town staff and prioritize the problem areas based on our results and input from Town maintenance staff and citizen feedback.

Once this task is complete, we will prepare a Baseline Hydrology and Hydraulics Report that will include the following:

A. Modeling approach (rainfall, soils, imperviousness, inputs/assumptions).
B. Basin characteristics and distinguishing features.
C. Maps/tables of basin hydrology for 2, 10, and 100-year storm events, and flood depths for the 100-year storm event.
D. Identification of strategic drainage corridors and priority problem areas based on ROG results.

Task 3: Alternatives Analysis and Conceptual Design

Once we have the Town's approval of the Baseline Hydrology and Hydraulics report, we will advance to alternatives analysis based on the agreed-upon problem areas.

We will prepare at least two alternatives for up to 10 problem areas, most likely a detention alternative that will take advantage of regional detention facilities and a conveyance alternative. If it is an area for future development, we will provide guidance to help the Town meet its MS4 permit responsibilities. This will include guidance for detention, LID, and water quality treatment to reduce off-site flow to below existing conditions.

We will use the MHFD cost estimating spreadsheet (MHFD-MP Cost) to develop a conceptual cost for each alternative. We will provide the Town with a decision-making matrix so that they can choose the recommended alternative based on factors like cost, maintenance, flood risk, ROW/land acquisition, environmental permitting, feasibility, and any other factors that are important to the Town. Some recommendations may also be to restrict development in historic drainageways like Dry Creek or create buffer areas around ditches, reservoirs, or lakes as nonstructural controls. We will have a meeting with the Town to go over the decision-making matrix. Then, based on this information, the Town will select an alternative, and we will complete the conceptual design of the selected alternative(s).

At the end of the alternative analysis and conceptual design, we will create an Alternatives Analysis and Conceptual Design report that will include information from the Baseline Hydrology and Hydraulics Report. We recognize that Berthoud celebrates its small-town heritage built from agricultural roots, and Wilson & Company will work with the Town to develop concept plan improvements that are appropriate for this area. BHA will produce artist renderings for selected strategic corridors for public communication—highlighting flood conveyance and riparian enhancements aligned with Berthoud's agricultural heritage.

Task 4: Stormwater Management Plan – Capital Improvement Plans and Planning Documents

Once we have the Town's approval of Conceptual Design, Wilson & Company will work with the Town to prepare a prioritization list of the top ten projects that will include a strategic land acquisition plan for regional detention pond locations. This will include a cost and implementation strategy for the maintenance of existing infrastructure based on information gathered during the alternatives analysis and conceptual design.

Based on the phasing plan and stormwater priorities we have developed with the Town, we will work with Town staff to prepare a 10-year Capital Improvement Plan (CIP) for stormwater improvements that meet the Town's budget and needs. For the projects that don't make the 10-year CIP, we will work with Town staff to produce a planning-level 20-year stormwater CIP.

The CIP will also include a management plan for priority projects that will include the type and ownership of each improvement. Many of the improvements will be funded by the Town, but some of them could be funded by developers with a "cash-in-lieu" or developer repayment plan for regional detention ponds or stream corridors. We will provide guidance and language for an implementation plan for a "cash-in-lieu" or repayment plan for future developments.

Wilson & Company will work with Town staff to understand what future construction projects the Town is planning for in the next 10 years. We will develop a template of these projects that includes criteria for public and private developments. We will also provide a framework for designing multi-use stormwater systems, such as parks with regional detention ponds or stormwater conveyance corridors. We will provide a phasing plan so the Town can prioritize stormwater improvements based on annual budget limits. We always recommend starting at the downstream end of an area and working upstream. This will most likely be outfalls into the Little Thompson River, Dry Creek, or one of the many lakes or reservoirs.

Since 2020, Wilson & Company has helped clients secure and administer more than $347 million in infrastructure funding. We have seven grant writers who have assisted clients in securing competitive grants and loans from state, federal, and private sources. Our services include grant research, grant application preparation, technical writing, and grant administration. Our team excels in delivering grant and funding solutions for complex projects involving multiple stakeholders and government entities.

We understand that the most current formal stormwater guidance was developed in either the Denver area through the Mile High Flood District (MHFD) or in the City of Fort Collins. By adopting this proactive stance, the Town will save valuable time and resources compared to reacting once regulations are imposed. Leveraging our experience in assisting other communities with stormwater capital improvement plans, development standards, and operations plans, our approach prioritizes the Town's long-term needs, ultimately enhancing the quality of life for its residents.

D. Fee proposal

a. Proposed cost of project

b. Ability to perform and complete proposed work within the proposed budget

Wilson & Company acknowledges that the approved budget for this project is $200,000. This limits the amount of work that we think we can accomplish. However, because of the work we have put into this proposal, we can hit the ground running on the baseline hydrology, so we are committing to complete tasks 1 through 3 for the estimated fees below:

TASK	DESCRIPTION	ESTIMATED FEE
1	Data Gathering and Site Analysis	$19,000
2	Baseline Hydrology & Hydraulics	$83,000
3	Alternatives Analysis and Conceptual Design	$97,000
	Total	**$199,000**

Once we have finished the three tasks above, we will work with the Town to help you produce the planning documents outlined in Task 4. We believe the Town will gain a lot of knowledge and understanding of the stormwater impacts on the community after the results of the baseline hydrology and hydraulics. This could lead to a tighter focus on important areas of concern for the Town, like Downtown redevelopment, or the 1st Street, US287, or I-25 corridors. Because of the relationship that Wilson & Company and BHA have with the Town, we can work with you in greater detail for future projects in those areas.

Additional services

Although not mentioned in the RFP, we can help the Town upgrade your stormwater GIS database. We have an in-house grantsmanship/funding team, and InVision GIS on our team who have worked with several small communities in Northern Colorado, like Estes Park and Wellington, to “stand up” their utilities databases. The Wilson & Company/ InVision team relies on best data management practices and current ESRI data models in the creation, maintenance, and distribution of spatial data. All data is handled and produced with the Town’s goals in mind. When developing new datasets, we begin by identifying the requirements and needs of the stormwater data. We can help the Town identify, catalog, and evaluate both formal storm infrastructure, such as inlets, storm drains, culverts, bridges, detention basins, and informal storm infrastructure, such as irrigation ditches, berms/swales, stock ponds, and roadway conveyance. We can also publish all the information and modeling data gathered during the stormwater master plan to build a GIS storybook to help convey this information to the public.

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WILSON &COMPANY
HIGHER RELATIONSHIPS



Stormwater Master Plan

Daniel Buendia, Public Works Project Engineer







Benefits of a Stormwater Master Plan (SWMP)

Safety – 113 annual flood deaths and over $180billion/year in damage NWS 2024, JEC Report 6/2024

Health – The most common natural hazard, can increase morbidity rates 38% https://doi.org/10.1016/j.envres.2024.120263

Environment – Storms are leading cause of pollution transportation and streambank erosion

- Encourages community members to **actively participate** in decisions that affect their environment and health.

- Puts communities in charge of their future by being more **proactive** and less reactive.

- Creates a **Comprehensive Approach** to reduce stormwater impacts over time and build resilience.

- Supports **balanced** planning and investment.

- Increases **accountability** and vested interests of staff, increases interdepartmental coordination.

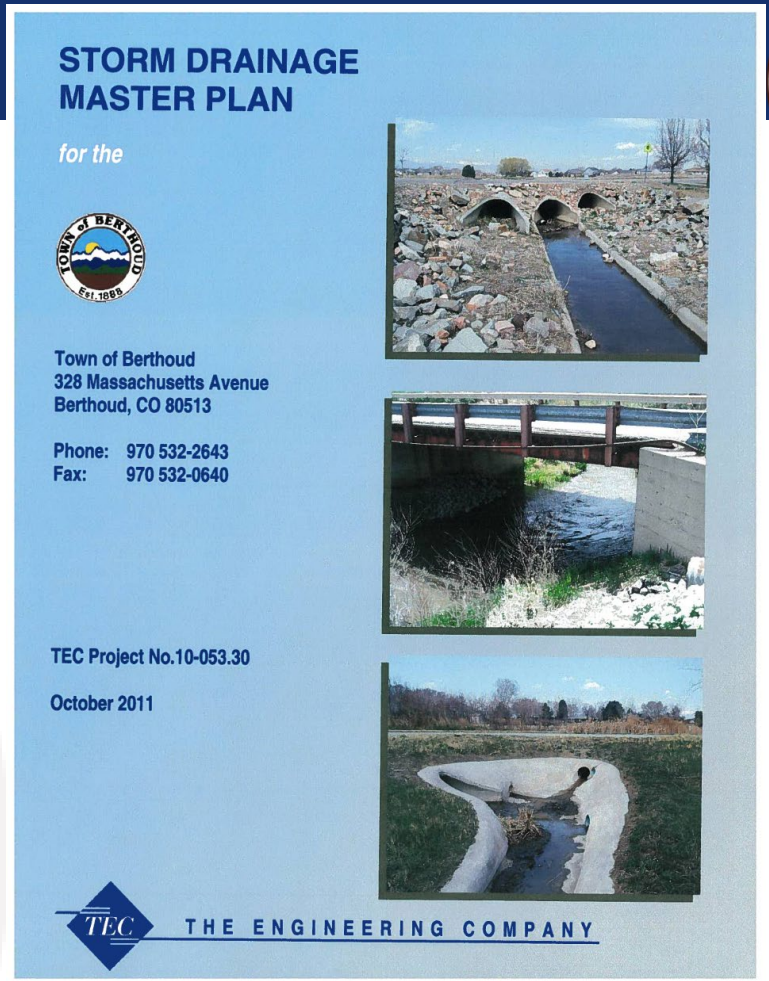
- Provides **certainty, predictability, and transparency** to developers and community members.

- Reduces flooding and pollution with **reliable infrastructure** that attracts and sustains businesses and residents.

Existing SWMP

2011 Storm Drainage Master Plan by TEC

- Outdated
- Does not provide design alternatives
- Does not provide guidance for developers
- Does not provide guidance for Town staff
- Limited H&H modeling capabilities
- Cannot accommodate recent growth
- Focus is too broad
- Does not account for modern weather patterns



SWMP Deliverables

Task 1: Data Gather and Site Analysis

Deliverables: Subbasin delineation, alternative funding opportunities, public outreach, assessment of current infrastructure.

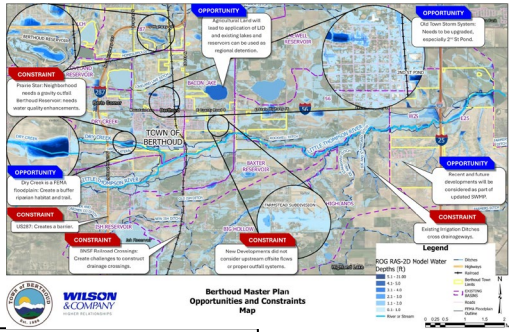
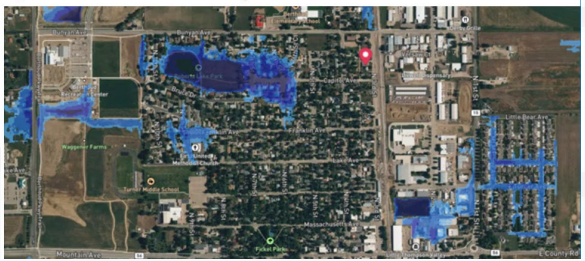


Figure 2. *ROG HEC-RAS 2D Flooding Extents*



Task 2: Conceptual Plan Development

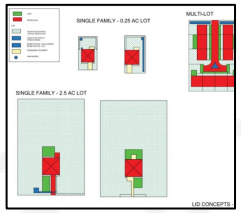
Deliverables: H&H model, strategic open space plan, design alternatives and cost estimates.

Task 3: Stormwater Management Plan

Deliverables: Stormwater Master Plan narrative, capital improvements plans (CIP) for 10- and 20-year growth, cost estimates for CIP, guidance for assessing development and commercial stormwater projects.



How to use the SWMP

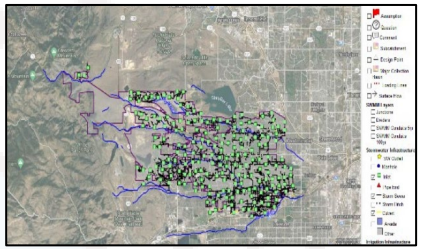


Assess proposed developments for conformance with recommendations



Create reliable models to effectively manage growth

Evaluate plans in context of system-wide drainage



Develop stormwater mitigation criteria for proposed designs



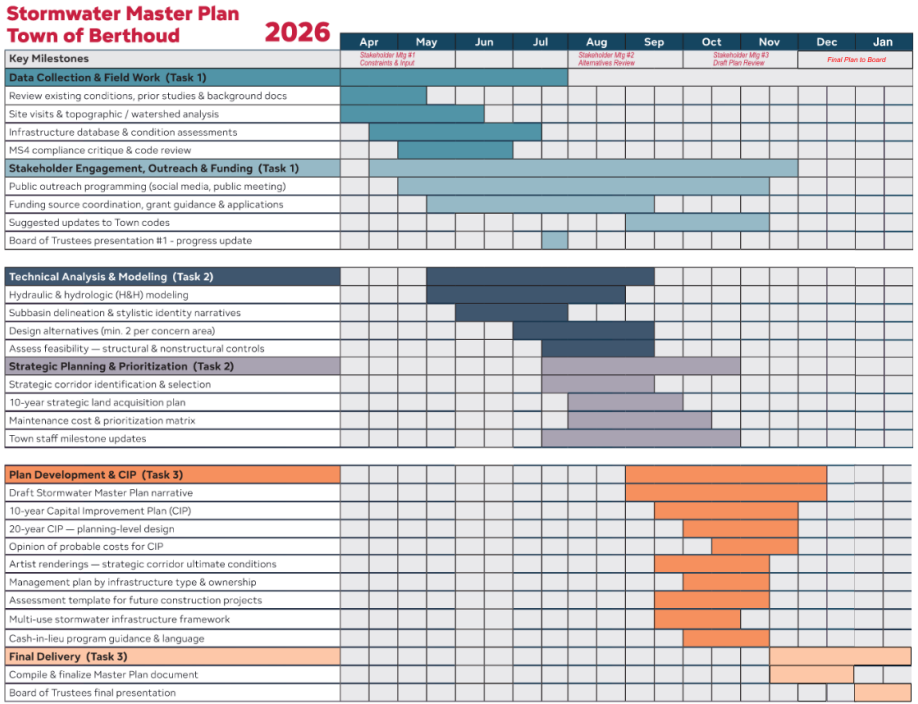
Increase transparency with developers, staff, and the public with education and outreach



Tentative Schedule

2/3/2026	RFP Published
3/5/2026	RFP Closed
4/28/2026	Board Approval
5/22/2026	Contracts fully executed
9/2026	H&H models complete
1/2027	Concept Designs complete
2/2027	10-year CIP complete
3/2027	All deliverables complete

Complete Tentative End of contract period



Board of Trustees Feedback

Today we are looking for overall approval of the proposal from Wilson & Co.

Authorize the Town Administrator to enter into an agreement with Wilson & Company for the creation of a Stormwater Master Plan, subject to approval of the Town Attorney.



Newell Farm Park Concept Update

Keith Knoll, Public Works Operations Manager







Park Planning Process

PORT Inventory

Early planning phase that defines a park's overall vision, goals, and layout, exploring ideas and possibilities without finalizing detailed designs, costs, or construction methods.

Conceptual Design

Construction Documents

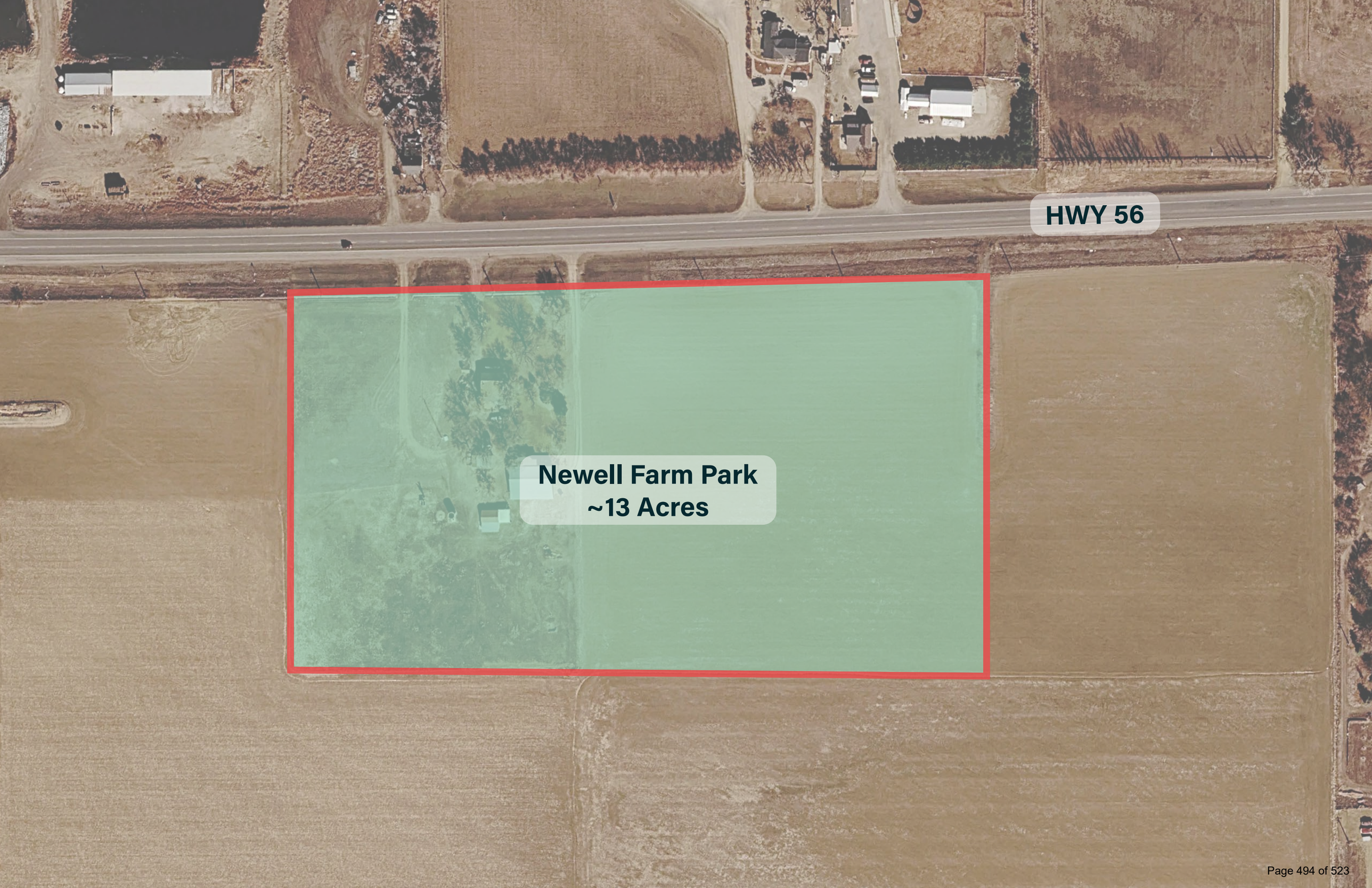
Property Construction

Newell Farm Park

Berthoud, CO

Board of Trustees Meeting 4/28/26


287
Downtown
Berthoud
Newell Farm Park
~13 Acres
HWY 56
I-25


HWY 56
Newell Farm Park
~13 Acres

Amphitheater Top Priorities

Family-Friendly – non-alcoholic (though currently patrons permitted to BYOB, free parking)

Impeccable Sound – efficient and effective network of speakers

Provide Shade - trees/tensile shade structures

Visual Cues - maintain rural/farming identity and Newell history – keep sense of place



Board of Trustees Top Priorities *(1/27/26 Meeting)*

- Develop a 1,500-person amphitheater integrated within a passive, naturalistic park setting
- Include the infrastructure required to support national touring talent
- Support the concept of a soft-surface parking lot
- Potential to partner with a nonprofit organization to manage bookings
- Locating horseshoes, bocce courts, and a children's play structure near the amphitheater is acceptable
- Plumbed restrooms for performers are a priority
- Retain the existing stage for smaller-scale performances
- Utilize bike parking and other transportation options to reduce the parking needs
- Keep the farm feel and make the project unique to Berthoud

Passive / Naturalistic Park

Proposed Program and Amenities

1. 1.5-2-acre native parking lot (mowed for events) - size TBD
2. (2) Individual picnic shelters
3. Natural area
4. Trails throughout the site
5. Public Art
6. Horseshoe pits
7. Nature based playground
8. Amphitheater - 1,500-person (¾ acre) + performer loading
9. Green Room
10. BBQ grills
11. Benches
12. Fire pit
13. Hammocks
14. Moveable seating
15. Drinking fountains
16. Portable restroom enclosure *(assumes port-o-lets are brought in for concerts)*
17. Tree, shrub, grass, and perennial planting
18. Food and beverage - parking and hook-ups for food trucks

Required improvements

1. Electricity
2. Irrigation
3. Security lighting
4. Trash receptacles
5. Water service
6. Bike racks
7. Landscaping





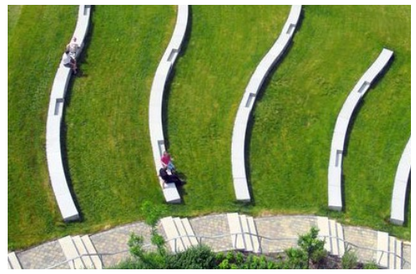

Google Maps








CORN MAZE
PLEASE
STOP

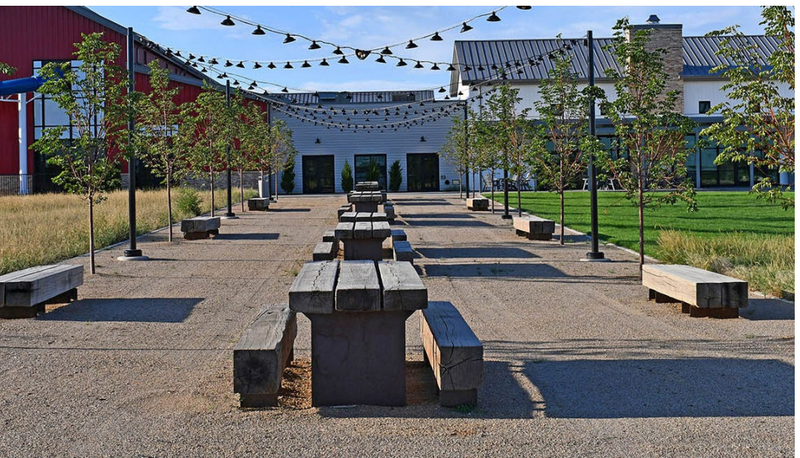



CHIEF














gas feuerstelle outdoor






DREAMY DRINKS
Tea • Smoothie • Fruit Tea
MENU


















80 Years Old
& Still Got My Stud





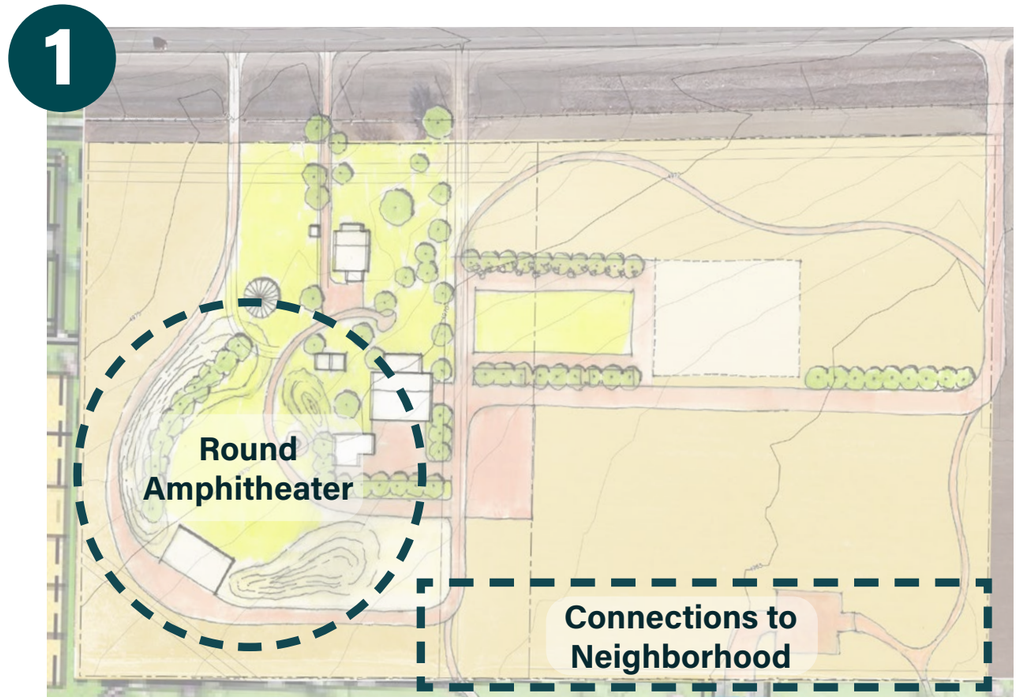


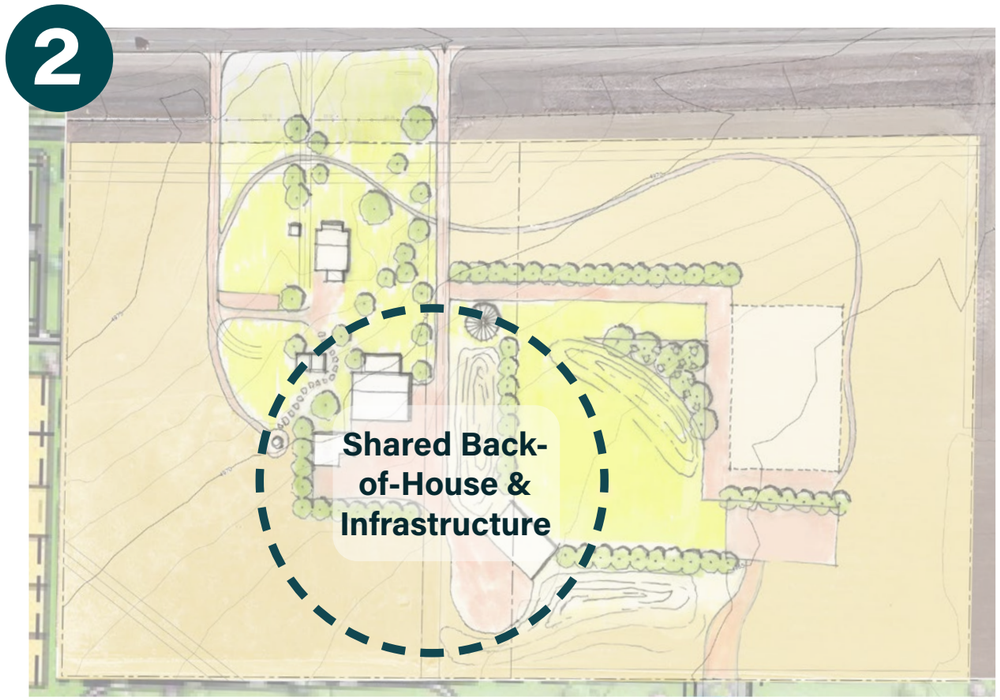


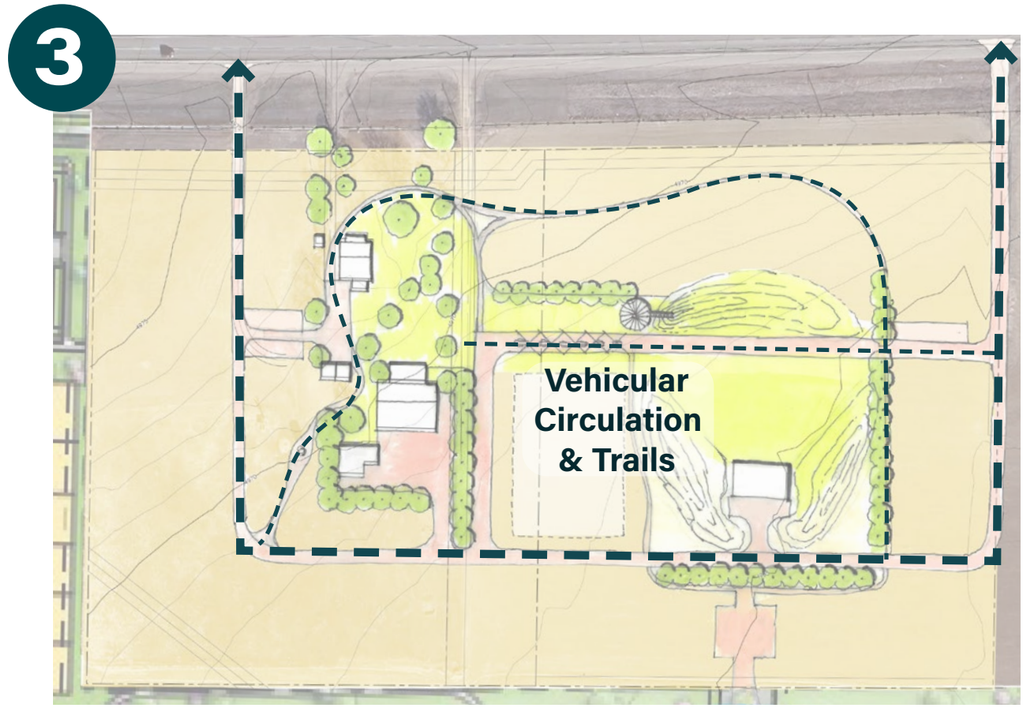
Previous Alternatives - Preferred Ideas

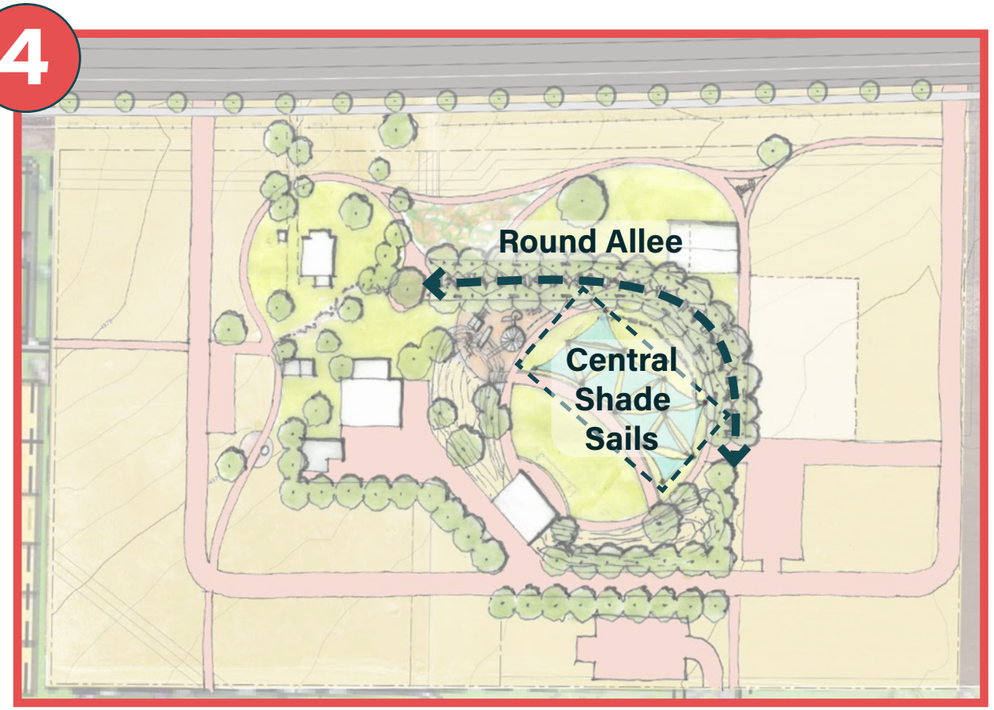
Presented 3 alternatives to PORT & designed hybrid concept from desired features, including:

- Round-Shaped Amphitheater
- Connections to adjacent Neighborhood (dead-end parking lot & trails)
- Shared back-of-house & infrastructure between stages
- Large vehicular & pedestrian loops
- Rounded tree / pinic allee and centralized shade sails





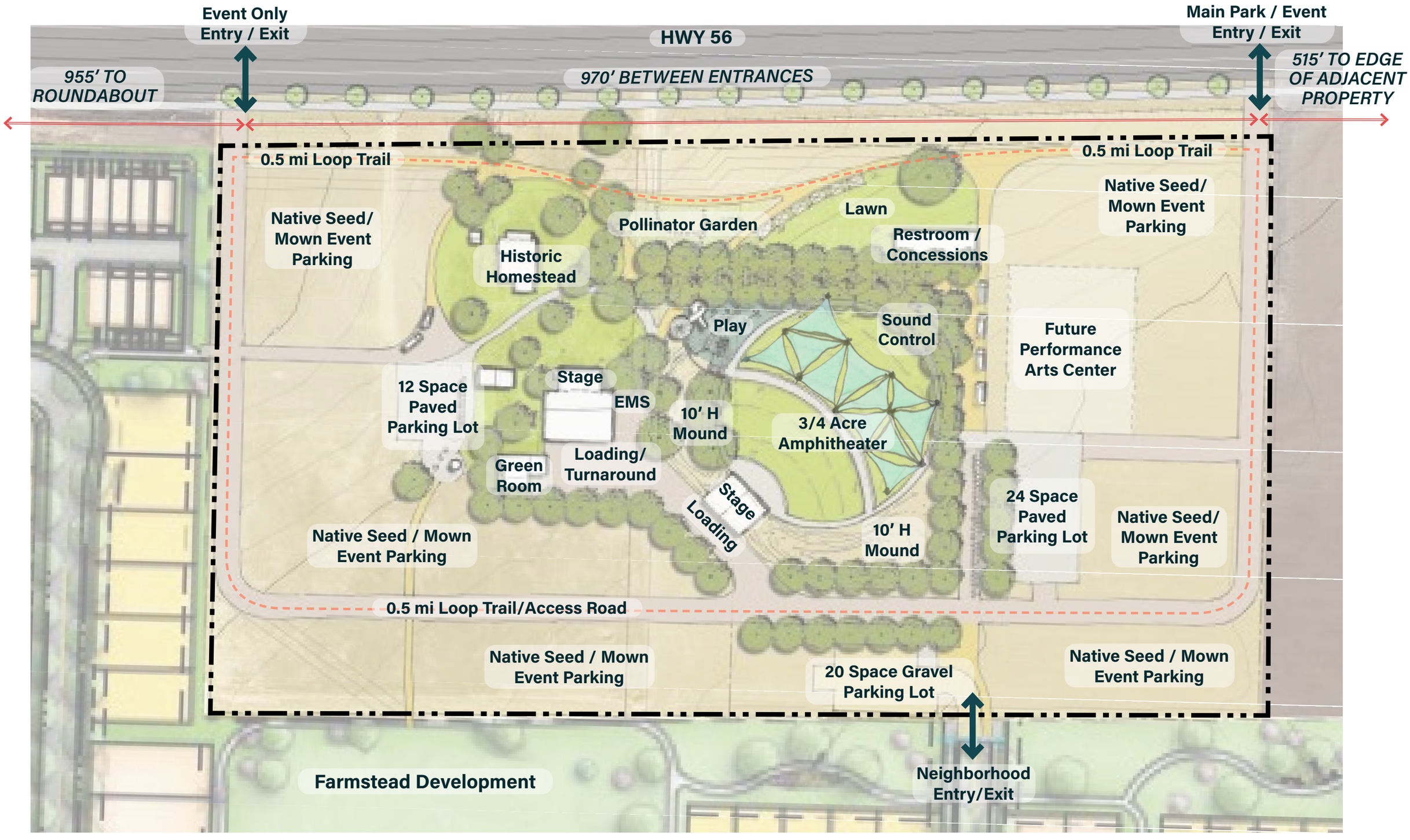




PORT Feedback

- They envisioned the playground to be more passive, natural play style. Not a destination playground
- Prefer curvy allee
- What does CDOT consider an event?
- Recommend a sun/shade diagram to confirm where the shade will be during normal show times.
- Shade sails in center of large amphitheater is preferred
- Confirm restroom types. Pre-development and post development.
- What is road material planned to be? Will mown parking track mud?
- Where would food trucks be, and do they have easy in-out access? Same thing for emergency services
- Is the silo safe during events? How would it be managed?
- Better labels on paths and roads for what they are.

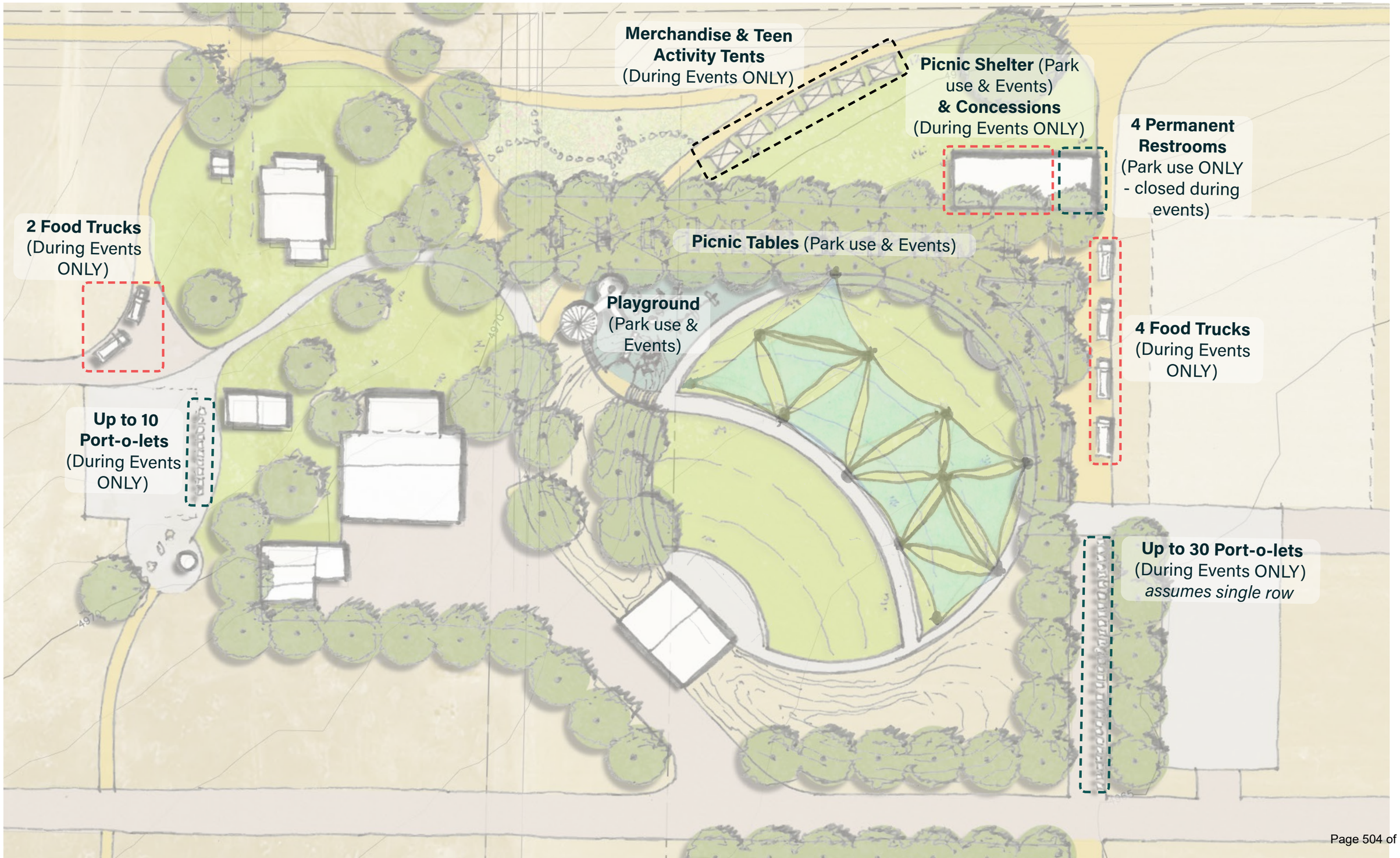
Proposed Plan



Proposed Plan - Enlargement



Proposed Plan - Temporary Uses



Proposed Plan - Event Security



Permanent Fencing



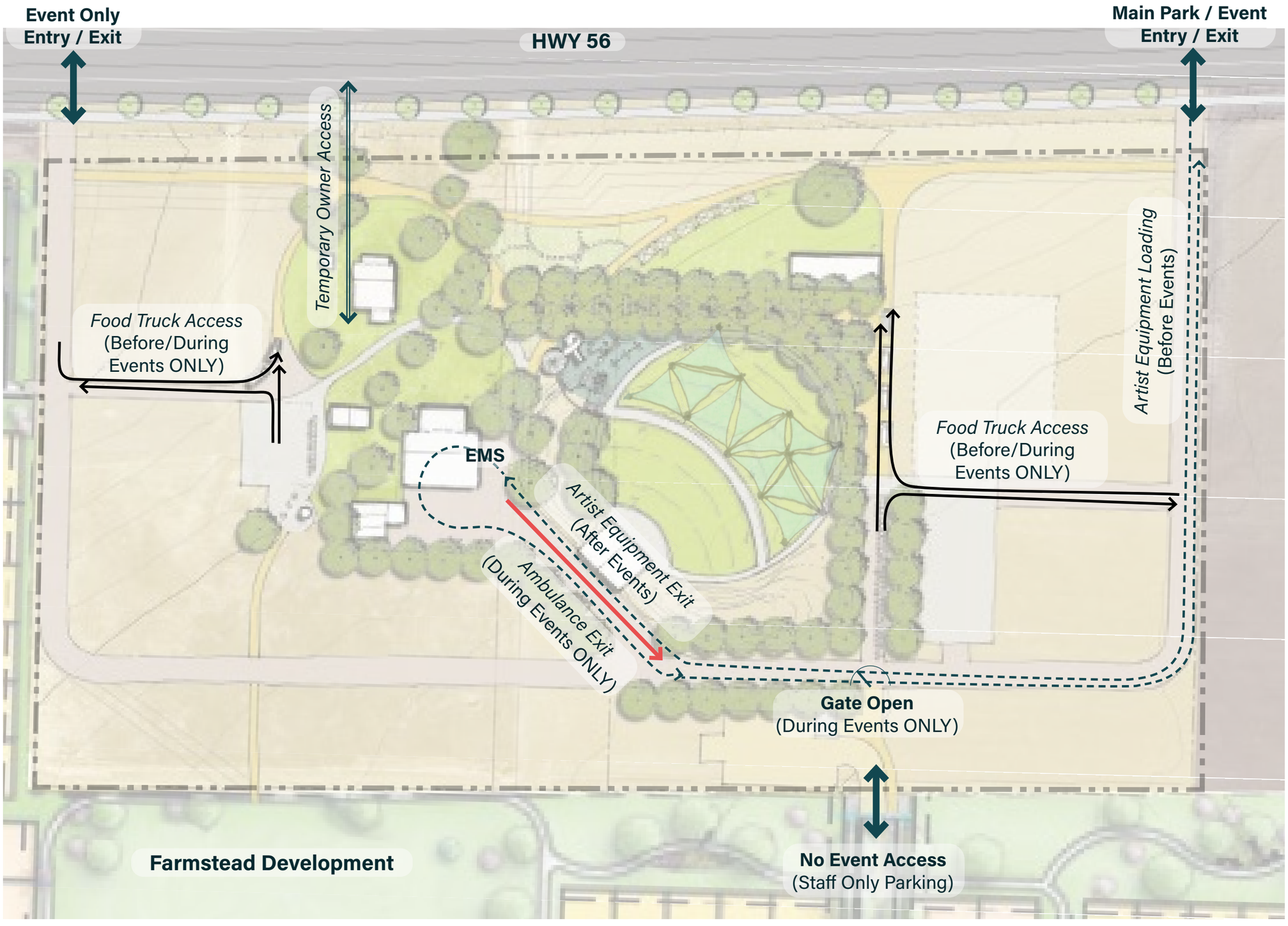
Temporary Fencing

LEGEND

- Permanent Fencing
- Temporary Fencing
- Gate Location
- Temporary Gate Location
- Property Line



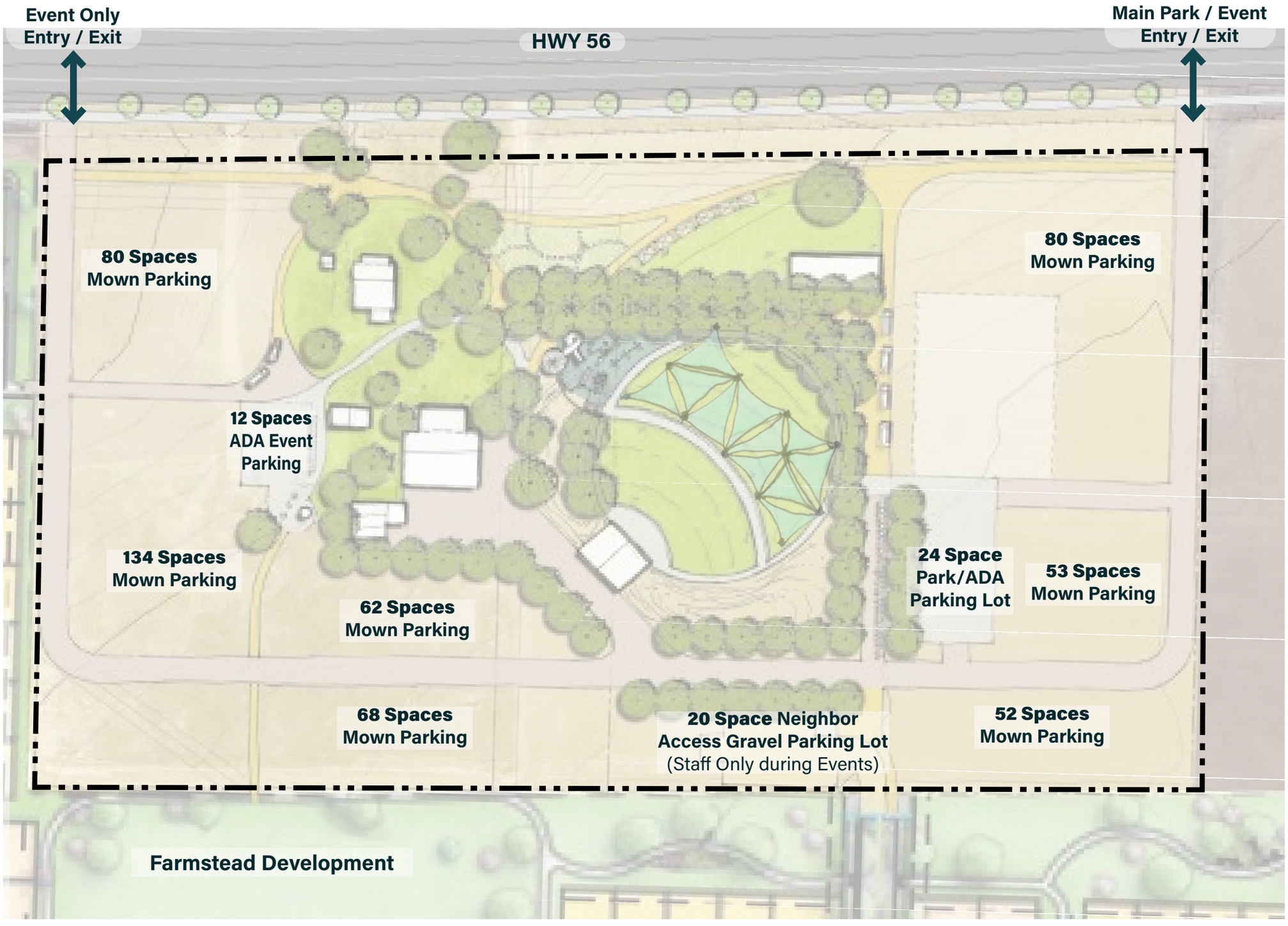
Proposed Plan - Event Site Access



LEGEND

- Event/Park Access
- Artist Equipment Access
- Food Truck Access
- Emergency Access
- Temporary Owner Access
- Property Line

Proposed Plan - Potential Parking Areas



585
Total Parking Spaces

*Assumes **10x20'** stalls and **24' drive aisles** throughout site*

Proposed Plan

- Visitors welcomed by historic homestead from West Entry
- Shared infrastructure for both stages with loading zone separated from the general public
- Vehicular roads and crusher fines paths can be used for 0.5 mi loop trail when concerts not taking place
- Earthen mounds minimize acoustic bleed between stages & to neighboring homes
- Future connection between Performance Arts Center and stages with picnic allee
- Passive space and play flank stages
- Play centered between stages
- Over 585 10'x20' Parking Spaces using mown native areas



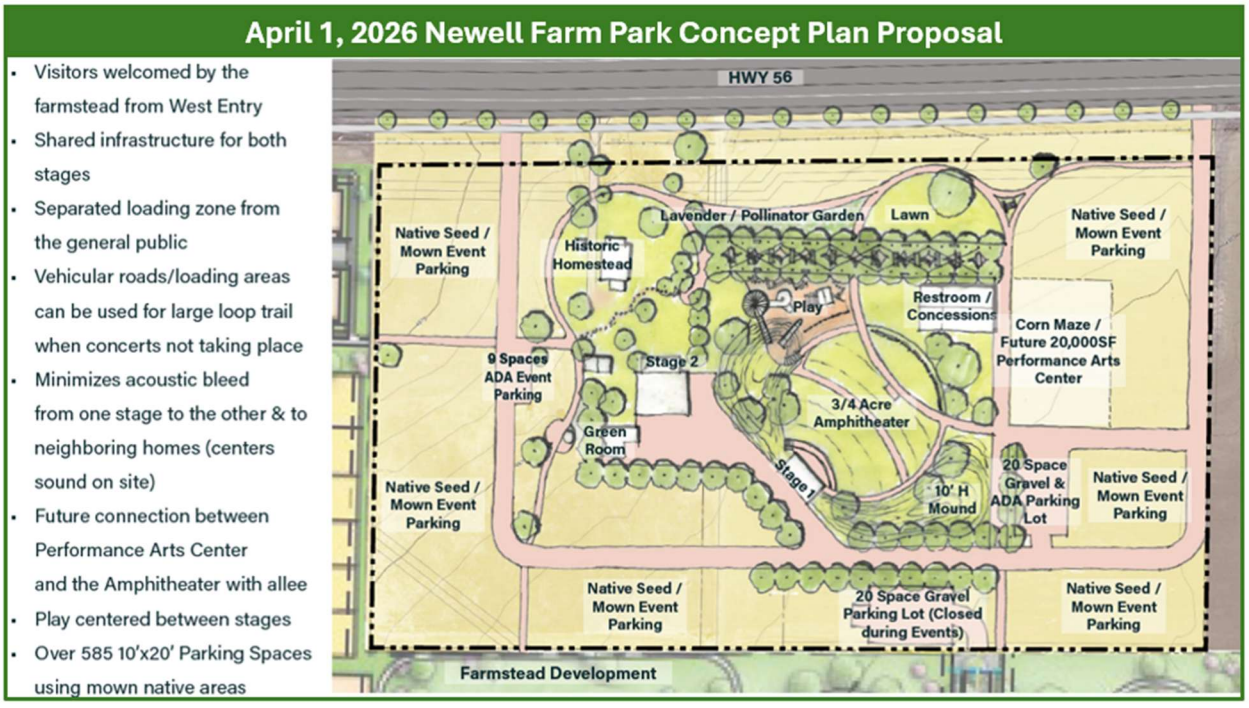
Feedback Regarding the April 1, 2026 Newell Farm Park *Draft* Concept Plan Created by Wenk and Semple Brown

Sarah Lincoln & Butch Hause April 13, 2026

On April 1, 2026, Keith Knoll presented to the PORT an excellent *draft* Concept Plan for Newell Farm Park, created by Wenk and Semple Brown. This version incorporated PORT and Town Staff feedback from prior meetings, including the March 4th PORT meeting. Once again, the PORT gave great feedback, and we also provided extensive verbal feedback during this meeting. Since then, we decided to put our points in writing and take time to explain the nuances because, with a design like this, the details matter and we didn't want them to get lost. We want to note that this writeup complements our November 5, 2025 overview for Wenk and Semple Brown.

If possible, we would like to discuss relevant points (bolded in this writeup) with Wenk and Semple Brown before they create the final Concept Plan because several impact the layout of the grounds. We understand that some points will be better considered during the Construction Drawing phase, and therefore we can promise to keep this meeting to an hour or less.

Our feedback here refers to the following drawing from page 15 of the April 1 package.



We also refer to the Curved Allee rendition on page 11 of the April 1 package.

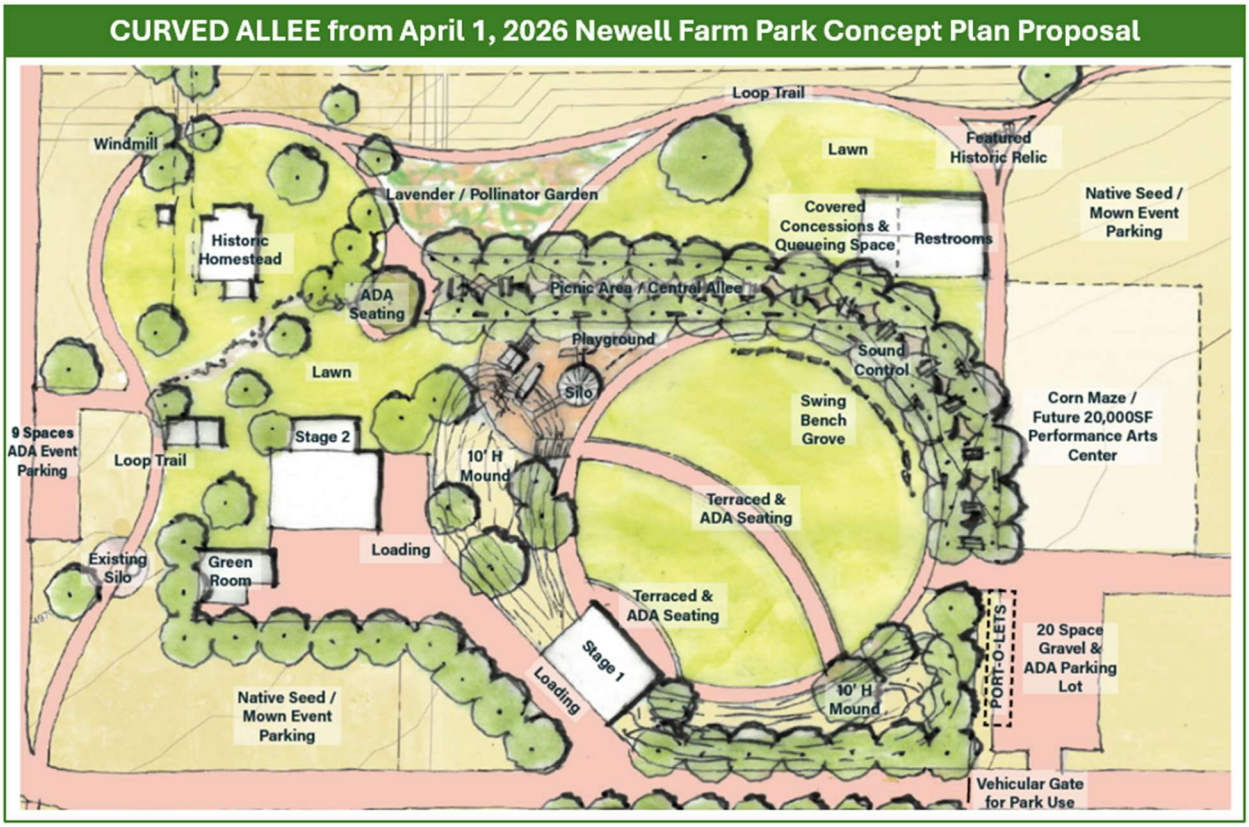


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Community Arts Center 8

Personal 9

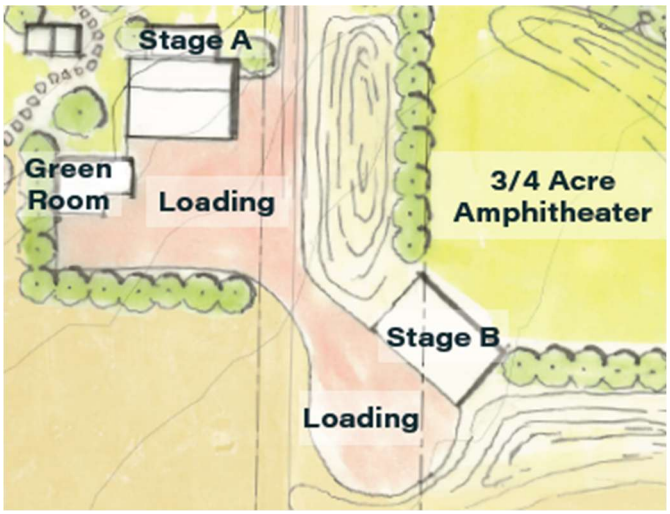
Thank You 9

Talent, Load-In, and Hospitality

Since the talent is what makes or breaks a venue, we'll talk about this first. We have learned that comfortable performers put on better shows and they're willing to offer good rates to return.

Describing how to get to a venue is easy when we have a solid address because all performers use their GPS on their phone. But describing how to get backstage within a site can be very difficult. **Given that the performers are usually asked to arrive for their soundcheck about 4 hours before their show, how will we tell them where to find their green room? How will we tell them where their box truck can load in? Where will they load in their merchandise?**

Alternative 2 on March 4th provided a nice turnaround. We need this to remain so that a truck can pull a u-turn, park in the curve across the way, and not backup to get out. This can be built within the road structure. It doesn't have to be at the end of a road.



Lighting and security will be needed in the loading area, so that folks feel safe going out to their cars or the truck. **We recommend getting rid of the berms near the stage and instead using 5-foot fencing with gates and security personnel. National acts usually require this.** In fact, the whole backstage area will need to be gated and secure.

We understand that Stage B will include a Green Room for the talent that is performing there. We recommend a hospitality room of at least 16' x 20' with a sink, 2 toilets, 2 changing rooms, 2 makeup mirrors, tables, comfortable seating, and a kitchenette for serving backstage food. The Rialto has a great Green Room which we can offer photos of, when it's time.

Performers prefer real toilets over trailers, but they will not complain if the bathrooms are clean and don't smell. **We definitely need to upgrade to real restrooms when Farmstead offers sewer utilities, so we'll want to make provisions for that upgrade.**

We also believe that Stage B needs an equipment room of at least 12′ x 12′. The stage itself will be comfortable for national acts if it is 30′ x 40′. The rigging needs to fly and stay put, with a big door or doors that house it against theft and weather.

And all of this needs to be ADA compliant as national performers often have health issues.

In addition, we need a hospitality area for volunteers where we can distribute food, supplies, name badges, water, and we can gather to train them. We would recommend that it be south of the barn and south of the gated backstage area, where (below) we recommend that we make room for volunteer parking. Even if it's in a tent, this would be a good place for them, but we'll need a portalet nearby.

Parking and Gates

Since parking is what makes or breaks a patron's or volunteer's enthusiasm as they enter the venue, we'll talk about this next. We have guidelines for our parking crew which explain that their smile is the first thing that patrons see. We also have a parking guide that we will gladly share which shows where our regular parking spots, ADA spots, and gate line (i.e., line of patrons waiting for the gates to open) are located.

We would like to note that page 14 states that there are 585 parking spaces in the mown fields, but we calculate 557 based on the numbers provided.

We feel that the road in the west mown field needs to run along the west-most boundary line in order to keep patrons safe as they walk to the venue from their cars. We don't want people cutting in front of cars as they carry their camp chairs and such to the gate. We recommend turning cars nose-north as it enters, so that they don't have to back up in the dark at the end of the night. This way, most folks drive north through the field to get to the exit. The folks in the south of the west field might have to be treated differently.

We also wonder how patrons will know to park in the west lots versus the east lots? One thought is to designate the east lots as paid lots since they're closer and have better ADA access, and to sell these passes ahead of time at the time a patron buys their tickets. Then "PAID LOT" signage could help. Starlight Amphitheater in Kansas City does this. They have paid parking that is closer, and we pay extra to get close-in ADA parking that is only steps from one of the gates. ADA parking needs to provide LOTS of room for vans and scooters and such. We use these lots and we can attest to the fact that ADA patrons tend to have questionable parking skills, so they need room to make mistakes.

That said, **we need a safe way to drive OUT at each of the two access points, so that cars can get out if they're in the wrong lot, or the show is sold out and they don't have tickets.**

For the Farm Concert, we check folks' tickets once they're inside the west parking lot and we send them out our driveway if they don't have tickets to the show, since it's always sold out.

We agree with the PORT that the south parking lot that is labelled "Closed During Events" should be opened to bicycles and maybe golf carts during events. And we would suggest that this parking lot be monitored (and lit) so that no theft occurs during a show.

We also need central parking for volunteers and staff. Most of these folks will arrive early. For the Farm Concert, we place them south of the barn, but that needs to be gated off for future National Acts. We make room for 30 cars since we have about 60 volunteers on the day of show. **We recommend that they gather near the south property line. Below are two options.**



We need to think about where the gates and waiting lines will be on both the east and west sides, so that patrons are out of the way of traffic as they wait to get into the venue after they park. Farm Concert patrons start arriving at noon for a 4pm show because seating is general and they want to ensure they get their special spot. We manage this by having a hostess talk with them and ensure that they line up where it's safe, and she hands them an umbrella, if the sun is too hot. By the time the gates open, we may have 200 people waiting. **Eventual tree cover for the waiting lines would be awesome. And every now and then, someone needs to use the restroom before the gate opens, so we need to think about how to handle that.**

All parking lots need to be lit, if the show ends at night. We use spot lights up on Butch's ham tower that we plug in during the encore. **We've also discovered that foot lighting is necessary to and through the gate.** While the show is going on this lighting is dim, so that it doesn't distract, but folks can leave early. Then we make it brighter when the show is over.

Finally, we don't see gate houses where folks can 1) present their tickets, 2) buy tickets, or 3) pick up Will Call tickets. We would need one for each side of the venue. Can we think about this together? Again, they will need to be placed near where we want waiting lines to form out of the way of car traffic.

These gates houses need shade for the workers, tables for searching bags and coolers, wifi and ways to take money, power, lighting, and a place to store items in between events.

Amphitheater, Shade, and Views

We love the placement and shape of the amphitheater, with the curved Allee to the north and east, and the mountain views to the south and west. How can we be sure that it will seat 1500 people? What is the slope of the lawn? What is meant by Terraced and ADA Seating? And, what is a Swing Bench Grove? How will we light the amphitheater?

If we don't provide shade for most of the amphitheater, folks will NOT come. Patrons seem to be willing to sit in the sun for a little bit, but they don't want to sit in the sun for a show because they can't see it. Older patrons have made it very clear over the years that they will not tolerate exposure to the sun. **The PORT suggested that we study the sun and shade patterns during the summer months in order to decide where to place trees and shade sails. And, we agree. This will need to be done during the Construction Drawing phase.** There will be tradeoffs between shade structures and site lines, so we'll want to make careful decisions. However, we do want to note that placing the new amphitheater east of the farmstead was a great idea because the tall trees provide nice shade even in April. **Below is a photo taken at 5pm within the past week from the middle of the current amphitheater. It shows that the shade from the old-growth trees extends all of the way to the eastern property line of the Park.** In the summer, this shade will extend not only east, but south, as the sun is farther north during those months. So, it will cover some of the new amphitheater as the sun sets, keeping folks from getting blasted from the side. How much it covers remains to be studied.



In addition to studying for shade during the Construction Drawing Phase, we recommend studying for view corridors. The most cherished views are to the southwest, down the range to Pikes Peak, so we recommend that trees and berms be used carefully in that direction. For instance, we would remove the 10' berms and put up 5-foot fences instead.

We would place bushes in the southwest to hide the housing development, but we would place few trees there to keep the mountain views open.

With the latest sound equipment, berms are not needed to tamp down sound. The equipment itself can be aimed carefully so that it will not bleed into the surrounding neighborhood, especially with the stage facing northeast. Without the berms, we would have more backstage parking. Or we could build a merch area to the right of the stage instead of having a berm there.

Around the Green Room for Stage 2, we recommend bushes to grant a bit of privacy for the Green Room porch and block the view of the houses from the Green Room, but we wouldn't recommend trees, if they block the view of the mountains. Maybe a tree or two would be good to provide shade for the building itself. On the back of Stage 1, we recommend having a deck with a roof that allows talent to sit outside and look at the mountains. Our national acts have always expressed awe over our western landscape. A mountain-view window in that green room would be a bonus too.

We absolutely love the tree-lined Allee to the north and east that hides the view of Highway 56 and "hugs" the amphitheater. It will also provide a place for families to camp out. Everyone on the PORT preferred the curved Allee. The only downside is that when the Community Arts Center is built to the east of the amphitheater, the Allee may block views of the amphitheater and mountains from the center. So, we'd want to consider planting tree types that take this into account.

Food and Merchandise

The PORT noticed that there's not a lot of room for food trucks and, frankly, we shy away from them. **We would recommend that patrons be encouraged to bring their own food, and that a charity, like the Lions Club, be given the opportunity to sell food for shows.** Food trucks are loud (with generators) and serve only 10-20 people per hour. Folks will not stand in line if it means that they'll miss the show. Patrons can be warned when they purchase tickets that "Concessions are limited" and "Food is allowed, but not coolers", and they will adjust accordingly. Or, like at our Farm Concerts, the Lions Club can serve 150 people in 30 minutes because they do it buffet style and they have plenty of cashiers. We like the placement of the concessions north of the Allee in a lawn where folks can line up.

That said, where is the food concession load-in area? Where can pickups with trailers turn around? [Note: this same load-in "road" would be used by the portalet delivery truck]

Performers merch sales tend to do better when the merch is near the stage. How do other venues handle this? Do they put the merch tent near the food or near the stage? For the Farm Concert, our merch tent is practically next to the stage and we've gotten strong feedback

when we've tried to move it elsewhere. **In this draft concept plan, concessions are on the opposite side of the venue from the stage, and that is too far away for performer merch load in. We recommend that the berms to the left and right of the stage be removed, that fencing be used instead, and that a merch "coop" be placed to the right of the stage where merch can be loaded in and out easily.**

We'd like to note that pay-ahead chair rental is a great revenue stream that we've seen work well at The Gardens on Spring Creek. If Berthoud wanted to do this, where would patrons pick up their chairs? We'd recommend that the pickup be placed near the merch tent, so patrons see the merch at the start of the show and want to come back. Where would the chairs be stored between shows? Could there be a "chicken coop" to the right of the stage for merch sales, chair distribution, and chair storage? How would chair distribution couple with the gates, if at all?

Restrooms and Trash

Town Staff has made it clear that the installation of permanent restrooms needs to wait until the Farmstead development supplies access to the sewer lines. So, what do we do in the meantime?

We've seen the use of clean portalets work well for patrons at our Farm Concert as well as the Gardens on Spring Creek, but this does NOT work for performers. **Portalets for performers will need to be high quality, like those supplied for upscale outdoor weddings. Where will these be placed relative to Stage 1, and how will performers get to them easily?**

Portalets for patrons will need to be plentiful and distributed around the site where the north and west winds don't drag the smell through the audience: near the playground, near the concessions, near the ADA areas. These areas need to be flat, protected from sun and wind, and accessible to a portalet delivery truck. Can we think about this together?

Where will portalets be placed for the older amphitheater when we have events there? We place them on the east farm road now, and that road seems to be going away. Also, if a patron who is waiting in line for a gate to open needs to use the restroom, what happens?

Trash cans will need to be distributed and plentiful as well. Where is the dumpster for the park going to be placed?

Community Arts Center

When the Berthoud community comes to rely on summer concerts to enjoy with their friends and family, they're going to ask for more shows year-round. At that time, discussions about a

Community Arts Center will become relevant. Given the level of talent that patrons will be used to with the 1500-seat amphitheater, we recommend building a 750-seat indoor performance room to be able to afford similar talent on-going. To ease utilities and sound issues, we recommend building the theater into the ground -under the facility – so that the main floors of the building may be used to house community gatherings and education (music lessons, painting, pottery, etc.), and perhaps a senior center from which ushers and other help may be recruited. **With this in mind, we believe that a 40,000 square foot center will be needed as the theater alone will require 20,000 square feet.**

Personal

We have always felt that Newell Farm belongs to the people of Berthoud, and we love to share it with them as much as possible. In light of this, we are constantly looking for ways to open the Farm up to others while staying happy ourselves. **Since Keith Knoll mentioned that CDOT would like the west entrance to be opened only for events, we're not sure how we would be able to do the following.**

1. **Get to our house from Highway 56 (and have guests do the same)**
2. **Get to our mailbox**
3. **Have Amazon deliver packages**
4. **Place our dumpster and have it easily emptied**
5. **Drive to our barn**

If CDOT allows us to keep our driveway for personal use, the first three items will be moot. Can we think through this together?

Thank You

We want to acknowledge that this Concept Plan is marvelous and that Wenk and Semple Brown are wonderful to work with. Thank you to them, the PORT, and Town Staff for great work so far.



Sidewalk Cost Share Program Expansion

Keith Knoll, Public Works Operations Manager





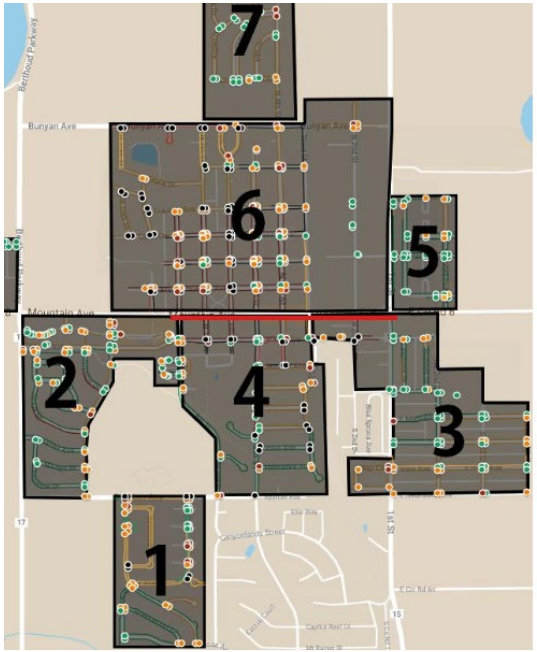


Sidewalk Maintenance Responsibility

Berthoud Municipal Code 15.11 assigns responsibility to property owners for the repair and maintenance of sidewalks adjacent to their property to ensure a safe pedestrian right-of-way.

The Town repairs sidewalks …

1. Adjacent to town owned property
2. Adjacent to yearly road improvements
3. As part of Board approved sidewalk improvement plans



2018 Sidewalk ADA Transition Plan

Sidewalk Cost-Share Program

- Created in 2020 to assist single-family property owners with necessary repairs.
- Updated in 2023 to include flagstone and adjusted the qualifying property owners

Sidewalk Cost Share Data			
Year	Concrete	Flagstone	Cost
2020	1	0	$ 1,250.00
2021	3	0	$ 3,579.00
2022	1	0	$ 750.00
2023	4	5	$ 8,120.97
2024	4	6	$ 26,255.88
2025	9	2	$ 12,457.33
2026	1	0	$ 749.99
Total	23	13	$ 53,163.17



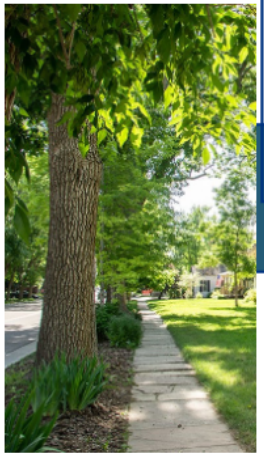
Sidewalk Replacement Cost Share Program

Did you know....

- Property owners are responsible for the repair and maintenance of the sidewalks adjacent to their properties.
- The Town of Berthoud has a Sidewalk Replacement Cost Share Program to help assist with the cost of the repairs related to safety issues.

Who is Eligible?

- The Concrete Sidewalk Cost Share is open to single family property homeowners and non-profit property owners.
- The Stone Sidewalk Cost Share is open to all property owners.
- The sidewalk damage must be a drainage or safety issue, such as a tripping hazard or settled curb and gutter. Aesthetic issues do not qualify.



Please Note:

- Claims are paid on a first-come, first-served basis.
- If work is completed prior to the Town's approval, the applicant will not be reimbursed.

How The Program Works:

1. Property owner submits application.
2. Town staff will inspect the sidewalk to determine eligibility.
3. Property owner submits three bids from contractors to the Town prior to beginning the work. Homeowner selects any contractor they want to perform the work.
4. The contractor requests a free Right-of-Way permit from the Town.
5. **If your sidewalk is concrete...**
   The Town will reimburse the property owner for 50% of the lowest bid received, with a maximum reimbursement of $3,000.00 per frontage. The cost to replace or repair accessible curb ramps should be itemized separately in the bid and will receive 100% reimbursement.
6. Upon completion, Town staff will inspect the work to ensure it is up to code.
7. Submit invoice and proof of payment to the Town within 30 days after completion of the project for reimbursement.



OR

If your sidewalk is made of stone or flagstone...

The Town will reimburse the property owner for 50% of the lowest bid received, with a maximum reimbursement of $3,000.00 per frontage.

- Stones must be leveled on a compacted base with a maximum cross slope of 2%.
- Stones with multiple cracks must be replaced.
- Trip hazards of 1/4 inch or greater removed.
- Gaps must be filled with material that will prevent grass and weeds from growing. A Polymer sand is recommended.





For More Information:

Website: berthoud.org

Call: 970.532.2210

Downtown Commercial Expansion Area

Downtown commercial properties located between 1st Street and 8th Street, from Massachusetts Avenue to Welch Avenue.



Board of Trustees Feedback

Board input and direction on expanding the sidewalk cost-share program to include commercial properties located between Massachusetts Avenue and Welch Avenue. from 1st Street to 8th Street