RG AND ASSOCIATES, LLC
4885 Ward Road, Suite 100 • Wheat Ridge, CO • 80033
303-293-8107 • 303-293-8106 (fax) • www.rgengineers.com

ENGINEER'S PROGRESS REPORT

Date:	March 24, 2014
To:	Mr. Rich Landreth, Public Works Director
From:	Gary E. Welp, P.E., CFM
RGA Job No.	1011.0019
RE:	2014 Town Drainage Master Plan – West Side of Highway 24

Town Drainage Master Plan – West Side of Highway 24

General

RG and Associates is preparing a Master Drainage Report for the Town of Buena Vista for the area west of Highway 24. The purpose of the Master Drainage Report is to evaluate the capacities of existing bridges and major culverts, the effectiveness of the primary channels / streams in the west side of Buena Vista and determine detention requirements. The primary emphasis of this analysis is the impacts of the western area drainage upon Highway 24 and the associated crossings thereof.

The area of study was comprised of approximately 18 square miles (11300-acres) from Highway 24 west across the alluvial plains and up into the wooded mountains. The headwaters of Cottonwood Creek were not a part of this study and the basis for the hydrology was from the approved flood insurance study (FIS) for Chaffee County published in 1987. The flood insurance rate map (FIRM) mapping of the floodplain by FEMA was also based upon a previous study completed in 1982 (included for reference). We understand that the mapping of the floodplain and floodway for Cottonwood Creek is being undertaken as a part of an agreement with Chaffee County and is anticipated to be complete in 2015 or 2016. Modeling of the Cottonwood Creek floodplain, floodway or HECRAS analysis was not a part of our scope for this project.

The portions of Highway 24 studied by this analysis extend beyond the boundary of the Town. The south boundary is near the southern portion of the airport and north boundary is north of the Town boundary to the closest ridgeline near the Mobile Home Park and CR 383.

Basin Analysis

The area of this study is an alluvial valley, in which, the primary surface soils consist of gravel, stone and generally sandy or loam deposits. The hydrologic soils within this study are classified as Type A

(sandy) soils. Type A soils are generally well drained and as such have a high infiltration / percolation rate which tend to absorb most of the rainfall from minor storm events and only generates minimal runoff during such storm events. This is verified by the results of our calculations using the Colorado Urban Hydrograph Procedure (CUHP) software from the Urban Drainage and Flood Control District (UDFCD). The summary of flows presented in Table 1 shows that during the 2-year, 5-year and 10-year storm events almost all of the rainfall is absorbed into the soils. This is expected since most of the areas within this study are undeveloped or are large acreage lots with only minimal development near Highway 24 and minimal paved areas. During the larger storm events (25-year 50-year and 100-year events) much more runoff is anticipated, since the soils have become saturated and as the low-laying depressions become filled with stormwater. This causes rate of runoff to increases dramatically (see Table 1).

Cottonwood Creek Analysis

The evaluation of Cottonwood Creek as it runs through the west portion of the Town consisted of measuring each bridge / culvert and analyzing the capacity of each structure. The roadway crossing over Cottonwood Creek ranged in type from single-span bridges, multiple box culverts, corrugated metal pipe (CMP) culvert to Arch pipe bridge structures. The sizes of the structure ranged from 10-feet to 30-feet in width.

The hydrologic flow rate from the FIS for Cottonwood Creek was 800 cfs, 1,140 cfs and 1,300 cfs for the 10-year, 50-year and 100-year storm events respectively. The striated nature of the overbank areas of Cottonwood Creek was not evaluated by the report; therefore it was conservatively assumed that the entire storm would pass through the roadway crossing. The percentage of stormwater passing through of each roadway crossing during each storm event is summarized in Table 2. In general roadway crossings Railroad Street, Cedar Street and Highway 24 appear to be adequate. West of Highway 24 the flow band becomes striated and there is flooding caused by (backwater effects) the confined channel between Highway 24 and West Main Street, the West Main Street and the McPhelemy Park control /diversion structure. Based upon available information, it is unclear if the roadway crossings West Main Street, Sterling Avenue, Pleasant Avenue and James Street have adequate capacity. The remaining crossings upstream from James Street to the western limits of the study appear to be adequately sized. A detailed analysis of the floodplain / floodway and the associated roadway crossings will be untaken by Chaffee County utilizing the one-dimensional bridge hydraulic routines and the river water surface profiles as a part of the HECRAS modeling effort..

Highway 24 Analysis

Highway 24 has several drainage crossings ranging from bridges to small diameter storm sewer pipe. The major crossings, hydraulically speaking, are the Cottonwood Creek Bridge, the 36-inch culvert near Mill Street, the 18-inch culvert north of Steele Drive and the two 42-inch culverts south of Steele Drive (see Table 2). The minor crossing of Highway 24 generally consist of a couple Type 13 inlets and 18-inch storm sewer; these minor crossing are located near Crossman Avenue, West Main Street, Pine Street, Mill Street, Oak Street and Gunnison Avenue. The minor crossings have carrying capacity for

only the smallest flows from the Highway 24 gutter, but do not convey enough stormwater to have any impacts upon master planning, and are therefore not included in this report.

The Cottonwood Creek Bridge appears to allow all of the smaller storms, but does create some backwater impacts during larger storms. The major crossing south of Mill Street, in combination with the crossings at Railroad Drive and the railroad tracks creates significant backwater and ponding on both sides of Highway 24 and according to our calculations is undersized. The major crossing north of Steele Drive is and 18-inch culvert, however, there is a significant amount of area for stormwater storage within this basin. The effect to control stormwater by providing storage (degree of attenuation) within this basin is being evaluated, but the existing culvert appears to be undersized. It provides minimal or only nuisance flow control under Highway 24. The last major crossing is south of Steele Street and consists of two 42-inch culverts. There is a sizable area of incidental stormwater storage near the Airport and within the Highway ROW. The degree of attenuation provided by the storage within this basin is also being evaluated further but these culverts appear to be adequately sized (see Table 2).

Table 1

Town of Buena Master Plan (West of Highway 24)
Runoff Calculations

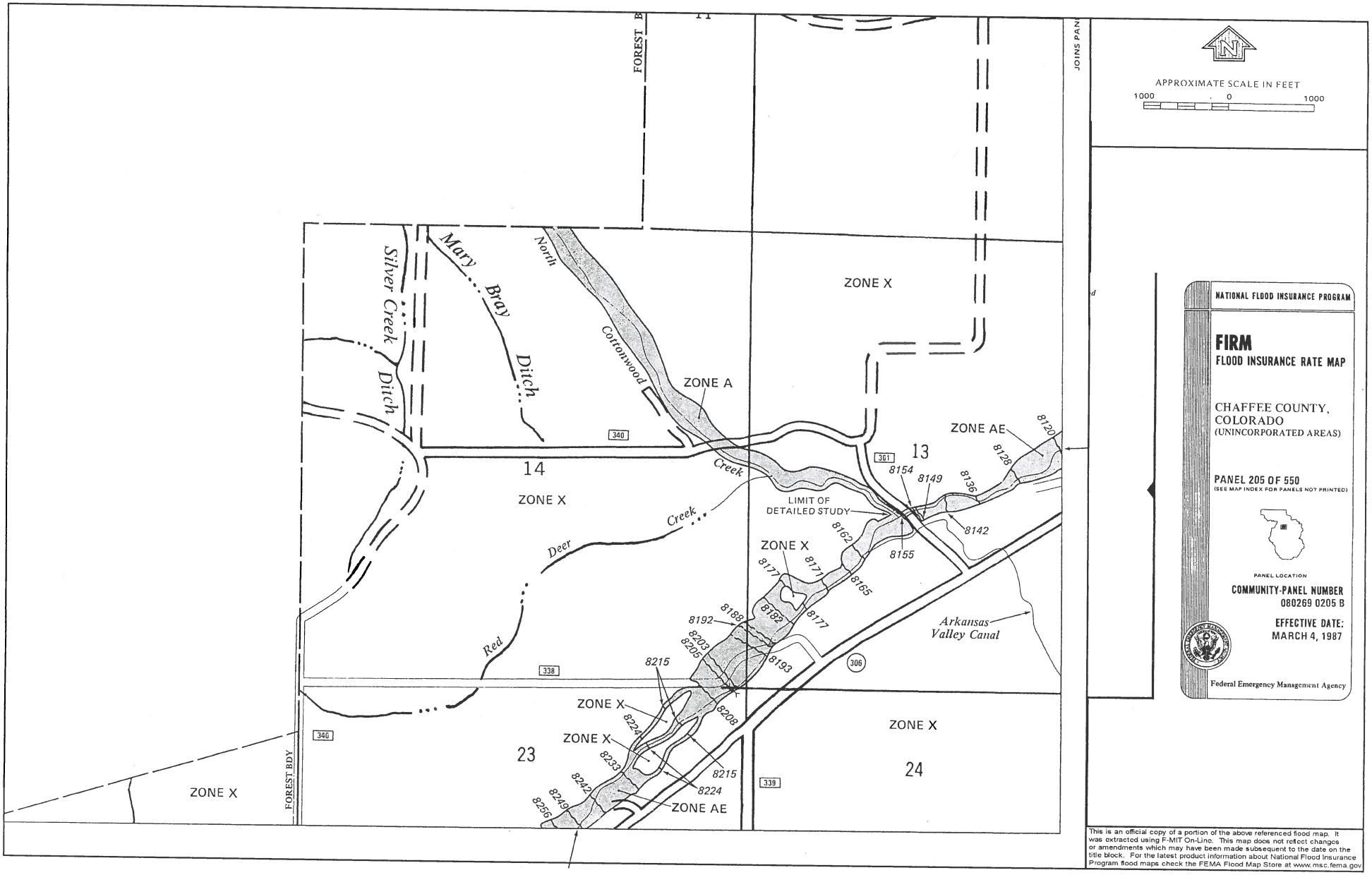
DESIGN POINT	DRAIN BASIN	AREA ac.	2-year Flow cfs	5-year Flow cfs	10-year Flow cfs	25-year Flow cfs	50-year Flow cfs	100-year Flow cfs
Proposed Basins								
A	P-A	1501	0	1	2	78	198	339
B	P-B	2676	0	1	1	129	349	609
C	P-C	231	5	18	35	78	125	178
D	P-D	343	5	16	32	77	131	193
E	P-E	1525	3	11	41	149	284	456
F	P-F	526	0	0	0	22	60	104
G	P-G	128	2	15	33	76	119	167
H	P-H	4360	0	2	3	148	383	661
Total		11290	17	65	148	758	1650	2706

DESIGN POINT	DRAIN BASIN	AREA ac.	2-year Flow cfs	5-year Flow cfs	10-year Flow cfs	25-year Flow cfs	50-year Flow cfs	10-year Flow cfs
Historic Basins								
A	H-A	1501	0	1	1	75	193	332
B	H-B	2676	0	1	1	129	349	609
C	H-C	231	7	24	45	96	150	209
D	H-D	343	2	6	15	44	82	128
E	H-E	1525	1	3	10	78	169	283
F	H-F	526	0	0	0	22	60	104
G	H-G	128	1	9	23	57	93	133
H	H-H	4360	0	1	2	134	364	634
Total		11290	12	45	97	634	1459	2432

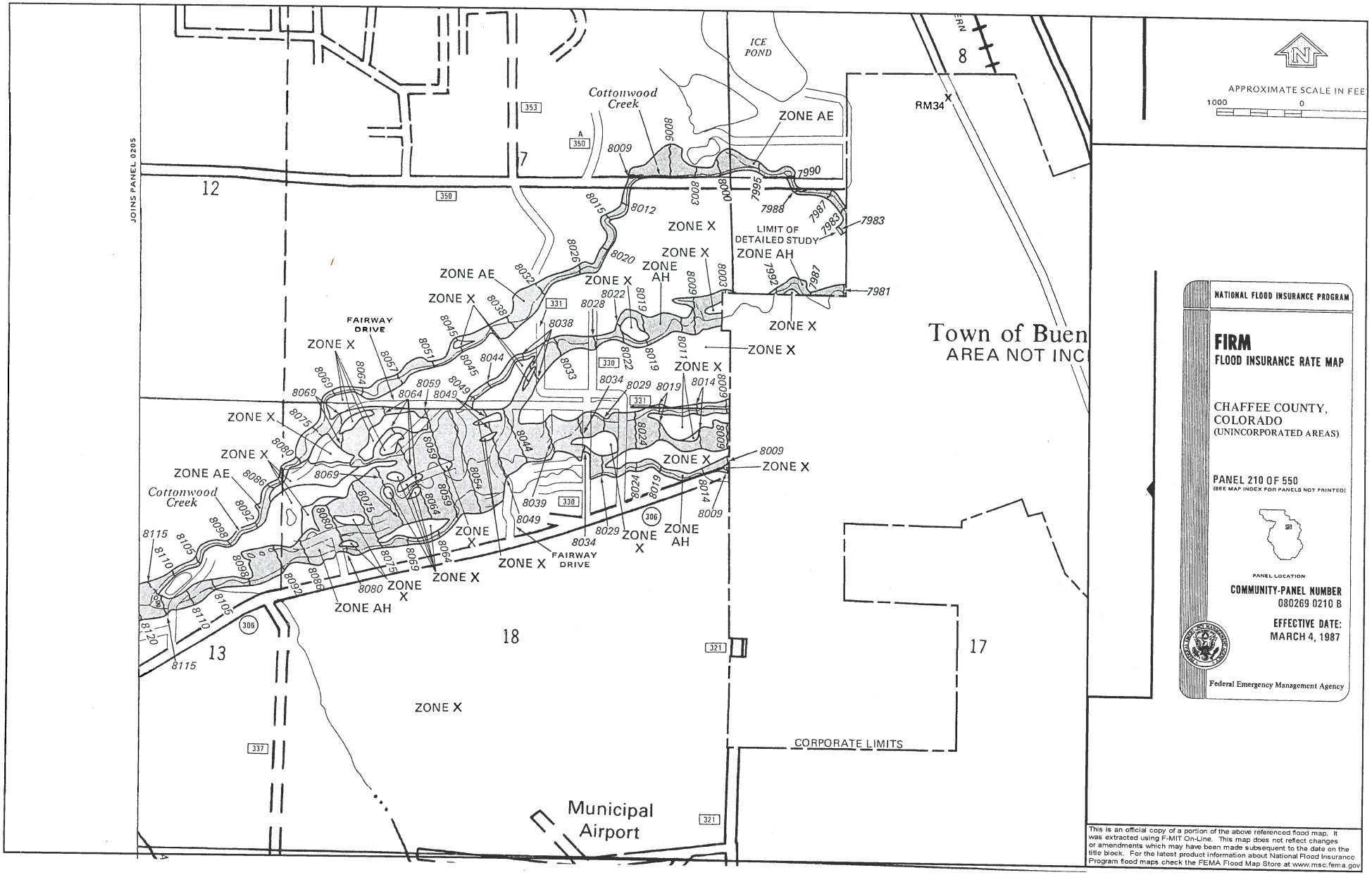
Table 2

Town of Buena Master Plan (West of Highway 24)
Drainage Structure Analysis

Street	Structure	Location	Storm Event Adequacy					
			2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
South Railroad Street	2 - 8' x 9' Box Culverts	Cottonwood Creek	OK	OK	OK	OK	OK	OK
Cedar Street	6' x 31' Bridge	Cottonwood Creek	OK	OK	OK	OK	OK	OK
Highway 24	3 - 4' x 6' Box Culverts	Cottonwood Creek	OK	OK	OK	OK	OK	96%
West Main Street	15' Arch Bridge	Cottonwood Creek	OK	OK	90%	77%	64%	56%
West Sterling Ave.	10' CMP Culvert	Cottonwood Creek	OK	OK	OK	OK	76%	66%
South Pleasant Ave.	5' x 28' Bridge	Cottonwood Creek	OK	OK	OK	OK	OK	96%
James Street	6' x 20' Bridge	Cottonwood Creek	OK	OK	OK	OK	97%	85%
Crossman Ave. (east)	6' x 30' Bridge	Cottonwood Creek	OK	OK	OK	OK	OK	OK
Crossman Ave. (west)	6' x 27' Bridge	Cottonwood Creek	OK	OK	OK	OK	OK	OK
Highway 361	6' x 25' Bridge	Cottonwood Creek	OK	OK	OK	OK	OK	OK
Highway 338	20' Arch Bridge	Cottonwood Creek	OK	OK	OK	OK	OK	99%
Highway 24	18" Culvert	Basin A near Farwell St	Highway Nusiance Flows Only -- No Master Plan Benefit					
North Gunnison Ave.	30" Culvert	Basin C	OK	OK	OK	52%	33%	23%
Highway 24	18" Culvert	Basin C near Crossman Ave	Highway Nusiance Flows Only -- No Master Plan Benefit					
Highway 24	18" Culvert	Basin C near West Main	Highway Nusiance Flows Only -- No Master Plan Benefit					
Highway 24	18" Culvert	Basin C near Pine St	Highway Nusiance Flows Only -- No Master Plan Benefit					
North San Juan Ave.	24" Culvert	Basin C	OK	OK	77%	34%	22%	15%
James Street	1 - 24" and 2 - 12" Culvert	Basin C	OK	OK	OK	42%	27%	19%
Highway 24	36" Culvert	Basin D	OK	OK	OK	OK	63%	43%
Highway 24	18" Culvert	Basin D north of Mill St	Highway Nusiance Flows Only -- No Master Plan Benefit					
Highway 24	18" Culvert	Basin D near Oak St	Highway Nusiance Flows Only -- No Master Plan Benefit					
North San Juan Ave.	24" Culvert	Basin D	OK	OK	84%	35%	21%	14%
South Pleasant Ave.	24" Culvert	Basin D	OK	OK	84%	35%	21%	14%
West Main Street	24" Culvert	Basin D	OK	OK	OK	47%	28%	19%
Sangre de Cristo Ave.	24" Culvert	Basin D	OK	OK	OK	47%	28%	19%
CR330	18" Culvert	Basin D	OK	OK	OK	42%	25%	17%
Highway 24	2 - 18" Culverts	Basin E	OK	OK	OK	OK	20%	10%
Highway 24	18" Culvert	Basin E near S. Gunnison	Highway Nusiance Flows Only -- No Master Plan Benefit					
CR 319	18" Culvert	Basin G detetnion pond outlet	Highway Nusiance Flows Only -- No Master Plan Benefit					
Highway 24	2 - 42" Culverts	Basin H	OK	OK	OK	OK	47%	29%



This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov.



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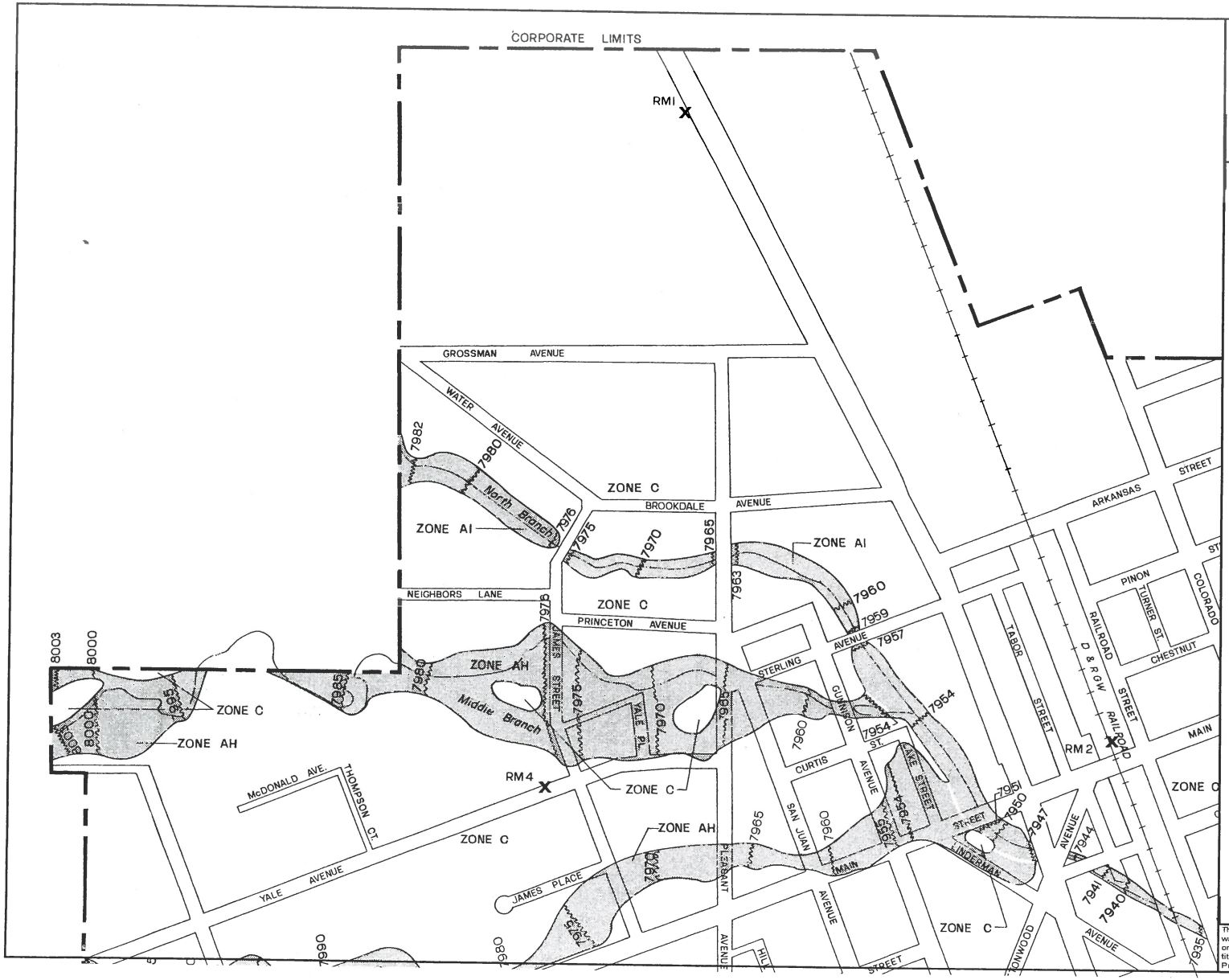

APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

TOWN OF
BUENA VISTA,
COLORADO
CHAFFEE COUNTY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER
080030 0001 C

EFFECTIVE DATE:
SEPTEMBER 30, 1982

Federal Emergency Management Agency

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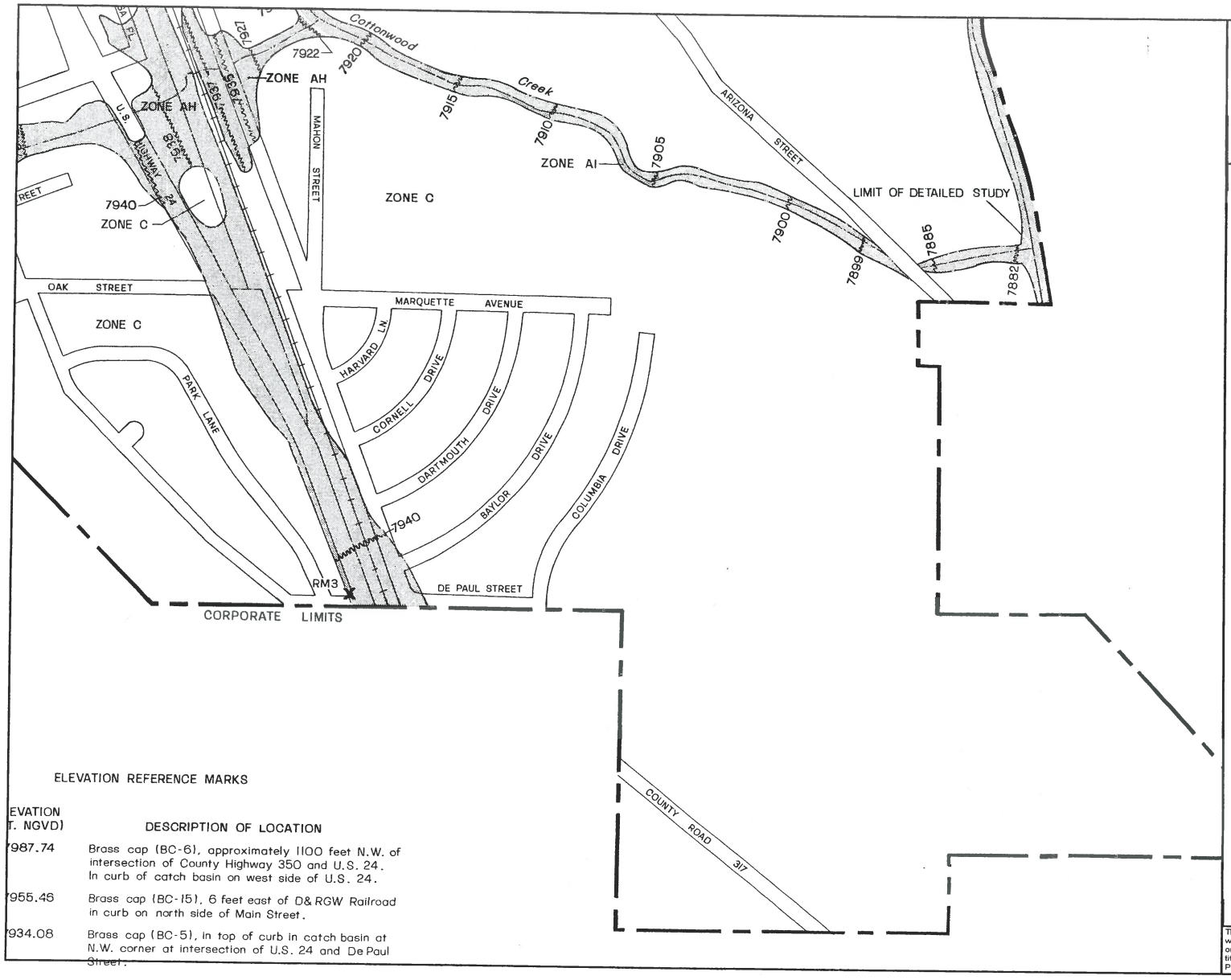

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ELEVATION REFERENCE MARKS

ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
7987.74	Brass cap (BC-6), approximately 1100 feet N.W. of intersection of County Highway 350 and U.S. 24. In curb of catch basin on west side of U.S. 24.
7955.46	Brass cap (BC-15), 6 feet east of D&RGW Railroad in curb on north side of Main Street.
7934.08	Brass cap (BC-5), in top of curb in catch basin at N.W. corner at intersection of U.S. 24 and De Paul Street.

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MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: Chaffee-Lake Area, Colorado, Parts of Chaffee and Lake Counties
Survey Area Data: Version 8, Dec 23, 2013

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

Date(s) aerial images were photographed: Jun 21, 2010—Nov 18, 2011

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 — Chaffee-Lake Area, Colorado, Parts of Chaffee and Lake Counties (CO658)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
AdC	Adilis loam, 1 to 5 percent slopes	B	45.7	0.8%
ChB	Chaffee loam 1 to 3 percent slopes	A/D	239.5	4.0%
CtD	Cotopaxi loamy sand, 3 to 9 percent slopes	A	72.7	1.2%
DoD	Dominson gravelly sandy loam, 1 to 9 percent slopes	A	2,740.7	45.3%
DoF	Dominson gravelly sandy loam, 9 to 45 percent slopes	A	431.2	7.1%
GcB	Gas Creek gravelly sandy loam, 1 to 3 percent slopes	A/D	250.7	4.1%
GP	Pits, gravel	A	6.8	0.1%
OrC	Ouray sandy loam, 1 to 5 percent slopes	A	93.6	1.5%
RcF	Rockland, 15 to 60 percent slopes	D	233.4	3.9%
Ro	Rock outcrop	D	197.3	3.3%
SsC	San Isabel stony sandy loam, 1 to 5 percent slopes	A	1,124.4	18.6%
StC	Sawatch sandy loam, 1 to 5 percent slopes	A/D	100.3	1.7%
W	Water		58.7	1.0%
Wa	Wet alluvial land		453.7	7.5%
Totals for Area of Interest			**6,049.1**	**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.

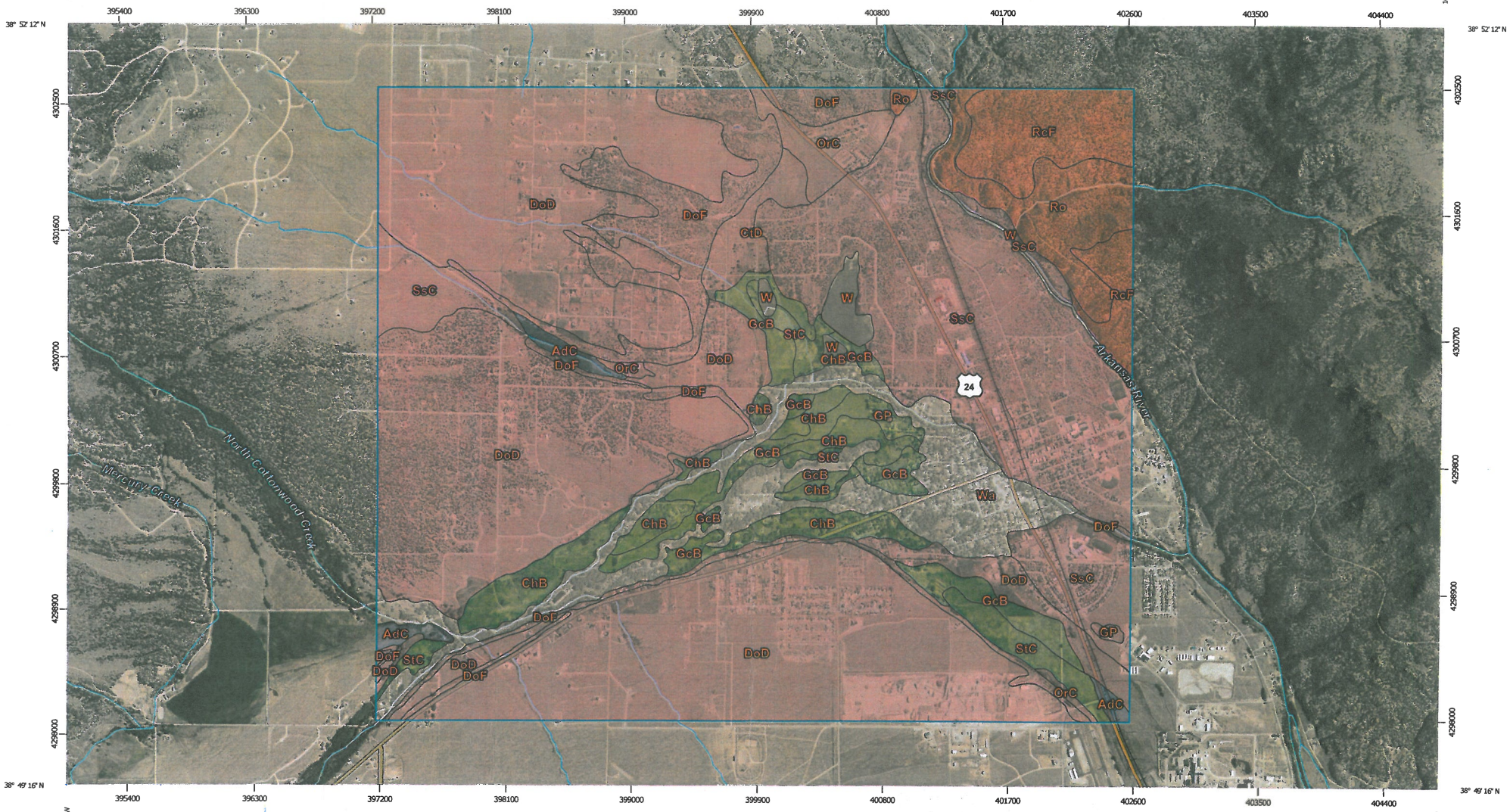
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Hydrologic Soil Group—Chaffee-Lake Area, Colorado, Parts of Chaffee and Lake Counties
(Buena Vista West)



Map Scale: 1:26,500 if printed on B landscape (17" x 11") sheet.

Meters: 0 350 700 1400 2100

Feet: 0 1000 2000 4000 6000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.4.3)
100-year Storm Event

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	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.)	Runoff per Unit Area (cfs/acre)
PA		0.142	0.350	101.6	28.78	52.8	20.34	48.0	693	5,448,630	0.50	2,699,173	75.0	339	2,698,815	0.23
PB		0.149	0.397	95.9	30.72	49.8	21.71	51.2	1,309	9,713,996	0.47	4,558,042	80.0	609	4,557,483	0.23
PC		0.097	0.366	41.1	13.05	21.4	9.22	21.8	241	765,959	0.95	728,029	50.0	178	727,466	0.84
PD		0.103	0.332	60.2	16.83	31.3	11.89	28.1	267	1,245,003	0.84	1,047,925	60.0	193	1,048,037	0.56
PE		0.110	0.369	109.4	32.46	56.9	22.94	54.1	654	5,535,721	0.73	4,030,929	85.0	456	4,030,831	0.30
PF		0.149	0.311	111.0	28.01	57.7	19.79	46.7	222	1,909,438	0.47	901,396	75.0	104	901,275	0.20
PG		0.102	0.372	25.3	8.73	13.2	6.17	14.5	237	464,640	1.01	467,540	45.0	167	467,411	1.30
PH		0.144	0.416	149.8	49.32	77.9	34.85	82.2	1,364	15,826,800	0.49	7,701,114	110.0	661	7,700,678	0.15
HA		0.144	0.354	102.0	29.25	53.0	20.67	48.8	690	5,448,631	0.49	2,651,233	80.0	332	2,651,047	0.22
HB		0.149	0.397	95.9	30.72	49.8	21.71	51.2	1,309	9,713,996	0.47	4,558,042	80.0	609	4,557,483	0.23
HC		0.095	0.408	35.9	12.57	18.7	8.40	21.3	276	765,959	1.01	776,365	50.0	209	776,082	0.99
HD		0.115	0.278	79.9	18.55	41.6	13.11	30.9	201	1,245,003	0.69	863,966	65.0	128	863,895	0.37
HE		0.126	0.328	141.0	37.01	73.3	26.15	61.7	507	5,535,721	0.57	3,137,934	95.0	283	3,137,818	0.19
HF		0.149	0.311	111.0	28.01	57.7	19.79	46.7	222	1,909,438	0.47	901,396	75.0	104	901,275	0.20
HG		0.106	0.314	31.4	9.07	16.3	6.41	15.1	191	464,640	0.91	421,154	45.0	133	420,112	1.04
HH		0.149	0.427	150.7	50.92	78.3	35.98	84.9	1,357	15,833,421	0.47	7,429,424	110.0	634	7,429,389	0.15

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.4.3)

50-year Storm Event

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	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.)	Runoff per Unit Area (cfs/acre)
PA		0.144	0.353	101.9	29.15	53.0	20.60	48.6	690	5,448,630	0.29	1,577,420	75.0	198	1,577,285	0.13
PB		0.150	0.400	96.0	30.97	49.9	21.89	51.6	1,307	9,713,996	0.27	2,613,935	80.0	349	2,613,481	0.13
PC		0.098	0.358	42.2	13.12	22.0	9.27	21.9	234	765,959	0.68	521,741	50.0	125	521,439	0.59
PD		0.104	0.326	61.8	16.96	32.1	11.98	28.3	260	1,245,003	0.58	724,578	60.0	131	724,589	0.38
PE		0.111	0.362	112.9	32.86	58.7	23.22	54.8	633	5,535,721	0.47	2,579,037	85.0	284	2,578,681	0.19
PF		0.150	0.313	111.1	28.24	57.8	19.96	47.1	222	1,909,438	0.27	519,252	75.0	60	519,164	0.11
PG		0.102	0.359	26.4	8.79	13.7	6.21	14.6	227	464,640	0.71	331,863	40.0	119	331,687	0.93
PH		0.146	0.419	150.2	49.88	78.1	35.25	83.1	1,361	15,826,800	0.28	4,473,162	110.0	383	4,473,122	0.09
HA		0.146	0.357	102.3	29.58	53.2	20.90	49.3	688	5,448,631	0.28	1,539,958	75.0	193	1,539,910	0.13
HB		0.150	0.400	96.0	30.97	49.9	21.89	51.6	1,307	9,713,996	0.27	2,613,935	80.0	349	2,613,481	0.13
HC		0.095	0.399	36.9	12.81	19.2	9.05	21.3	268	765,959	0.74	566,197	50.0	150	566,102	0.71
HD		0.116	0.275	81.5	18.72	42.4	13.23	31.2	197	1,245,003	0.45	562,354	65.0	82	562,229	0.24
HE		0.128	0.331	142.7	37.74	74.2	26.67	62.9	501	5,535,721	0.34	1,890,747	90.0	169	1,890,639	0.11
HF		0.150	0.313	111.1	28.24	57.8	19.96	47.1	222	1,909,438	0.27	519,252	75.0	60	519,164	0.11
HG		0.108	0.305	32.7	9.16	17.0	6.47	15.3	183	464,640	0.62	289,158	45.0	93	288,895	0.72
HH		0.150	0.430	150.8	51.34	78.4	36.28	85.6	1,356	15,833,421	0.27	4,260,608	110.0	364	4,260,510	0.08

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.4.3)

25-year Storm Event

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	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.)	Runoff per Unit Area (cfs/acre)
PA		0.147	0.359	102.4	29.71	53.2	21.00	49.5	687	5,448,630	0.12	630,137	80.0	78	630,131	0.05
PB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.10	965,744	80.0	129	965,517	0.05
PC		0.099	0.347	44.0	13.24	22.9	9.35	22.1	225	765,959	0.45	347,528	50.0	78	347,338	0.37
PD		0.105	0.317	64.3	17.16	33.4	12.12	28.6	250	1,245,003	0.37	457,085	60.0	77	456,878	0.22
PE		0.113	0.352	118.2	33.49	61.5	23.66	55.8	605	5,535,721	0.26	1,434,140	90.0	149	1,434,123	0.10
PF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.10	195,274	75.0	22	195,247	0.04
PG		0.104	0.342	28.1	8.88	14.6	6.28	14.8	213	464,640	0.47	218,630	45.0	76	218,555	0.60
PH		0.148	0.426	150.6	50.75	78.3	35.87	84.6	1,357	15,826,800	0.11	1,743,581	110.0	148	1,743,581	0.03
HA		0.148	0.363	102.6	30.08	53.3	21.26	50.1	686	5,448,631	0.11	600,256	80.0	75	600,271	0.05
HB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.10	965,744	80.0	129	965,517	0.05
HC		0.096	0.386	38.4	12.89	20.0	9.11	21.5	257	765,959	0.50	386,395	50.0	96	386,394	0.45
HD		0.117	0.271	83.7	18.96	43.5	13.40	31.6	192	1,245,003	0.25	316,418	65.0	44	316,403	0.13
HE		0.133	0.336	145.0	38.94	75.4	27.52	64.9	493	5,535,721	0.16	887,890	95.0	78	887,902	0.05
HF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.10	195,274	75.0	22	195,247	0.04
HG		0.109	0.292	34.8	9.29	18.1	6.56	15.5	173	464,640	0.40	183,800	45.0	57	183,755	0.44
HH		0.152	0.436	150.9	52.01	78.5	36.75	86.7	1,355	15,833,421	0.10	1,574,123	115.0	134	1,574,060	0.03

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.4.3)

10-year Storm Event

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	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.)	Runoff per Unit Area (cfs/acre)
PA		0.147	0.359	102.4	29.71	53.2	21.00	49.5	687	5,448,630	0.00	18,382	120.0	2	18,381	0.00
PB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.00	14,565	115.0	1	14,562	0.00
PC		0.099	0.347	44.0	13.24	22.9	9.35	22.1	225	765,959	0.25	188,030	50.0	35	187,927	0.17
PD		0.105	0.317	64.3	17.16	33.4	12.12	28.6	250	1,245,003	0.18	224,844	60.0	32	224,742	0.09
PE		0.113	0.352	118.2	33.49	61.5	23.66	55.8	605	5,535,721	0.08	435,351	90.0	41	435,346	0.03
PF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.00	3,026	120.0	0	3,026	0.00
PG		0.104	0.342	28.1	8.88	14.6	6.28	14.8	213	464,640	0.22	101,760	35.0	33	101,726	0.26
PH		0.148	0.426	150.6	50.75	78.3	35.87	84.6	1,357	15,826,800	0.00	42,187	140.0	3	42,187	0.00
HA		0.148	0.363	102.6	30.08	53.3	21.26	50.1	686	5,448,631	0.00	14,524	120.0	1	14,524	0.00
HB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.00	14,565	115.0	1	14,562	0.00
HC		0.096	0.386	38.4	12.89	20.0	9.11	21.5	257	765,959	0.28	217,788	45.0	45	217,788	0.21
HD		0.117	0.271	83.7	18.96	43.5	13.40	31.6	192	1,245,003	0.10	125,519	65.0	15	125,513	0.04
HE		0.133	0.336	145.0	38.94	75.4	27.52	64.9	493	5,535,721	0.02	124,417	105.0	10	124,418	0.01
HF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.00	3,026	120.0	0	3,026	0.00
HG		0.109	0.292	34.8	9.29	18.1	6.56	15.5	173	464,640	0.17	79,882	40.0	23	79,862	0.18
HH		0.152	0.436	150.9	52.01	78.5	36.75	86.7	1,355	15,833,421	0.00	23,740	140.0	2	23,739	0.00

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.4.3)

5-year Storm Event

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	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.)	Runoff per Unit Area (cfs/acre)
PA		0.147	0.359	102.4	29.71	53.2	21.00	49.5	687	5,448,630	0.00	12,075	120.0	1	12,075	0.00
PB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.00	9,568	120.0	1	9,566	0.00
PC		0.099	0.347	44.0	13.24	22.9	9.35	22.1	225	765,959	0.14	110,712	50.0	18	110,651	0.09
PD		0.105	0.317	64.3	17.16	33.4	12.12	28.6	250	1,245,003	0.10	122,492	65.0	16	122,437	0.05
PE		0.113	0.352	118.2	33.49	61.5	23.66	55.8	605	5,535,721	0.02	129,052	125.0	11	129,051	0.01
PF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.00	2,044	120.0	0	2,044	0.00
PG		0.104	0.342	28.1	8.88	14.6	6.28	14.8	213	464,640	0.11	52,639	40.0	15	52,621	0.12
PH		0.148	0.426	150.6	50.75	78.3	35.87	84.6	1,357	15,826,800	0.00	27,714	140.0	2	27,714	0.00
HA		0.148	0.363	102.6	30.08	53.3	21.26	50.1	686	5,448,631	0.00	9,541	120.0	1	9,541	0.00
HB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.00	9,568	120.0	1	9,566	0.00
HC		0.096	0.386	38.4	12.89	20.0	9.11	21.5	257	765,959	0.17	131,940	50.0	24	131,940	0.11
HD		0.117	0.271	83.7	18.96	43.5	13.40	31.6	192	1,245,003	0.04	54,378	75.0	6	54,375	0.02
HE		0.133	0.336	145.0	38.94	75.4	27.52	64.9	493	5,535,721	0.01	37,037	130.0	3	37,037	0.00
HF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.00	2,044	120.0	0	2,044	0.00
HG		0.109	0.292	34.8	9.29	18.1	6.56	15.5	173	464,640	0.08	36,931	40.0	9	36,922	0.07
HH		0.152	0.436	150.9	52.01	78.5	36.75	86.7	1,355	15,833,421	0.00	15,596	145.0	1	15,595	0.00

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 1.4.3)

2-year Storm Event

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	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.)	Runoff per Unit Area (cfs/acre)
PA		0.147	0.359	102.4	29.71	53.2	21.00	49.5	687	5,448,630	0.00	2,616	140.0	0	2,616	0.00
PB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.00	2,073	140.0	0	2,072	0.00
PC		0.099	0.347	44.0	13.24	22.9	9.35	22.1	225	765,959	0.05	37,976	80.0	5	37,955	0.03
PD		0.105	0.317	64.3	17.16	33.4	12.12	28.6	250	1,245,003	0.03	41,184	115.0	5	41,165	0.01
PE		0.113	0.352	118.2	33.49	61.5	23.66	55.8	605	5,535,721	0.01	36,031	140.0	3	36,031	0.00
PF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.00	571	135.0	0	571	0.00
PG		0.104	0.342	28.1	8.88	14.6	6.28	14.8	213	464,640	0.03	12,832	70.0	2	12,828	0.02
PH		0.148	0.426	150.6	50.75	78.3	35.87	84.6	1,357	15,826,800	0.00	6,004	170.0	0	6,004	0.00
HA		0.148	0.363	102.6	30.08	53.3	21.26	50.1	686	5,448,631	0.00	2,067	140.0	0	2,067	0.00
HB		0.152	0.405	96.0	31.36	49.9	22.16	52.3	1,306	9,713,996	0.00	2,073	140.0	0	2,072	0.00
HC		0.096	0.386	38.4	12.89	20.0	9.11	21.5	257	765,959	0.06	45,826	75.0	7	45,826	0.03
HD		0.117	0.271	83.7	18.96	43.5	13.40	31.6	192	1,245,003	0.01	18,447	120.0	2	18,446	0.01
HE		0.133	0.336	145.0	38.94	75.4	27.52	64.9	493	5,535,721	0.00	10,341	150.0	1	10,341	0.00
HF		0.152	0.317	111.2	28.60	57.8	20.21	47.7	222	1,909,438	0.00	571	135.0	0	571	0.00
HG		0.109	0.292	34.8	9.29	18.1	6.56	15.5	173	464,640	0.02	9,224	70.0	1	9,222	0.01
HH		0.152	0.436	150.9	52.01	78.5	36.75	86.7	1,355	15,833,421	0.00	3,378	170.0	0	3,378	0.00

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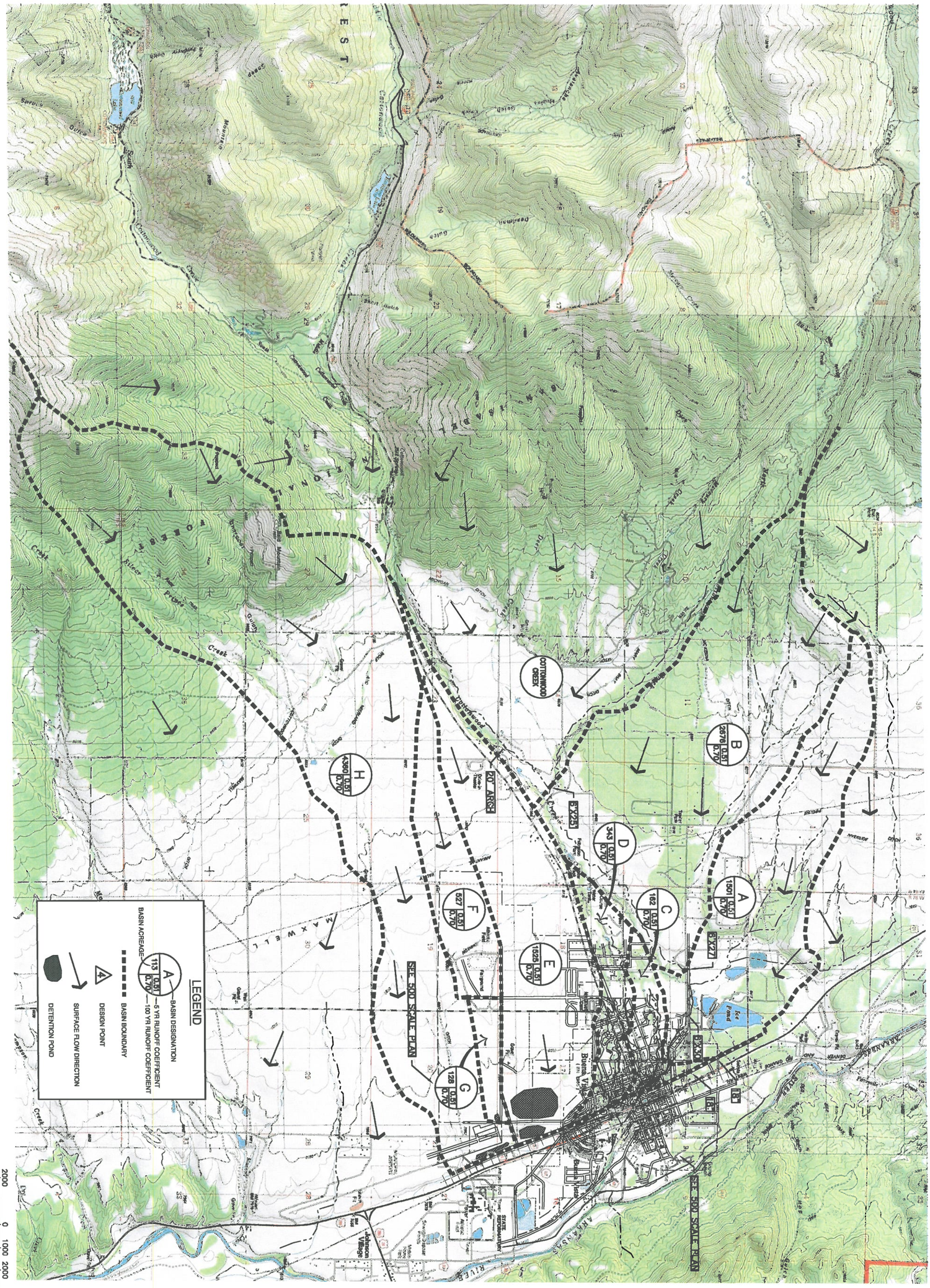

DRAWN BY: WPM	DESIGNED BY: GEW	BUENA VISTA MASTER PLAN	
JOB NUMBER: 1101.0004		description: West of Highway 24	
DATE: MAY 2013		HISTORIC DRAINAGE PLAN	
SCALE: 1"=2000'		prepared for: TOWN OF BUENA VISTA, 210 EAST MAIN STREET – P.O. BOX 2002, BUENA VISTA, CO 81211	
DRAWING NAME:			
SHEET NO: 1 of 2			

RG AND ASSOCIATES, LLC
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SCALE VERIFICATION

BAR IS ONE INCH ON ORIGINAL DRAWING

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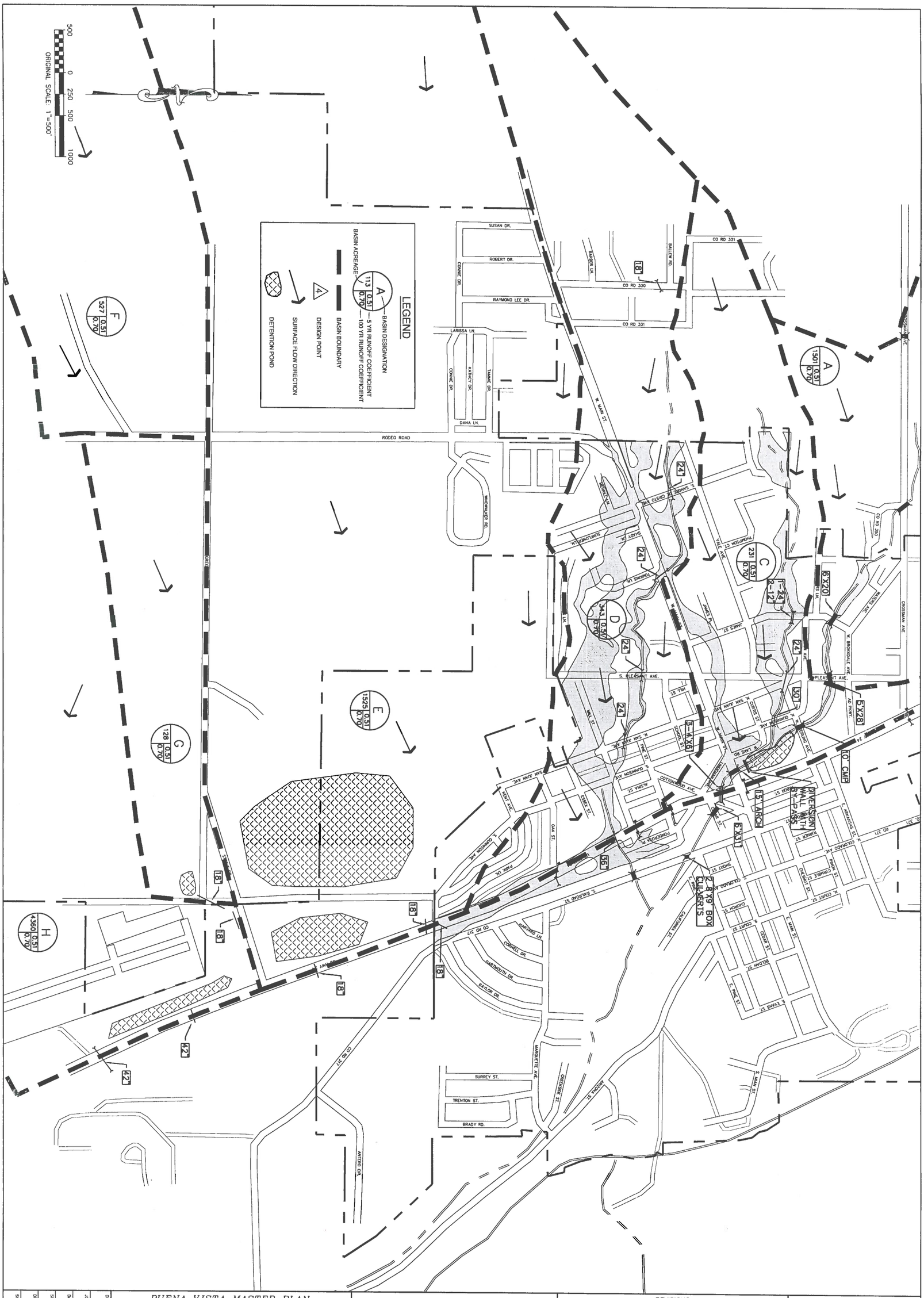
S:\1011.0002 Buena Vista 2013 Roads\dwg\sheets\Drainage\West Side Drainage Map.dwg, 3/25/2014 8:39:07 AM, 1:2, WPM



DRAWN BY: WPM	DESIGNED BY: GEW	JOB NUMBER: 1101.0004	DATE: MAY 2013
SCALE: 1"=500'	DRAWING NAME:	SHEET NO: 2 of 2	

BUENA VISTA MASTER PLAN

description

West of Highway 24

HISTORIC DRAINAGE PLAN

prepared for

TOWN OF BUENA VISTA
210 EAST MAIN STREET – P.O. BOX 2002
BUENA VISTA, CO 81211

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