Preliminary Drainage Report

Orchard Grove Subdivision

September 3, 2003

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Engineer's Certification

I hereby certify that this report was prepared by me or under my direct supervision for the Owner's hereof.

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I. GENERAL LOCATION AND DESCRIPTION:

A. Site and Major Basin Location:

The proposed Orchard Grove Subdivision is located in the northeast corner of the intersection between N Maple Street (17.5 Road) and Ottley Avenue (K Road). In more legal terms, it lies within the Southwest ¼ of the Southeast ¼ of Section 8, Township 1 North, Range 2 West of the Ute Meridian.

In the vicinity of the proposed development are the existing La Serenas, Maple Heights and Maple Grove Subdivisions. Each of these is of comparable type and density to the proposed subdivision.

B. Site and Major Basin Description:

The proposed development is included within the major drainage basin known as the Little Salt Wash Drainage Basin. This basin is comprised of approximately 36.5 square miles that originate in the Bookcliffs and drains from the northeast to the southwest ultimately discharging into the Colorado River.

The site is made up of two existing parcels that form a sub basin that contributes to Little Salt Wash. A topographical ridge created by an irrigation ditch forms a watershed boundary separating the site into two smaller basins. Each of the two basins is defined on the east by an existing irrigation ditch. The northern basin flows primarily westward being bordered by North Maple Street on the west. South of the ridge, runoff flows mostly in a southerly direction towards Ottley Avenue which makes up the southern boundary.

The project site is 4.24 acres with approximately 0.8 acres being an existing home site and the remainder previously undeveloped agricultural ground currently tilled. According to the Soil Survey, Series 1940, No. 19, performed by the U.S. Department of Agriculture's Soil Conservation Service for the Grand Junction area, the soils present at the site are a combination of Billings Silty Clay Loam (B_C) and Ravola Clay Loam (R_A). Billings Silty Clay Loam and Ravola Clay Loam are predominate soil types found throughout the Grand Valley. Both soil types are derived from alluvial deposits that came mostly from Mancos Shale with the Ravola Clay Loam being more porous because of the higher content of fine sands. Surface runoff is medium to slow with internal drainage also being medium to slow. Due to the higher content of fine sands in the Ravola Clay Loam, both surface and internal drainage occur at slightly higher rate. A pre-development basin map has been included in the Appendix.

II. EXISTING DRAINAGE CONDITIONS:

A. Major Basin:

The predominant drainage pattern for the major watershed area is characterized by overland flow sloping towards the river at varying grades. Channels and ditches intermittently cross the sloping ground surface collecting surface runoff as well as ground water and typically flow from northeast to southwest. The construction of major arterial roads, such as 17.5 and K Road, also serves to intercept and collect surface water runoff. Consideration of these parameters led to the watershed boundary definitions of the major basin.

The proposed site is not affected by any previously determined floodplain.

B. Site:

Primarily urban drainage conditions currently surround the project site. The site is gradually sloping from northeast to southwest with grades varying from approximately zero to one percent. Currently, runoff from the northern area of the site, Basin H-1, sheet flows across the site and collects in an abandoned concrete irrigation ditch. This ditch crosses the parcel from north to south and has no apparent downstream discharge point. West of the ditch (downstream) the existing terrain slopes gradually to a low point behind the existing curb, gutter and sidewalk. The southern portion, Basin H-2, sheet flows in a southwesterly direction towards Ottley Avenue where it is collected by curb and gutter. The curb and gutter conveys these flows to the west and into an existing curb inlet near the intersection of Maple Street and Ottley Avenue.

The site is isolated from upstream flows by an irrigation canal to the east and a topographical ridge created by the development of the parcel to the north.

A small amount of runoff from the southern basin sheet flows across the southeast corner of the adjoining parcel to the west as it is conveyed to the Ottley Avenue curb and gutter.

III PROPOSED DRAINAGE CONDITIONS:

A. Changes in Drainage Patterns

Historic drainage patterns will remain intact, where possible, in an effort to minimize the impact of the development of this parcel on surrounding properties. At a minimum, the fronts of the proposed lots will drain toward the street with an effort to drain as much of the lots to the street as grades will allow. The majority of runoff from the site will be collected in the proposed Orchard Court and conveyed via concrete curb and gutter to inlets located at a low point within the subdivision. Flows entering these inlets will be transmitted through an underground storm sewer system to be constructed in Ottley Avenue to a point of discharge into the existing storm sewer at the intersection of Ottley Avenue and Maple Street. In addition, a new double inlet will be constructed on the south side of Ottley and connected to the proposed Ottley Avenue storm sewer. Minor flows to the west will be collected and conveyed by the Maple Street curb and gutter and into the Ottley Avenue storm sewer system. The offsite improvements to the storm sewer system are being constructed as a condition set by the City in order to allow discharge without detention. Costs associated with the construction of the offsite storm sewer system will be applied as a credit towards the drainage fee in lieu of detention.

B. Maintenance Issues:

Maintenance of the on-site collection and conveyance facilities within the right of way will be the responsibility of the City. Facilities outside of the right of way will be maintained by the Homeowners Association.

IV DESIGN CRITERIA AND APPROACH:

A. General Considerations:

Storm water runoff for the 2-year and 100-year events will be quantified using the Rational Method as detailed in Section VI "Hydrology" of the Storm water Management Manual for the City of Grand Junction and Mesa County dated May 1996.

The overall drainage patterns for the major basin are not being significantly altered. Notable differences in drainage will occur in the area of the proposed subdivision and these differences will be reflected in the runoff characteristics of the historic conditions versus those of the new development. The rate at which storm water runoff is drained from the project site will be increased due to the developed conditions. However, the developed flows will be collected and conveyed directly into the underground storm sewer system where it will not affect surrounding parcels or the major drainage basin.

The 2-year and the 100-year design storms will be considered when sizing all proposed drainage features. Inlets, pipes, gutters, and swales will be sized to carry the 2-year storm water flows at a minimum. For events with flows greater than the 2-year storm, excess flow will be conveyed by the remainder of the street section. For areas where storm sewer pipe crosses through private property, or within easements, the storm sewer will be designed to carry the 100-year runoff volume while flowing 80% full.

The analysis and design procedures as outlined in the Storm Water Management Manual for the City of Grand Junction and Mesa County (SWMM) will be adhered to during the design of all on-site collection and storm conveyance facilities proposed for the subdivision.

B. Hydrology:

According to the Soil Conservation Service soil survey for the Grand Junction Area, the dominant soil type is Billings Silty Clay Loam (B_C) and Ravola Clay Loam (R_A) having a hydrologic soil group index of “B”.

The maximum times of concentration used by the Modified Rational Method to determine maximum flow quantities for individual sub-basins will be a cumulative result of overland, curb and gutter and storm sewer flow times.

For the determination of maximum flows, the total area of each sub-basin with its corresponding runoff coefficient will be used in the calculations. For the existing condition, the "natural" sub-basin will have uniform coefficients related to the hydrologic soil group. The runoff coefficients for developed conditions will be the corresponding coefficient based on developed density and hydrologic soil grouping Table "B-1" from the SWMM.

C. Hydraulics:

Flow capacity of concrete pans, curb and gutter, and underground conduits will be calculated using Manning's Equation with the required flow resistance coefficients taken from appendices "G" and "H" of the SWWM.

The maximum allowable ½ street flow quantities for street sections were taken from Figure "G-5" on page G-7 of the SWMM. The curves for Urban Residential Collectors were used to maintain the street inundation limits as set forth in Section VII – Hydraulics and Appendix G of the SWMM. Inlet capacities for a sump condition were verified not to exceed the maximum per Table "G-1" on page G-14 of the SWMM.

These values have been tabulated for comparison in the Runoff Rates at Specific Design Points table shown in the Results and Conclusions section to follow.

V RESULTS AND CONCLUSIONS:

A. Detention

As previously mentioned, the developed runoff from the proposed development will be allowed to release from the site undetained. In lieu of detention a fee will be paid which will be adjusted to reflect a credit for off-site improvements constructed by the developer.

B. Runoff Rates for 2 and 100 Year Storms

The calculations necessary for the Rational Method – Composite Runoff Coefficients, Time of Concentration and Rainfall Intensities, and Runoff Rates - have been incorporated into spreadsheets and attached to the Appendix of this report. These results were utilized to develop storm water runoff quantities at specific locations in the project site. Allowable conveyance values for streets and inlets were compared to these results. The drainage plan drawings for the proposed conditions attached to this report show the locations isolated and analyzed for flow quantities. The following table depicts flow quantities along with allowable flow quantities taken from figure "G-5" on page G-7 of the SWMM.

Tabulated Runoff Rates at Specific Design Points

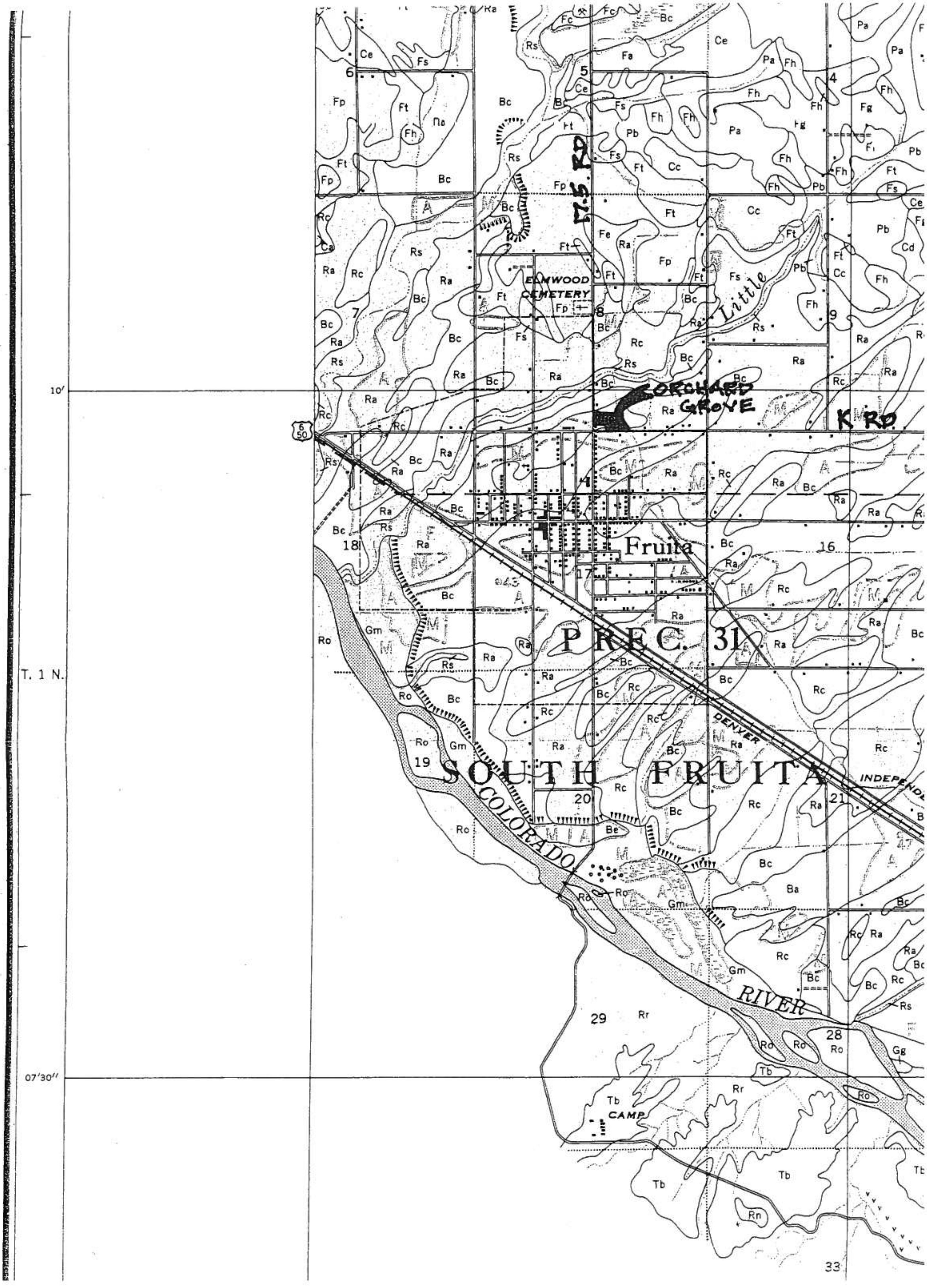
Design Point No.	Contributing Runoff (ft^3/sec) 2 year/100 year	Pipe Capacity (ft^3/sec @ 80% full) HDPE	Allowable Runoff (street/inlet - ft^3/sec) 100 yr event
1	0.06 / 0.47	NA	11.5 / 13
2	0.46 / 3.30	5.80	11.5 / 13

C. **Overall Compliance**

The designed curb inlet and street sections are adequate for both the 2-Year and 100-Year storm events. The storm sewer is capable of conveying 100-year flows while remaining less then 80% full.

This report has been prepared using the joint City/County Storm Water Management Manual as a guide. The methods of analysis, recommendations and conclusions presented in this report are in conformance with these guidelines.

APPENDIX



10′
T. 1 N.
07′30″
ELMWOOD CEMETERY
17.5 RD
ORCHARD GROVE
K RD
Little
Fruita
PREC. 31
SOUTH FRUITA
COLORADO
RIVER
DENVER
CAMP

Billings silty clay loam, 0 to 2 percent slopes (Bc).—This soil, locally called adobe, is one of the most important and extensive in the Grand Valley. It covers nearly one-fifth of the Grand Junction Area. The areas occur on the broad flood plains and very gently sloping coalescing alluvial fans along streams. Many large areas are north of the Colorado River.

The soil is derived from deep alluvial deposits that came mainly from Mancos shale but in a few places from fine-grained sandstone materials. The deposits ordinarily range from 4 to 40 feet deep but in places exceed 40 feet. The deposits have been built up from thin sediments brought in by the streams that have formed the coalescing alluvial fans or have been dropped by the broad washes that have no drainage channel. The thickest deposit, near Grand Junction, was built up by Indian Wash.

The color and texture of the soil profile vary from place to place. The 8- to 10-inch surface soil normally consists of gray, light-gray, light olive-gray, or light brownish-gray silty clay loam. This layer grades into material of similar color and texture that extends to depths of 3 or 4 feet. Below this depth the successive depositional layers show more variation. Although the dominant texture is silty clay loam, the profile may have a loam, clay loam, fine sandy loam, or a very fine sandy loam texture.

Where there are fairly uniform beds of Mancos shale and where the soil is not influenced by materials deposited by adjoining drainage courses, the profile varies only slightly within the upper 3 or 4 feet. In areas bordering drainage courses, however, the soil varies more in texture and color from the surface downward.

One small area about 1½ miles southeast of Loma consists of light grayish-brown or pale-brown heavy silty clay loam that shows only slight variation in texture to depths of 4 to 6 feet. The underlying soil material is more variable. Below depths of 6 to 10 feet the layers generally are somewhat thicker and have a higher percentage of coarse soil material.

Also included with this soil are several small areas totaling about 3 square miles that are dominantly pale yellow. These are located 2½ to 3½ miles northeast of Fruita, 5 miles north of Fruita, 2½ miles northeast of Loma, 3 to 5 miles north of Loma, 1½ miles northwest of Loma, and 4 miles northwest of Mack. In these areas the 8- or 10-inch surface soil is pale-yellow silty clay loam, and the subsoil is a relatively uniform pale-yellow silty clay loam to depths of 4 to 8 feet. The accumulated alluvial layers are difficult to distinguish, but in a few places transitional to Fruita soils there are small areas having a pale-brown to light-yellowish brown color. These transitional areas are included with Billings silty clay loam because they have a finer textured subsoil than is characteristic of the Ravola soils.

Although moderately fine textured, this Billings soil permits successful growth of deep-rooted crops such as alfalfa and tree fruits. Its permeability is normally not so favorable as that of the Mesa, Fruita, and Ravola soils. Its tilth and workability are fair, but it puddles so quickly when wet and bakes so hard when dry that good tilth can be maintained only by proper irrigation and special cultural practices. Runoff is slow and internal drainage is very slow.

Like all other soils in the area, this one has a low organic-matter content. Under natural conditions it contains a moderate concentration of salts derived from the parent rock (Mancos shale). In places, however, it contains so much salt that good yields cannot be obtained. Some large areas are so strongly saline they cannot be used for crops. Generally, this soil is without visible lime, but it is calcareous. In many places small white flecks or indistinct light-colored streaks or seams indicate that lime, gypsum, or salts are present.

Use and management.—About 80 percent of this soil is cultivated. The chief irrigated crops are alfalfa, corn, dry beans, sugar beets, small grains, and tomatoes and other truck crops. Where the soil is located so as to avoid frost damage, tree fruits are grown.

Most of the field crops are grown in the central and western parts of the valley, or from Grand Junction westward. The entire acreage in tree fruits—approximately 3 square miles—lies between Grand Junction and Palisade. Because the climate is more favorable near Palisade, the acreage in orchard fruits is greater there. A few small orchards are located northeast of Grand Junction in the direction of Clifton. The main fruit acreage is between Clifton and Palisade. Peach orchards predominate, but a considerable acreage is in pears, especially near Clifton. Yields depend on the age of the trees and other factors, including management, but the estimated potential yield is somewhat less on this soil than on Mesa soils. This takes into account the slower internal drainage of this soil and its susceptibility to salinity if overirrigated. Yields of other crops vary according to the length of time the land has been irrigated, internal drainage or subdrainage, salt content of the soil, management practices, and local climate.

The uncultivated areas of this soil are mostly inaccessible places adjoining the larger washes, which occur mainly in the western part of the area, and those places that cannot be cropped profitably because they have inadequate drainage and a harmful concentration of salts. The uncultivated land supports a sparse growth of greasewood, saltbush, shadscale, rabbitbrush, ryegrass, peppergrass, and saltgrass. From 70 to 90 acres are required to pasture one animal during a season.

A number of places shown on the map by small marsh symbols are low and seepy. They could be ditched, but their acreage is likely too small to justify the expense. Left as they are, their salt content makes them worthless for any use except pasture.

Sizeable acreages of this soil apparently were overirrigated in the past. Irrigation water applied at higher levels to the north seeps upward in this soil where it occurs in low areas toward the river. Even now, new saline areas are appearing, and existing areas are getting larger. The total acreage affected by salts has remained more or less the same for the last two decades, but affected areas will continue to change in size and shape because of seepage.

Most fields are ditched where necessary. Some uncultivated areas require both leveling and ditching. In places subdrainage is inadequate because irregularities in the underlying shale tend to create pockets and prevent underground water from flowing into the drainage ditches. Also, in some areas where the alluvial mantle is 30 to 40 feet thick, the ditches are not always deep enough to drain the soil. Some areas are seepy because there are no ditches running in an east-west comparatively sharp rises or undulations having slopes of more than 5 percent that extend 4 to 6 feet above the prevailing level or in small irregularly shaped bodies on relatively smooth topography. Wherever the areas of Chipeta soil occur, they are too small and too intricately associated with the Persayo soil to be mapped separately.

Use and management.—About 25 percent of this complex is cultivated, but practically all of it could be. The Chipeta soil is not difficult to level, but the expense of leveling and the isolated location of the areas have not favored development for irrigation and cropping. The kinds of crops grown, the management practiced, and the yields produced are approximately the same as for Persayo-Chipeta silty clay loams, 0 to 2 percent slopes.

Ravola clay loam, 0 to 2 percent slopes (RA).—This soil, the second most extensive in the area, has developed in material that consists largely of reworked Mancos shale but includes an appreciable amount of sandy alluvium from the higher Mesaverde formation. The surface of these deposits is relatively level, but the depth of the deposits ranges from 5 to 30 feet. The soil is associated with the Billings silty clay loams and the Ravola fine sandy loams. The most important areas are east, northeast, and southeast of Fruita, north and northwest of Palisade, and north and northwest of Clifton.

The soil is much like the Billings silty clay loams but more porous because it contains more fine sand, especially in the subsoil. Ordinarily, the 10- or 12-inch surface layer consists of light brownish-gray to very pale-brown light clay loam. The underlying layers vary from place to place in thickness and texture and become more sandy below depths of 4 to 5 feet. The range in the subsoil is from fine sandy loam to clay loam.

Small fragments of shale and sandstone are common from the surface downward and are especially noticeable in areas nearest the source of the soil material. The entire profile is calcareous and friable, so internal drainage is medium and development of plant roots is not restricted. The surface is smooth. Most areas are at slightly higher levels than the associated areas of Billings silty clay loams and therefore have better drainage and a lower content of salts. The soil, however, is slightly saline under native cover, and in places it has strongly saline spots and a high water table.

Use and management.—About 95 percent of this soil is cultivated. The chief crops are alfalfa, corn, pinto beans, small grains, and, where climate is favorable, orchard fruits. Practically all the acreage used for tree fruits is near Clifton and Palisade. The acreage used for field crops varies from year to year, but by rough estimate about 30 percent is cropped to corn, 25 percent to alfalfa, 15 percent to pinto beans, 13 percent to orchard fruits, 10 percent to small grains, and the rest to sugar beets, tame hay, tomatoes, and various vegetable crops.

In general, the tilth and workability of this soil are favorable. The content of organic matter is generally less than 1 percent, but many farmers are improving the supply by growing more alfalfa and by using other improved management.

Ravola clay loam, 2 to 5 percent slopes (RB).—This soil differs from Ravola clay loam, 0 to 2 percent slopes, mainly in having greater slopes. Although the combined areas total only seven-tenths of a square mile, this soil is important because the largest single area—approximately 300 acres—is located southeast of Palisade in the Vinelands and is used for peach growing. The remaining areas, widely scattered over the valley, total about 150 acres and are of minor importance.

The large area occupies a position intermediate between the Green River soils and the higher Mesa soils. Its underlying gravel and stone strata consist not only of sandstone but also of granite, schist, basalt, and lava. Much of the lava was deposited by drainage from the southeast. This large area was included with the soil unit largely because its color was similar to that of the other soil areas. Not many years ago subdrainage became inadequate for existing tree fruits and it was not until a number of tile drains were laid, as deep as 7 to 8 feet in places, that subdrainage was corrected in parts of this particular area.

Use and management.—All of the large soil area is in peaches. On it peach yields average as high as in any section of the valley, primarily because the danger of frost damage is negligible. Some of the orchards are now more than 50 years old but have produced steadily and still yield more than 400 bushels an acre according to reports from local growers. About half of the small scattered areas are cultivated. They are used largely for field crops because climatic conditions are not so favorable for peach growing. In building up the organic matter content, the growing of legumes, application of manure in large amounts, and use of commercial fertilizer generally are practiced.

Ravola very fine sandy loam, 0 to 2 percent slopes (RF).—This extensive and important soil occurs either along washes or arroyas extending from the north or on broad coalescing alluvial fans. The alluvial material from which the soil has developed was derived from sandstone and shale and ranges from 4 to 20 feet deep. The principal areas of the soil are north and northwest of Grand Junction and north, northwest, and southwest of Fruita.

This soil is much like Ravola fine sandy loam, 0 to 2 percent slopes, but is generally more uniformly level. The texture is prevailingly very fine sandy loam, but the percentage of silt is noticeably higher in some places. A few small areas that have a loam texture are included.

The 10- or 12-inch surface layer consists of light brownish-gray to very pale-brown very fine sandy loam. In some places the underlying thin depositional layers vary only slightly in color or texture. In other places, especially near drainage courses, the layers are more variable and may grade to loam, silt loam, or fine sandy loam. Nevertheless, layers of very fine sandy loam are more numerous. Below depths of 4 to 5 feet, the texture is sandier, and at depths of 8 to 12 feet strata of loamy fine sand, gravel, and scattered sandstone rock are common.

Disseminated lime occurs from the surface downward. Owing to the friable consistence of the successive layers, the tilth, internal drainage, available supply of moisture for plants, permeability to plant roots, and other physical properties are favorable and assure a wide suitability range for crops. The organic-matter content, however, is low. The soil is slightly saline under native cover and has a few strongly saline spots. Occasionally the water table is high.

Use and management.—More than 99 percent of this soil is cultivated. The chief crops are alfalfa, corn, pinto beans, small grains,

Exhibit A-1, continued: Hydrologic soil groups for United States soils

Soil	Group
BELMONT	B
BELMORE	B
BELPRE	C
BELSAC	B
BELTED	D
BELTON	C
BELTRAMI	B
BELTSVILLE	C
BELUGA	D
BELUGA, DRAINED, SLOPING	C
BELVOIR	C
BELZAR	C
BEMIDJI	A
BEN LOMOND	B
BENCHLEY	C
BENCLARE	C
BENCO	B
BENDER	B
BENDIRE	C
BENEVOLA	C
BENEWAH	D
BENFIELD	C
BENGAL	C
BENGE	B
BENHAM	B
BENIN	D
BENITO	D
BENJAMIN	D
BENKLIN	C
BENMAN	C
BENNDALE	B
BENNINGTON	C
BENRIDGE	B
BENSLEY	B
BENSON	D
BENTEEN	C
BENWY	B
BENZ	D
BEOR	D
BEOSKA	B
BEOTIA	B
BEOWAWE	B
BEQUINN	B
BERCUMB	B
BERDA	B
BEREA	C
BERENICETON	B
BERGHOLZ	C
BERGLAND	D
BERGQUIST	B
BERGSTROM	B
BERGSVIK	D
BERINO	B
BERIT	D
BERKS	C
BERKSHIRE	B
BERLAKE	B
BERLIN	C
BERMESA	C
BERMUDIAN	B
BERNAL	D
BERNALDO	B
BERNARD	D
BERNARDINO	C
BERNARDSTON	C
BERNHILL	B
BERNICE	A
BERNING	C
BERNOW	B
BERRYLAND	B/D
BERRYMAN	C
BERSON	B
BERTAG	C
BERTELSON	B
BERTHOUD	B
BERTIE	B
BERTO	D
BERTOLOTTI	B
BERTRAM	B
BERTRAND	B
BERVILLE	B/D
BERWOLF	B
BERYL	B
BERZATIC	D
BESEMAN	A/D
BESHERM	C
BESNER	B
BESSEMER	C
BESSIE	D
BESTROM	C
BETHANY	C
BETHEL	B
BETHERA	D
BETHESDA	C
BETHLEHEM	B
BETIS	A
BETONNIE	B
BETRA	C
BETTERAVIA	C
BETTS	B
BEULAH	B
BEVENT	A
BEVERIDGE	D
BEVERLY	B
BEVERLY, GRAVELLY	A
BEW	C
BEWLEYVILLE	B
BEXAR	D
BEZO	D
BEZZANT	B
BIBB	C
BIBLESPRINGS	B
BICE	B
BICKERDYKE	D
BICKETT	D
BICKLETON	B
BICKMORE	C
BICONDOA	D
BICONDOA, DRAINED	C
BIDDEFORD	D
BIDDLEMAN	B
BIDMAN	C
BIDWELL	B
BIEBER	D
BIEDELL	D
BIEDSAW	C
BIENVILLE	A
BIG BLUE	D
BIG HORN	B
BIG TIMBER	D
BIGARM	B
BIGBEE	A
BIGBEND	B
BIGBROWN	C
BIGELOW	B
BIGETTY	B
BIGFLAT	D
BIGFOOT	C
BIGFORK	C
BIGHAMS	B
BIGHILL	B
BIGLAKE	A
BIGMEADOW	C
BIGNELL	C
BIGRIVER	B
BIGSHEEP	B
BIGSPRING	D
BIGWIN	C
BIGWINDER	D
BIJORJA	C
BIJOU	B
BILBO	C
BILGER	D
BILLETT	B
BILLINGS	C
BILLINGS, MODERATELY SLOW PERM	B
BILLYCREEK	C
BILLYHAW	D
BILTMORE	A
BIMMER	D
BINCO	D
BINDLE	B
BINFORD	B
BINGER	B
BINGHAM	B
BINGHAMPTON	B
BINGHAMVILLE	D
BINNA	B
BINNSVILLE	D
BINS	B
BINTON	C
BINTON, RECLAIMED	B
BIOYA	B
BIPPUS	B
BIRCHBAY	C
BIRCHFIELD	D
BIRCHWOOD	C
BIRDOW	B
BIRDS	C/D
BIRDSALL	D
BIRDSBORO	B
BIRDSLEY	D
BIRDSVIEW	A
BIRKBECK	B
BIRMINGHAM	B
BIRNEY	B
BIROME	C
BISBEE	A
BISCARO	D
BISCAY	B/D
BISGANI, MODERATELY WET	B
BISGANI, FLOODED	C
BISHOP	D
BISMARCK	D
BISODDI	D
BISPING	B
BISSELL	B
BISSONNET	D
BIT	C
BITTER	B
BITTER SPRING	B
BITTERROOT	C
BITTERWATER	B
BITTON	B
BIVANS	D
BIXBY	B
BIXLER	C
BJORK	C
BLACHLY	B
BLACK BUTTE	B
BLACK CANYON	D
BLACK CANYON, DRAINED	C
BLACK RIDGE	D
BLACKA	C
BLACKBURN	B
BLACKDRAW	D
BLACKETT	B
BLACKFOOT	C
BLACKFOOT, DRAINED	B
BLACKHALL	D
BLACKHALL, WARM	C
BLACKHAMMER	B
BLACKHAWK	D
BLACKHOOF	D
BLACKHORSE	C
BLACKLEED	B
BLACKLEG	C
BLACKLOCK	D
BLACKMAN	C
BLACKMOUNT	B
BLACKNOLL	C
BLACKOAK	B/D
BLACKPIPE	C
BLACKPRINCE	B
BLACKROCK	B
BLACKSAN	B
BLACKSPAR	D
BLACKSPOT	D
BLACKSTON	B
BLACKTHORN	B
BLACKTOP	D
BLACKWATER	D
BLACKWELL	D
BLADEN	D
BLAG	D
BLAGO	D
BLAINE	C
BLAIR	C
BLAIRTON	C
BLAKABIN	C
BLAKE	B
BLAKELAND	A
BLAKENEY	C
BLAKEWELL	C
BLALOCK	D
BLAMER	C
BLANCA	B
BLANCHARD	A
BLANCHE	B
BLANCHESTER	B/D
BLANCOT	B
BLAND	C
BLANDING	B
BLANEY	B
BLANKET	C
BLANTON	A
BLANTON, MODERATELY WET	B
BLANYON	C
BLAPPERT	D
BLAQUIERE	C
BLASDELL	A
BLASE	C
BLASINGAME	C
BLAYDEN	D
BLAZBIRD	D
BLAZON	D
BLEAKWOOD	C
BLEDSOE	C
BLEIBLERVILLE	D
BLENCOE	D
BLEND	D
BLENDON	B
BLETHEN	B
BLEVINS	B
BLEVINTON	B
BLEWETT	D
BLICHTON	D
BLICKENSTAFF	B
BLIMO	B
BLIMSTER	C
BLINN	C
BLISS	C
BLITZEN	C
BLOCKHOUSE	D
BLOMFORD	B/D
BLOOM	D
BLOOMFIELD	A
BLOOMING	B
BLOOMSDALE	B
BLOOR	C
BLOOR, GRAVELLY SUBSTRATUM	D
BLOUNT	C
BLOWERS	B
BLUCHER	C
BLUE EARTH	B/D
BLUE EARTH, SLOPING	D
BLUE LAKE	A
BLUE STAR	B
BLUEBELL	C
BLUECHIEF	C
BLUECREEK	D
BLUEDOME	C
BLUEFLAT	C
BLUEGROVE	C
BLUEGULCH	B
BLUEHILL	C
BLUEMON	C
BLUEJOINT	B
BLUENOSE	B
BLUEPOINT	A
BLUERIM	C
BLUESLIDE	D
BLUESPRIN	C
BLUESTONE	D
BLUEWING	A
BLUFF	D
BLUFFDALE	C
BLUFFTON	C/D
BLUFORD	C
BLUM	C
BLY	B
BLYBURG	B
BLYTHE	D
BOARDMAN	D
BOARDTREE	C
BOASH	D
BOAZ	C
BOBBITT	C
BOBILLO	A
BOBNBOB	C
BOBS	D
BOBTAIL	C
BOBTOWN	B
BOCA	B/D
BOCA, DEPRESSIONAL	D
BOCA, TIDAL	D
BOCK	B
BOCKER	D
BOCKSTON	B
BODE	B
BODECKER	A
BODELL	D
BODEN	C
BODENBURG	B
BODINE	B
BODORUMPE	C
BODOT	C
BOEL	A
BOEL, OVERWASH	C
BOELUS	A
BOERNE	B
BOESEL	C
BOESEL, PROTECTED	B
BOETTCHER	C
BOGAN	C
BOGART	B
BOGGS	C
BOGGY	C
BOGRAP	B
BOGUE	D
BOGUS	C
BOHANNON	C
BOHEMIAN	B
BOHICKET	D
BOHNA	B
BOHNLY	D
BOHNSACK	B
BOISTFORT	B
BOJAC	B
BOJO	D
BOLAN	B
BOLAR	C
BOLD	B
BOLENT	A
BOLES	C

NOTES: TWO HYDROLOGIC SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION. MODIFIERS SHOWN, E.G., BEDROCK SUBSTRATUM, REFER TO A SPECIFIC SOIL SERIES PHASE FOUND IN SOIL MAP LEGEND.

Exhibit A-1, continued: Hydrologic soil groups for United States soils

POQUONOCK	C	PREMIER	B	PUNCHBOWL	D	QUINLIVEN	C	RAMROD	C
PORFIRIO	C	PRENTISS	C	PUNG	C	QUINN	B/D	RAMSDELL	D
PORRETT	D	PRESA	B	PUNGO	D	QUINNEY	C	RAMSDELL, DRAINED	C
PORRONE	B	PRESHER	B	PUNOHU	A	QUINTANA	B	RAMSEY	D
PORT	B	PRESTO	B	PUNSIT	C	QUINTO	D	RAMSHORN	B
PORT BYRON	B	PRESTON	A	PUNTA	B/D	QUINTON	C	RANA	D
PORTAGE	D	PREWITT	B	PUNTILLA	B	QUITERIA	B	RANCE	C
PORTAGEVILLE	D	PREY	C	PURCELLA	B	QUITMAN	C	RANCHOSECO	D
PORTALES	B	PRICE	B	PURCHES	C	QUIVERA	C	RANDADO	C
PORTALTO	B	PRIDA	C	PURDAM	C	QUONSET	A	RANDALL	D
PORTERFIELD	C	PRIDHAM	D	PURDY	D	QUOPANT	D	RANDCORE	D
PORTERS	B	PRIESTLAKE	B	PURETT	B	QUOSATANA	D	RANDMAN	D
PORTERVILLE	D	PRIETA	D	PURGATORY	C	RABBITEX	B	RANDOLPH	C
PORTHILL	D	PRIM	D	PURNER	D	RABER	C	RANDS	C
PORTIA	C	PRIMEAUX	C	PUROB	D	RABIDEUX	B	RANDSBURG	D
PORTINO	C	PRIMEN	D	PURSLEY	B	RABUN	B	RANGEE	D
PORTLAND	D	PRIMGHAR	B	PURVES	D	RACE	B	RANGER	C
PORTMOUNT	B	PRINCETON	B	PUSHMATAHA	C	RACINE	B	RANPUFF	D
PORTNEUF	B	PRINEVILLE	C	PUSTOI	B	RACKER	A	RANSLO	D
PORTOLA	B	PRING	B	PUTNAM	D	RACOMBES	B	RANSOM	B
PORTSMOUTH	B/D	PRINGLE	D	PUTNEY	B	RACOON	C/D	RANSTEIN	B
PORUM	D	PRITCHARD	C	PUTT	C	RAD	B	RANTOUL	D
POSANT	D	PRITCHETT	C	PUTTSTER	C	RAD, LACUSTRINE	C	RAPATEE	D
POSEN	B	PROCHASKA	A/D	PUU OO	A	SUBSTRATUM		RAPELJE	B
POSEY	B	PROCTOR	B	PUU OPAE	B	RAD, FLOODED	C	RAPH	B
POSEYVILLE	C	PROGRESSO	C	PUU PA	A	RADDLE	B	RAPHO	B
POSITAS	D	PROMISE	D	PUU PA, NONSTONY	B	RADER	D	RAPIDAN	B
POSKIN	C	PROMO	D	PUUKALA	C	RADERSBURG	B	RAPLEE	C
POSO	B	PRONG	C	PUUONE	C	RADFORD	B	RAPPAHANNOCK	D
POSOS	C	PROPHETSTOWN	B/D	PUYALLUP	B	RADLEY	B	RAPSON	B
POST	D	PROSPECT	B	PYBURN	D	RADNOR	C	RARDEN	C
POTAMUS	B	PROSPER	B	PYLE	B	RAFAEL	D	RARICK	C
POTCHUB	C	PROSSER	C	PYLON	D	RAFTON	D	RARITAN	C
POTEET	C	PROTIVIN	C	PYOTE	A	RAFTRIVER	C	RASBAND	B
POTELL	B	PROUT	C	PYRAMID	D	RAGLAN	B	RASILLE	B
POTH	C	PROUTY	C	PYRMONT	D	RAGNAR	B	RASSER	B
POTLATCH	C	PROVIDENCE	C	PYRMONT, BEDROCK	C	RAGNEL	B	RASSET	B
POTOMAC	A	PROVIG	C	SUBSTRATUM		RAGO	C	RASTUS	C
POTOSI	A	PROVO	D	PYWELL	D	RAGPIE	D	RATAKE	D
POTRATZ	C	PROVO BAY	D	QUAFENO	C	RAGSDALE	B/D	RATHBUN	C
POTSDAM	C	PROW	D	QUAKER	C	RAGSDALE, OVERWASH	B	RATHDRUM	B
POTTER	C	PRUDY	B	QUAKERTOWN	C	RAGTOWN	C	RATLAKE	D
POTTINGER	B	PRUE	B	QUAM	B/D	RAHAL	C	RATLEFLAT	B
POTTS	B	PRUITTON	B	QUAMON	A	RAHM	C	RATLIFF	B
POTTSBURG	B/D	PRUNIE	D	QUANAH	B	RAMWORTH	B	RATON	D
POUDRE	D	PRYOR	C	QUANDER	B	RAIL	D	RATSOW	C
POUJADE	D	PSUGA	B	QUANTICO	B	RAILCITY	A	RATTLEP	D
POULSBO	D	PTARMIGAN	C	QUARLES	D	RAINBOW	C	RATTO	C
POUNCEY	D	PUAPUA	D	QUARTZBURG	C	RAINEY	C	RATTO, STONY	D
POVERTY	D	PUAULU	A	QUARTZVILLE	B	RAINIER	C	RAUB	C
POVEY	B	PUCHYAN	B	QUARZ	C	RAINO	D	RAUGHT	B
POWDER	B	PUDDLE	B	QUATAMA	C	RAINS	B/D	RAUVILLE	D
POWDERHORN	C	PUERCO	D	QUAY	B	RAINS, FLOODED	D	RAUZI	B
POWDERWASH	C	PUERTA	D	QUAZO	D	RAINSBORO	C	RAVALLI	D
POWEEN	C	PUERTECITO	D	QUEALMAN	C	RAINSVILLE	B	RAVALLI, BEDROCK	B
POWELL	C	PUETT	D	QUEALY	D	RAIRDENT	B	SUBSTRATUM	
POWER	B	PUFFER	D	QUEBRADA	C	RAISIO	C	RAVEN	A
POWERLINE	C	PUGET	D	QUEENY	D	RAKANE	C	RAVENDALE	D
POWLEY	D	PUGET, PROTECTED	C	QUEETS	B	RAKE	D	RAVENELL	D
POWMENT	C	PUGSLEY	C	QUEMADO	C	RAKIED	C	RAVENNA	C
POWWAHKEE	B	PUHI	B	QUENZER	D	RALEIGH	D	RAVENSWOOD	C
POWWATKA	C	PUHIMAU	D	QUERC	C	RALLOD	D	RAVIA	C
POY	D	PUICE	C	QUERENCIA	B	RALLS	B	RAVOLA	B
POYGAN	D	PULA	C	QUETICO	D	RALPH	B	RAWAH	C
POYNOR	B	PULANTAT	C	QUICKSELL	C	RALPHSTON	B	RAWE	C
POZO	C	PULASKI	B	QUICKSILVER	D	RALSEN	D	RAWLES	B
POZO BLANCO	B	PULCAN	C	QUICKVERT	C	RAMADERO	B	RAWLINS	B
PRAG	C	PULEHU	B	QUIDEN	B	RAMBLA	C	RAWSON	B
PRAIRIEVILLE	B	PULEXAS	B	QUIENSABE	C	RAMBOUILLET	B	RAWSONVILLE	C
PRAMISS	C	PULLMAN	D	QUIETUS	C	RAMELLI	D	RAYBURN	D
PRATHER	C	PULPIT	C	QUIGLEY	B	RAMIRES	C	RAYEX	D
PRATLEY	C	PULS	D	QUIHI	C	RAMMEL	C	RAYFORD	C
PRATT	A	PULSIPHER	D	QUILCENE	C	RAMO	C	RAYLAKE	D
PREACHER	B	PULTNEY	C	QUILLAYUTE	B	RAMONA	B	RAYMONDVILLE	D
PREAKNESS	B/D	PUMEL	D	QUILOTOSA	D	RAMONA, HARD	C	RAYNE	B
PREATORSON	B	PUMEL, NONGRAVELLY	C	QUILT	D	SUBSTRATUM		RAYNESFORD	B
PREBISH	C/D	PUMPER	B	QUIMA	B	RAMPART	B	RAYNHAM	C
PREBLE	D	PUNA	A	QUINCY	A	RAMPAPTER	B	RAYNOLDSON	B
PRELO	B	PUNALUU	D	QUINLAN	C	RAMPS	B	RAYOHILL	C

NOTES: TWO HYDROLOGIC SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION.
MODIFIERS SHOWN, E.G., BEDROCK SUBSTRATUM, REFER TO A SPECIFIC SOIL SERIES PHASE FOUND IN SOIL MAP LEGEND.

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 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .40 - .48	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Cultivated/Agricultural	.08 - .18 .14 - .24	.13 - .23 .18 - .28	.16 - .26 .22 - .32	.11 - .19 .16 - .24	.15 - .23 .21 - .29	.21 - .29 .28 - .36	.14 - .22 .20 - .28	.19 - .27 .25 - .33	.26 - .34 .34 - .42	.18 - .26 .24 - .32	.23 - .31 .29 - .37	.31 - .39 .41 - .49
Pasture	.12 - .22 .15 - .25	.20 - .30 .25 - .35	.30 - .40 .37 - .47	.18 - .26 .23 - .31	.28 - .36 .34 - .42	.37 - .45 .45 - .53	.24 - .32 .30 - .38	.34 - .42 .42 - .50	.44 - .52 .52 - .60	.30 - .38 .37 - .45	.40 - .48 .50 - .58	.50 - .58 .62 - .70
Meadow	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .44 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Forest	.05 - .15 .08 - .18	.08 - .18 .11 - .21	.11 - .21 .14 - .24	.08 - .16 .10 - .18	.11 - .19 .14 - .22	.14 - .22 .18 - .26	.10 - .18 .12 - .20	.13 - .21 .16 - .24	.16 - .24 .20 - .28	.12 - .20 .15 - .23	.16 - .24 .20 - .28	.20 - .28 .25 - .33
RESIDENTIAL AREAS 1/8 acre per unit	.40 - .50 .48 - .58	.43 - .53 .52 - .62	.46 - .56 .55 - .65	.42 - .50 .50 - .58	.45 - .53 .54 - .62	.50 - .58 .59 - .67	.45 - .53 .53 - .61	.48 - .56 .57 - .65	.53 - .61 .64 - .72	.48 - .56 .56 - .64	.51 - .59 .60 - .68	.57 - .65 .69 - .77
1/4 acre per unit	.27 - .37 .35 - .45	.31 - .41 .39 - .49	.34 - .44 .42 - .52	.29 - .37 .38 - .46	.34 - .42 .42 - .50	.38 - .46 .47 - .55	.32 - .40 .41 - .49	.36 - .44 .45 - .53	.41 - .49 .52 - .60	.35 - .43 .43 - .51	.39 - .47 .47 - .55	.45 - .53 .57 - .65
1/3 acre per unit	.22 - .32 .31 - .41	.26 - .36 .35 - .45	.29 - .39 .38 - .48	.25 - .33 .33 - .41	.29 - .37 .38 - .46	.33 - .41 .42 - .50	.28 - .36 .36 - .44	.32 - .40 .41 - .49	.37 - .45 .48 - .56	.31 - .39 .39 - .47	.35 - .43 .43 - .51	.42 - .50 .53 - .61
1/2 acre per unit	.16 - .26 .25 - .35	.20 - .30 .29 - .39	.24 - .34 .32 - .42	.19 - .27 .28 - .36	.23 - .31 .32 - .40	.28 - .36 .36 - .44	.22 - .30 .31 - .39	.27 - .35 .35 - .43	.32 - .40 .42 - .50	.26 - .34 .34 - .42	.30 - .38 .38 - .46	.37 - .45 .48 - .56
1 acre per unit	.14 - .24 .22 - .32	.19 - .29 .26 - .36	.22 - .32 .29 - .39	.17 - .25 .24 - .32	.21 - .29 .28 - .36	.26 - .34 .34 - .42	.20 - .28 .28 - .36	.25 - .33 .32 - .40	.31 - .39 .40 - .48	.24 - .32 .31 - .39	.29 - .37 .35 - .43	.35 - .43 .46 - .54
MISC. SURFACES Pavement and roofs	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97
Traffic areas (soil and gravel)	.55 - .65 .65 - .70	.60 - .70 .70 - .75	.64 - .74 .74 - .79	.60 - .68 .68 - .76	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.69 - .77 .77 - .85	.72 - .80 .79 - .87	.75 - .83 .82 - .90	.77 - .85 .84 - .92
Green landscaping (lawns, parks)	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .42 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Non-green and gravel landscaping	.30 - .40 .34 - .44	.36 - .46 .42 - .52	.45 - .55 .50 - .60	.45 - .55 .50 - .60	.42 - .50 .48 - .56	.50 - .58 .57 - .65	.40 - .48 .46 - .54	.48 - .56 .55 - .63	.56 - .64 .64 - .72	.44 - .52 .50 - .58	.50 - .58 .60 - .68	.60 - .68 .70 - .78
Cemeteries, playgrounds	.20 - .30 .24 - .34	.26 - .36 .32 - .42	.35 - .45 .40 - .50	.35 - .45 .40 - .50	.32 - .40 .38 - .46	.40 - .48 .47 - .55	.30 - .38 .36 - .44	.38 - .44 .45 - .53	.46 - .54 .54 - .62	.34 - .42 .40 - .48	.40 - .48 .50 - .58	.50 - .58 .60 - .68

NOTES:
1. Values above and below pertain to the 2-year and 100-year storms, respectively.
2. 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 ($Tc \leq 10$ 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.
3. 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"

TIME OF CONCENTRATION and RAINFALL INTENSITIES

For: Orchard Grove
BASIN H1

Descrip. of Flow	L Length ft.	S Slope %	N* Mannings coef.	V_2 Vel. fps	V_{100} Vel. fps	Tt_2 Travel Time min.	Tt_{100} Travel Time min.	Tc_2 Time of Concentration min.	Tc_{100} Time of Concentration min.	2-Year i Intensity Grd. Jctn. Curves	100-Year i Intensity Grd. Jctn. Curves
Overland*	300	1.21%	0.090			40.99	24.19	54.9	38.1	0.36	1.84
Shallow Concentrated Flow**	542	3.05%	0.255	0.65	0.65	13.90	13.90				
Curb and Gutter Flow	0.00	1.02%	0.016	2.04	3.64	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	0.00	0.54%	0.016	1.48	2.65	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	0.00	0.50%	0.016	1.34	2.39	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											

* T_0 based on SCS formula pg. E-2 Storm Water Management Manual
** Figure "E-3", Pg. E-9, Storm Water Management Manual was used for shallow flows.
*** Mannings Equation was used to determine gutter and concrete pan flow velocities
an N value of 0.016 was used for conrete gutters and pans

RUNOFF RATES (Q)

For: Orchard Grove
USING RATIONAL METHOD Q=CxCfxIxA

BASIN H1	Q Volume cfs	C Composite Coefficient n/a	Cf Antecedent Precip. Fac. n/a	I* Rainfall Intensity in/hr	A Basin Area acres
2-Yr	0.18	0.20	1	0.36	2.57
100-Yr	1.18	0.25	1	1.84	2.57

TIME OF CONCENTRATION and RAINFALL INTENSITIES

For: Orchard Grove

BASIN H2

Descrip. of Flow	L Length ft.	S Slope %	N* Mannings coef.	V_2 Vel. fps	V_{100} Vel. fps	Tt_2 Travel Time min.	Tt_{100} Travel Time min.	Tc_2 Time of Concentration min.	Tc_{100} Time of Concentration min.	2-Year i Intensity Grd. Jctn. Curves	100-Year i Intensity Grd. Jctn. Curves
Overland*	300	1.26%	0.090			40.33	23.80	43.9	27.4	0.42	2.27
Shallow Concentrated Flow**	173	0.76%	0.255	0.80	0.80	3.60	3.60				
Curb and Gutter Flow	0.00	1.02%	0.016	2.04	3.64	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	0.00	0.54%	0.016	1.48	2.65	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	0.00	0.50%	0.016	1.34	2.39	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											

* T_0 based on SCS formula pg. E-2 Storm Water Management Manual
** Figure "E-3", Pg. E-9, Storm Water Management Manual was used for shallow flows.
*** Mannings Equation was used to determine gutter and concrete pan flow velocities an N value of 0.016 was used for conrete gutters and pans

RUNOFF RATES (Q)

For: Orchard Grove

USING RATIONAL METHOD Q=CxCfxIxA

BASIN H2	Q Volume cfs	C Composite Coefficient n/a	Cf Antecedent Precip. Fac. n/a	I* Rainfall Intensity in/hr	A Basin Area acres
2-Yr	0.12	0.15	1	0.42	1.82
100-Yr	0.83	0.20	1	2.27	1.82

TIME OF CONCENTRATION and RAINFALL INTENSITIES

For: Orchard Grove
BASIN D1

Descrip. of Flow	L Length ft.	S Slope %	N* Mannings coef.	V_2 Vel. fps	V_{100} Vel. fps	Tt_2 Travel Time min.	Tt_{100} Travel Time min.	Tc_2 Time of Concentration min.	Tc_{100} Time of Concentration min.	2-Year i Intensity Grd. Jctn. Curves	100-Year i Intensity Grd. Jctn. Curves
Overland*	267.6	2.00%	0.400			100.91	59.55	102.5	60.4	0.22	1.32
Shallow Concentrated Flow**	0	2.52%	0.255	2.50	2.50	0.00	0.00				
Curb and Gutter Flow	0.00	1.02%	0.016	2.04	3.64	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	0.00	0.54%	0.016	1.48	2.65	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	128.70	0.50%	0.016	1.34	2.39	1.60	0.90				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											

* T_0 based on SCS formula pg. E-2 Storm Water Management Manual
** Figure "E-3", Pg. E-9, Storm Water Management Manual was used for shallow flows.
*** Mannings Equation was used to determine gutter and concrete pan flow velocities an N value of 0.016 was used for conrete gutters and pans

RUNOFF RATES (Q)

For: Orchard Grove
USING RATIONAL METHOD Q=CxCfxIxA

BASIN D1	Q Volume cfs	C Composite Coefficient n/a	Cf Antecedent Precip. Fac. n/a	I* Rainfall Intensity in/hr	A Basin Area acres
2-Yr	0.06	0.33	1	0.22	0.85
100-Yr	0.47	0.42	1	1.32	0.85

TIME OF CONCENTRATION and RAINFALL INTENSITIES

For: Orchard Grove
BASIN D2

Descrip. of Flow	L Length ft.	S Slope %	N* Mannings coef.	V_2 Vel. fps	V_{100} Vel. fps	Tt_2 Travel Time min.	Tt_{100} Travel Time min.	Tc_2 Time of Concentration min.	Tc_{100} min.	2-Year i Intensity Grd. Jctn. Curves	100-Year i Intensity Grd. Jctn. Curves
Overland*	102	2.00%	0.400			46.65	27.53	50.1	29.5	0.39	2.17
Shallow Concentrated Flow**	0	1.20%	0.255	1.70	1.70	0.00	0.00				
Curb and Gutter Flow	0.00	0.67%	0.016	1.65	2.95	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	299.00	0.50%	0.016	1.43	2.55	3.48	1.95				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											
Curb and Gutter Flow	0.00	0.50%	0.016	1.43	2.55	0.00	0.00				
(from SDSK calculator - d=2" for 2-Yr. & d=5" for 100-Yr.)											

* T_0 based on SCS formula pg. E-2 Storm Water Management Manual
** Figure "E-3", Pg. E-9, Storm Water Management Manual was used for shallow flows.
*** Mannings Equation was used to determine gutter and concrete pan flow velocities an N value of 0.016 was used for conrete gutters and pans

RUNOFF RATES (Q)

For: Orchard Grove
USING RATIONAL METHOD Q=CxCfxIxA

BASIN D2	Q Volume cfs	C Composite Coefficient n/a	Cf Antecedent Precip. Fac. n/a	I* Rainfall Intensity in/hr	A Basin Area acres
2-Yr	0.46	0.33	1	0.39	3.61
100-Yr	3.30	0.42	1	2.17	3.61

ORCHARD GROVE

Manning Pipe Calculator

Given Input Data:

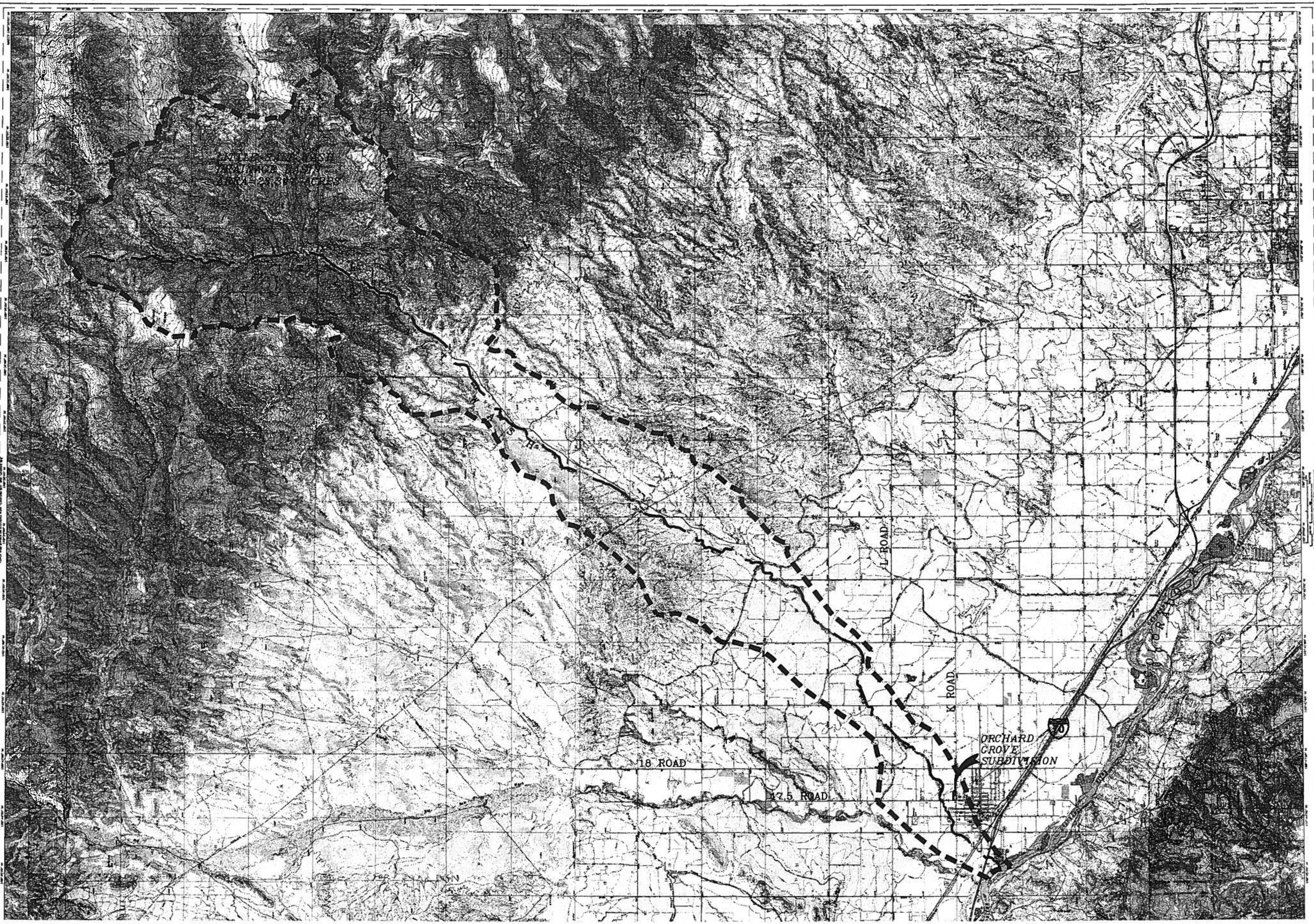
Shape	Circular
Solving for	Flowrate
Diameter	15.0000 in
Depth	12.0000 in
Slope	0.0050 ft/ft
Manning's n	0.0100

Computed Results:

Flowrate	5.8043 cfs
Area	1.2272 ft2
Wetted Area	1.0525 ft2
Wetted Perimeter	33.2145 in
Perimeter	47.1239 in
Velocity	5.5150 fps
Hydraulic Radius	4.5629 in
Percent Full	80.0000 %
Full flow Flowrate	5.9381 cfs
Full flow velocity	4.8388 fps

Critical Information

Critical depth	12.5385 in
Critical slope	0.0044 ft/ft
Critical velocity	5.4132 fps
Critical area	1.1384 ft2
Critical perimeter	33.6389 in
Critical hydraulic radius	4.8734 in
Critical top width	15.0000 in
Specific energy	1.5038 ft
Minimum energy	1.5673 ft
Froude number	1.0787
Flow condition	Supercritical



LEGEND

EXISTING BASIN BOUNDARY

EXISTING LEWS WASH PATH

REVISION	DATE	DESCRIPTION	BY	CK'D

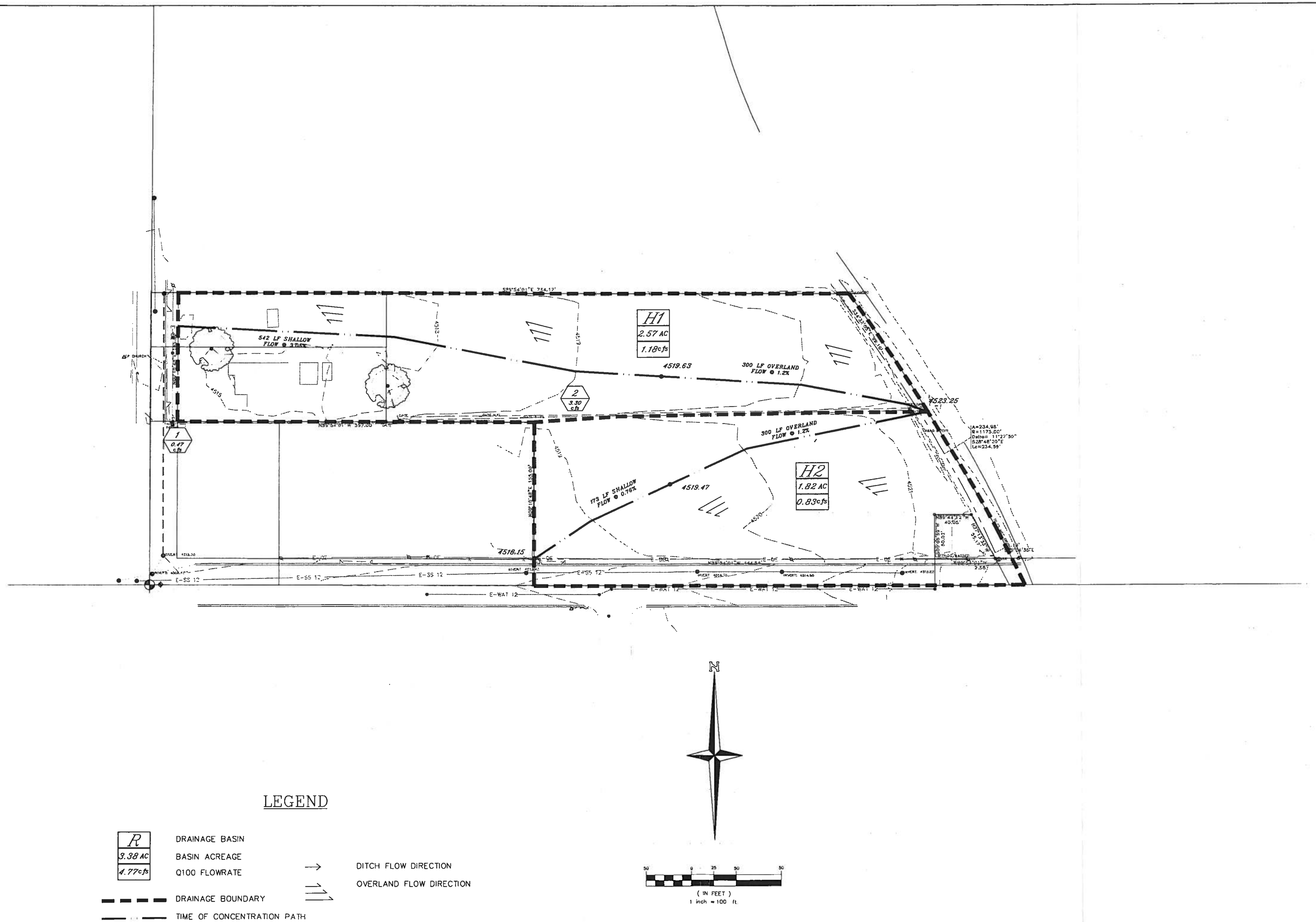
CONSTRUCTORS WEST, INC. GRAND JUNCTION

ORCHARD GROVE SUBDIVISION
MAJOR DRAINAGE BASIN

THOMPSON-LANGFORD CORP.
ENGINEERS AND LAND SURVEYORS
529 25 1/2 RD., SUITE B210
GRAND JUNCTION, COLORADO
PH. (970) 243-6067
FAX (970) 241-2845
tlc@tlcwest.com

DRAWN BY: JWM
CHECKED BY:

DATE: 07/14/2003
SCALE: Horiz: 1"=8000'
Project No: 0187-034
SHEET NO: 1 OF 1



S:\design\0006-053 Orchard Grove\dwg\drainage\prelim-drain.dwg, 9/4/2003 1:30:05 PM, Auto HP LaserJet 4V on MARCO-PC.pc3

REVISION	DATE	DESCRIPTION	BY	CKD

GRAND JUNCTION

CIAVONNE & ASSOCIATES

ORCHARD GROVE SUBDIVISION
HISTORIC DRAINAGE CONDITIONS

THOMPSON-LANGFORD CORP.
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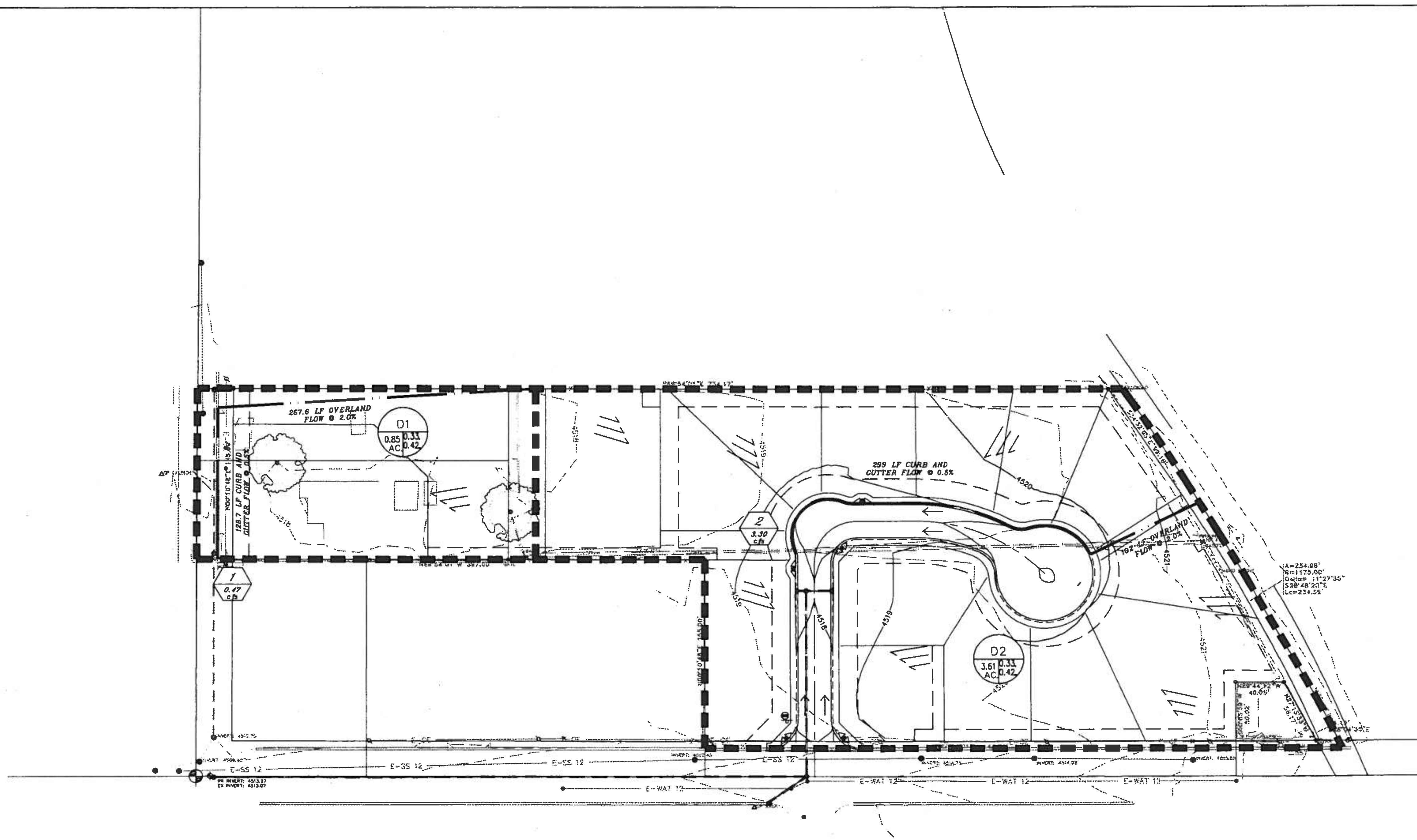
DRAWN BY: JWM
CHECKED BY:

DATE: 07/14/2003
SCALE: Horiz: 1"=100'
Project No: 0187-034
SHEET NO: 1 OF 2



LEGEND

D3 7.79 AC 0.36 0.45	DRAINAGE BASIN BASIN ACREAGE/RUNOFF COEFFICIENT
■ ■ ■ ■	DRAINAGE BOUNDARY
5b 2.61 cfs	DESIGN POINT 100 YEAR FLOW
—— · · ——	TIME OF CONCENTRATION PATH
- - - - - -	STORM SEWER PIPE
◎	STORM SEWER MANHOLE
▪	STORM SEWER INLET
←	CURB & GUTTER FLOW DIRECTION
⫽	OVERLAND FLOW DIRECTION

100 0 50 100 200

(IN FEET)
1 inch = 200 ft.

REVISION	DATE	DESCRIPTION	BY	CH'D

CIAVONNE & ASSOCIATES GRAND JUNCTION

ORCHARD GROVE SUBDIVISION
DEVELOPED DRAINAGE CONDITIONS

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DRAWN BY:

CHECKED BY:

DATE:

SCALE:
Horiz: 1"=100'

Project No:
0187-034

SHEET NO:
2 OF 2