

# **FINAL DRAINAGE REPORT**

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**SANTA FE RANCH SUBDIVISION**

**FRUITA, COLORADO**

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**PREPARED FOR:**

**Mr. John Folkestad**  
1255 Q Road  
Loma, CO 81524  
(970) 858-1436

**PREPARED BY:**

**VISTA ENGINEERING CORP.**  
2777 Crossroads Blvd.  
Grand Junction, CO 81506  
(970) 243-2242

September 24, 2003  
VEC # 4107.02-02

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# CERTIFICATION

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I hereby certify that this Final Drainage Report for Santa Fe Ranch Subdivision was prepared under my direct supervision.



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Patrick M. O'Connor, P.E.  
Registered Professional Engineer  
State of Colorado, # 20759

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# FINAL DRAINAGE REPORT

## SANTA FE RANCH SUBDIVISION

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### I. LOCATION AND DESCRIPTION OF PROJECT

Santa Fe Ranch Subdivision is located approximately 1/8 mile north of K Road along the east side of Big Salt Wash. The Sketch-Plan was approved earlier this year and the project is currently within the Fruita City limits zoned "Community Residential". The project is comprised of one Mesa County Tax parcel (number 2697-074-00-046) containing 9.691 acres. This is a request for Preliminary-Final Plan approval.

The proposed project will ultimately consist of 26 single-family residential lots for an overall density of 2.68 units per acre. Included are 2.920 acres of open-space (30.1% of total area) to be dedicated to the City of Fruita for various uses including public trails.

Existing streets in the vicinity include Juniper Street adjacent immediately to the east, and Ponderosa Drive which exists in the Orchard Valley subdivision immediately adjacent to the south. Urban residential streets are capable of being extend into the adjacent parcel to the east to provide neighborhood connectivity. All streets and utilities will be constructed in conformance with current City of Fruita Standards and Specifications. The project will be designed to comply with the standards listed in the current City of Fruita Development Code for "Community Residential" zoning.

The site is currently vacant and being utilized as flood-irrigated pasture. Access to the project will occur initially from the Juniper Street entrance, but can also be accomplished from the east once the adjacent parcel is developed. Disturbance of the open space tract will be minimal in an attempt to minimize impacts on the natural vegetation and wildlife of the Big Salt Wash. Irrigation of the developed area, especially along the bank of Big Salt Wash, will be restricted to aid soil stability of the bank and to accommodate peak watering demands with available water. Ownership of the open space tract will be dedicated to the City. The landscaping, and maintenance, of all single family lots will be the responsibility of individual lot owners.

The soils at the site have been evaluated by a geotechnical analysis included within Final Plan submittal and are typical for the Fruita area. The surface soils generally consist of lean clays, sandy silts, and silty sand. These soils are categorized as hydrologic soils group "B" which have low to moderate infiltration capability and moderate runoff potential. This should not pose an adverse impact to development of the site. There are no known geological hazards at this location which would preclude site development as planned, provided the engineering recommendations of the construction drawings and the Subsurface Exploration Report are followed.

## II. EXISTING DRAINAGE CONDITIONS

### MAJOR BASIN

Santa Fe Ranch is located in northwest Fruita within the major basin of the Big Salt Wash. Contours on topographic maps of the site included in the appendix show that the site drains directly to the Big Salt Wash, which ultimately drains into the Colorado River approximately ½ mile downstream.

The developed portions of Santa Fe Ranch do not exist within the designated 100 year floodplain of the Big Salt Wash, Colorado River Basin, or any other basin as delineated by the July 15, 1992 Flood Insurance Rate Maps produced by FEMA. The 100 year floodplain, per these maps, does exist along the Big Salt Wash, but is contained below the upper bank and is not within the area designated for residential construction.

### SITE

Topography of the property is relatively "flat" in nature, sloping generally southwest at an average rate of less than one percent. Pasture grasses cover most of the site with gated-pipe providing irrigation delivery and tail-water being collected around the perimeter by surface ditches. Irrigation is delivered to the property by a Grand Valley Irrigation Company pipeline existing in the northeast corner of the site. Runoff from the site has historically flowed south to be collected by a tailwater ditch along the southern boundary. This ditch flows west to an existing drain pipe in the southwest corner which discharges stormwater runoff and irrigation return flows directly into the Big Salt Wash.

### OFF-SITE IMPACTS TO THE SITE

Offsite surface runoff in the vicinity is collected and diverted away from the site by the existing topography and surface ditches surrounding the project. Existing topography of the area can be seen from maps in the appendix to drain generally south and west, toward Big Salt Wash and the river. The wash exists generally along the north and west boundaries, providing a collection barrier from the north. The property to the east drains to the south, not to the west, along the common boundary with Santa Fe Ranch and, therefore, does not impact the site. An existing subdivision (Evening Breeze) exists immediately south of the site which contains and discharges runoff directly to the Big Salt Wash through its own system of streets and stormwater management.

### **III. PROPOSED DRAINAGE CONDITIONS**

#### **CHANGES IN DRAINAGE PATTERNS**

No major change in the released drainage pattern is proposed for the site. Drainage patterns within the site will be modified to accommodate development and to better control surface flows to designated collection areas. Development of the site will eliminate flood-irrigation practices through the installation of a pressurized irrigation system delivering water to each lot for distribution to small individual lawns. Upon development, runoff will flow into the streets to be collected and directed for direct-discharge into the Big Salt Wash near the southwest corner of the site, where it has historically drained

Improvements are proposed for the discharge location to prevent erosion. Once the runoff reaches the low-point in the streets (near the southwest corner) it will be carried by a concrete channel/walkway to the bank of the wash. Here it will be discharged into an underground pipeline to transport flows to the wash, under proposed walking trails in the open-space.

#### **MAINTENANCE**

Access to the stormwater management improvements will be by platted streets and easements as required. A Home Owners Association will be formed to provide maintenance responsibility for the surface improvements related to the facility. Operation and maintenance of the future underground storm sewers will ultimately be the responsibility of the City of Fruita.

#### IV. DRAINAGE DESIGN CRITERIA AND APPROACH

##### REGULATIONS

The City of Fruita Stormwater Management Master Plan (SWMM - June, 1998) and Mesa County Stormwater Management Manual (SWMM - May, 1996) were used as the basis for analysis and facility design criteria. No other master drainage plan has been completed for the area, to our knowledge. This development was designed within the guidelines of the SWMM and the SWMM to assure minimal impacts to downstream properties.

##### HYDROLOGICAL CRITERIA

Because the project is a residential development containing sub-basins less than 25 acres, the "Rational Method" was used to calculate the historic and developed flow rates. As required, a minor storm is considered to be a 2-year frequency and a major storm is considered to be a 100-year frequency event.

Runoff Coefficients and intensity-duration-frequency data used in the computations were based on the most recent SWMM criteria defined above. Coefficients were assigned based on land use and hydrologic soils group. Haestad Methods software ("Pondpack") was used to perform the calculations.

##### HYDRAULIC CRITERIA

All site facilities and conveyance elements were designed in accordance with the City of Fruita SWMM and the City of Fruita Design Standards and Construction Specifications.

The design includes a concrete channel/walkway and a section of 15" RCP pipeline to carry water from the street to the discharge location in the wash. Open channels and pipelines were analyzed using Manning's Equation and roughness coefficients found in the SWMM Manual. Haestad Flowmaster Software was used to perform the calculations. Copies of these calculations are included in the appendix.

##### DIRECT-DISCHARGE (DRAINAGE IMPACT FEE)

A calculation of the DRAINAGE IMPACT FEE follows. It is based on the composite "C" values calculated in the appendix and the formula contained within the Fruita SWMM manual.

$$\begin{aligned} \$FEE &= \$12,000 (C_{d100} - C_{h100}) A^{0.7} \\ &= \$12,000 (0.36 - 0.25) 9.691^{0.7} \\ &= \$6,471.90 \end{aligned}$$



## V. RESULTS AND CONCLUSION

### AREAS

Site (Total) 9.70 Acres

### RUNOFF COEFFICIENTS - "C"

Big Salt Wash area	- 0.18 (2 yr.)	0.21 (100 yr.)
Pasture	- 0.22 (2 yr.)	0.27 (100 yr.)
Developed (¼ ac./unit)	- 0.33 (2 yr.)	0.42 (100 yr.)

### TIMES OF CONCENTRATION

Historic Site	-	32 minutes
Developed Site	-	20 minutes

### RUNOFF (All Flows are cubic-feet per second)

	Historic Site (Undeveloped)	Total Site (Developed)
2 Year	1.05	1.89
100 Year	4.98	9.32

### CONCLUSION

The developed site will direct-discharge runoff into the Big Salt Wash at rates greater than the historic rates, but generally in the same location. No detention is proposed for developed runoff from this site, therefore a Drainage Impact Fee has been calculated. Irrigation return flows from the site should be greatly reduced by the elimination of furrow irrigation and the implementation of reduced landscaping and watering restrictions.

# APPENDIX

## 1. SITE MAPS

Santa Fe Ranch - Grading and Drainage Plan  
Santa Fe Ranch - Stormwater Management Plan  
Vicinity Topography Map - Mesa County Mapping  
Major Basin Drainage Map (partial U.S.G.S. Quad Sheet - Fruita)

## 2. COEFFICIENTS

Runoff "C" Values (Rational Formula)  
Composite "C" Value Calculations  
Drainage Impact Fee Calculation

## 3. TIMES OF CONCENTRATION

Summary  
Existing Site (HISTORIC)  
Existing Site (DEVELOPED)

## 4. RUNOFF

SITE - Historic	-	2 Year & 100 Year
SITE - Developed	-	2 Year & 100 Year

## 5. HYDRAULICS

Storm Outlet Channel - Capacity Calculation  
Storm Outlet Channel - Cross-Section  
Storm Outlet Pipeline - Capacity Calculation  
Storm Outlet Pipeline - Rating Table for varied hydraulic slopes

**SECTION 1**  
**SITE MAPS**

**NOTE:**  
FEMA CONTOURS BASED ON NAVD '29 DATUM  
ADD 3.3'± TO NAVD '29 TO EQUAL NAVD '88 DATUM

**NOTE:**  
FLOOD PROFILE CONTOURS (ADJUSTED TO PROJECT DATUM) INDICATE 100 YEAR FLOOD BOUNDARY IS BELOW TOP OF BANK

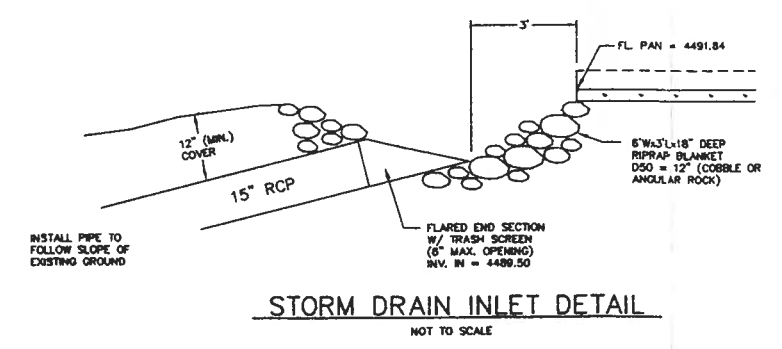
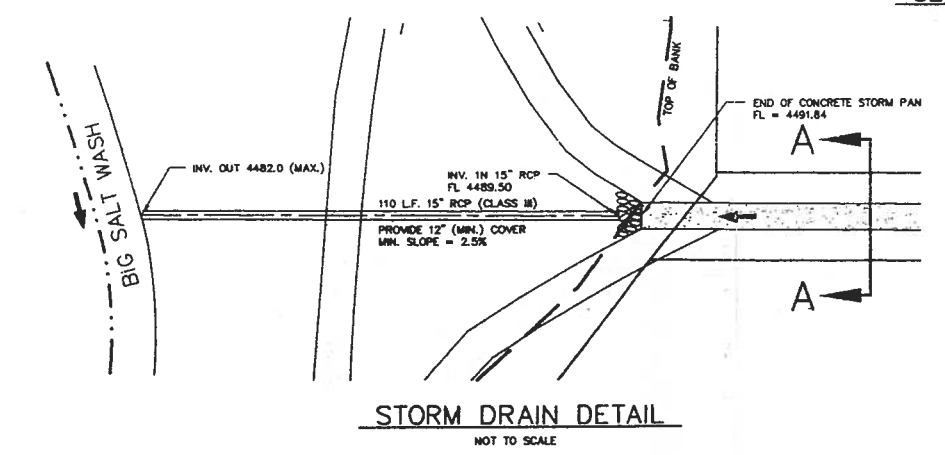
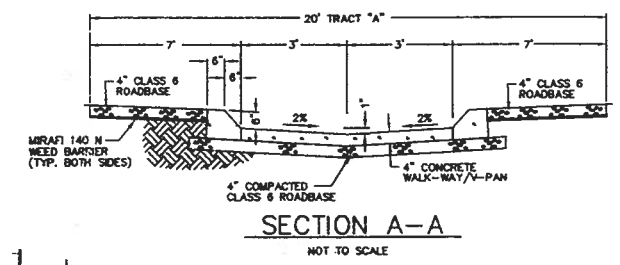
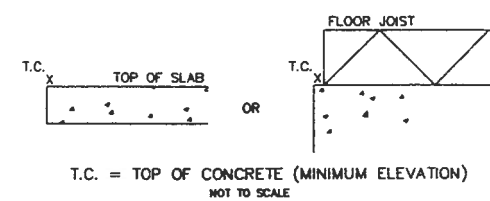
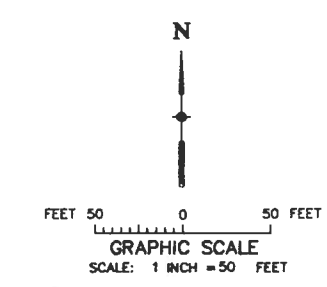
**NOTE:**  
ALL BUILDERS AND HOMEOWNERS ARE STRONGLY ADVISED TO REVIEW AND COMPLY WITH RECOMMENDATIONS CONTAINED IN THE "SUBSURFACE SOILS EXPLORATION" REPORT (BY GRAND JUNCTION LINCOLN DEVORE, DATED JANUARY 3, 2003) REGARDING EROSION POTENTIAL FOR THE BIG SALT WASH BANK AND FOR GENERAL FOUNDATION INFORMATION.

SANTA FE RANCH SUBDIVISION  
TOP-OF-CONCRETE ELEVATION TABULATION  
09-05-03

LOT	BLOCK	ADDRESS	T.C. ELEV. (MIN.)
1	1	SANTA FE PLACE	4496.5
1	1	JUNIPER STREET	4496.5
2	1	SANTA FE PLACE	4496.2
3	1	SANTA FE PLACE	4494.9
4	1	SANTA FE PLACE	4494.7
5	1	SANTA FE PLACE	4494.4
6	1	SANTA FE PLACE	4494.4
7	1	SANTA FE PLACE	4494.4
1	2	CACTUS DRIVE	4494.5
2	2	CACTUS DRIVE	4495.1
3	2	CACTUS DRIVE	4496.2
4	2	CACTUS DRIVE	4496.7
5	2	CACTUS DRIVE	4497.5
1	3	JUNIPER STREET	4497.4
1	3	CACTUS DRIVE	4497.4
2	3	CACTUS DRIVE	4497.0
3	3	CACTUS DRIVE	4496.7
4	3	CACTUS DRIVE	4496.1
5	3	CACTUS DRIVE	4495.0
6	3	CACTUS DRIVE	4494.5
7	3	SANTA FE PLACE	4495.5
8	3	SANTA FE PLACE	4496.0
9	3	SANTA FE PLACE	4496.5
9	3	JUNIPER STREET	4496.5

**LEGEND**

- - - - - EXISTING CONTOURS
- 4870 — PROPOSED CONTOURS
- 4543.6 T.C. PROPOSED TOP-OF-CONCRETE ELEVATION (MINIMUM)



**BENCHMARK/CONTROL**  
S 1/4 CORNER  
SECTION 7, T.1N, R.2W, U.M.  
FLETCHER, LS 24953  
NORTHING 71188.7940  
EASTING 39329.2830  
ELEVATION 4491.67 (NAVD '88)

**TOTAL SITE RUNOFF (CFS)**

HISTORIC	DEVELOPED
Q2 = 1.05	1.89
Q100 = 4.98	9.32

DRAWN BY: F.J.B.  
DESIGNED BY: P.M.O.  
CHECKED BY: P.M.O.

REVIEWED \_\_\_\_\_ FOR \_\_\_\_\_  
DATE: \_\_\_\_\_

REVIEWED \_\_\_\_\_ FOR VISTA ENGINEERING CORP.  
DATE: \_\_\_\_\_

**VISTA ENGINEERING CORP.**  
CONSULTING ENGINEERS AND LAND SURVEYORS  
2777 CROSSROADS BOULEVARD • GRAND JUNCTION, CO 81608 • (970) 243-2242

REVISION	DATE	DESCRIPTION	BY	CHKD

JOHN FOLKESTAD

GRADING AND DRAINAGE PLAN  
SANTA FE RANCH

APPROVED FOR CONSTRUCTION

CITY OF FRUITA DATE \_\_\_\_\_  
ACCEPTED AS CONSTRUCTED

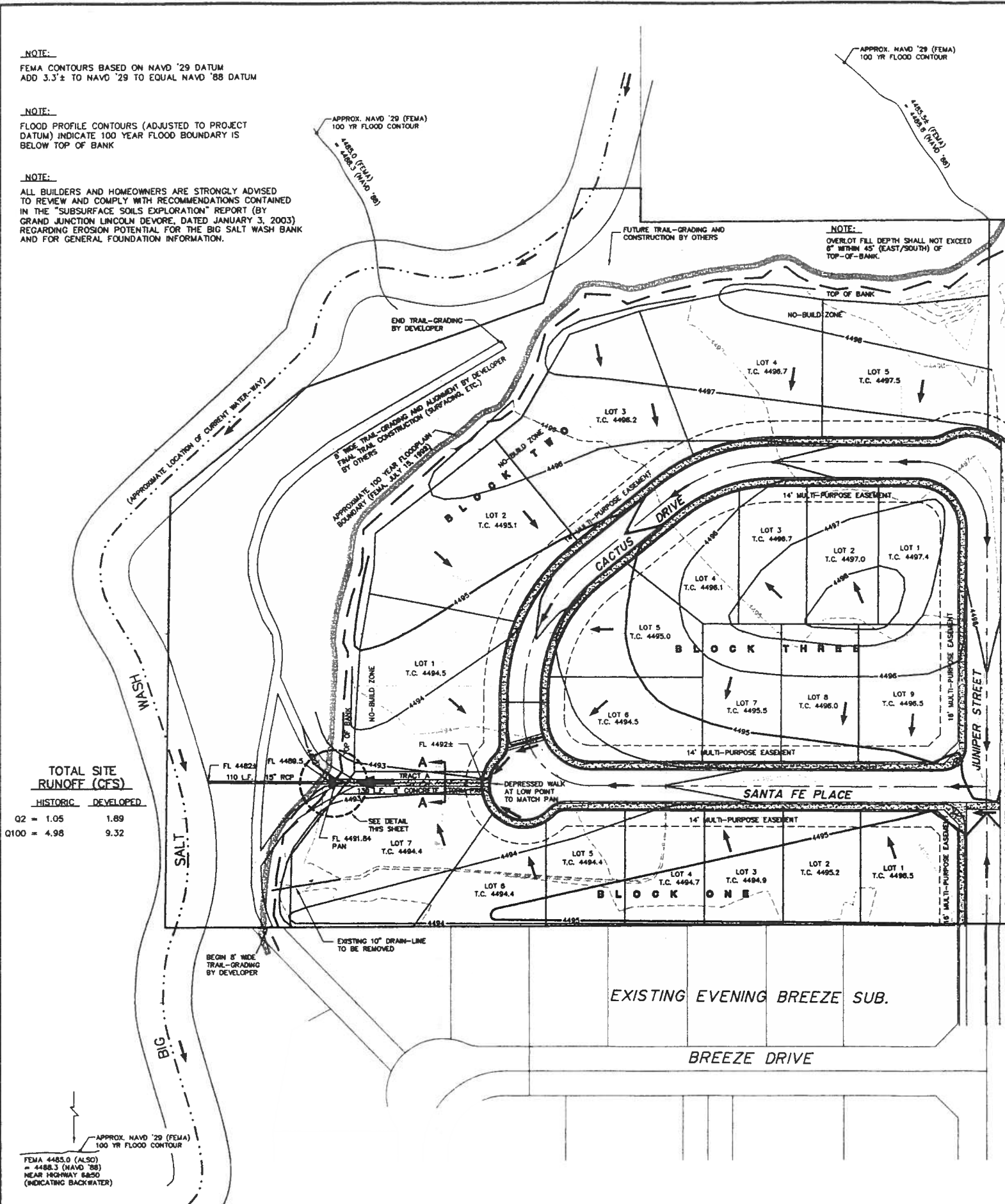
CITY OF FRUITA DATE \_\_\_\_\_

SCALE: 1" = 50' JOB NO: 407.02-02 DATE: 9-05-03  
SHEET NO: 10 of 19

**NOTE:**  
FEMA CONTOURS BASED ON NAVD '29 DATUM  
ADD 3.3' ± TO NAVD '29 TO EQUAL NAVD '88 DATUM

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FLOOD PROFILE CONTOURS (ADJUSTED TO PROJECT DATUM) INDICATE 100 YEAR FLOOD BOUNDARY IS BELOW TOP OF BANK

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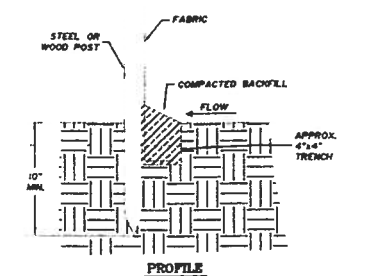
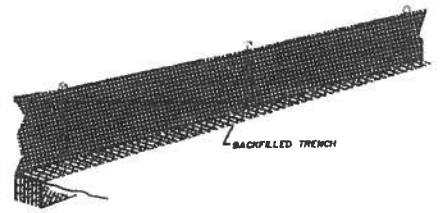
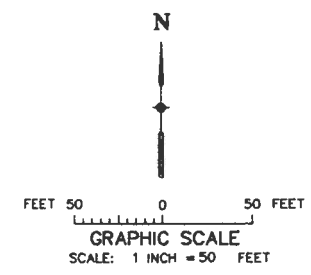


**TOTAL SITE RUNOFF (CFS)**

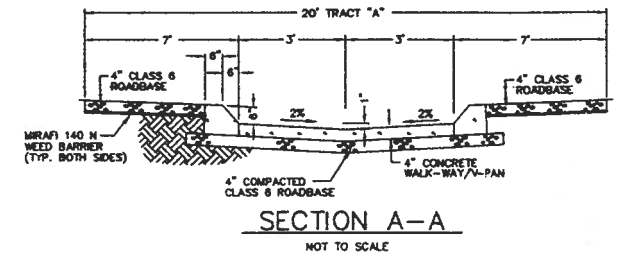
HISTORIC	DEVELOPED
Q2 = 1.05	1.89
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**LEGEND**

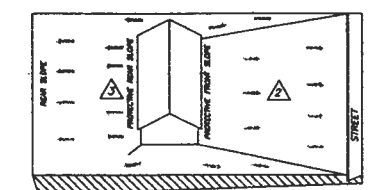
- EXISTING CONTOURS
- 4670 PROPOSED CONTOURS
- 4543.6 T.C. PROPOSED TOP-OF-CONCRETE ELEVATION (MINIMUM)



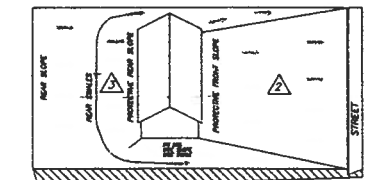
**DETAIL B - SILT FENCE**



**SECTION A-A**

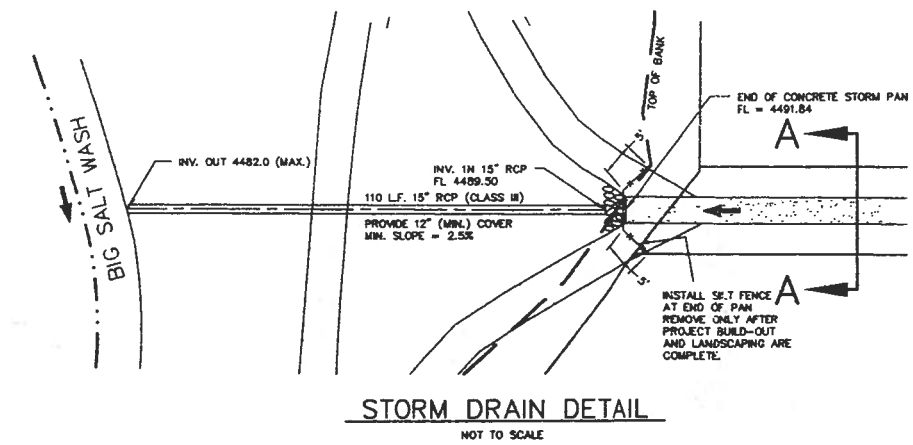


**TYPE 'B' TYPICAL LOT GRADING**

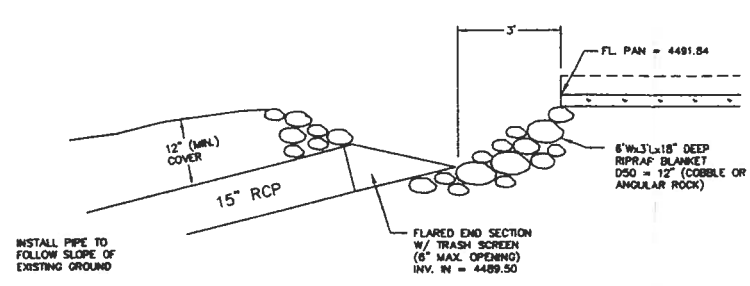


**TYPE 'A' TYPICAL LOT GRADING**

- NOTES:**
- △ ALL LOTS ARE TYPE 'A' UNLESS MARKED OTHERWISE ON PLAN.
  - △ MINIMUM ELEVATION OF TC (TOP OF SLAB OR FOUNDATION) SHALL BE 0.87 FT. ± 2% OF SETBACK (25' = 1.17' ABOVE MEASURED FROM FLOWLINE OF GUTTER).
  - △ MINIMUM SIDE AND REAR SLOPES SHALL BE 8" DROP FROM FOUNDATION IN FIRST 10'.



**STORM DRAIN DETAIL**



**STORM DRAIN INLET DETAIL**



CALL 1-800-922-1987  
UTILITY NOTIFICATION CENTER OF COLORADO

**BENCHMARK/CONTROL**  
S 1/4 CORNER SECTION 7, T.1N. R.2W. U.M. FLETCHER, LS 24953  
NORTHING 71188.7940  
EASTING 39329.2830  
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**APPROVED FOR CONSTRUCTION**

CITY OF FRUITA DATE \_\_\_\_\_

**ACCEPTED AS CONSTRUCTED**

CITY OF FRUITA DATE \_\_\_\_\_

SCALE: 1" = 50'  
JOB NO: 407.02-02  
DATE: 9-05-03

SHEET NO: 11 of 19

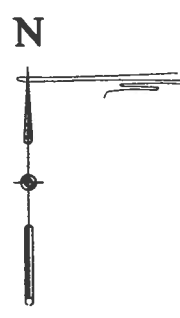
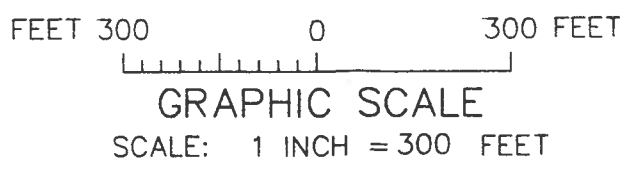
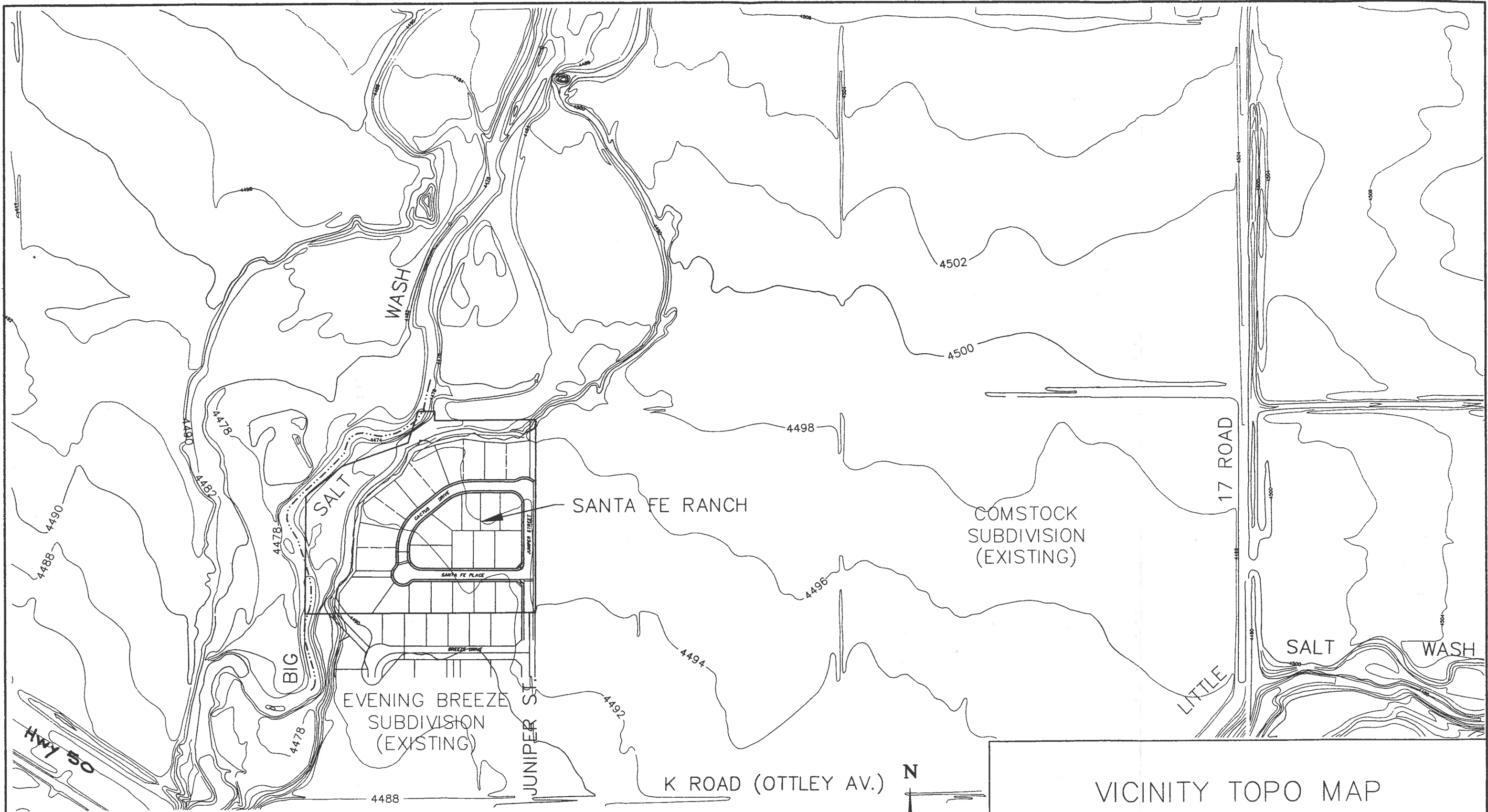
DRAWN BY: S.G.S.	REVIEWED _____ DATE: _____ FOR _____
DESIGNED BY: P.M.O.	REVIEWED _____ DATE: _____ FOR VISTA ENGINEERING CORP.
CHECKED BY: P.M.O.	

**VISTA ENGINEERING CORP.**  
CONSULTING ENGINEERS AND LAND SURVEYORS  
2777 CROSSROADS BOULEVARD • GRAND JUNCTION, CO 81808 • (970) 243-2242

REVISION	DATE	DESCRIPTION	BY	CHKD

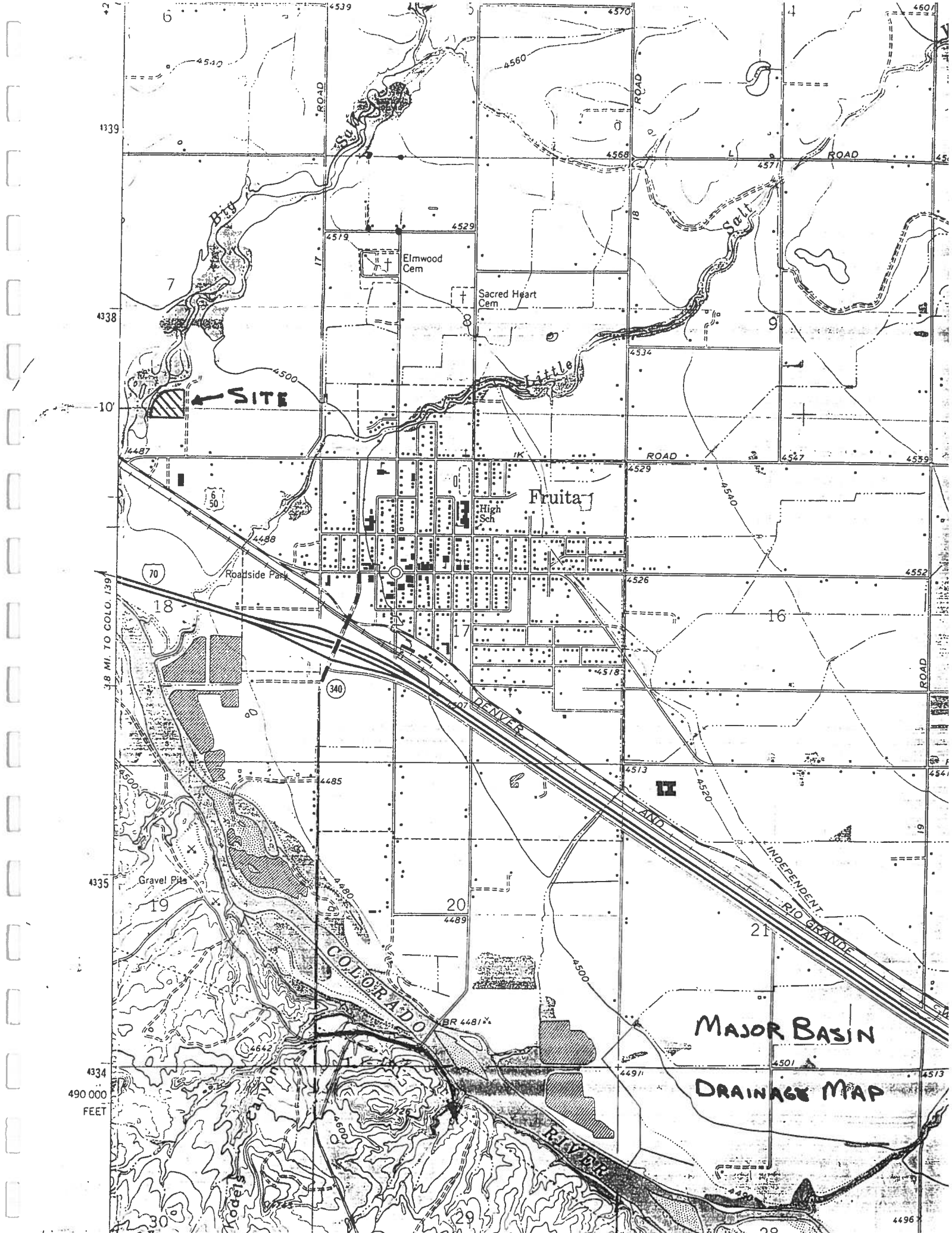
BY: JOHN FOLKESTAD  
DATE: \_\_\_\_\_  
CITY OF FRUITA, COLORADO

**STORMWATER MANAGEMENT PLAN**  
SANTA FE RANCH



VICINITY TOPO MAP

**VISTA ENGINEERING CORP.**  
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 2777 CROSSROADS BOULEVARD • GRAND JUNCTION, CO 81506 • (970) 243-2242



4339

4338

10

3.8 MI. TO COLO. 139

4335

4334

490 000  
FEET

6

7

18

19

30

4539

ROAD

17

18

19

29

Elmwood Cem

Sacred Heart Cem

High Sch

BR 4481 1/2

20

4560

ROAD

4529

ROAD

340

4500

29

4570

ROAD

18

ROAD

4526

4500

20

4568

ROAD

18

ROAD

4526

4500

20

4571

ROAD

9

ROAD

4526

4500

20

4569

ROAD

4

ROAD

4526

4500

20

SITE

Fruita

COLORADO

DEANER

AND

INDEPENDENT

RIO GRANDE

MAJOR BASIN

DRAINAGE MAP

4496

**SECTION 2**  
**COEFFICIENTS**



2 YR. 100 YR.  
 PASTURE 0.27 0.27  
 WASH/DENSE 0.18 0.21  
 DEVELOPED 0.55 0.42

LAND USE OR SURFACE CHARACTERISTICS	SCS HYDROLOGIC SOIL GROUP (SEE APPENDIX "C" FOR DESCRIPTIONS)											
	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
UNDEVELOPED AREAS Bare ground	10-20	16-26	25-35	14-22	22-30	30-38	20-28	28-36	36-44	24-32	30-38	40-48
	14-24	22-32	30-40	20-28	28-36	37-45	26-34	35-43	40-48	30-38	40-48	50-58
	08-18	13-23	16-26	11-19	15-23	21-29	14-22	19-27	26-34	18-26	23-31	31-39
Cultivated/Agricultural	14-24	18-28	22-32	16-24	21-29	28-36	20-28	25-33	34-42	24-32	29-37	41-49
	12-22	20-30	30-40	18-26	28-36	37-45	24-32	34-42	44-52	30-38	40-48	50-58
	15-25	25-35	37-47	23-31	34-42	45-53	30-38	42-50	52-60	37-45	50-58	62-70
Pasture	10-20	16-26	25-35	14-22	22-30	30-38	20-28	28-36	36-44	24-32	30-38	40-48
	14-24	22-32	30-40	20-28	28-36	37-45	26-34	35-43	44-52	30-38	40-48	50-58
	05-15	08-18	11-21	08-16	11-19	14-22	10-18	13-21	16-24	12-20	16-24	20-28
Meadow	08-18	11-21	14-24	10-18	14-22	18-26	12-20	16-24	20-28	15-23	20-28	25-33
	40-50	43-53	46-56	42-50	45-53	50-58	35-53	48-56	53-61	48-56	51-59	57-65
	48-58	52-62	55-65	50-58	54-62	59-67	53-61	57-65	64-72	56-64	60-68	69-77
1/4 acre per unit	27-37	31-41	34-44	29-37	34-42	38-46	32-40	36-44	41-49	35-43	39-47	45-53
	35-45	39-49	42-52	38-46	42-50	47-55	41-49	45-53	52-60	43-51	47-55	57-65
	22-32	26-36	29-39	23-33	29-37	33-41	28-36	32-40	37-45	31-39	35-43	42-50
1/3 acre per unit	31-41	35-45	38-48	33-41	38-46	42-50	36-44	41-49	48-56	39-47	43-51	53-61
	16-26	20-30	24-34	19-27	23-31	28-36	22-30	27-35	32-40	26-34	30-38	37-45
	25-35	29-39	32-42	23-31	32-40	36-44	31-39	35-43	42-50	34-42	38-46	48-56
1/2 acre per unit	14-24	19-29	22-32	17-25	21-29	26-34	20-28	25-33	31-39	24-32	29-37	35-43
	22-32	26-36	29-39	24-32	28-36	34-42	28-36	32-40	40-48	31-39	35-43	46-54
	93	94	95	93	94	95	93	94	95	93	94	95
MISC. SURFACES Pavement and roofs	93	96	97	95	96	97	95	96	97	95	96	97
	55-65	60-70	64-74	60-68	64-72	67-75	64-72	67-75	69-77	72-80	75-83	77-85
	65-70	70-75	74-79	68-76	72-80	75-83	72-80	75-83	77-85	79-87	82-90	84-92
Traffic areas (soil and gravel)	10-20	16-26	25-35	14-22	22-30	30-38	20-28	28-36	36-44	24-32	30-38	40-48
	14-24	22-32	30-40	20-28	28-36	37-45	26-34	35-43	42-50	30-38	40-48	50-58
	30-40	36-46	45-55	45-55	42-50	50-58	40-48	48-56	56-64	44-52	50-58	60-68
Green landscaping (lawns, parks)	34-44	42-52	50-60	50-60	48-56	57-65	46-54	55-63	64-72	50-58	60-68	70-78
	20-30	26-36	35-45	35-45	32-40	40-48	30-38	38-44	46-54	34-42	40-48	50-58
	24-34	32-42	40-50	40-50	38-46	47-55	36-44	45-53	54-62	40-48	50-58	60-68
Non-green and gravel landscaping	20-30	26-36	35-45	35-45	32-40	40-48	30-38	38-44	46-54	34-42	40-48	50-58
	24-34	32-42	40-50	40-50	38-46	47-55	36-44	45-53	54-62	40-48	50-58	60-68
	93	94	95	93	94	95	93	94	95	93	94	95
Cemeteries, playgrounds	93	96	97	95	96	97	95	96	97	95	96	97
	55-65	60-70	64-74	60-68	64-72	67-75	64-72	67-75	69-77	72-80	75-83	77-85
	65-70	70-75	74-79	68-76	72-80	75-83	72-80	75-83	77-85	79-87	82-90	84-92

VALUES ABOVE AND BELOW PERTAIN TO THE 2-YEAR AND 100-YEAR STORMS, RESPECTIVELY.  
 THE RANGE OF VALUES PROVIDED ALLOWS FOR ENGINEERING JUDGEMENT OF SITE CONDITIONS SUCH AS BASIC SHAPE, HOMOGENEITY OF SURFACE TYPE, SURFACE DEPRESSION STORAGE, AND STORM DURATION. IN GENERAL, DURING SHORTER DURATION STORMS (Tc < 10 MINUTES), INFILTRATION CAPACITY IS HIGHER, ALLOWING USE OF A "C" VALUE IN THE LOW RANGE. CONVERSELY, FOR LONGER DURATION STORMS (Tc > 30 MINUTES), USE A "C" VALUE IN THE HIGHER RANGE.  
 FOR RESIDENTIAL DEVELOPMENT AT LESS THAN 1/8 ACRE PER UNIT OR GREATER THAN 1 ACRE PER UNIT, AND ALSO FOR COMMERCIAL AND INDUSTRIAL AREAS, USE VALUES UNDER MISC SURFACES TO ESTIMATE "C" VALUE RANGES FOR USE.

RATIONAL METHOD RUNOFF COEFFICIENTS  
 (Modified from Table 4, UC-Davis, which appears to be a modification of work done by Rawls)

TABLE "B-1"

Quick TR-55 Ver.5.46 S/N:  
Executed: 21:24:30 09-04-2003

SANTA FE RANCH SUBDIVISION  
JOHN FOLKESTAD - FRUITA, CO  
COMPOSITE "C" VALUES  
9/1/03

"C" VALUE  
RUNOFF ~~CURVE NUMBER~~ SUMMARY

.....

<u>Subarea Description</u>	<u>Area (acres)</u>	<u>"C" VALUE <del>CN</del> (weighted)</u>
HIST SITE 2 YR	9.70	0.21
HISTORIC 100 YR	9.70	0.25
DEV. SITE 2 YR	9.70	0.29
DEV SITE 100 YR	9.70	0.36

Quick TR-55 Ver.5.46 S/N:  
 Executed: 21:24:30 09-04-2003

SANTA FE RANCH SUBDIVISION  
 JOHN FOLKESTAD - FRUITA, CO  
 COMPOSITE "C" VALUES  
 9/1/03

RUNOFF CURVE NUMBER DATA

.....

Composite Area: HIST SITE 2 YR

SURFACE DESCRIPTION	AREA (acres)	CN	
FURROW IRRIGATED FIELD	6.90	22	
BIG SALT WASH - DENSE VEG.	2.80	18	
COMPOSITE AREA --->	9.70	20.8	( 21 )

.....

Composite Area: HISTORIC 100 YR

SURFACE DESCRIPTION	AREA (acres)	CN	
FURROW IRRIGATED FIELD	6.90	27	
BIG SALT WASH - DENSE VEG.	2.80	21	
COMPOSITE AREA --->	9.70	25.3	( 25 )

.....

Composite Area: DEV. SITE 2 YR

SURFACE DESCRIPTION	AREA (acres)	CN	
DEVELOPED AREA - 1/4 AC/UNIT	6.90	33	
BIG SALT WASH - DENSE VEG.	2.80	18	
COMPOSITE AREA --->	9.70	28.7	( 29 )

.....

Quick TR-55 Ver.5.46 S/N:  
Executed: 21:24:30 09-04-2003

Composite Area: DEV SITE 100 YR

SURFACE DESCRIPTION	AREA (acres)	CN
DEVELOPED AREA - 1/4 AC/UNIT	6.90	42
BIG SALT WASH - DENSE VEG.	2.80	21
COMPOSITE AREA --->	9.70	35.9 ( 36 )

.....

### DRAINAGE IMPACT FEE CALCULATION

$$\begin{aligned} * F_{SS} &= \$12,000 (C_{D100} - C_{H100}) A^{0.7} \\ &= \$12,000 (0.36 - 0.25) 9.691^{0.7} \\ &= \$6,471.90 \end{aligned}$$

**SECTION 3**  
**TIMES OF CONCENTRATION**

Quick TR-55 Ver.5.46 S/N:  
Executed: 20:58:13 09-04-2003 SANTA FE.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS  
(Solved for Time using TR-55 Methods)

SANTA FE RANCH SUBDIVISION  
HISTORIC AND DEVELOPED Tc's  
9/01/03

Subarea descr.	Tc or Tt	Time (hrs)
HISTORIC SITE	Tc	0.53 = 32 MINUTES
DEVELOPED SITE	Tc	0.33 = 20 MINUTES

SANTA FE RANCH SUBDIVISION  
 HISTORIC AND DEVELOPED Tc's  
 9/01/03

Tc COMPUTATIONS FOR: HISTORIC SITE

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	PASTURE		
Manning's roughness coeff., n	0.0300		
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	0.700	
Land slope, s	ft/ft	0.0050	
		0.8	
		.007 * (n*L)	
T =	hrs	0.40	= 0.40
		0.5	0.4
		P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft	500.0	
Watercourse slope, s	ft/ft	0.0050	
		0.5	
Avg.V = Csf * (s)	ft/s	1.1409	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.12	= 0.12

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
		1.49 * r <sup>2/3</sup> * s <sup>1/2</sup>	
V =	ft/s	0.0000	
		n	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

.....  
 TOTAL TIME (hrs) 0.53

Quick TR-55 Ver.5.46 S/N:  
 Executed: 20:58:13 09-04-2003 SANTA FE.TCT

SANTA FE RANCH SUBDIVISION  
 HISTORIC AND DEVELOPED Tc's  
 9/01/03

Tc COMPUTATIONS FOR: DEVELOPED SITE

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		LAWN	
Manning's roughness coeff., n		0.0450	
Flow length, L (total < or = 300)	ft	120.0	
Two-yr 24-hr rainfall, P2	in	0.700	
Land slope, s	ft/ft	0.0100	
		0.8	
$T = \frac{.007 * (n*L)}{0.5 * P2 + 0.4 * s}$		hrs	0.20 = 0.20

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
		0.5	
$Avg.V = Csf * (s)$		ft/s	0.0000
where:	Unpaved Csf = 16.1345		
	Paved Csf = 20.3282		
$T = L / (3600*V)$		hrs	0.00 = 0.00

CHANNEL FLOW

Segment ID		2	
Cross Sectional Flow Area, a	sq.ft	4.00	
Wetted perimeter, Pw	ft	24.00	
Hydraulic radius, r = a/Pw	ft	0.167	
Channel slope, s	ft/ft	0.0050	
Manning's roughness coeff., n		0.0160	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$		ft/s	1.9943
Flow length, L	ft	900	
$T = L / (3600*V)$		hrs	0.13 = 0.13

.....  
 TOTAL TIME (hrs) 0.33



**SECTION 4**  
**RUNOFF**

Quick TR-55 Ver.5.46 S/N:  
 Executed: 22:05:19 09-04-2003

SANTA FE RANCH SUBDIVISION - FRUITA  
 HISTORIC RUNOFF - TOTAL SITE  
 9/1/03

\* \* \* \* \* SUMMARY OF RATIONAL METHOD PEAK DISCHARGES \* \* \* \* \*

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres  
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 2 years  
 'C' adjustment, k = 1  
 Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
PASTURE	0.220	6.90						
WASH/DENSE	0.180	2.80						
			32.00	0.208	0.208	0.520	9.70	1.05

Quick TR-55 Ver.5.46 S/N:  
 Executed: 22:05:19 09-04-2003

SANTA FE RANCH SUBDIVISION - FRUITA  
 HISTORIC RUNOFF - TOTAL SITE  
 9/1/03

\* \* \* \* \* SUMMARY OF RATIONAL METHOD PEAK DISCHARGES \* \* \* \* \*

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres  
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years  
 'C' adjustment, k = 1.1905  
 Adj. 'C' = Wtd.'C' x 1.1905

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
PASTURE	0.220	6.90						
WASH/DENSE	0.180	2.80						
			32.00	0.208	0.248	2.070	9.70	4.98

Quick TR-55 Ver.5.46 S/N:  
 Executed: 22:03:48 09-04-2003

SANTA FE RANCH SUBDIVISION - FRUITA  
 DEVELOPED RUNOFF - TOTAL SITE  
 9/1/03

\* \* \* \* \* SUMMARY OF RATIONAL METHOD PEAK DISCHARGES \* \* \* \* \*

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres  
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 2 years  
 'C' adjustment, k = 1  
 Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
DEVELOPED	0.330	6.90						
WASH/DENSE	0.180	2.80						
			20.00	0.287	0.287	0.680	9.70	1.89

Quick TR-55 Ver.5.46 S/N:  
 Executed: 22:03:48 09-04-2003

SANTA FE RANCH SUBDIVISION - FRUITA  
 DEVELOPED RUNOFF - TOTAL SITE  
 9/1/03

\* \* \* \* \* SUMMARY OF RATIONAL METHOD PEAK DISCHARGES \* \* \* \* \*

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres  
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years  
 'C' adjustment, k = 1.2414  
 Adj. 'C' = Wtd.'C' x 1.2414

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
DEVELOPED	0.330	6.90						
WASH/DENSE	0.180	2.80						
			20.00	0.287	0.356	2.700	9.70	9.32

**SECTION 5**  
**HYDRAULICS**

SANTA FE RANCH - STORM OUTLET CHANNEL  
Worksheet for Trapezoidal Channel

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Project Description	
Project File	c:\haestad\fmw\santa fe.fm2
Worksheet	OUTLET CHANNEL
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

---

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Input Data	
Mannings Coefficient	0.013
Channel Slope	0.005000 ft/ft
Depth	0.50 ft
Left Side Slope	1.000000 H : V
Right Side Slope	1.000000 H : V
Bottom Width	6.00 ft

---

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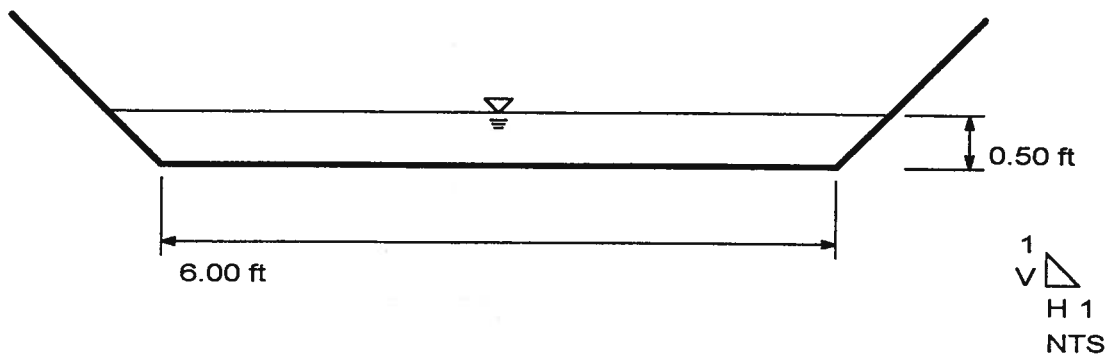
Results		
Discharge	15.16	cfs
Flow Area	3.25	ft <sup>2</sup>
Wetted Perimeter	7.41	ft
Top Width	7.00	ft
Critical Depth	0.56	ft
Critical Slope	0.003334	ft/ft
Velocity	4.66	ft/s
Velocity Head	0.34	ft
Specific Energy	0.84	ft
Froude Number	1.21	
Flow is supercritical.		

---

SANTA FE RANCH - STORM OUTLET PAN  
Cross Section for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\santa fe.fm2
Worksheet	OUTLET CHANNEL
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Section Data	
Mannings Coefficient	0.013
Channel Slope	0.005000 ft/ft
Depth	0.50 ft
Left Side Slope	1.000000 H : V
Right Side Slope	1.000000 H : V
Bottom Width	6.00 ft
Discharge	15.16 cfs





SANTA FE RANCH - STORM OUTLET PIPE  
Worksheet for Circular Channel

Project Description	
Project File	c:\haestad\fmw\santa fe.fm2
Worksheet	Storm Outlet
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.050000	ft/ft
Depth	1.25	ft
Diameter	15.00	in

Results		
Discharge	14.44	cfs
Flow Area	1.23	ft <sup>2</sup>
Wetted Perimeter	3.93	ft
Top Width	0.33e-7	ft
Critical Depth	1.23	ft
Percent Full	100.00	
Critical Slope	0.045594	ft/ft
Velocity	11.77	ft/s
Velocity Head	2.15	ft
Specific Energy	3.40	ft
Froude Number	0.34e-3	
Maximum Discharge	15.54	cfs
Full Flow Capacity	14.44	cfs
Full Flow Slope	0.050000	ft/ft
Flow is subcritical.		

Table  
Rating Table for Circular Channel

Project Description	
Project File	c:\haestad\fmw\santa fe.fm2
Worksheet	Storm Outlet
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.013
Depth	1.25 ft
Diameter	15.00 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.005000	0.050000	0.005000 ft/ft

Rating Table	
Channel Slope (ft/ft)	Discharge (cfs)
0.005000	4.57
0.010000	6.46
0.015000	7.91
0.020000	9.14
0.025000	10.21
0.030000	11.19
0.035000	12.08
0.040000	12.92
0.045000	13.70
0.050000	14.44

