

PRELIMINARY DRAINAGE REPORT

FOR THE

SIDE CREEK ELEMENTARY

IN

**CITY OF AURORA, COLORADO
19191 E ILLIF PL
AURORA, CO 80231**

Prepared For:

**AURORA PUBLIC SCHOOLS
1085 PEORIA STREET
DENVER, CO 80011**

Prepared By:

**COLLINS ENGINEERS, INC.
ATTN: BRYAN FRANTZ, P.E.
455 SHERMAN STREET, SUITE 160
DENVER, CO 80203
(303) 447-0090
COLLINS JOB NO.**

This needs to be submitted to engineering for review as well as a review fee paid

APPROVED ONE YEAR FROM THIS DATE	

_____	_____
City Engineer	Date
_____	_____
Water Department	Date

AUGUST 14, 2017

I hereby certify that this report and plan for the Preliminary Drainage Report design of the Side Creek Elementary School improvements were prepared under my direct supervision in accordance with the provisions of City of Aurora Storm Drainage Design and Technical Criteria for the owners thereof. I understand that the City of Aurora does not and will not assume liability for drainage facilities designed by others.

Bryan Frantz, P.E.
Registered Professional Engineer
State of Colorado
No. 37362

Table of Contents

	PURPOSE.....	3
A.	INTRODUCTION	3
B.	HISTORIC DRAINAGE	4
C.	DRAINAGE CRITERIA	4
D.	DRAINAGE PLAN	5
E.	CONCLUSIONS.....	6
F.	LIST OF REFERENCES.....	7

APPENDIX A – Maps (Site Vicinity Map, Soils Map, FEMA Map)

APPENDIX B – Hydrologic Computations

APPENDIX C – Final Drainage Plan

APPENDIX D- Master Final Drainage Report Supplements

PRELIMINARY DRAINAGE REPORT

FOR

SIDE CREEK ELEMENTARY

IN

CITY OF AURORA, COLORADO

PURPOSE

This Preliminary Drainage Report provides hydrologic and hydraulic concepts for the proposed site improvements for Side Creek Elementary located in Aurora, Colorado. This report has been prepared in accordance with the City of Aurora Storm Drainage Design and Technical Criteria Manual (SDDTCM), other criteria manuals referenced herein and standard engineering practices.

A. INTRODUCTION

1. Location

- a. Side Creek Elementary is located at 19191 East Iliff Place in the City of Aurora, Colorado. The property is located at the northwest corner of the intersection of East Iliff Place and South Ceylon Way. The project site runs along the Southwest side of the property along East Iliff Place.
- b. The vicinity map for the project can be found in Appendix A – Vicinity Map.
- c. The areas adjacent to the project site include low-density residential uses to the north, south, and east, and multi-family residential uses to the west.

2. Description of Property

- a. The existing Side Creek Elementary project site is approximately 9.5 acres in size.

This Preliminary Drainage Report intends to provide hydrologic and hydraulic calculations for the proposed site improvements (the addition of a parking lot, improvements to the existing drop off lanes and existing parking lot).

No major drainageways exist onsite.

- b. The existing soils on-site were determined by the U.S. Department of Agriculture-Natural Resources Conservation Service and consist mostly of Buick Loam and Fondis silt loam with a hydraulic soil group of C. Please see appendix A for a soil map. Existing grades of the site are moderately flat with slopes of 3-5%, draining toward the north and into the master-designed storm water conveyance system by others.

- c. Variances. No variances will be needed for the project.

B. HISTORIC DRAINAGE

1. Overall Basin Description

- a. There are no off-site basins contributing runoff to the project site.
- b. This project falls within the previously approved Iliff Commons Subdivision Filing No. 4 Final Drainage Report (213113) by TST Inc. of Denver Consulting Engineers dated August 7, 2013 and updated October 18, 2013. The site is located within Final Drainage Report - Sub-Basin OS1 and a portion of Sub-Basin A2.

The existing school parking lot located at the corner of East Iliff Place and South Ceylon Way discharges into the existing storm sewer along the west side of South Ceylon Way. This approximate 1.06 acre area was included in Sub-Basin OS1 the Filing No. 4 drainage report, but was shown in the Filing No. 1 Drainage Report (205084) in Appendix C. The Master Drainage Plan was prepared by Kirkham Michael and Associates (860279).

- c. The project site is located in Flood Zone X: "Areas determined to be outside the 0.2% annual chance floodplain" per FEMA Flood Map 08005C0192K, dated December 17, 2010.

2. Drainage Pattern through Property

Storm water from the existing Side Creek Elementary site has historically flowed overland from the southwest to the northeast. The site will drain toward the northeast into an existing type R inlet storm-water conveyance system by others. The existing parking lot and a portion of the property abutting South Ceylon Way discharges offsite to the northeast.

3. Outfalls Downstream from Property

The project drains to the northeast side of the site and is collected through an existing storm water conveyance system. This runoff is conveyed to a private storm water detention pond (sub-basin D-1 as shown on the Final Drainage Plan within the approved Final Drainage Report) for treatment and attenuation. As this site is already designed for treatment, no additional storm water improvements are proposed provided post-development impervious does not exceed pre-development levels.

C. DESIGN CRITERIA

1. List References

- a. Iliff Commons Subdivision Filing No. 4 Final Drainage Report (213113) by TST Inc. of Denver Consulting Engineers dated August 7, 2013 and updated October 18, 2013.
- b. Iliff Commons Subdivision Filing No. 1 Final Drainage Report (205084) which includes a Master Drainage Plan by Kirkham Michael and Associates (860279).
- c. Urban Storm Drainage Criteria Manual prepared by Urban Drainage and Flood Control District, latest revision.
- d. City of Aurora Storm Drainage Design and Technical Criteria, latest addition.

2. Hydrologic Criteria

a. Rainfall Source and P1 Identified

Intensities for various durations and frequencies in the City of Aurora are as follows:

<u>Event Frequency</u>	<u>1-Hour Rainfall (in)</u>
2 year	0.99
100 year	2.64

b. Calculation Method

The Rational Method is used to compute peak runoff. This method is defined as follows:

$$Q = CIA$$

Where: Q = Peak Discharge in Cubic Feet Per Second (cfs)

C = Runoff Coefficient

I = Rainfall Intensity

A = Drainage Area in Acres

"C" values for this project match the "Rational Method Runoff Coefficients for Streets-Paved, Drives and Walks, and Lawns" from the Iliff Commons Subdivision Filing No. 4 Final Drainage Report (213113).

d. Detention volume calculation method

Detention is not proposed for this improvements project as it is provided within the off-site detention pond.

e. Design storm frequencies

The 2-yr and 100-yr design storm intervals are used on this project.

3. Hydraulic Criteria

- a. City of Aurora – Storm Drainage Design and Technical Criteria.
- b. The 100-year storm was used to size the private storm pipes and inlets.
- c. There were no water surface profiles determined for this project.
- d. There are no major drainageways for this project.

D. DRAINAGE PLAN

1. General Concept

- a. There are no off-site flows that flow through the project site. The existing school site is part of the overall Iliff Commons subdivision and the overall drainage has been master designed.

The school building, landscape play areas, and proposed parking lot drain to the north and existing storm system. The existing parking lot discharges off-site toward the existing South Ceylon Way storm sewer. The parent and bus drop off lanes are discharge on the surface to the west along East Iliff Place. The existing drainage patterns will not be altered with the school improvements.

- b. As part of this project, improvements to the existing drop off lanes, existing parking lot, and a new parking lot are proposed. Additional inlets and conveyance pipes are proposed to route storm water from the proposed parking lot to the existing drainage conveyance system in the northeast corner of the site. The modifications to the existing drop off lanes and parking lot are designed to match existing drainage patterns.

The existing school site is tributary to an existing off-site water quality and detention pond. The detention pond is sized to accommodate the EURV volume for the school, but the major flow will be bypassed undetained.

- c. Aurora Public Schools has a MS4 permit and are responsible for the ownership and maintenance for the private on-site storm sewer.

2. Specific Details

a. Sub-Basin Discussion

Sub-Basin A-1: Sub-Basin A-1 (DP#1) includes the northern portion of the school property including the existing school building and grass field area. Sub-Basin A-1 is within the Final Drainage Plan - Basin OS1. The site will sheet flow toward the northeast before discharging into the existing storm water culvert. This sub-basin includes the proposed parking lot improvements.

Sub-Basin A-1 is 7.04 acres. The Final Drainage Plan – Basin OS1 is 8.07 acres. The difference between the areas is Sub-Basin A-2.

Comparison of Sub-Basin A-1 with OS-1:

	BASIN AREA (AC.)	"C" (2-YR)	Q, 2-YR (CFS)	"C" (100-YR)	Q, 100-YR (CFS)
ILIFF FILING No. 4 FINAL DRAINAGE REPORT (OS-1)	8.07	0.40*	6.80	0.60*	28.10
A-1 (DP #1)	7.04	0.45	7.00	0.58	24.13

*The Iliff Filing No. 4 – Final Drainage Report calculations for OS-1 - Q 2-yr and Q 100-yr are based on land use only. The calculations used the general "C" number for single-family housing land use and not the school land use as described in the Final Drainage Report. The school land use "C" numbers are 0.45 and 0.70 for the 2-yr and 100-yr respectively. The actual weighted "C" numbers for the school improvements for sub-basin A-1 are less than or equal to the "C" numbers for the school land use that is described in the Final Drainage Report.

Sub-Basin A-2: Sub-Basin A-2 (DP #2) includes the existing parking lot and a portion of the front entrance of the school. Runoff from the parking lot is collected by a series of inlets and is routed to a storm water conveyance system located in South Ceylon Way.

The Iliff Commons Subdivision Filing No. 4 - Final Drainage Plan shows this sub-basin as part of Basin OS-1. In Iliff Commons Subdivision Filing No. 1 shows this sub-basin correctly as part of the existing South Ceylon Way storm sewer system.

Sub-Basin A-2 drains to an existing inlet within the parking lot.

OS-1: Sub-Basin OS-1 (DP #3) includes the proposed drop off lane modifications. The sub-basin is representative of a portion of Master Development Basin A2. As part of this development, the bus drop off lane will shift and the parent drop off lane will be extended. The sub-basin has increased in size to accommodate this extension, however sub-basin A-1 was reduced in size proportionally.

OS-2: Sub-Basin OS-2 (DP #4) includes a portion of the school and green space directly adjacent to South Ceylon Way on the northeast portion of the site. Runoff sheet flows directly off-site into an existing off-site drainage conveyance system in South Ceylon Way. Sub-Basin OS-2 has no proposed improvements.

Summary of Sub-Basins A-2, OS-1, and OS-2:

	BASIN AREA (AC)	% IMPERVIOUS	Q, 2-YR (CFS)	Q, 100-YR (CFS)
A-2 (DP #2)	1.06	62.1	2.20	6.73
OS-1 (DP #3)	0.91	64.3	1.98	5.94
OS-2 (DP #4)	0.30	29.2	0.37	1.38

E. CONCLUSIONS

1. Compliance with Standards

The Preliminary Drainage Report for the Side Creek Elementary site improvements was prepared in accordance with the Aurora Storm Criteria Manual and Urban Drainage and Flood Control District's Urban Storm Drainage Design and Technical Criteria Manual.

This Preliminary Drainage Report has discussed the on-site drainage concepts including conveyance to the existing outfall locations. The water quality, EURV volume, is included in the existing off-site detention pond.

2. Summary of Concept

- a. The site improvements have been designed to convey water into designed inlets or allow runoff to the existing stormwater and street conveyance systems.
- b. The drainage improvements are sized accordingly for the anticipated storm runoff.
- c. The proposed site improvements will provide no effect on the adjacent and downstream conditions and match existing drainage patterns.

F. LIST OF REFERENCES

Urban Storm Drainage Criteria Manual; Volumes 1, 2 and 3. Urban Drainage and Flood Control District (latest revision).

City of Aurora Storm Drainage Design and Technical Criteria, latest revision.

Iliff Commons Subdivision Filing No. 4 Final Drainage Report dated August 7, 2013 and updated October 18, 2013.

APPENDIX A

Maps

Site Vicinity Map

Soils Map



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Arapahoe County, Colorado



Custom Soil Resource Report Soil Map



MAP LEGEND

- Area of Interest (AOI)**
-  Area of Interest (AOI)
- Soils**
-  Soil Map Unit Polygons
-  Soil Map Unit Lines
-  Soil Map Unit Points
- Special Point Features**
-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features
- Water Features**
-  Streams and Canals
- Transportation**
-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads
- Background**
-  Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Arapahoe County, Colorado
 Survey Area Data: Version 12, Sep 22, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 10, 2014—Aug 21, 2014

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.

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Arapahoe County, Colorado (CO005)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BxC	Buick loam, 3 to 5 percent slopes	C	5.5	57.8%
FdC	Fondis silt loam, 3 to 5 percent slopes	C	4.0	42.2%
Totals for Area of Interest			9.5	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Arapahoe County, Colorado

BxC—Buick loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 34y8
Elevation: 4,700 to 6,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 45 to 46 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Buick and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buick

Setting

Landform: Drainageways, hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and/or eolian deposits

Typical profile

H1 - 0 to 6 inches: loam
H2 - 6 to 22 inches: clay loam
H3 - 22 to 60 inches: sandy clay loam, clay loam
H3 - 22 to 60 inches:

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 16.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: Loamy Foothill (R049BY202CO)
Hydric soil rating: No

Minor Components

Reno Hill

Percent of map unit: 5 percent
Hydric soil rating: No

Weld

Percent of map unit: 5 percent
Hydric soil rating: No

Colby

Percent of map unit: 5 percent
Hydric soil rating: No

FdC—Fondis silt loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 34yj
Elevation: 4,700 to 6,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Fondis and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fondis

Setting

Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and/or silty

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 24 inches: clay
H3 - 24 to 32 inches: silty clay loam
H4 - 32 to 46 inches: loam, silt loam
H4 - 32 to 46 inches: clay loam
H5 - 46 to 84 inches:

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low

Custom Soil Resource Report

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 15 percent

Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3c

Hydrologic Soil Group: C

Ecological site: Loamy Foothill (R049BY202CO)

Hydric soil rating: No

Minor Components

Weld

Percent of map unit: 8 percent

Hydric soil rating: No

Buick

Percent of map unit: 7 percent

Hydric soil rating: No

Fema FIRM Map

APPENDIX B

Hydrologic Computations

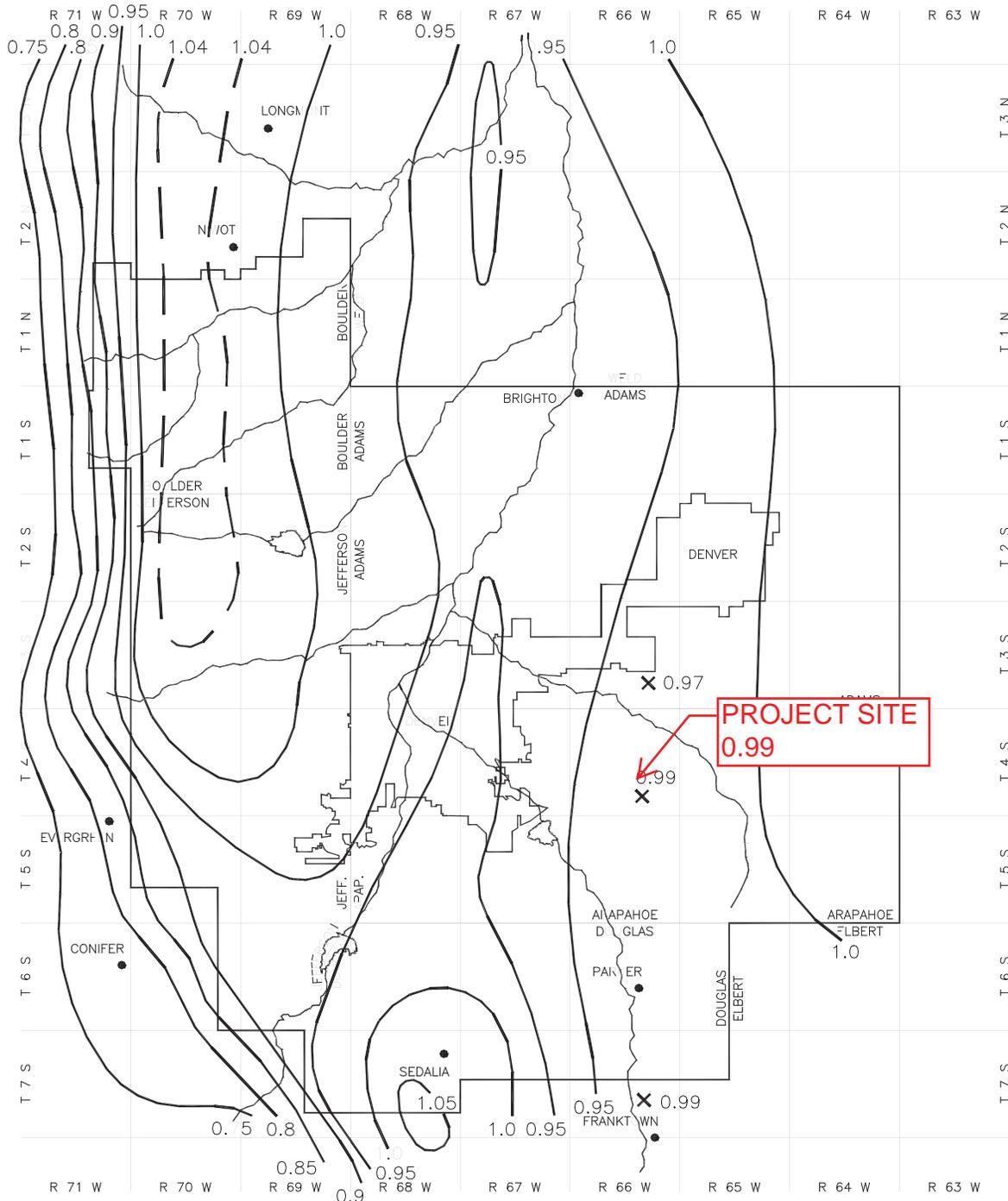


Figure 5-1. Rainfall depth-duration-frequency: 2-year, 1-hour rainfall

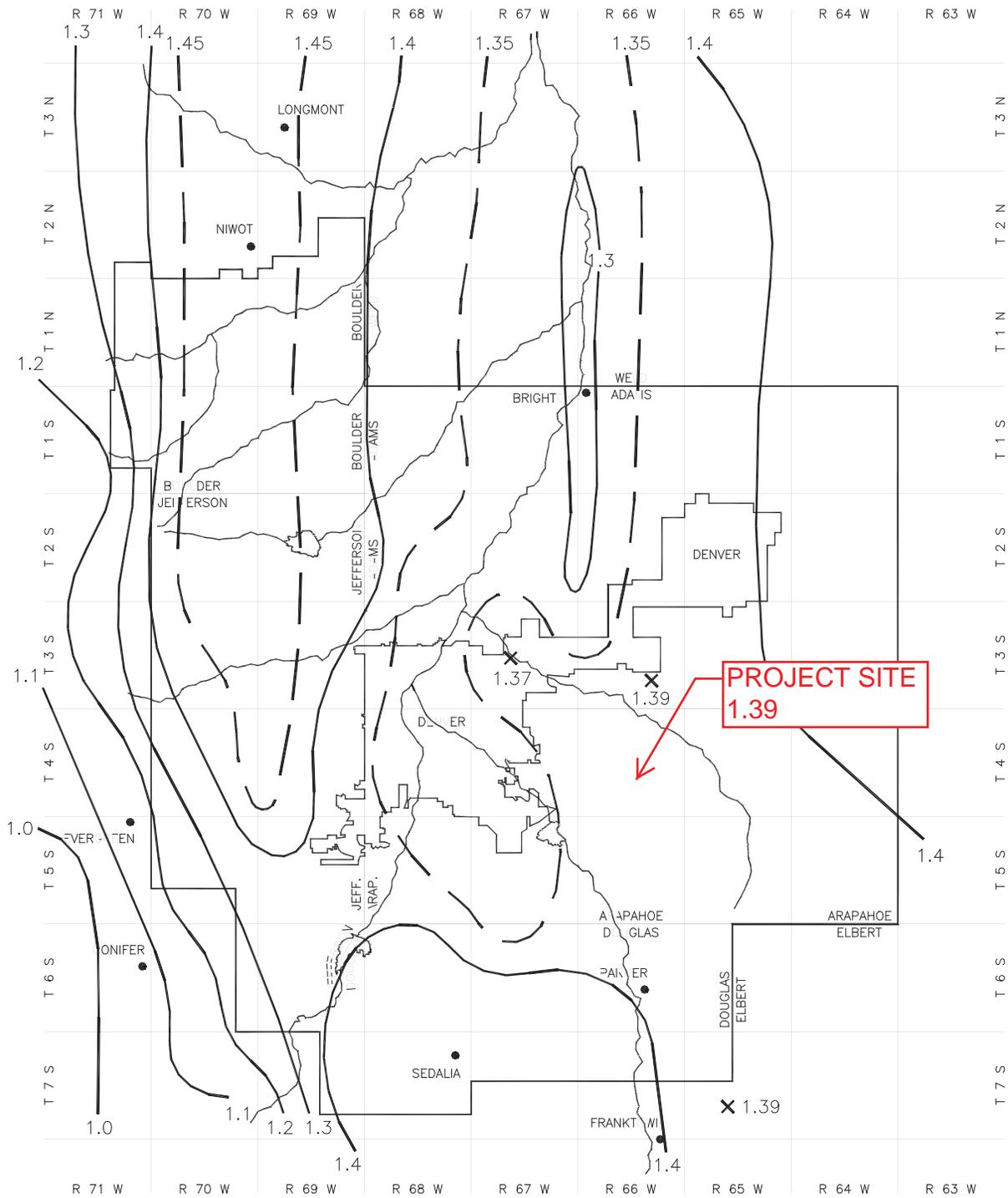


Figure 5-2. Rainfall depth-duration-frequency: 5-year, 1-hour rainfall

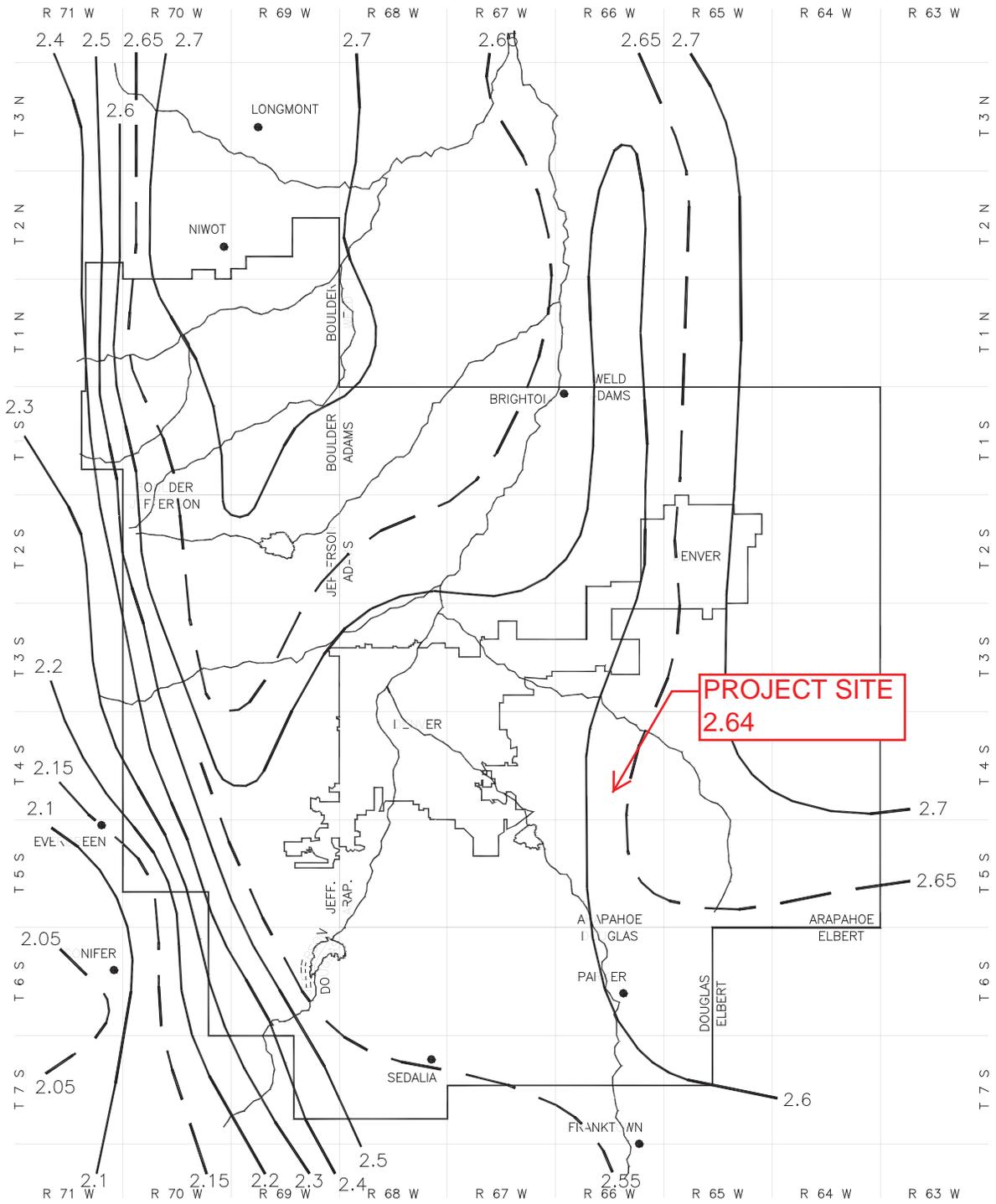


Figure 5-6. Rainfall depth-duration-frequency: 100-year, 1-hour rainfall

APPENDIX C

Final Drainage Plan

COMPARISON OF SUB-BASINS A-1 AND OS-1					
	BASIN AREA (AC.)	"C" (2-YR)	Q, 2-YR (CFS)	"C" (100-YR)	Q, 100-YR (CFS)
ILIFF FILING NO. 4 FINAL DRAINAGE REPORT (OS-1)	8.07	0.40*	6.80	0.60*	28.10
A-1 (DP #1)	7.04	0.45	7.00	0.58	24.13

*THE ILIFF FILING NO. 4 - FINAL DRAINAGE REPORT CALCULATIONS FOR OS-1 - Q 2-YR AND Q 100-YR ARE BASED ON LAND USE ONLY. THE CALCULATIONS USED THE GENERAL "C" NUMBER FOR SINGLE-FAMILY HOUSING LAND USE AND NOT THE SCHOOL LAND USE AS DESCRIBED IN THE FINAL DRAINAGE REPORT. THE SCHOOL LAND USE "C" NUMBERS ARE 0.45 AND 0.70 FOR THE 2-YR AND 100-YR RESPECTIVELY. THE ACTUAL WEIGHTED "C" NUMBERS FOR THE SCHOOL IMPROVEMENTS FOR SUB-BASIN A-1 ARE LESS THAN OR EQUAL TO THE "C" NUMBERS FOR THE SCHOOL LAND USE THAT IS DESCRIBED IN THE FINAL DRAINAGE REPORT.

COMPARISON OF SUB-BASINS A-2, OS-1 AND OS-2				
	BASIN AREA (AC.)	% IMPERVIOUS	Q, 2-YR (CFS)	Q, 100-YR (CFS)
A-2 (DP #2)	1.06	62.1	2.20	6.73
OS-1 (DP #3)	0.91	64.3	1.98	5.94
OS-2 (DP #4)	.30	29.2	0.37	1.38

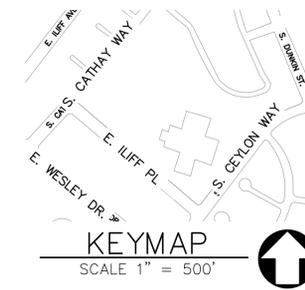
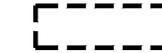
BENCHMARK: CITY OF AURORA BM 456622SW003 - 3" DIAMETER BRASS CAP AT THE SOUTHWEST CORNER OF THE INTERSECTION OF EAST ILIFF AVENUE AND SOUTH DUNKIRK STREET. ELEVATION: 5635.04 FEET (NAVD 1988 DATUM).

BASIS OF BEARING: WEST LINE OF THE NORTHWEST 1/4 OF SECTION 27, TOWNSHIP 4 SOUTH, RANGE 66 WEST, OF THE 6TH PRINCIPAL MERIDIAN BEARING S00°20'40"E AS REFERENCED IN THE CITY OF AURORA HORIZONTAL CONTROL NETWORK AS SHOWN ON SHEET 13N.

A = BASIN DESIGNATION
B = AREA IN ACRES
I = 2-YR "C"
100-YR "C"

DESIGN POINT DESIGNATION

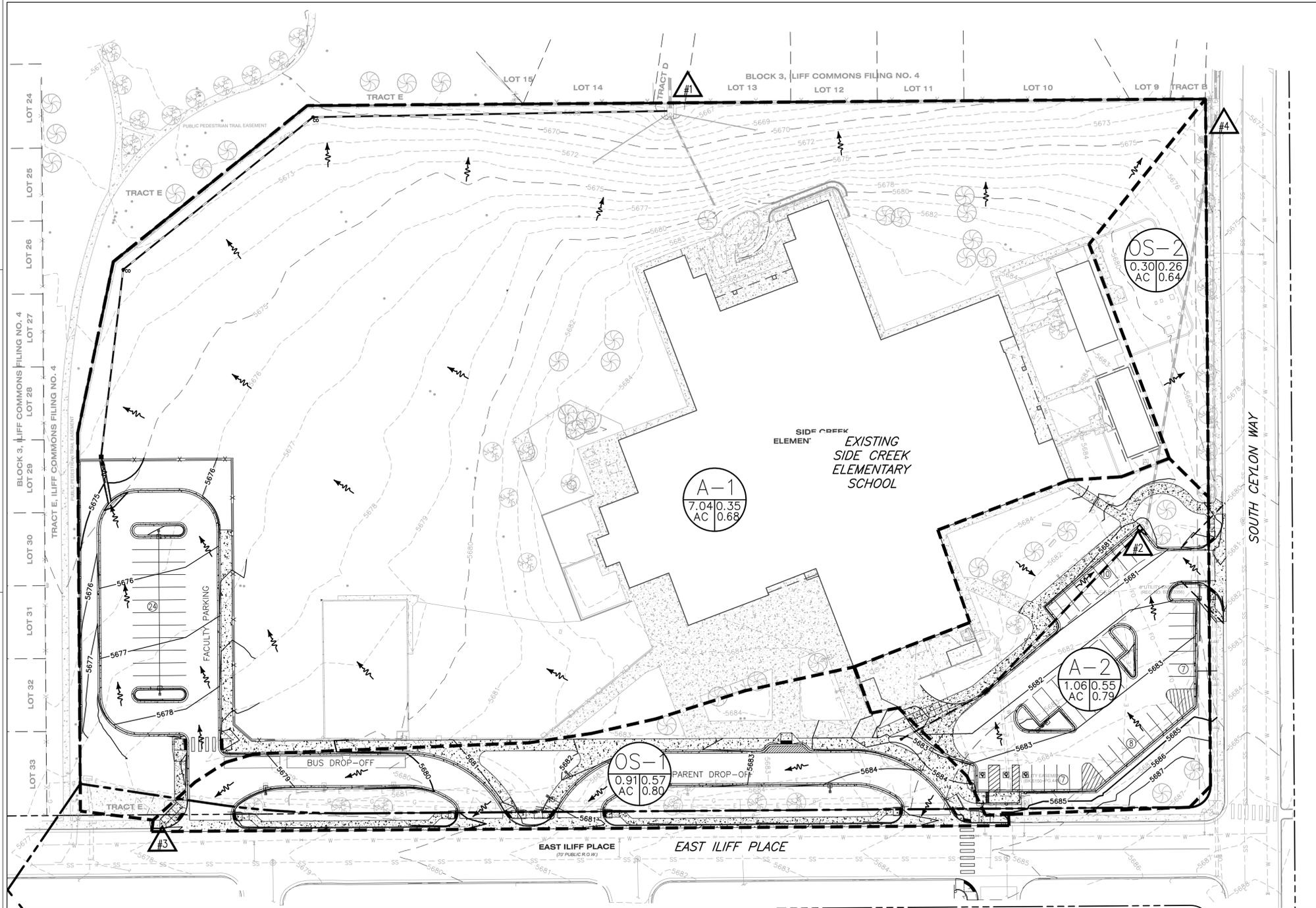
PROPOSED BASIN BOUNDARY



KEYMAP
SCALE 1" = 500'

LEGEND

- PROPERTY LINE
- RIGHT OF WAY
- EXISTING EASEMENTS
- EASEMENTS
- EXISTING CONTOURS
- CONTOURS
- EXISTING CURB & GUTTER
- CATCH CURB & GUTTER
- SPILL CURB & GUTTER
- EXISTING CONCRETE
- CONCRETE
- EXISTING SIGN
- PROPOSED SIGN
- EXISTING STREET LIGHT
- PROPOSED SITE LIGHT
- EXISTING STORM SEWER
- STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING WATER LINES
- EXISTING ELECTRIC
- EXISTING GAS
- EXISTING MANHOLE
- EXISTING TYPE R INLET
- INLET
- AREA INLET
- MANHOLE
- FIRE HYDRANT
- EXISTING FIRE HYDRANT
- HP
- LP
- FLOW ARROW



hord | coplan | macht

1331 Nineteenth Street
Denver, CO. 80202

P 303.607.0977
www.hcm2.com

CONSULTANT:

COLLINS ENGINEERS

455 Sherman Street, Suite 160
Denver, Colorado 80202
voice: (303) 447-0060
fax: (303) 447-9141
www.collinsengr.com

PROJECT:

**SIDE CREEK
ELEMENTARY
SCHOOL**

19191 E ILIFF PL.
AURORA, CO 80013

OWNER:

**AURORA PUBLIC
SCHOOLS**

ISSUE:

2017/08/15 MINOR AMENDMENT

DRAWING INFORMATION:

PROJECT NO: 11722.000

DRAWN BY: JLS

CHECKED BY: BMF

APPROVED BY: BMF

SHEET TITLE:

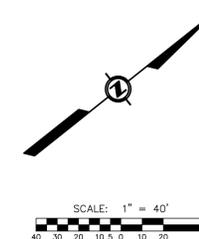
DRAINAGE PLAN

D1

SHEET OF



Know what's below.
Call before you dig.



APPENDIX D

Master Final Drainage Report Supplements



Vertically
Conscious
Engineering

213113FD1
2012-3009
13N

FINAL DRAINAGE REPORT

ILIFF COMMONS SUBDIVISION FILING No. 4

AURORA, COLORADO

PREPARED FOR
ILIFF COMMONS LLC.
333 South Monroe Street
Denver, CO 80206
CONTACT: Art Kleinstein
(303) 941-4856

August 7, 2013
Updated October 18, 2013

APPROVED ONE YEAR FROM THIS DATE 11.13.13	
<i>ht</i>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"><i>H. E. McCarroll for K. W.</i></div> <div>11/01/2013</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="text-align: center;">City Engineer</div> <div>Date</div> </div>
<i>JAV</i>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"><i>[Signature]</i></div> <div>10/31/13</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="text-align: center;">Water Department</div> <div>Date</div> </div>

FACSIMILE

THIS ELECTRONIC PLAN IS A FACSIMILE OF THE
SIGNED AND SEALED PDF SET.

WARD MAHANKE, P.E.

10-18-13
DATE

BY:
**TST INC. OF DENVER
CONSULTING ENGINEERS**
9222 TEDDY LANE
LONE TREE, CO 80124
Contact: Ward Mahanke, P.E.
303-792-0557

PROJECT NO. 088-008

HYDROLOGIC CRITERIA

The Rational Method (for basins less than 160 acres per Manual Section 5.20) was used to calculate the 2-year (minor storm) and 100-year (major storm) frequency storm runoffs. The Rational Method is defined as follows:

$$Q = cia$$

- Q = maximum rate of runoff in cubic feet per second
- c = a runoff coefficient as a ratio between the maximum rate of run off and the average rate of rainfall intensity over a duration equal to the time of concentration
- i = average intensity of rainfall in inches per hour for a duration equal to the time of concentration
- a = area of basin or sub-basin in acres

The time of concentration is defined as the time required for water to flow from the most remote point of the area to the point being investigated. For this study, the runoff coefficients for the 2-year and 100-year frequency storms have been calculated, per the City of Aurora, using the coefficients listed in the City of Aurora Table 1:

Land Use	c2	c5	c100
Single Family Residential	.40	.45	.60
Neighborhood Commercial	.60	.65	.80
School	.45	.50	.70
Streets - Paved	.87	.88	.93
Drives and Walks	.87	.87	.90
Lawns, Clay Soil	.25	.27	.35

Additionally, the detention pond areas were calculated using the same coefficients as Streets-paved.

The percent imperviousness for residential was calculated using UD&FCD Figure RO-4 for Single Family Dwellings/Acre. The density was calculated at 3.5 units/acre and 2,000 sf footprints. The rest of the land uses using City of Aurora Table 1.

Land Use	Imperviousness
Residential	35%
Neighborhood Commercial	85%
School	50%
Streets - Paved	100%
Drives and Walks	96%
Lawns, Clay Soil	5%

Additionally, the detention pond areas were calculated using an imperviousness of 100%.

Basin C1

Basin C1 (Design Point 9) represents the northerly detention pond and some backyard drainage from lots along Iliff Avenue. The calculated flows for this basin are $Q_2 = 1.0$ cfs and $Q_{100} = 4.5$ cfs. Major flows will be collected via overland flow and directed into the detention pond that includes a water quality volume. The outfall of the detention facility will be into the existing 30' Type R inlet at the southwest corner of Iliff Avenue and Dunkirk Street.

Basin OS1

Basin OS1 (Design Point 10) represents a portion of the playground area and school buildings for the Side Creek Elementary School that are collected at an existing special type R inlet and piped to Dunkirk. The proposed site plan and available volume in Pond D1 allow for the re-direction of the school's outfall. The existing pipe will be directed into the back of the inlet for Basin A5, which will direct all flow to the northern pond. The pond is sized to accommodate the EURV volume required for the school, but the major flow will be passed undetained. Without the benefit of the City-approved Drainage Report, the calculated flows for this basin, based only on land use, are $Q_2 = 6.8$ cfs and $Q_{100} = 28.1$ cfs. Any flow that is not captured by the existing inlet will spill over the existing curb and be conveyed through a tract by grassed swale until spilling into Pacific Place and then captured by the inlets in Danube Way or bypassing those inlets and into Dunkirk Street.

Basin D1

Basin D1 (Design Point 11) represents the parcel that has been designated for a neighborhood commercial use. This location can be developed separately from the single-family housing. The total calculated flows for this basin are $Q_2 = 1.2$ cfs and $Q_{100} = 11.7$ cfs. Major flows (one half of the total flow) on the south side of the entry street are collected by a 10' Type R inlet that is in an at-grade condition. The 5' Type R inlet on the north side of the entry street captures the flows on the north side of the street. The storm sewer is designed to convey the major flows into the south detention pond. The outfall of the detention facility will be into the proposed inlet for Basin N3. In the event of a complete blockage at these inlets, flows will be conveyed by the proposed street section, but will be routed onto East Wesley and will bypass the detention pond.

Basin N1

Basin N1 (Design Point 12) represents the east half of Iliff Avenue north (downhill) of the west entry drive. As stated above, this includes small areas of landscaping outside the right-of-way. These flows will be collected by an existing 15' Type R inlet and piped around the proposed detention pond at the intersection of Dunkirk and Iliff. The

**STORM FLOW CALCULATIONS
ILIFF COMMONS FILING NO. 4**

Design Point	Basin Desig.	Area (ac)	tc (min)	Runoff Coeff.	C*A (ac)	P1	i (in/hr)	Q2 (cfs)	Q100 (cfs)
1	A1	3.98	14.4	0.28	1.11	0.95	2.2	2.4	13.9
		3.98	14.4	0.58	2.31	2.60	6.0		
2	A2	10.00	19.8	0.28	2.80	0.95	1.9	5.3	29.6
		10.00	19.8	0.58	5.80	2.60	5.1		
3	A3	1.96	12.5	0.28	0.55	0.95	2.3	1.3	7.3
		1.96	12.5	0.58	1.14	2.60	6.4		
4	A4	4.36	11.7	0.28	1.22	0.95	2.4	2.9	16.7
		4.36	11.7	0.58	2.53	2.60	6.6		
5	A5	4.82	14.3	0.28	1.35	0.95	2.2	3.0	16.8
		4.82	14.3	0.58	2.80	2.60	6.0		
6	A6	2.16	12.0	0.28	0.60	0.95	2.4	1.4	8.1
		2.16	12.0	0.58	1.25	2.60	6.5		
7	A7	4.43	11.7	0.28	1.24	0.95	2.4	3.0	17.0
		4.43	11.7	0.58	2.57	2.60	6.6		
8	B1	1.97	11.0	0.28	0.55	0.95	2.5	1.4	7.8
		1.97	11.0	0.58	1.14	2.60	6.8		
9	C1	1.12	11.9	0.37	0.41	0.95	2.4	1.0	4.5
		1.12	11.9	0.62	0.69	2.60	6.5		
10	OS1	8.07	15.3	0.40	3.23	0.95	2.1	6.8	28.1
		8.07	15.3	0.60	4.84	2.60	5.8		
11	D1	0.70	5.8	0.57	0.40	0.95	3.1	1.2	4.3
		0.70	5.8	0.71	0.50	2.60	8.5		
12	N1	1.57	9.5	0.73	1.15	0.95	2.6	3.0	8.9
		1.57	9.5	0.79	1.24	2.60	7.2		
13	N2	0.31	9.1	0.25	0.08	0.95	2.7	0.2	0.8
		0.31	9.1	0.35	0.11	2.60	7.3		
14	N3	2.62	10.8	0.60	1.57	0.95	2.5	3.9	12.0
		2.62	10.8	0.67	1.76	2.60	6.8		
Cummulative Flow									
4/5	A1-A4 A7	24.73	22.7	0.58	14.34	2.60	4.8		68.8

STORM DRAINAGE SYSTEM DESIGN
ILIFF COMMONS FILING NO 4
MAJOR (100-year) STORM

Design Point	DIRECT				TOTAL RUNOFF				STREET		PIPE		TRAVEL TIME									
	Design Basin(s)	Area (ac)	Runoff Coeff.	tc (min)	CxA (ac)	P1 (in/hr)	I (in/hr)	Q (cfs)	Basins	tc (min)	ΣCxA (ac)	P1 (in/hr)	I (in/hr)	Q (cfs)	Slope (%)	Q (cfs)	Qallow (cfs)	Slope (%)	Size (in)	Length (ft)	Velocity (fps)	Travel (min)
1	A1	3.98	0.58	14.4	2.31	2.60	6.0	13.9	A1	14.4	2.31	2.60	6.0	13.9	1.0	13.9	212.0	0.4%	18	35	15.0	0.0
2	A2	10.00	0.58	19.8	5.80	2.60	5.1	29.6	A1-A2	19.8	8.11	2.60	5.1	41.4	1.5	41.4	212.0	2.88%	18	186	19.0	0.7
3	A3	1.96	0.58	12.5	1.14	2.60	6.4	7.3	A1-A3	20.5	9.25	2.60	5.0	46.3	4.0	46.3	204.0	3.5%	18	496	19.0	2.0
4	A4	4.36	0.58	11.7	2.53	2.60	6.6	16.7	A1-A4, A7	22.7	14.35	2.60	4.8	68.9	n/a	68.9	212.0	2.0%	36			
5	A5	4.82	0.58	14.3	2.80	2.60	6.0	16.8	A5	14.3	2.80	2.60	6.0	16.8	1.0	3.0 ⁽²⁾	212.0	4.5%	18	60	13.0	0.1
6	A6	2.16	0.58	12.0	1.25	2.60	6.5	8.1	A5-A6	14.3	4.05	2.60	6.0	24.3	1.0	0.8	199.0	1.0%	30			
7	A7	4.43	0.58	11.7	2.57	2.60	6.6	17.0	A1-A7	22.7	18.40	2.60	4.8	88.3	"A" Storm Sewer Only			0.2%	36			
8	B1	1.97	0.58	11.0	1.14	2.60	6.8	7.8						7.8	"B" Storm Sewer Only			8.0%	18			
9	C1	1.12	0.62	11.9	0.69	2.60	6.5	4.5						4.5								
10	OS1	8.07	0.60	15.3	4.84	2.60	5.8	28.1	ABOVE + 30.0 cfs					30.0 ⁽³⁾				2.5%	21 (ex)			
11	D1	1.94	0.71	5.8	1.38	2.60	8.5	11.7						11.7	1.5	2.8	212.0	2.0%	18			
12	D1 - Cathay Inlets	0.70	0.71	5.8	0.50	2.60	8.5	4.3	TOTAL FLOW TO POND C1					130.6								
13	N1	1.57	0.79	9.5	1.24	2.60	7.2	8.9	TOTAL FLOW TO POND D1					11.7								
14	N2	0.31	0.35	9.1	0.11	2.60	7.3	0.8														
	N3	2.62	0.67	10.8	1.76	2.60	6.8	12.0														

- (1) Total Flow 68.8 cfs split (33.4) for A4/A7 sump inlet requirements
- (2) Overflow routes to Basin B1
- (3) Capacity of existing 21" pipe using Figure 4 in the appendix
- (4) Includes 30 cfs from OS1

* Note: Since Storm Sewer System from A-1 through A-3 designed for Minor Storm, all these inlets considered blocked for the Major Storm.

STORM DRAINAGE SYSTEM DESIGN
ILIFF COMMONS FILING NO 4
MINOR (2-year) STORM

Design Point	Design Basin(s)	DIRECT				TOTAL RUNOFF				STREET		PIPE		TRAVEL TIME								
		Area (ac)	Runoff Coeff.	t _c (min)	CxA (ac)	P1	I (in/hr)	Q (cfs)	Basins	t _c (min)	∑CxA (ac)	P1	I (in/hr)	Q (cfs)	Slope (%)	Q (cfs)	Qallow (cfs)	Slope (%)	Size (in)	Length (ft)	Velocity (fps)	Travel (min)
1	A1	3.98	0.28	14.4	1.11	0.95	2.2	2.4	A1	14.4	1.11	0.95	2.2	2.4	1.0	0.0	9.2	0.4%	18	50	3.1	0.3
2	A2	10.00	0.28	19.8	2.80	0.95	1.9	5.3	A1-A2	19.8	3.91	0.95	1.9	7.4	4.0	0.2 ⁽¹⁾	10.8	2.88%	18	186	8.8	0.4
3	A3	1.96	0.28	12.5	0.55	0.95	2.3	1.3	A1-A3	20.2	4.46	0.95	1.9	8.5	4.0	0.0 ⁽¹⁾	10.8	3.5%	18	496	9.5	0.9
4	A4	4.36	0.28	11.7	1.22	0.95	2.4	2.9	A1-A4	21.1	5.68	0.95	1.8	10.2								
5	A5	4.82	0.28	14.3	1.35	0.95	2.2	3.0	A5	14.3	1.35	0.95	2.2	3.0								
6	A6	2.16	0.28	12.0	0.60	0.95	2.4	1.4	A5-A6	14.3	1.95	0.95	2.2	4.3								
7	A7	4.43	0.28	11.7	1.24	0.95	2.4	3.0	A1-A7	22.7	8.87	0.95	1.7	15.1								
8	B1	1.97	0.28	11.0	0.55	0.95	2.5	1.4	A1-A7, B1	22.7	9.42	0.95	1.7	16.0								
9	C1	1.12	0.37	11.9	0.41	0.95	2.4	1.0	A1-A7, B1, C1	22.7	9.83	0.95	1.7	16.7								
10	OS1	8.07	0.40	15.3	3.23	0.95	2.1	6.8	ABOVE + 8.0 cfs													
11	D1	0.70	0.57	5.8	0.40	0.95	3.1	1.2	TOTAL FLOW TO POND C1					23.5								
12	N1	1.57	0.73	9.5	1.15	0.95	2.6	3.0	TOTAL FLOW TO POND D1					1.2								
13	N2	0.31	0.27	9.1	0.08	0.95	2.7	0.2														
14	N3	2.62	0.60	10.8	1.57	0.95	2.5	3.9														

(1) 1.4 cfs Bypass Flow at Inlet A2 Captured at A3
 Note: Storm Sewer System from A-1 through A-3 designed for Minor Storm



NOTES:

- 1) Elevation (FEMA) on this site.
- 2) Benchmark City of Aurora Vertical Control Point/COA 0-0-08C: Found 3" diameter brass cap atop a 30" x 2-3/4" steel pipe set in concrete at the corner of the intersection of the 6th P.M. The monument is 6.7' south of an east-west chain link fence. The cap is ELEVATION: 5693.733 feet NAD83.
- 3) Topographic interval: Two (2) feet.
- 4) City of Aurora plan review is only for general conformance with the City of Aurora Design Ordinance. The Engineer is responsible for the design, of dimensions and elevations which shall be verified and corrected at the job site. The City of Aurora has no responsibility for the completeness and/or accuracy of this document.
- 5) PDES Notice of Federal Compliance (NFC) National Pollutant Discharge Elimination System (NPDES), including, if required, a discharge permit, shall be obtained prior to construction and maintenance of storm water collection or detention ponds shown on this plan. The facilities may not be used for any other purpose until approved by the City of Aurora.
- 6) Storm water collection and detention ponds shall be designed for Design Points 1-3 one size for the minor storm, all other facilities, including detention ponds, shall be designed for the major storm event.

LIFF COMMONS FILING NO. 4

LIFF COMMONS, LLC

FINAL DRAINAGE PLAN

REGISTERED PROFESSIONAL ENGINEER

STATE OF COLORADO

NO. 172107

DATE: 2014-10-18

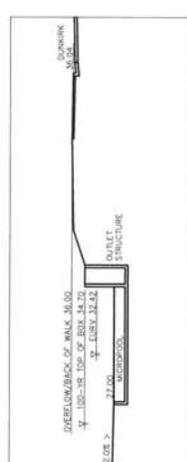
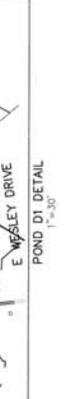
TST

TST INC. OF DENVER

1333 SOUTH MONROE STREET

DENVER, COLORADO 80202

PHONE: (303) 941-4858



SUMMARY OF DETENTION

Basin	V ₁₀₀ (cu ft)	V ₁₀ (cu ft)	V ₂ (cu ft)	R ₁₀₀ (cfs)	R ₁₀ (cfs)	R ₂ (cfs)	Flow (cfs)
C1	N/A	1.54	2.90	N/A	N/A	72.74	34.0
D1	0.081	0.181	N/A	9534.70	0.58	N/A	66.8*
Detention	9557.92	9559.02	-	9559.99	-	-	1.93

V Represents Volume, V10 and V100 includes WQV or DUV.
R Represents Release Rate.
* Total Flow, with C01 routed to overflow.

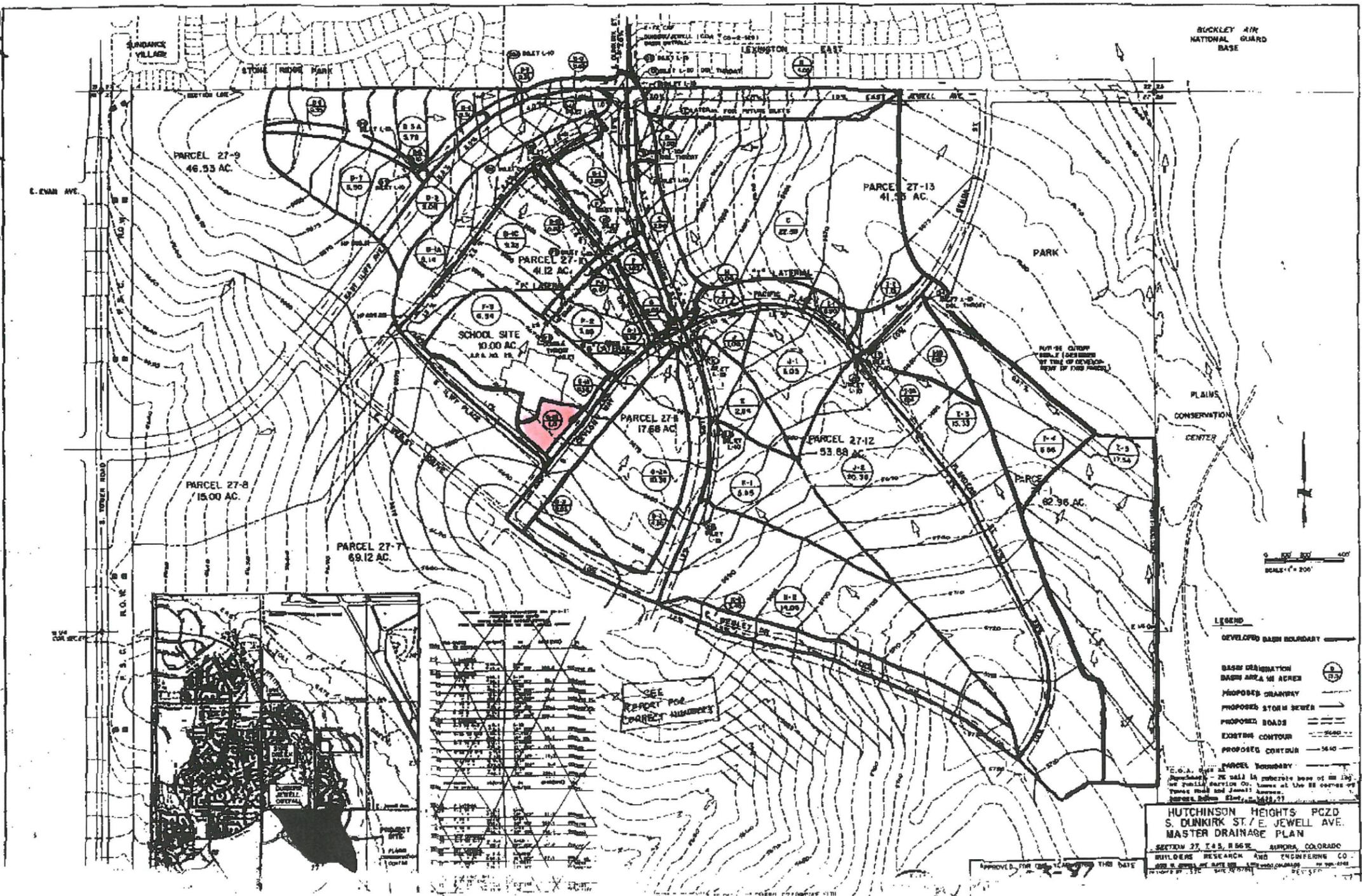
SUMMARY OF FLOWS

Basin	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)
1	1.0	1.0	1.0	1.0
2	1.0	1.0	1.0	1.0
3	1.0	1.0	1.0	1.0
4	1.0	1.0	1.0	1.0
5	1.0	1.0	1.0	1.0
6	1.0	1.0	1.0	1.0
7	1.0	1.0	1.0	1.0
8	1.0	1.0	1.0	1.0
9	1.0	1.0	1.0	1.0
10	1.0	1.0	1.0	1.0
11	1.0	1.0	1.0	1.0
12	1.0	1.0	1.0	1.0
13	1.0	1.0	1.0	1.0
14	1.0	1.0	1.0	1.0

MARKET FLOW TABLE

Basin	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)
1	1.0	1.0	1.0	1.0
2	1.0	1.0	1.0	1.0
3	1.0	1.0	1.0	1.0
4	1.0	1.0	1.0	1.0
5	1.0	1.0	1.0	1.0
6	1.0	1.0	1.0	1.0
7	1.0	1.0	1.0	1.0
8	1.0	1.0	1.0	1.0
9	1.0	1.0	1.0	1.0
10	1.0	1.0	1.0	1.0
11	1.0	1.0	1.0	1.0
12	1.0	1.0	1.0	1.0
13	1.0	1.0	1.0	1.0
14	1.0	1.0	1.0	1.0

4/2
860279



SEE REPORT FOR PARCEL ASSIGNMENTS

Parcel No.	Area (Ac.)	Drainage Area (Ac.)	Flow (cfs)	Velocity (ft/s)	Notes
27-1	62.96	62.96	1.5	1.5	
27-2	53.68	53.68	1.5	1.5	
27-3	41.25	41.25	1.5	1.5	
27-4	10.00	10.00	1.5	1.5	School Site
27-5	41.12	41.12	1.5	1.5	
27-6	17.68	17.68	1.5	1.5	
27-7	69.12	69.12	1.5	1.5	
27-8	15.00	15.00	1.5	1.5	
27-9	46.53	46.53	1.5	1.5	

HUTCHINSON HEIGHTS PCZD
S. DUNKIRK ST / E. JEWELL AVE.
MASTER DRAINAGE PLAN

SECTION 27, T.4S, R.66E, AIRBORNE, COLORADO
 HILDRETH RESEARCH AND ENGINEERING CO.
 1000 N. GARDEN ST. SUITE 100, DENVER, CO 80202
 PHONE: 303.733.1111 FAX: 303.733.1112

APPROVED FOR THE CITY OF DENVER THIS DATE: 11-1-97