PULPIT ROCK

drainage basin Plan

for the

CITY OF COLORADO SPRINGS

Prepared by

R. KEITH HOOK & ASSOCIATES, INC.

ENGINEERS—PLANNERS—CONSULTANTS

MARCH, 1968
HYDROLOGIC ENGINEERING STUDY

of the

PULPIT ROCK
DRAINAGE BASIN

for

THE DEPARTMENT OF PUBLIC WORKS
COLORADO SPRINGS, COLORADO

March, 1968

Engineers-Planners-Consultants
Colorado Springs, Colorado
# TABLE OF CONTENTS

Letter of Transmittal

Location Map

Drainage Basin Plan

Hydrograph Location

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Description</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>II. Geological Formation &amp; Soils</td>
<td>2</td>
</tr>
<tr>
<td>III. Rainfall</td>
<td>3</td>
</tr>
<tr>
<td>IV. Surface Flow Criteria</td>
<td>3 &amp; 4</td>
</tr>
<tr>
<td>V. Greenbelt systems</td>
<td>4 &amp; 5</td>
</tr>
<tr>
<td>VI. Improvements</td>
<td>5 &amp; 6</td>
</tr>
<tr>
<td>VII. Sub-basin Description</td>
<td>6 - 10</td>
</tr>
<tr>
<td>VIII. Calculations</td>
<td>Part I.</td>
</tr>
<tr>
<td></td>
<td>Part II.</td>
</tr>
<tr>
<td>IX. Estimate of Cost</td>
<td>13 &amp; 14</td>
</tr>
<tr>
<td>X. Typical Ditch Sections</td>
<td></td>
</tr>
<tr>
<td>XI. Hydrographs</td>
<td></td>
</tr>
</tbody>
</table>
Maury Pearce
Director of Public Works
City Hall
Colorado Springs, Colorado

Dear Sir:

Enclosed herewith is the engineering study of Pulpit Rock Drainage Basin System.

This report describes precipitation run-off conditions as affected by existing terrain and as will affect proposed developed areas within the basin and methods of conveying subject run-off.

Very truly yours,

R. KEITH HOOK & ASSOCIATES, INC.

[Signature]
Leonard C. Becker, P.E.
HYDROGRAPH LOCATION

POINT I  North Greenbelt  Intersection greenbelt and Academy Boulevard.

POINT II  Academy Hills Subdivision  Intersection greenbelt and most westerly intersection.

POINT III  West boundary sub-basin D and greenbelt.

POINT IV  West end basin and greenbelt.
1. DESCRIPTION

   A. General

   This drainage study and report establishes a run-off criteria showing all drainage systems that fall within the Pulpit Rock drainage basin to the confluence with Monument Creek.

   The drainage systems, as described and shown, will determine, to some extent, future street systems and land development. It is intended to locate drainage structures and systems to best suit natural drainage ways throughout the Pulpit Rock basin.

   Final development of land may require modification to the described and shown drainage facilities, however, general requirements should be maintained.

   B. Basin Description

   Pulpit Rock drainage basin is located in portions of Sections 15, 16, 17 and 18, all in Township 13 South, Range 67 West of the 6th P.M. The basin covers approximately 1,331 acres.

   Surface run-off is in a general Westerly direction to termination at Monument Creek. Some flow is channeled into Cottonwood Creek prior to flowing into Monument Creek.

   Pulpit Rock basin is rolling hills in the Easterly portion and mountainous terrain in the Westerly portion. The steeper grades are found in the Westerly portion of the basin, as is tree cover.
I. B. (Continued)

Stream flow is intermittent throughout the basin.

In the Westerly portion of Pulpit Rock, Dawson Arkose outcropping is prevalent particularly along the dividing ridge areas. Some clays are evidenced along with mottled sand. The area is heavily wooded.

The ridge line at the South boundary has few scattered trees. The North slope being fairly well wooded.

In the main greenbelt channel, distinct channel configuration commences approximately 500 feet Westerly of Academy Boulevard.

II. GEOLOGICAL FORMATION AND SOILS

Pulpit Rock area consists mainly of sandy gravelly materials with some clay evident in the Easterly portion.

As the slopes increase toward the Westerly portion, mesa gravels and sands are more predominate with a large amount of rock formations in evidence. This rock outcropping is decomposed and quite subject to erosion and scaling. The designation of this rock located along both slopes of the major greenbelt channel is Dawson Arkose. Mixed with this formation, the overburden appears to contain certain amounts of disintegrated granite.

In the North greenbelt system in the Academy hills area, the soil is mostly gravelly, mixed with sands and a small amount of disintegrated granite.

Fifty percent (50%) direct run-off in inches was used in the design of Basin A, B and C and seventy percent (70%) in the remainder basins.
III. RAINFALL

For this report, a storm of one (1) hour duration with two (2) inch intensity and 50-year frequency has been used for design.

From U. S. Weather Bureau records, approximately 14.5 inches of rainfall per year appears average, with higher precipitation occurring in April, May, July and August. Peak rainfall has been measured at 8.2 inches. Average high has been measured in July at 2.94 inches in one hour.

Intense storms estimated at lasting two (2) hours.

IV. SURFACE FLOW CRITERIA

Pulpit Rock drainage basin has been divided into ten (10) sub-basins, as shown on the Master Drainage Plan. These basins and flow criteria and recommended improvements will be individually described.

The drainage basin has two (2) greenbelt systems. One system is located within the central portion of Pulpit Rock and the other greenbelt is located in the Northealy portion of Pulpit Rock.

Peak run-off has been computed at each outfall point of each sub-basin. This run-off will give the quantity of each sub-basin, combined basins and finally, totally combined flow.

From calculation tables and the drainage plan, surface flow can then be determined at any point in the basin.

All flow has been computed on a time basis.
IV. (Continued)

Synthetic hydrographs have been constructed for succeeding points as peak flow proceeds downstream.

Peak time of the hydrograph increases as the crest flows downstream.

In the event the Pulpit Rock basin outfall points are gaged, the synthetic hydrograph quantities may require adjustment.

V. GREENBELT SYSTEMS

Two (2) greenbelt systems will be described as North and South systems:

A. North Greenbelt System

This system extends through sub-basins A and B and empties into Cottonwood Creek, approximately 300 feet North of Academy Hills Subdivision. This greenbelt is approximately 8,900 feet in length.

B. South Greenbelt System

This system extends through sub-basins C, D, E, F, G and H, and empties into Monument Creek, approximately 1,400 feet from the westerly boundary of the Pulpit Rock Drainage Basin.

This greenbelt is approximately 7,200 feet in length.

The proposed routing of these greenbelt systems will follow natural drainage courses in order to allow the best use of the land, as subdivisions are developed.
V. (Continued)

In the Easterly portion of the drainage basin, the drainage systems are not distinctly shaped and will require shaping and alignment. As the area does not contain steep grades, velocities should not be high, thereby requiring no velocity control measures.

In the Westerly portion, particularly in the South greenbelt system, the area is quite mountainous with steep slopes down to the greenbelt from North and South face.

The grade on the existing channel flowing westerly is not steep and erosion is at a minimum. Tree cover and foliage also keeps erosion to a minimum.

Due to the rustic appearance of the area, and with development proposed in a mountain-type subdivision, it is recommended the South greenbelt system be maintained in its present condition. Some slope treatment, shaping and clearing and grubbing is required.

VI. IMPROVEMENTS

Proposed improvements consist of:

A. Lined greenbelt channels, where necessary, as described and shown.
B. Catch basins.
C. Intersection drainage.
D. Drainage outlets and piping or drainage ditches.
E. Concrete culverts or piping.
F. Channel construction, where necessary.
VI. (Continued)

All drainage structures and systems are tentatively located to best suit anticipated land development and to contain surface run-off in greenbelt systems, piping or ditches in order that streets and roadways are not overloaded, or in the case of arterial systems, that the majority of surface flow is removed.

The location of proposed future streets, as shown, and those drainage structures and appurtenances relative to removing surface flow from the streets, as shown and described as a guide only in order that a drainage criteria and cost estimate be established.

Final subdivision street systems may vary from those as shown on the drainage plan, however, these basic drainage requirements should be considered. The sizing of drainage structures utilizes full capacity of a pipe or culvert. When actual profiles are established for drainage channels and roadways, the size of the drainage structure may vary slightly to suit final grade conditions.

No entrance losses, headwater, submerged inlet or outlet conditions have been considered. If concrete culverts are used, allowance should be made for free board of at least 1.0-foot minimum.

To compensate for above losses, in general drainage structures are sized to provide a safety factor in excess of design flow conditions.

VII. SUB-BASIN DESCRIPTION

BASIN A - North Greenbelt System
557.85 Acres - 496 CFS at West boundary
Gentle Sloping to Northwest.

a. Defines proposed street systems with drainage improvements.

b. Greenbelt right of way, 35 and 40-foot, will require shaping as channel is not distinct in the Easterly portion.
VII (Continued)

BASIN B - North Greenbelt System
100 Acres - 622.7 CFS at West boundary
Slopes to North.

a. Westerly portion, from Academy Hills Subdivision to Cottonwood Creek. This greenbelt channel will require shaping and clearing. Dawson Arkose outcroppings predominate and should require little lining to prevent erosion. Improvement of the channel is also required at the confluence with Cottonwood Creek.

b. Existing piping crossing under streets in Academy Hills Subdivision and crossing under Academy Boulevard is in every case too small to handle run-off. To accommodate flow, piping may require re-placing with culverts to satisfy allowable space. Additional piping is satisfactory if right of way widths will not be exceeded.

Improvements should be made when Sub-Basin A is developed, Easterly of Academy Boulevard.

BASIN C - South Greenbelt System
76.0 Acres - 97.6 CFS at West boundary - 36-foot right of way
Gentle rolling to West.

a. Drainage improvement at Academy Boulevard crossing and greenbelt system. Requires 36-inch R.C.P. or equivalent.

BASIN D - South Greenbelt System
228.0 Acres - 450.1 CFS at West Boundary - 35-40-foot right of way
Moderate to steep slopes - wooded.

a. Proposed street system and piping as greenbelt crossing.

b. This basin has four (4) well-defined drainage channels draining into the greenbelt system. These channels are in mountainous terrain and if the area is developed should be designated as drainage easements only and left in their natural state.
VII. (Continued)

BASIN E - South Greenbelt System
25.4 Acres - 490.1 CFS at West boundary. - 40-foot right of way
Steep slopes to South - wooded - Dawson Arkoose outcropping
a. This basin is mountainous with steep slopes with minimum proposed street systems and
drainage structures, as shown. One (1) well-defined drainage channel drains into
the greenbelt and should be designated as a drainage easement only.

BASIN F - South Greenbelt System
24.0 Acres - 598.9 CFS at West boundary (includes 53 CFS from Basin G)
Steep slopes to South - wooded, with Dawson outcropping predominate.
45-foot right of way.

a. This basin is mountainous with steep slopes to the South. Minimum street
systems and drainage improvements.
b. One (1) well-defined drainage channel drains into the greenbelt and should be de-
signated as a drainage easement only and remain in its natural state

BASIN G - South Greenbelt System
82.4 Acres - 104.8 CFS surface run-off flows onto three (3) proposed
street systems and then into the greenbelt.
45-foot right of way.

a. Heavily wooded - steep slope to North. Minimum proposed street system.
b. One (1) well-defined drainage channel flows North into the Greenbelt. Channel
should be designated a drainage easement. No improvements recommended
VII. (Continued)

BASIN H - South Greenbelt system
52.7 Acres - 100.8 CFS flows onto street systems into the South greenbelt system - 50-foot right of way
Steep to moderate slopes Southerly and Southwesterly.

a. Some evidence of outcropping in the Easterly portion; light to moderate tree cover. Proposed street systems and drainage improvements, as shown

b. One (1) well-defined drainage channel flows Southerly into the greenbelt. This channel should be designated a drainage easement. No improvements recommended

BASIN I - 51.5 Acres - 92.8 CFS flows onto street systems and into a drainage channel and the South greenbelt system.

a. This basin is mountainous and mainly of steep slopes draining Northerly and Northwesterly. The area is wooded; outcropping is predominant, particularly in the higher areas.

Street systems and drainage improvements shown in lower region.

b. One (1) drainage channel flows Northerly into the South Greenbelt. This channel should be designated a drainage easement and retained in its natural state

BASIN J - 90.6 Acres - 153.0 CFS flows onto street systems and flows into Dublin Lane or directly into an existing drainage culvert at the Westerly boundary; thence Into Monument Creek. That flow to Dublin Lane is removed at the Westerly boundary into a ditch along the railroad right of way and then into the above mentioned culvert.

9.
VII. (Continued)

BASIN J (Continued)

a. This basin slopes to the North and Northwest and is moderately steep and wooded. Minimum outcropping is in evidence.

b. Some drainage channels will be in evidence as the area is developed, as shown

BASIN K - 41.6 Acres - 78.7 CFS at Southwesterly boundary. This surface run-off is contained in both street systems and drainage channels, as shown.

a. This basin slopes to the West, moderate to steep slopes with only the Easterly portion containing any tree cover.

b. Street systems and drainage improvements are indicated

No specific design of drainage structures are included in this study. The requirements of size and configuration will be determined when specific areas are developed and submitted as detailed and final drainage reports for that area.

The Greenbelt channels in certain locations will require velocity control structures as subdivisions are developed. Actual location of these structures should be determined at that time.
### SECTION VIII-CALCULATIONS

#### Part I

<table>
<thead>
<tr>
<th>BASIN</th>
<th>AREA ACRES</th>
<th>Sq.Mi.</th>
<th>L(ft.)</th>
<th>H(ft.)</th>
<th>Tc(Hrs.)</th>
<th>Tp(Hrs.)</th>
<th>Q(In.)</th>
<th>Qp(CFS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>557.85</td>
<td>0.87</td>
<td>9700</td>
<td>320</td>
<td>0.50</td>
<td>0.800</td>
<td>1.00</td>
<td>496.0</td>
</tr>
<tr>
<td>B</td>
<td>100.0</td>
<td>0.156</td>
<td>2500</td>
<td>120</td>
<td>0.16</td>
<td>0.596</td>
<td>1.00</td>
<td>126.7</td>
</tr>
<tr>
<td>C</td>
<td>76.0</td>
<td>0.119</td>
<td>2200</td>
<td>100</td>
<td>0.15</td>
<td>0.590</td>
<td>1.00</td>
<td>97.6</td>
</tr>
<tr>
<td>D</td>
<td>228.0</td>
<td>0.36</td>
<td>4500</td>
<td>120</td>
<td>0.32</td>
<td>0.692</td>
<td>1.4</td>
<td>352.5</td>
</tr>
<tr>
<td>E</td>
<td>25.4</td>
<td>0.40</td>
<td>1600</td>
<td>180</td>
<td>0.085</td>
<td>0.551</td>
<td>1.4</td>
<td>49.1</td>
</tr>
<tr>
<td>F</td>
<td>24.0</td>
<td>0.038</td>
<td>1400</td>
<td>240</td>
<td>0.065</td>
<td>0.539</td>
<td>1.4</td>
<td>47.8</td>
</tr>
<tr>
<td>G</td>
<td>82.4</td>
<td>0.129</td>
<td>2000</td>
<td>260</td>
<td>0.090</td>
<td>0.554</td>
<td>1.4</td>
<td>157.8</td>
</tr>
<tr>
<td>H</td>
<td>52.7</td>
<td>0.082</td>
<td>1500</td>
<td>140</td>
<td>0.085</td>
<td>0.551</td>
<td>1.4</td>
<td>100.8</td>
</tr>
<tr>
<td>I</td>
<td>51.5</td>
<td>0.080</td>
<td>2500</td>
<td>160</td>
<td>0.140</td>
<td>0.586</td>
<td>1.4</td>
<td>92.8</td>
</tr>
<tr>
<td>J</td>
<td>30.6</td>
<td>0.14</td>
<td>3200</td>
<td>140</td>
<td>0.20</td>
<td>0.620</td>
<td>1.4</td>
<td>153.0</td>
</tr>
<tr>
<td>K</td>
<td>41.6</td>
<td>0.065</td>
<td>1600</td>
<td>120</td>
<td>0.10</td>
<td>0.560</td>
<td>1.4</td>
<td>78.7</td>
</tr>
</tbody>
</table>

**Design:** 2 inches - 1 hour - 50 year frequency

\[
484 \text{ Aq} \quad Tp = \frac{D - 1.0\text{ hour}}{2} + 0.6 Tc
\]

- **Aq** = Area in square miles.
- **Q** = Direct runoff in inches.
- **D** = Excess period of rainfall period in time.
- **Tp** = Time in hours from start of rise to peak rate.
- **Tc** = Time of concentration, from most distant point to point of interest.

**Hydraulic Design**

- Manning = 1.486
- \( n \) = 0.015 for concrete pipes
- \( n \) = 0.020 for unlined channels.

11.
<table>
<thead>
<tr>
<th>LINE</th>
<th>BASE Qp</th>
<th>BASE Tp</th>
<th>DITCH L(feet)</th>
<th>SS</th>
<th>Time(hrs)</th>
<th>POINT Tp(hrs)</th>
<th>Qp</th>
<th>EITCH Cap(CFS)</th>
<th>R.O.W. CHANNEL W.(ft)</th>
<th>Vel TIPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A to 1</td>
<td>496</td>
<td>0.722</td>
<td>6450</td>
<td>2.4</td>
<td>0.078</td>
<td>0.800</td>
<td>496</td>
<td>990</td>
<td>35</td>
<td>23</td>
</tr>
<tr>
<td>1 to 2</td>
<td>496</td>
<td>0.80</td>
<td>2200</td>
<td>1.8</td>
<td>0.055</td>
<td>0.86</td>
<td>622.7</td>
<td>650</td>
<td>35-40</td>
<td>11</td>
</tr>
<tr>
<td>2 to Cottonwood Creek</td>
<td>622.7</td>
<td>0.86</td>
<td>300</td>
<td>2.9</td>
<td>0.006</td>
<td>0.866</td>
<td>650.0</td>
<td>820</td>
<td>40</td>
<td>13.8</td>
</tr>
<tr>
<td>3 to 4</td>
<td>97.6</td>
<td>0.590</td>
<td>4400</td>
<td>3.2</td>
<td>0.085</td>
<td>0.675</td>
<td>450.1</td>
<td>880</td>
<td>35-40</td>
<td>14.5</td>
</tr>
<tr>
<td>4 to 5</td>
<td>450.1</td>
<td>0.675</td>
<td>1400</td>
<td>5.0</td>
<td>0.020</td>
<td>0.695</td>
<td>598.9</td>
<td>1070</td>
<td>45</td>
<td>18.0</td>
</tr>
<tr>
<td>5 to 6</td>
<td>598.9</td>
<td>0.695</td>
<td>2000</td>
<td>3.5</td>
<td>0.036</td>
<td>0.731</td>
<td>804.0</td>
<td>890</td>
<td>50</td>
<td>15.0</td>
</tr>
<tr>
<td>6 to Monument Creek</td>
<td>976.0</td>
<td>0.731</td>
<td>----</td>
<td>---</td>
<td>---</td>
<td>----</td>
<td>976.0</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>7 to 8</td>
<td>60.0</td>
<td>0.620</td>
<td>700</td>
<td>1.0</td>
<td>0.062</td>
<td>0.682</td>
<td>65.0</td>
<td>200</td>
<td>--</td>
<td>10.4</td>
</tr>
<tr>
<td>Portion J to 8</td>
<td>----</td>
<td>----</td>
<td>(3200</td>
<td>4.4</td>
<td>0.250(tc)</td>
<td>0.620</td>
<td>93.0</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>8 to Monument Creek</td>
<td>158.0</td>
<td>------</td>
<td>----</td>
<td>---</td>
<td>---</td>
<td>----</td>
<td>158.0</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
### SECTION IX

ESTIMATE OF COST
(Costs in Place)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>UNIT COST</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Greenbelt Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>North Greenbelt construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shaping &amp; slope treatment</td>
<td>8800</td>
<td>LF</td>
<td>$ 9.00</td>
<td>$ 79,200.00</td>
</tr>
<tr>
<td></td>
<td>2. Piping R.C.P.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) 36-Inch</td>
<td>1350</td>
<td>LF</td>
<td>$17.00</td>
<td>$22,950.00</td>
</tr>
<tr>
<td></td>
<td>(b) 42-Inch</td>
<td>350</td>
<td>LF</td>
<td>$20.00</td>
<td>7,000.00</td>
</tr>
<tr>
<td></td>
<td>(c) 48-Inch</td>
<td>50</td>
<td>LF</td>
<td>$25.00</td>
<td>1,250.00</td>
</tr>
<tr>
<td></td>
<td>(d) 54-Inch</td>
<td>200</td>
<td>LF</td>
<td>$28.00</td>
<td>5,600.00</td>
</tr>
<tr>
<td></td>
<td>(e) 60-Inch</td>
<td>150</td>
<td>LF</td>
<td>$33.00</td>
<td>4,950.00</td>
</tr>
<tr>
<td></td>
<td>(f) 66-Inch</td>
<td>100</td>
<td>LF</td>
<td>$35.00</td>
<td>3,500.00</td>
</tr>
<tr>
<td></td>
<td>3. Drainage Outlets</td>
<td>5</td>
<td>LS</td>
<td>$-----</td>
<td>$5,000.00</td>
</tr>
<tr>
<td></td>
<td>at stream crossing and streets, as shown.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Concrete wingwalls and aprons</td>
<td>9</td>
<td>Ea</td>
<td>$4,000.00</td>
<td>$36,000.00</td>
</tr>
<tr>
<td></td>
<td>construction at stream</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Velocity control structures</td>
<td>7</td>
<td>Ea</td>
<td>$1,000.00</td>
<td>$7,000.00</td>
</tr>
<tr>
<td></td>
<td>6. Ditch construction</td>
<td>300</td>
<td>LF</td>
<td>$ 8.00</td>
<td>$2,400.00</td>
</tr>
</tbody>
</table>

13.
## SECTION IX (Continued)  
### ESTIMATE OF COST

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>UNIT COST</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Greenbelt Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>South Greenbelt construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Shaping &amp; slope treatment</td>
<td>7200</td>
<td>LF</td>
<td>$4.00</td>
<td>$28,800.00</td>
</tr>
<tr>
<td></td>
<td>2. Piping R.C.P.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) 30-Inch</td>
<td>50</td>
<td>LF</td>
<td>$10.00</td>
<td>$500.00</td>
</tr>
<tr>
<td></td>
<td>(b) 36-Inch</td>
<td>300</td>
<td>LF</td>
<td>$17.00</td>
<td>$5,100.00</td>
</tr>
<tr>
<td></td>
<td>(c) 42-Inch</td>
<td>350</td>
<td>LF</td>
<td>$20.00</td>
<td>$7,000.00</td>
</tr>
<tr>
<td></td>
<td>(d) 54-Inch</td>
<td>50</td>
<td>LF</td>
<td>$28.00</td>
<td>$1,400.00</td>
</tr>
<tr>
<td></td>
<td>(e) 66-Inch</td>
<td>50</td>
<td>LF</td>
<td>$35.00</td>
<td>$1,750.00</td>
</tr>
<tr>
<td></td>
<td>(f) 72-Inch</td>
<td>50</td>
<td>LF</td>
<td>$40.00</td>
<td>$2,000.00</td>
</tr>
<tr>
<td></td>
<td>(g) 90-Inch</td>
<td>50</td>
<td>LF</td>
<td>$55.00</td>
<td>$2,750.00</td>
</tr>
<tr>
<td></td>
<td>3. Drainage outlets at stream crossing and streets, as shown</td>
<td>19</td>
<td>Ea</td>
<td>$1,000.00</td>
<td>$19,000.00</td>
</tr>
<tr>
<td></td>
<td>4. Concrete wingwall and aprons construction at stream</td>
<td>17</td>
<td>Ea</td>
<td>$4,000.00</td>
<td>$68,000.00</td>
</tr>
<tr>
<td></td>
<td>5. Velocity control structures</td>
<td>7</td>
<td>Ea</td>
<td>$1,000.00</td>
<td>$7,000.00</td>
</tr>
<tr>
<td></td>
<td>6. Ditch construction</td>
<td>4500</td>
<td>LF</td>
<td>$8.00</td>
<td>$36,000.00</td>
</tr>
</tbody>
</table>

**TOTAL ESTIMATED CONSTRUCTION COST (In place)** $354,150.00

1331 Acres = $266.00 per acre
For use as Street Divider

Variable

Right of Way

For use as Street Divider or
High Capacity Ditch

"16' Roadway for
Maintenance"

Variable

Right of Way

For use as Park Strip, Playground
Strip, or Low Capacity Residential
Ditch

"16' roadway for
maintenance"
POINT II
Tp = 0.86
Qp = 623

Unit Hydrograph
POINT III

Tp = 0.68
Qp = 450

Unit Hydrograph
POINT IV

Tp = 0.73
Qp = 804

Unit Hydrograph