

## DRAINAGE COMPLIANCE LETTER

To: Town of Parker

From: Dan Skeehan, P.E.  
Kimley-Horn and Associates, Inc

Date: April 26, 2021

Subject: **Parker and Pine Everbrook Academy - Drainage Compliance Letter  
Lot 6, Parker and Pine Filing 1**

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Kimley-Horn and Associates, Inc. (Kimley-Horn) is submitting this Drainage Compliance Letter for the above referenced project as required by the Town of Parker for Construction Development approval.

The purpose of this letter is to demonstrate that the proposed improvements for this project will not negatively impact the existing drainage conditions for the site and will conform to all previously approved drainage reports below:

- “Parker and Pine Filing No. 1 - Final Drainage Report Amendment” prepared by Kimley-Horn and Associates, Inc. Dated April 2021 (the “Existing Report Amendment”)
- “Parker and Pine Filing No. 1 - Final Drainage Report” prepared by Kimley-Horn and Associates, Inc. Dated April 2020 (the “Existing Report”)
- “Parker Auto Plaza Final Drainage Report” prepared by Kiowa Engineering Corporation dated July 12, 2004 (the “Master Report”)

## PROJECT DESCRIPTION

The proposed Everbrook Academy development on Lot 6, Parker and Pine Filing 1 (the “Site”) is located at the southeast corner of Twenty Mile Road and Pine Lane in the Town of Parker, Colorado (“the Town”). The project is the second phase in a multi-phase mixed used development. As part of phase 1, the overall developer graded the site, installed private drives and utility mains across the site, and made improvements to the existing shared detention pond. The Everbrook Academy project consists of a vacant 1.38 acres parcel and the development includes site grading, utility service installation, new building construction, parking and sidewalk improvements, and landscaping. The site is bordered to the north by Pine Lane, to the east by undeveloped lots and a private drive, to the south by undeveloped lots and a private drive, and to the west by Twenty Mile Road.

## EXISTING DRAINAGE INFORMATION

Per the “Parker and Pine Filing No. 1 - Final Drainage Report,” Lot 6 contains 1 onsite drainage basin with the following characteristics:

**Table 1**

| Drainage Basin | Area (AC) | Imperviousness |
|----------------|-----------|----------------|
| SB 1.1         | 1.43      | 85%            |

The existing drainage report and existing drainage report amendment can be found in **Appendix D and E**. The master drainage report can be found in **Appendix F**.

## **COMPLIANCE WITH COLORADO DISCHARGE PERMIT SYSTEM GENERAL PERMIT COR080000**

The Town of Parker has coverage under the Colorado Discharge Permit System General Permit COR080000 Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4s). This permit states that applicable developments must implement control measures to meet the effluent requirements of the permit.

*“Applicable development sites” are those that result in land disturbance of greater than or equal to one acre, including sites less than one acre that are part of a larger common plan of development or sale, unless excluded below. Applicable development sites include all new development and redevelopment sites for which permanent water quality control measures were required in accordance with an MS4 permit. “New Development” means land disturbing activities; structural development, including construction or installation of a building or structure, creation of impervious surfaces; and land subdivision for a site that does not meet the definition of redevelopment.*

This project meets the requirements of an applicable development site.

*The control measure for applicable development sites shall meet one of the following base design standards listed below:*

*(A) WQCV Standard: The control measure(s) is designed to provide treatment and/or infiltration of the WQCV and:*

*1) 100% of the applicable development site is captured, except the permittee may exclude up to 20 percent, not to exceed 1 acre, of the applicable development site area when the permittee has determined that it is not practicable to capture runoff from portions of the site that will not drain towards control measures. In addition, the permittee must also determine that the implementation of a separate control measure for that portion of the site is not practicable (e.g., driveway access that drains directly to street).*

*2) Evaluation of the minimum drain time shall be based on the pollutant removal mechanism and functionality of the control measure implemented. Consideration of drain time shall include maintaining vegetation necessary for operation of the control measure (e.g., wetland vegetation).*

*(B) Pollutant Removal Standard: The control measure(s) is designed to treat at a minimum the 80th percentile storm event. The control measure(s) shall be designed to treat stormwater runoff in a manner expected to reduce the event mean concentration of total suspended solids (TSS) to a median value of 30 mg/L or less.*

*1) 100% of the applicable development site is captured, except the permittee may exclude up to 20 percent not to exceed 1 acre of the applicable development site area when the permittee has determined that it is not practicable to capture runoff from portions of the site that will not drain towards control measures. In addition, the permittee must also determine that the implementation of a separate control measure for that portion of the site is not practicable (e.g., driveway access that drains directly to street).*

*(C) Runoff Reduction Standard: The control measure(s) is designed to infiltrate into the ground where site geology permits, evaporate, or evapotranspire a quantity of water equal to 60% of what the calculated WQCV would be if all impervious area for the applicable development site discharged without infiltration. This base design standard can be met through practices such as green infrastructure. “Green infrastructure” generally refers to control measures that use vegetation, soils, and natural processes or mimic natural processes to manage stormwater. Green infrastructure can be used in place of or in addition to low impact development principles.*

The development will meet the WQCV Standard listed above through the existing detention and water quality pond. The total on-site area (Lots 6) is 1.38 acres; approximately 0.25 acres of the site is infeasible to be collected due to Site topographic constraints. The total area not collected or treated for water quality is 0.23 acres, which equates to 16.7% of the Site.

## **PROPOSED DRAINAGE INFORMATION**

Drainage patterns proposed in the Existing Report are generally maintained for this project. Proposed storm sewer infrastructure includes area inlets, curb inlets, and storm sewer pipe that ultimately tie into the existing storm drain infrastructure on site. Stormwater will then follow the system proposed in the existing drainage report to the existing detention and water quality pond in the southwest corner of the site.

The Site has been divided into 6 sub drainage basins. Runoff from the sub drainage basins are proposed to be routed through the development via storm sewer and ultimately discharge into the system proposed in the existing drainage report to the existing detention and water quality pond in the southwest corner of the site. The proposed drainage basin locations and layout of the storm sewer is shown on the Proposed Drainage Map included in **Appendix A** of this Report. Calculations are included in **Appendix B** of this Report.

### **Sub-Basin 05**

Sub-Basin 05 is approximately 0.28 acres and will consist of landscaping and sidewalk paving. Sub-Basin 05 has been calculated to be 59% impervious at its ultimate build out condition. The resulting runoff coefficients for this basin are 0.56 and 0.78 for the 5-year and 100-year storm, respectively. The tributary area from 05 shall be conveyed via an area inlet and proposed storm pipe to the existing onsite Storm Sewer system.

### **Sub-Basin 10**

Sub-Basin 10 is approximately 0.33 acres and will consist of roof area. Sub-Basin 10 has been calculated to be 90% impervious at its ultimate build out condition. The resulting runoff coefficients for this basin are 0.83 and 0.91 for the 5-year and 100-year storm, respectively. The tributary area from 10 shall be conveyed via roof drains and proposed storm pipe to the existing onsite Storm Sewer system.

### **Sub-Basin 15**

Sub-Basin 15 is approximately 0.52 acres and will consist of landscaping, sidewalk, and asphalt paving. Sub-Basin 15 has been calculated to be 84% impervious at its ultimate build out condition. The resulting runoff coefficients for this basin are 0.78 and 0.89 for the 5-year and 100-year storm, respectively. The tributary area from 15 shall be conveyed via an curb inlet and proposed storm pipe to the existing onsite Storm Sewer system.

### **Sub-Basin OS-1**

Sub-Basin OS-1 is approximately 0.02 acres and consists of landscaping and a small amount of sidewalk paving. It has been calculated to be 15% impervious at its ultimate build out condition. The resulting runoff coefficients for this basin are 0.18 and 0.58 for the 5-year and 100-year storm, respectively. The tributary area from OS-1 shall sheetflow onto the adjacent development and then conveyed via area inlets to existing Storm Sewer infrastructure.

### **Sub-Basin OS-2**

Sub-Basin OS-2 is approximately 0.12 acres and consists of landscaping and sidewalk paving. It has been calculated to be 18% impervious at its ultimate build out condition. The resulting runoff coefficients for this basin

are 0.21 and 0.59 for the 5-year and 100-year storm, respectively. The tributary area from OS-2 shall sheetflow into public roadways and then conveyed via curb inlets to existing Town Storm Sewer infrastructure.

### Sub-Basin OS-3

Sub-Basin OS-3 is approximately 0.11 acres and consists of landscaping and sidewalk paving. It has been calculated to be 51% impervious at its ultimate build out condition. The resulting runoff coefficients for this basin are 0.50 and 0.74 for the 5-year and 100-year storm, respectively. The tributary area from OS-3 shall sheetflow into public roadways and then conveyed via curb inlets to existing Town Storm Sewer infrastructure.

## DETENTION COMPLIANCE

Detention compliance is based on the Existing Report Amendment. The Master Report had a regional pond peak discharge rate of 13.1 CFS in the 100-year storm event. The Existing Report modified the regional pond design to account for Town standards on water quality treatment. Pond discharge calculations were included in the Existing Report to demonstrate the 100-year storm event peak discharge rate did not exceed the Master Report peak discharge rate. The 100-year peak discharge rate from the Existing Report is 10.70 CFS due to the previously approved un-detained flows from sub-basins 19.0 and 20.0. Per discussions with Town Staff, it was determined that the Existing Report peak discharge is the governing historic peak discharge rate for the development. Therefore, the Existing Report required an amendment to account for the un-detained flows for the all lots in the overall development. The maximum proposed 100-year design discharge rate for the overall development (90% of the historical peak discharge rate of 10.70 CFS) is therefore 9.63 CFS. With the Existing Report Amendment 100-year design peak discharge rate calculated as 5.50 CFS, this results in a net flow of 4.13 CFS that can be utilized for the un-detained flows from the lots in the overall development. Proposed un-detained flows for this drainage compliance letter are 1.37 CFS, and we understand that un-detaining flows for the proposed multi-family drainage compliance letter are 0.76 CFS, resulting in 2.00 CFS available for the remaining lots in the development. Pond discharge calculations from the Existing Report and the Existing Report Amendment can be found in **Appendix D and E**. The Master Report pond discharge calculations can be found in **Appendix F**. This drainage compliance letter proposes no improvements to the regional pond as the compensatory storage required for the site is accounted for in the pond discharge calculations from the Existing Report Amendment. However, proposed modifications to the regional pond outlet structure from the Existing Report Amendment will be completed as part of the Multi-Family development construction. **Table 2** below demonstrates that the compensatory storage requirements are being met for the Site.

**Table 2: Peak Discharge Rate Comparison**

|                                                                             | Master Report | Existing Report | Existing Report Amendment | Proposed Drainage Letter |
|-----------------------------------------------------------------------------|---------------|-----------------|---------------------------|--------------------------|
| Regional Pond Peak Discharge Rate                                           | 13.1 CFS      | 9.70 CFS        | 4.50 CFS                  | 5.50 CFS *               |
| Un-detained Flows for 100-Year Storm Event (Multi-Family – Separate Permit) | N/A           | 1.00 CFS        | 1.00 CFS                  | 0.76 CFS                 |
| Un-detained Flows for 100-Year Storm Event (Lot 6)                          | N/A           | N/A             | N/A                       | 1.37 CFS                 |
| Total Design Peak Discharge Rate                                            | 13.1 CFS      | 10.70 CFS       | 5.50 CFS                  | 6.26 CFS                 |
| Net Compensatory Storage**                                                  | N/A           | N/A             | 4.13 CFS                  | 3.37 CFS                 |



\*Regional pond peak discharge rate for the Proposed Drainage Compliance Letter incorporates the compensatory storage off-site flows from the Existing Report Amendment.

\*\*Net compensatory storage is calculated by subtracting the 90% historical peak discharge rate (9.63 CFS) by the total design peak discharge rate

## CONCLUSION

The project proposes to reduce the impervious surface ratio for the Site anticipated in the Existing Report. Table 2 below compares the Existing Overall Development design parameters to our Proposed design. Our design conforms to the Existing Report and generally maintains the proposed drainage patterns therein.

**Table 2: Design Comparison**

|                        | Area | Imperviousness | Runoff Coefficient |          | Runoff (CFS) |          |
|------------------------|------|----------------|--------------------|----------|--------------|----------|
|                        |      |                | 5 Year             | 100 Year | 5 Year       | 100 Year |
| Existing Report Design | 1.43 | 85%            | 0.73               | 0.82     | 4.93         | 10.37    |
| Proposed Design        | 1.38 | 71%            | 0.67               | 0.83     | 4.88         | 10.30    |

## APPENDICES:

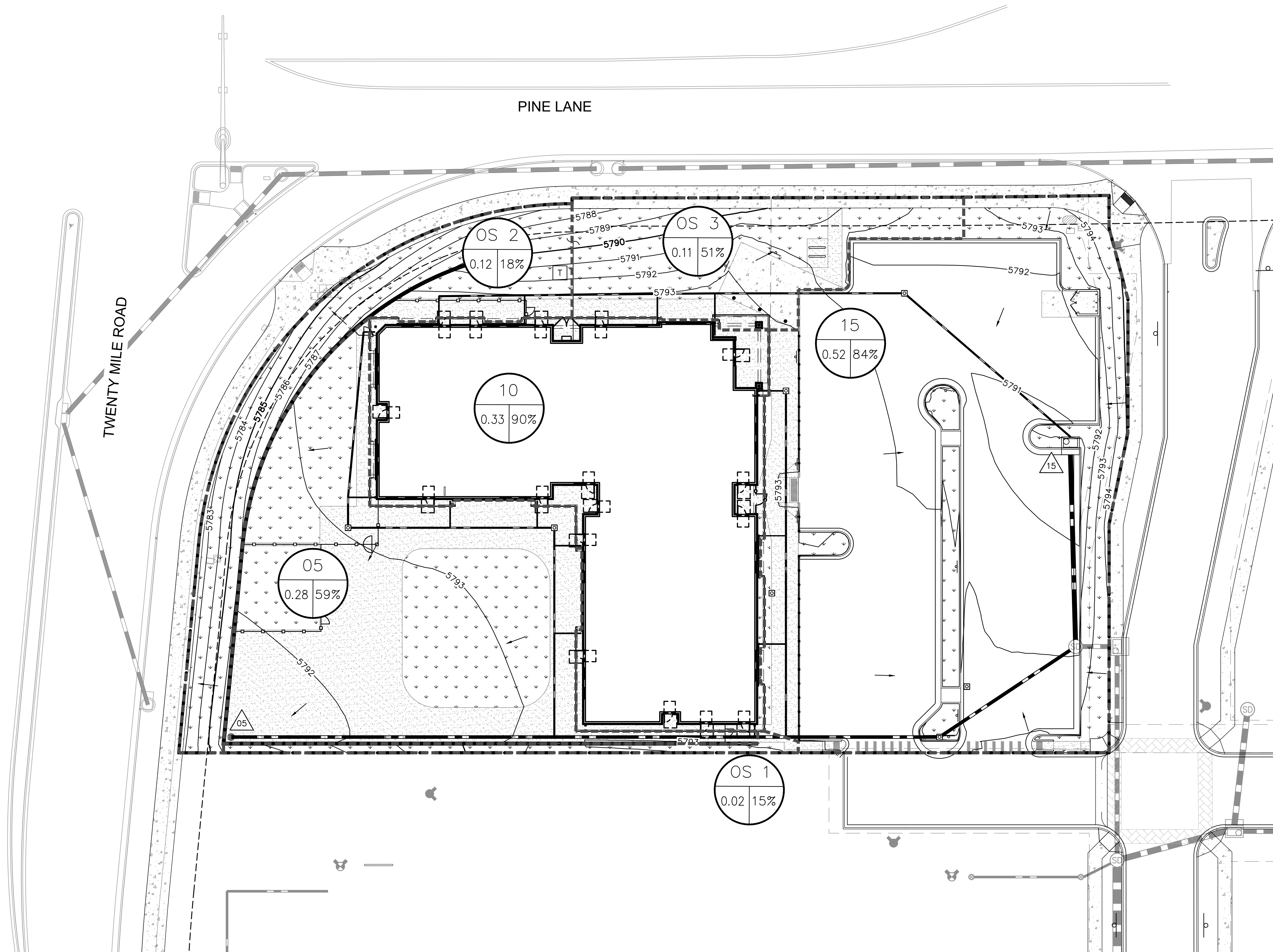
- Appendix A: Drainage Map
- Appendix B: Runoff Calculations
- Appendix C: Soil Information and FEMA Flood Plain Map
- Appendix D: Parker and Pine Filing No. 1 – Final Drainage Report Amendment
- Appendix E: Parker and Pine Filing No. 1 – Final Drainage Report
- Appendix F: Parker Auto Plaza Final Drainage Report



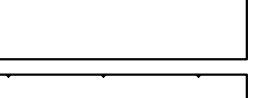
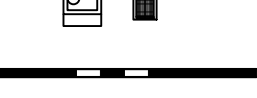
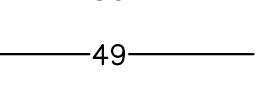
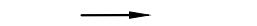
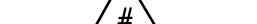
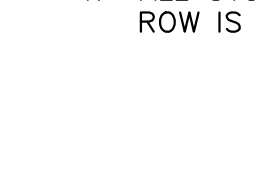
By: Daniel L. Skeehan, P.E.  
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## APPENDIX A

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LEGEND

- |                                                                                       |                                                                                    |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|    | PROPERTY LINE                                                                      |
|    | DRAINAGE EASEMENT LINE                                                             |
|    | PROPOSED ASPHALT PAVEMENT                                                          |
|    | PROPOSED LANDSCAPE AREA                                                            |
|    | CONCRETE SIDEWALK                                                                  |
|    | PROPOSED STORM INLET                                                               |
|    | PROPOSED STORM PIPE                                                                |
|    | PROPOSED MAJOR CONTOUR                                                             |
|    | PROPOSED MINOR CONTOUR                                                             |
|  | EXISTING MAJOR CONTOUR                                                             |
|  | EXISTING MINOR CONTOUR                                                             |
|  | DRAINAGE BASIN BOUNDARY                                                            |
|  | PROPOSED FLOW ARROW                                                                |
|  | <p>A = BASIN ID</p> <p>B = BASIN AREA (AC)</p> <p>C = BASIN IMPERVIOUSNESS (%)</p> |
|  | DESIGN POINT                                                                       |

NOTES

1. ALL STORM INFRASTRUCTURE NOT WITHIN ROW IS PRIVATELY OWNED AND MAINTAINED.

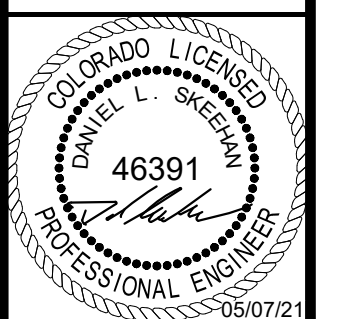


**Kimley»»Horn**  
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DESIGNED BY: MCN  
DRAWN BY: NMH  
CHECKED BY: DLS  
DATE: 05/07/2021

LOT 6 PARKER AND PINE FILING 1  
PARKER, CO  
EVERBROOK ACADEMY CONSTRUCTION DOCUMENTS  
DRAINAGE MAP



PROJECT NO.  
096895001

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## APPENDIX B



## 5. HYDROLOGIC CRITERIA

### 5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general, hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions is required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (UDFCD) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this manual.

### 5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation—Frequency Atlas of the Western United States, Volume III—Colorado. The design storm events developed and utilized are the same as those used by UDFCD.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where,  $I$  = rainfall intensity (in/hr)  
 $P_1$  = one-hour point rainfall depth (in)  
 $t_c$  = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1 herein. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

**TABLE 5.1**  
**ONE-HOUR POINT RAINFALL**

| <b>Frequency of Design<br/>Event<br/>(yr)</b> | <b>One-hour Point<br/>Rainfall, <math>P_1</math><br/>(in)</b> |
|-----------------------------------------------|---------------------------------------------------------------|
| 2                                             | 0.99                                                          |
| 5                                             | 1.39                                                          |
| 10                                            | 1.64                                                          |
| 25                                            | 1.98                                                          |
| 50                                            | 2.31                                                          |
| 100                                           | 2.60                                                          |

## 5.3 FLOOD HYDROLOGY OVERVIEW

Various methods exist to determine appropriate flood peaks or hydrographs for storm drainage planning and design. Methods for determining flood peaks or hydrographs are the Rational Method, the Colorado Urban Hydrograph Procedure (CUHP), and Urban Drainage Stormwater Management (UDSWM) model. The Town of Parker discourages the use of computer models other than CUHP and UDSWM since these programs are preferred, if not required, by UDFCD for studies involving major drainageways where UDFCD approval is sought or where maintenance eligibility is requested.

The three methods are briefly described in this section, and a discussion of their applicability to the Town of Parker is discussed. UDSWM is mostly used to combine and route the hydrographs generated using CUHP.

In general, the Rational Method is the most widely used and accepted technique for determining peak flows in urban areas for small basins. Within the constraints outlined in the MANUAL, use of the Rational Method provides a relatively simple but effective way to analyze storm runoff.

CUHP is somewhat more complicated than the Rational Method. It allows a manual computation of a runoff hydrograph which may be used for further hydraulic routing through channels and/or detention ponds. Historically, CUHP is best used in urban areas for which runoff coefficients have been derived. However, recent improvements by UDFCD include consideration for different soil types, thus CUHP is now more applicable to rural areas. The reader is referred to UDFCD for the latest version of CUHP.

UDSWM is a computer model that generates runoff hydrographs and routes and combines these hydrographs. UDSWM is a modified version of the Runoff Block of the Environmental Protection Agency's Storm Water Management Model (SWMM). It has been modified to be used in conjunction with CUHP. Table 5.2 herein provides guidance on selecting the appropriate method for a given project.



Table 6-5. Runoff coefficients, *c*

| Total or Effective<br>% Impervious | NRCS Hydrologic Soil Group A |        |         |         |         |          |          |
|------------------------------------|------------------------------|--------|---------|---------|---------|----------|----------|
|                                    | 2-Year                       | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year | 500-Year |
| 2%                                 | 0.01                         | 0.01   | 0.01    | 0.01    | 0.04    | 0.13     | 0.27     |
| 5%                                 | 0.02                         | 0.02   | 0.02    | 0.03    | 0.07    | 0.15     | 0.29     |
| 10%                                | 0.04                         | 0.05   | 0.05    | 0.07    | 0.11    | 0.19     | 0.32     |
| 15%                                | 0.07                         | 0.08   | 0.08    | 0.1     | 0.15    | 0.23     | 0.35     |
| 20%                                | 0.1                          | 0.11   | 0.12    | 0.14    | 0.2     | 0.27     | 0.38     |
| 25%                                | 0.14                         | 0.15   | 0.16    | 0.19    | 0.24    | 0.3      | 0.42     |
| 30%                                | 0.18                         | 0.19   | 0.2     | 0.23    | 0.28    | 0.34     | 0.45     |
| 35%                                | 0.21                         | 0.23   | 0.24    | 0.27    | 0.32    | 0.38     | 0.48     |
| 40%                                | 0.25                         | 0.27   | 0.28    | 0.32    | 0.37    | 0.42     | 0.51     |
| 45%                                | 0.3                          | 0.31   | 0.33    | 0.36    | 0.41    | 0.46     | 0.54     |
| 50%                                | 0.34                         | 0.36   | 0.37    | 0.41    | 0.45    | 0.5      | 0.58     |
| 55%                                | 0.39                         | 0.4    | 0.42    | 0.45    | 0.49    | 0.54     | 0.61     |
| 60%                                | 0.43                         | 0.45   | 0.47    | 0.5     | 0.54    | 0.58     | 0.64     |
| 65%                                | 0.48                         | 0.5    | 0.51    | 0.54    | 0.58    | 0.62     | 0.67     |
| 70%                                | 0.53                         | 0.55   | 0.56    | 0.59    | 0.62    | 0.65     | 0.71     |
| 75%                                | 0.58                         | 0.6    | 0.61    | 0.64    | 0.66    | 0.69     | 0.74     |
| 80%                                | 0.63                         | 0.65   | 0.66    | 0.69    | 0.71    | 0.73     | 0.77     |
| 85%                                | 0.68                         | 0.7    | 0.71    | 0.74    | 0.75    | 0.77     | 0.8      |
| 90%                                | 0.73                         | 0.75   | 0.77    | 0.79    | 0.79    | 0.81     | 0.84     |
| 95%                                | 0.79                         | 0.81   | 0.82    | 0.83    | 0.84    | 0.85     | 0.87     |
| 100%                               | 0.84                         | 0.86   | 0.87    | 0.88    | 0.88    | 0.89     | 0.9      |
| Total or Effective<br>% Impervious | NRCS Hydrologic Soil Group B |        |         |         |         |          |          |
|                                    | 2-Year                       | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year | 500-Year |
| 2%                                 | 0.01                         | 0.01   | 0.07    | 0.26    | 0.34    | 0.44     | 0.54     |
| 5%                                 | 0.03                         | 0.03   | 0.1     | 0.28    | 0.36    | 0.45     | 0.55     |
| 10%                                | 0.06                         | 0.07   | 0.14    | 0.31    | 0.38    | 0.47     | 0.57     |
| 15%                                | 0.09                         | 0.11   | 0.18    | 0.34    | 0.41    | 0.5      | 0.59     |
| 20%                                | 0.13                         | 0.15   | 0.22    | 0.38    | 0.44    | 0.52     | 0.61     |
| 25%                                | 0.17                         | 0.19   | 0.26    | 0.41    | 0.47    | 0.54     | 0.63     |
| 30%                                | 0.2                          | 0.23   | 0.3     | 0.44    | 0.49    | 0.57     | 0.65     |
| 35%                                | 0.24                         | 0.27   | 0.34    | 0.47    | 0.52    | 0.59     | 0.66     |
| 40%                                | 0.29                         | 0.32   | 0.38    | 0.5     | 0.55    | 0.61     | 0.68     |
| 45%                                | 0.33                         | 0.36   | 0.42    | 0.53    | 0.58    | 0.64     | 0.7      |
| 50%                                | 0.37                         | 0.4    | 0.46    | 0.56    | 0.61    | 0.66     | 0.72     |
| 55%                                | 0.42                         | 0.45   | 0.5     | 0.6     | 0.63    | 0.68     | 0.74     |
| 60%                                | 0.46                         | 0.49   | 0.54    | 0.63    | 0.66    | 0.71     | 0.76     |
| 65%                                | 0.5                          | 0.54   | 0.58    | 0.66    | 0.69    | 0.73     | 0.77     |
| 70%                                | 0.55                         | 0.58   | 0.62    | 0.69    | 0.72    | 0.75     | 0.79     |
| 75%                                | 0.6                          | 0.63   | 0.66    | 0.72    | 0.75    | 0.78     | 0.81     |
| 80%                                | 0.64                         | 0.67   | 0.7     | 0.75    | 0.77    | 0.8      | 0.83     |
| 85%                                | 0.69                         | 0.72   | 0.74    | 0.78    | 0.8     | 0.82     | 0.85     |
| 90%                                | 0.74                         | 0.76   | 0.78    | 0.81    | 0.83    | 0.84     | 0.87     |
| 95%                                | 0.79                         | 0.81   | 0.82    | 0.85    | 0.86    | 0.87     | 0.88     |
| 100%                               | 0.84                         | 0.86   | 0.86    | 0.88    | 0.89    | 0.89     | 0.9      |

## Rainfall Intensity

### IDF - Intensity, Duration, Frequency Data

| Time Intensity Frequency Tabulation |      |      |       |        |
|-------------------------------------|------|------|-------|--------|
| TIME                                | 2 YR | 5 YR | 10 YR | 100 YR |
| 5                                   | 3.36 | 4.71 | 5.56  | 8.82   |
| 6                                   | 3.19 | 4.48 | 5.29  | 8.38   |
| 7                                   | 3.04 | 4.27 | 5.04  | 7.99   |
| 8                                   | 2.91 | 4.09 | 4.82  | 7.64   |
| 9                                   | 2.79 | 3.92 | 4.62  | 7.32   |
| 10                                  | 2.68 | 3.76 | 4.44  | 7.03   |
| 11                                  | 2.58 | 3.62 | 4.27  | 6.77   |
| 12                                  | 2.49 | 3.49 | 4.12  | 6.53   |
| 13                                  | 2.40 | 3.37 | 3.98  | 6.30   |
| 14                                  | 2.32 | 3.26 | 3.84  | 6.09   |
| 15                                  | 2.25 | 3.16 | 3.72  | 5.90   |
| 16                                  | 2.18 | 3.06 | 3.61  | 5.72   |
| 17                                  | 2.12 | 2.97 | 3.50  | 5.56   |
| 18                                  | 2.06 | 2.89 | 3.41  | 5.40   |
| 19                                  | 2.00 | 2.81 | 3.31  | 5.25   |
| 20                                  | 1.95 | 2.73 | 3.23  | 5.11   |
| 21                                  | 1.90 | 2.66 | 3.14  | 4.98   |
| 22                                  | 1.85 | 2.60 | 3.07  | 4.86   |
| 23                                  | 1.81 | 2.54 | 2.99  | 4.75   |
| 24                                  | 1.76 | 2.48 | 2.92  | 4.64   |
| 25                                  | 1.73 | 2.42 | 2.86  | 4.53   |
| 26                                  | 1.69 | 2.37 | 2.80  | 4.43   |
| 27                                  | 1.65 | 2.32 | 2.74  | 4.34   |
| 28                                  | 1.62 | 2.27 | 2.68  | 4.25   |
| 29                                  | 1.58 | 2.22 | 2.62  | 4.16   |
| 30                                  | 1.55 | 2.18 | 2.57  | 4.08   |
| 31                                  | 1.52 | 2.14 | 2.52  | 4.00   |
| 32                                  | 1.49 | 2.10 | 2.48  | 3.93   |
| 33                                  | 1.47 | 2.06 | 2.43  | 3.85   |
| 34                                  | 1.44 | 2.02 | 2.39  | 3.78   |
| 35                                  | 1.42 | 1.99 | 2.35  | 3.72   |
| 36                                  | 1.39 | 1.95 | 2.31  | 3.66   |
| 37                                  | 1.37 | 1.92 | 2.27  | 3.59   |
| 38                                  | 1.35 | 1.89 | 2.23  | 3.53   |
| 39                                  | 1.32 | 1.86 | 2.19  | 3.48   |
| 40                                  | 1.30 | 1.83 | 2.16  | 3.42   |
| 41                                  | 1.28 | 1.80 | 2.13  | 3.37   |
| 42                                  | 1.26 | 1.77 | 2.09  | 3.32   |
| 43                                  | 1.25 | 1.75 | 2.06  | 3.27   |
| 44                                  | 1.23 | 1.72 | 2.03  | 3.22   |
| 45                                  | 1.21 | 1.70 | 2.00  | 3.18   |
| 46                                  | 1.19 | 1.67 | 1.98  | 3.13   |
| 47                                  | 1.18 | 1.65 | 1.95  | 3.09   |
| 48                                  | 1.16 | 1.63 | 1.92  | 3.05   |
| 49                                  | 1.14 | 1.61 | 1.90  | 3.01   |
| 50                                  | 1.13 | 1.59 | 1.87  | 2.97   |
| 51                                  | 1.11 | 1.57 | 1.85  | 2.93   |
| 52                                  | 1.10 | 1.55 | 1.82  | 2.89   |
| 53                                  | 1.09 | 1.53 | 1.80  | 2.85   |
| 54                                  | 1.07 | 1.51 | 1.78  | 2.82   |
| 55                                  | 1.06 | 1.49 | 1.76  | 2.79   |
| 56                                  | 1.05 | 1.47 | 1.74  | 2.75   |
| 57                                  | 1.04 | 1.45 | 1.72  | 2.72   |
| 58                                  | 1.02 | 1.44 | 1.70  | 2.69   |
| 59                                  | 1.01 | 1.42 | 1.68  | 2.66   |
| 60                                  | 1.00 | 1.40 | 1.66  | 2.63   |

**Note:**

Intensity values utilized as published within the Town of Parker  
Storm Drainage Criteria Manual, Table 5.1

Time Intensity Frequency Tabulation

| TIME | 2 YR | 5 YR | 10 YR | 100 YR |
|------|------|------|-------|--------|
| 5    | 3.36 | 4.71 | 5.56  | 8.82   |
| 6    | 3.19 | 4.48 | 5.29  | 8.38   |
| 7    | 3.04 | 4.27 | 5.04  | 7.99   |
| 8    | 2.91 | 4.09 | 4.82  | 7.64   |
| 9    | 2.79 | 3.92 | 4.62  | 7.32   |
| 10   | 2.68 | 3.76 | 4.44  | 7.03   |
| 11   | 2.58 | 3.62 | 4.27  | 6.77   |
| 12   | 2.49 | 3.49 | 4.12  | 6.53   |
| 13   | 2.40 | 3.37 | 3.98  | 6.30   |
| 14   | 2.32 | 3.26 | 3.84  | 6.09   |
| 15   | 2.25 | 3.16 | 3.72  | 5.90   |
| 16   | 2.18 | 3.06 | 3.61  | 5.72   |
| 17   | 2.12 | 2.97 | 3.50  | 5.56   |
| 18   | 2.06 | 2.89 | 3.41  | 5.40   |
| 19   | 2.00 | 2.81 | 3.31  | 5.25   |
| 20   | 1.95 | 2.73 | 3.23  | 5.11   |
| 21   | 1.90 | 2.66 | 3.14  | 4.98   |
| 22   | 1.85 | 2.60 | 3.07  | 4.86   |
| 23   | 1.81 | 2.54 | 2.99  | 4.75   |
| 24   | 1.76 | 2.48 | 2.92  | 4.64   |
| 25   | 1.73 | 2.42 | 2.86  | 4.53   |
| 26   | 1.69 | 2.37 | 2.80  | 4.43   |
| 27   | 1.65 | 2.32 | 2.74  | 4.34   |
| 28   | 1.62 | 2.27 | 2.68  | 4.25   |
| 29   | 1.58 | 2.22 | 2.62  | 4.16   |
| 30   | 1.55 | 2.18 | 2.57  | 4.08   |
| 31   | 1.52 | 2.14 | 2.52  | 4.00   |
| 32   | 1.49 | 2.10 | 2.48  | 3.93   |
| 33   | 1.47 | 2.06 | 2.43  | 3.85   |
| 34   | 1.44 | 2.02 | 2.39  | 3.78   |
| 35   | 1.42 | 1.99 | 2.35  | 3.72   |
| 36   | 1.39 | 1.95 | 2.31  | 3.66   |
| 37   | 1.37 | 1.92 | 2.27  | 3.59   |
| 38   | 1.35 | 1.89 | 2.23  | 3.53   |
| 39   | 1.32 | 1.86 | 2.19  | 3.48   |
| 40   | 1.30 | 1.83 | 2.16  | 3.42   |
| 41   | 1.28 | 1.80 | 2.13  | 3.37   |
| 42   | 1.26 | 1.77 | 2.09  | 3.32   |
| 43   | 1.25 | 1.75 | 2.06  | 3.27   |
| 44   | 1.23 | 1.72 | 2.03  | 3.22   |
| 45   | 1.21 | 1.70 | 2.00  | 3.18   |
| 46   | 1.19 | 1.67 | 1.98  | 3.13   |
| 47   | 1.18 | 1.65 | 1.95  | 3.09   |
| 48   | 1.16 | 1.63 | 1.92  | 3.05   |
| 49   | 1.14 | 1.61 | 1.90  | 3.01   |
| 50   | 1.13 | 1.59 | 1.87  | 2.97   |
| 51   | 1.11 | 1.57 | 1.85  | 2.93   |
| 52   | 1.10 | 1.55 | 1.82  | 2.89   |
| 53   | 1.09 | 1.53 | 1.80  | 2.85   |
| 54   | 1.07 | 1.51 | 1.78  | 2.82   |
| 55   | 1.06 | 1.49 | 1.76  | 2.79   |
| 56   | 1.05 | 1.47 | 1.74  | 2.75   |
| 57   | 1.04 | 1.45 | 1.72  | 2.72   |
| 58   | 1.02 | 1.44 | 1.70  | 2.69   |
| 59   | 1.01 | 1.42 | 1.68  | 2.66   |
| 60   | 1.00 | 1.40 | 1.66  | 2.63   |

**Lot 6 Parker and Pine**

| Proposed Site  | Area (sf)     | Area (Ac)   | Landscape    | Roof         | Pavement     | I <sub>WEIGHTED</sub> | C <sub>5</sub> | C <sub>10</sub> | C <sub>100</sub> |
|----------------|---------------|-------------|--------------|--------------|--------------|-----------------------|----------------|-----------------|------------------|
| 5              | 12,344        | 0.28        | 5,173        | -            | 7,170.71     | 58.93%                | 0.56           | 0.64            | 0.78             |
| 10             | 14,402        | 0.33        | -            | 14,402       | -            | 90.00%                | 0.83           | 0.87            | 0.91             |
| 15             | 22,702        | 0.52        | 3,775        | -            | 18,926.53    | 83.70%                | 0.78           | 0.82            | 0.89             |
| <b>Total</b>   | <b>49,447</b> | <b>1.14</b> | <b>8948</b>  | <b>14402</b> | <b>26097</b> | <b>79.35%</b>         | <b>0.74</b>    | <b>0.79</b>     | <b>0.87</b>      |
|                |               |             |              |              |              |                       |                |                 |                  |
| Offsite Basins | Area (sf)     | Area (Ac)   | Landscape    | Roof         | Pavement     | I <sub>WEIGHTED</sub> | C <sub>5</sub> | C <sub>10</sub> | C <sub>100</sub> |
| OS 1           | 703           | 0.02        | 609          | -            | 94.39        | 15.16%                | 0.18           | 0.32            | 0.58             |
| OS 2           | 5,267         | 0.12        | 4,388        | -            | 878.78       | 18.35%                | 0.21           | 0.34            | 0.59             |
| OS 3           | 4,713         | 0.11        | 2,347        | -            | 2,366.72     | 51.21%                | 0.50           | 0.58            | 0.74             |
| <b>Total</b>   | <b>10,683</b> | <b>0.25</b> | <b>7,344</b> | <b>-</b>     | <b>3,340</b> | <b>32.64%</b>         | <b>0.34</b>    | <b>0.45</b>     | <b>0.66</b>      |

| Land Use      | I    | C <sub>5</sub> | C <sub>100</sub> |
|---------------|------|----------------|------------------|
| Lawns         | 2%   | 0.07           | 0.52             |
| Roof          | 90%  | 0.83           | 0.91             |
| Paved Streets | 100% | 0.92           | 0.96             |

\*Hydraulic Soil Group C

## Lot 6 Parker and Pine

### 2-Year Design Storm Runoff Calculations

(Rational Method Procedure)

| BASIN INFORMATION |          |              |          | DIRECT RUNOFF |         |       |
|-------------------|----------|--------------|----------|---------------|---------|-------|
| DRAIN BASIN       | AREA ac. | RUNOFF COEFF | T(c) min | C x A         | I in/hr | Q cfs |
| 5                 | 0.28     | 0.56         | 5.0      | 0.1598        | 3.50    | 0.56  |
| 10                | 0.33     | 0.83         | 5.0      | 0.2744        | 3.50    | 0.96  |
| 15                | 0.52     | 0.78         | 5.0      | 0.4058        | 3.50    | 1.42  |
|                   |          |              |          |               |         |       |
| OS 1              | 0.02     | 0.18         | 5.0      | 0.0030        | 3.50    | 0.01  |
| OS 2              | 0.12     | 0.21         | 5.0      | 0.0256        | 3.50    | 0.09  |
| OS 3              | 0.11     | 0.50         | 5.0      | 0.0538        | 3.50    | 0.19  |

### 5-Year Design Storm Runoff Calculations

(Rational Method Procedure)

| BASIN INFORMATION |          |              |          | DIRECT RUNOFF |         |       |
|-------------------|----------|--------------|----------|---------------|---------|-------|
| DRAIN BASIN       | AREA ac. | RUNOFF COEFF | T(c) min | C x A         | I in/hr | Q cfs |
| 5                 | 0.28     | 0.64         | 5.0      | 0.1809        | 4.9     | 0.88  |
| 10                | 0.33     | 0.87         | 5.0      | 0.2876        | 4.9     | 1.40  |
| 15                | 0.52     | 0.82         | 5.0      | 0.4275        | 4.9     | 2.07  |
|                   |          |              |          |               |         |       |
| OS 1              | 0.02     | 0.32         | 5.0      | 0.0051        | 4.85    | 0.02  |
| OS 2              | 0.12     | 0.34         | 5.0      | 0.0411        | 4.85    | 0.20  |
| OS 3              | 0.11     | 0.58         | 5.0      | 0.0629        | 4.85    | 0.31  |

### 100-Year Design Storm Runoff Calculations

(Rational Method Procedure)

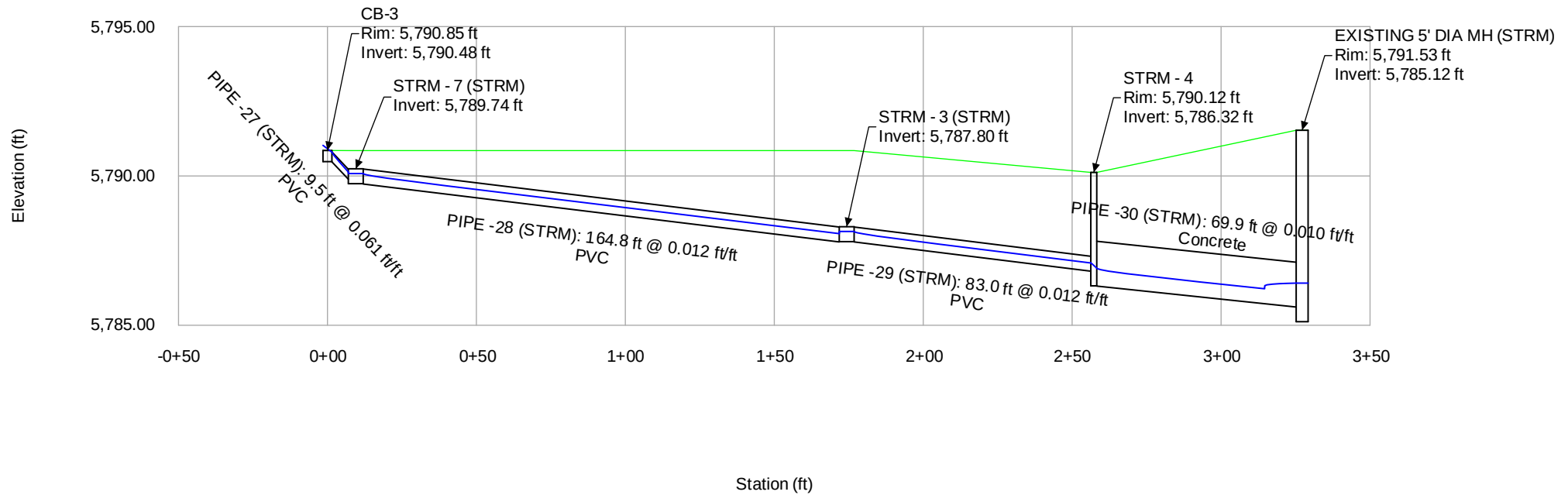
| BASIN INFORMATION |          |              |          | DIRECT RUNOFF |         |       |
|-------------------|----------|--------------|----------|---------------|---------|-------|
| DRAIN BASIN       | AREA ac. | RUNOFF COEFF | T(c) min | C x A         | I in/hr | Q cfs |
| 5                 | 0.28     | 0.78         | 5.0      | 0.2198        | 9.00    | 1.98  |
| 10                | 0.33     | 0.91         | 5.0      | 0.3009        | 9.00    | 2.71  |
| 15                | 0.52     | 0.89         | 5.0      | 0.4622        | 9.00    | 4.16  |
|                   |          |              |          |               |         |       |
| OS 1              | 0.02     | 0.58         | 5.0      | 0.0093        | 9.00    | 0.08  |
| OS 2              | 0.12     | 0.59         | 5.0      | 0.0718        | 9.00    | 0.65  |
| OS 3              | 0.11     | 0.74         | 5.0      | 0.0802        | 9.00    | 0.72  |

**Lot 6 Parker and Pine**

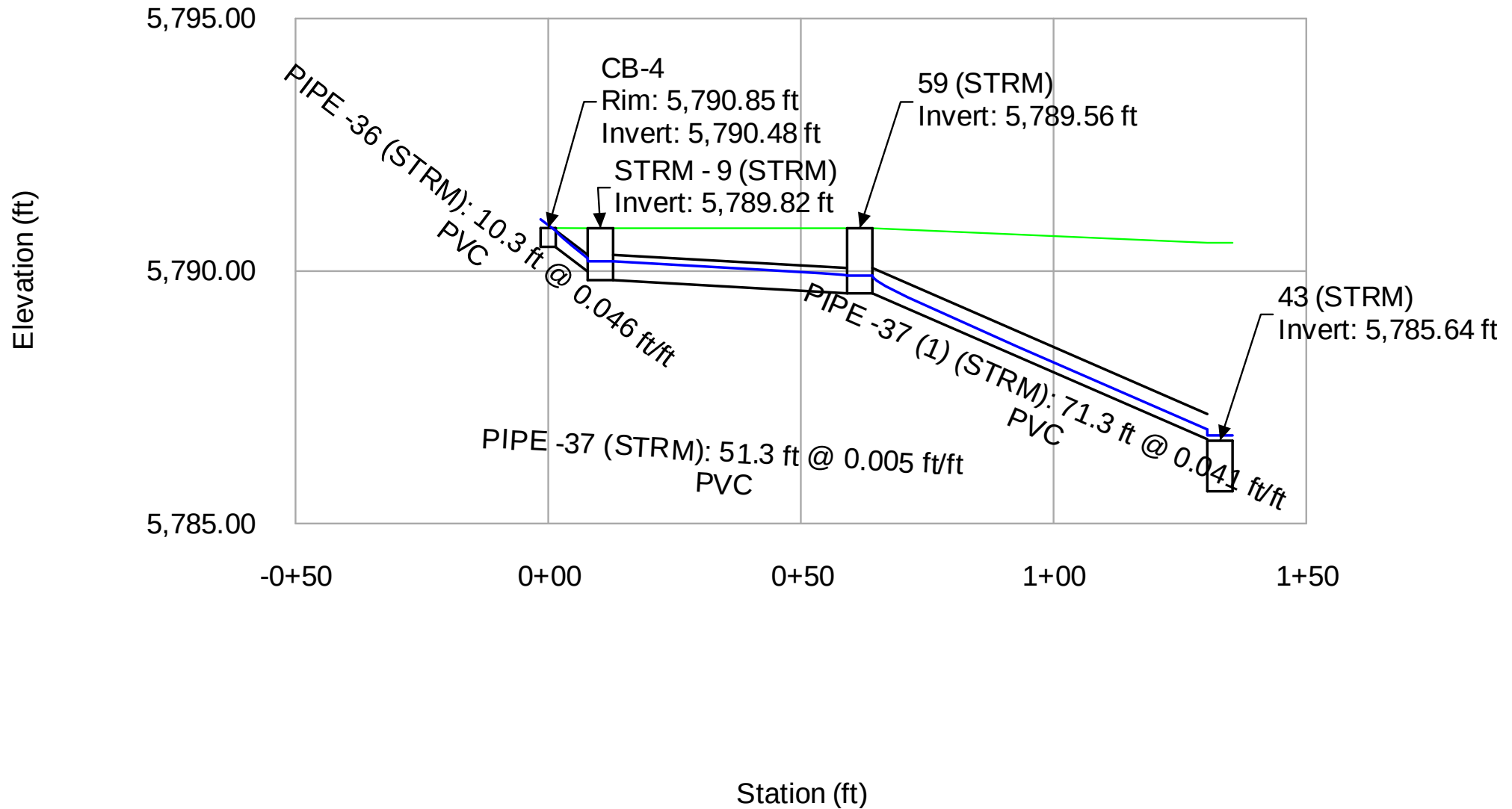
| Direct Runoff Summary |             |                      |                        |
|-----------------------|-------------|----------------------|------------------------|
| Drainage Basin        | Area (Ac)   | Q <sub>5</sub> (CFS) | Q <sub>100</sub> (CFS) |
| 5                     | 0.28        | 0.88                 | 1.98                   |
| 10                    | 0.33        | 1.40                 | 2.71                   |
| 15                    | 0.52        | 2.07                 | 4.16                   |
| <b>Total</b>          | <b>1.14</b> | <b>4.35</b>          | <b>8.85</b>            |

| Offsite Runoff Summary |             |                      |                        |
|------------------------|-------------|----------------------|------------------------|
| Drainage Basin         | Area (Ac)   | Q <sub>5</sub> (CFS) | Q <sub>100</sub> (CFS) |
| OS 1                   | 0.02        | 0.02                 | 0.08                   |
| OS 2                   | 0.12        | 0.20                 | 0.65                   |
| OS 3                   | 0.11        | 0.30518              | 0.72                   |
| <b>Total</b>           | <b>0.25</b> | <b>0.52943</b>       | <b>1.45</b>            |

Profile Report  
Engineering Profile - Roof Drain to EX MH (Lot 6.stsw)  
**5 - YEAR**



Profile Report  
Engineering Profile - Roof Drain to STRM - 1 (Lot 6.stsw)  
**5 - YEAR**

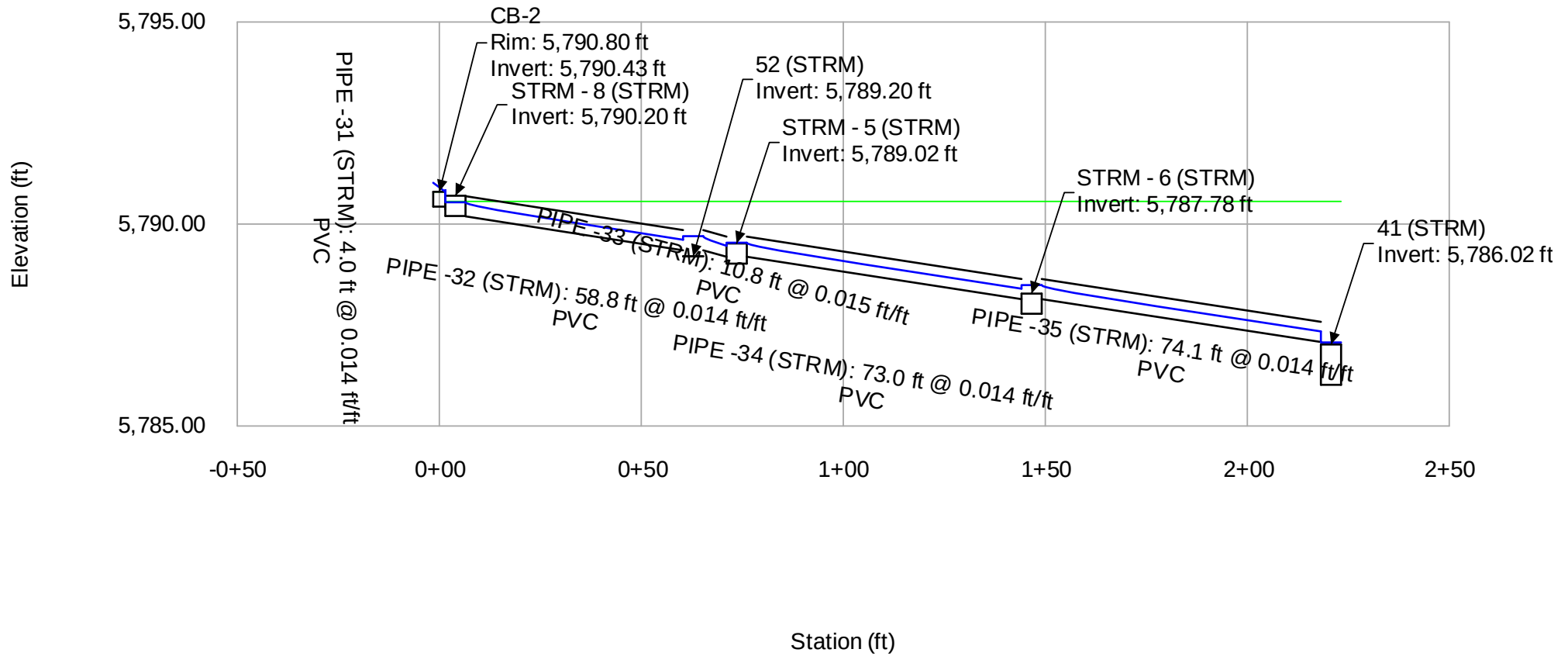




# Profile Report

## Engineering Profile - Roof Drain to STRM - 6 (Lot 6.stsw)

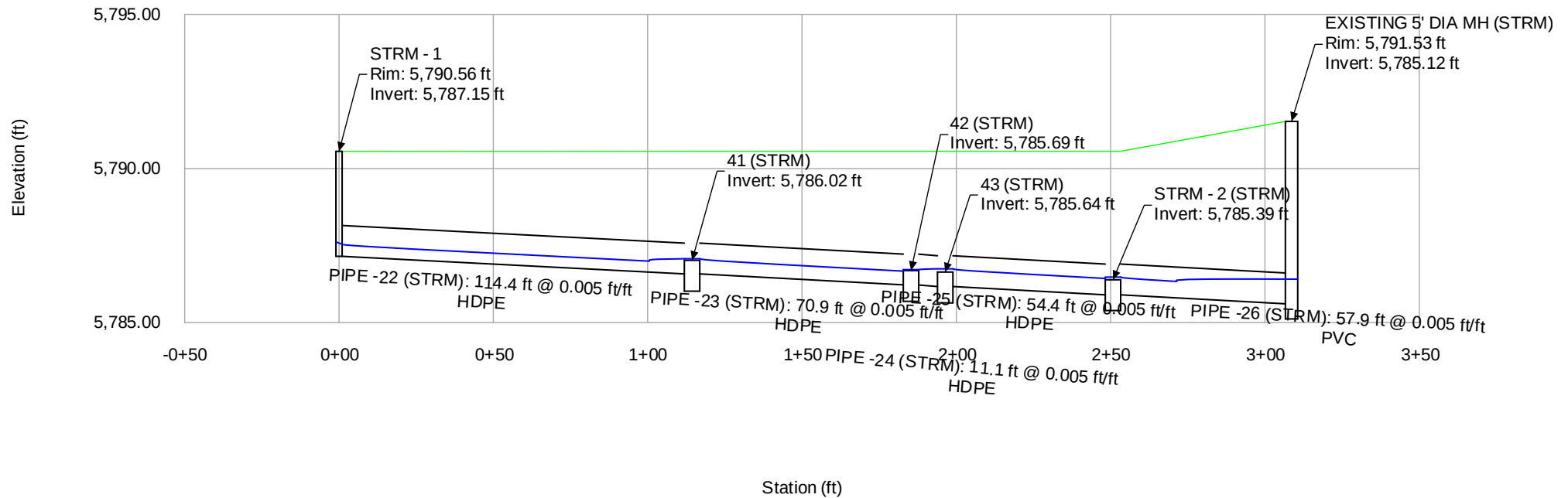
### 5 - YEAR



# Profile Report

## Engineering Profile - STRM-1 to EX MH (Lot 6.stsw)

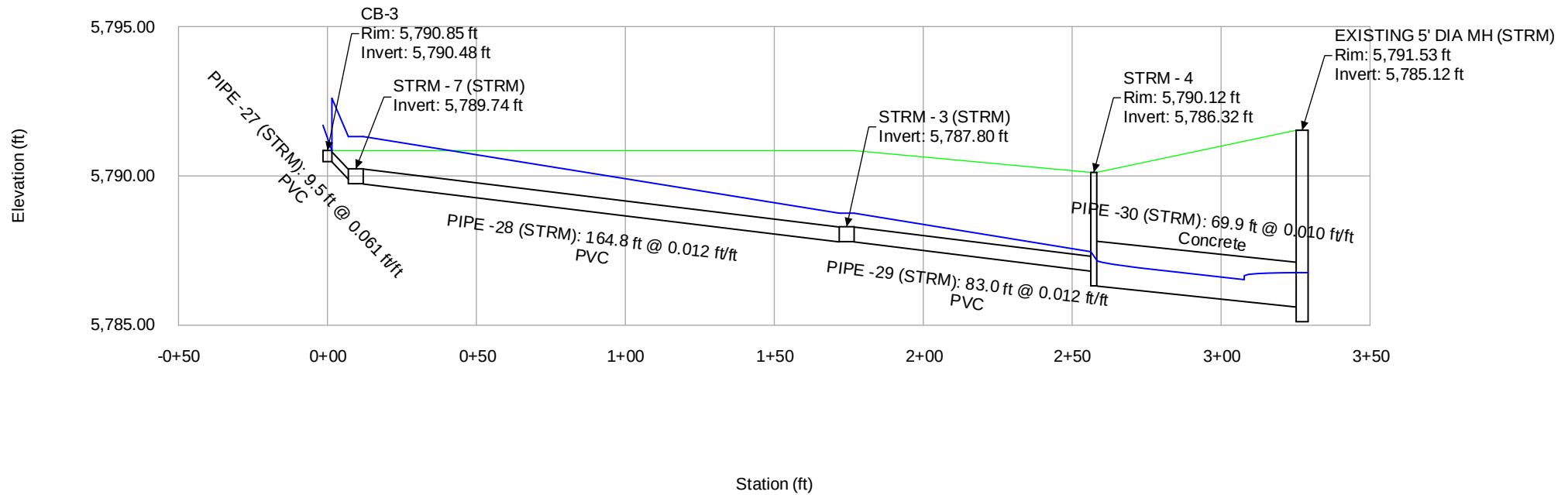
### 5 - YEAR



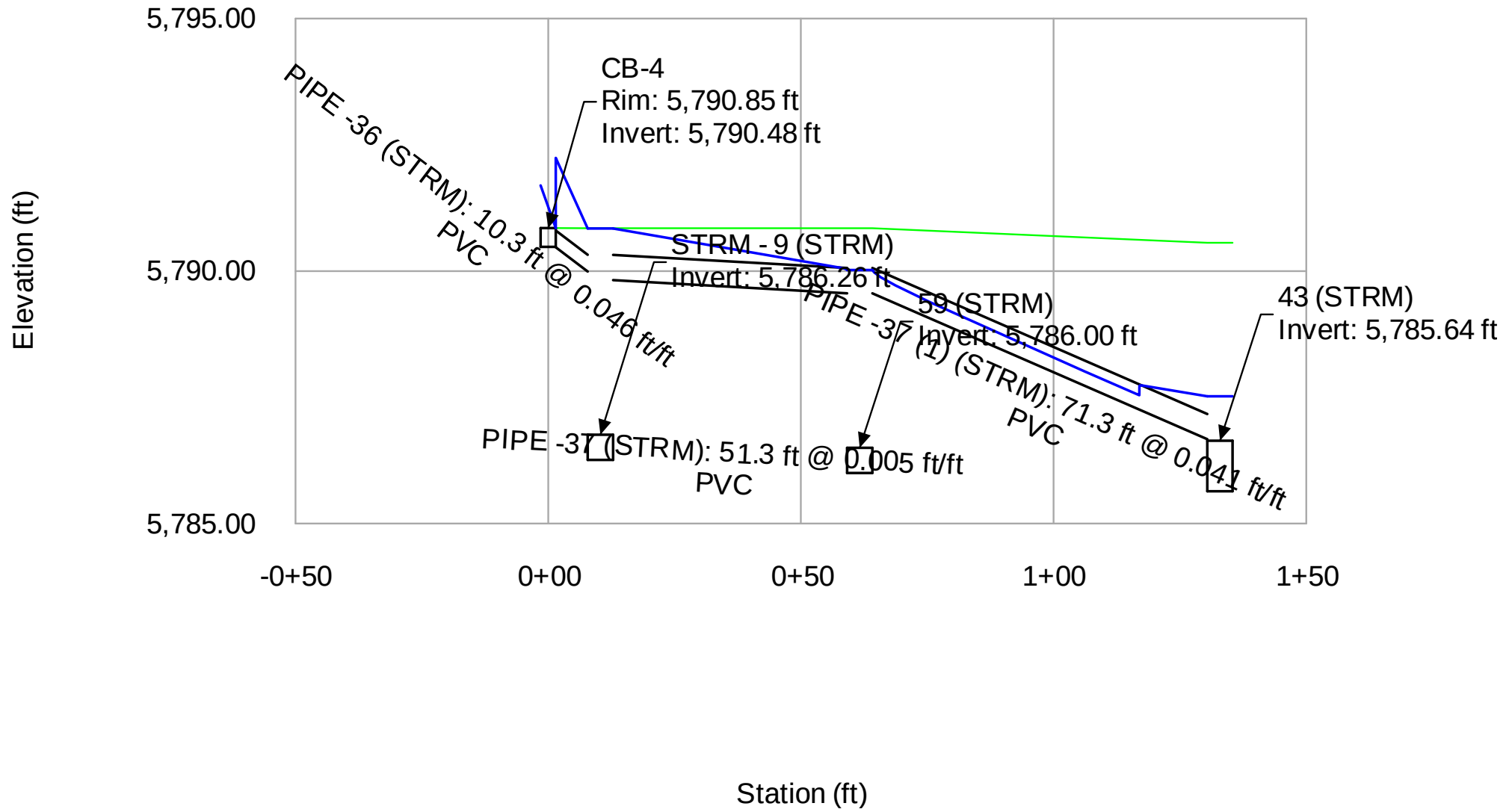
# Profile Report

## Engineering Profile - Roof Drain to EX MH (Lot 6.stsw)

### 100 - YEAR



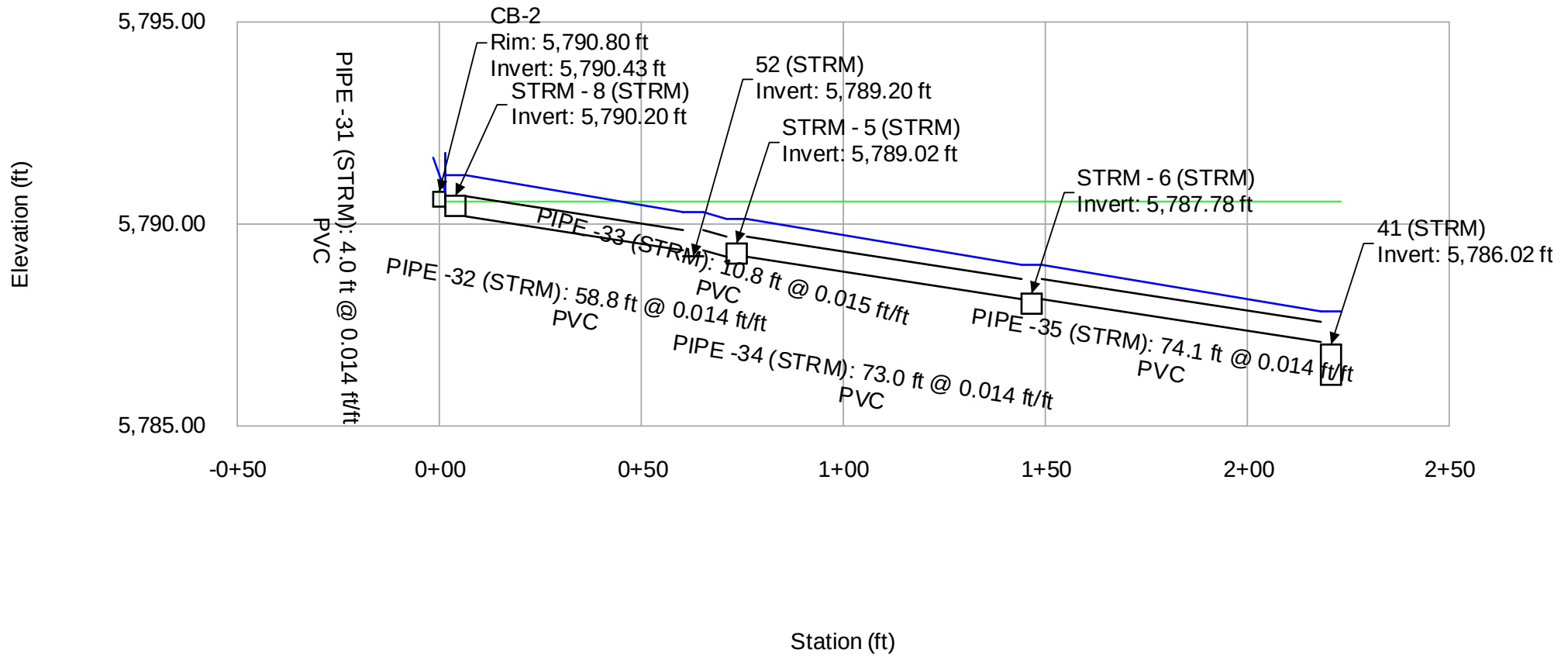
Profile Report  
Engineering Profile - Roof Drain to STRM - 1 (Lot 6.stsw)  
**100 - YEAR**



# Profile Report

## Engineering Profile - Roof Drain to STRM - 6 (Lot 6.stsw)

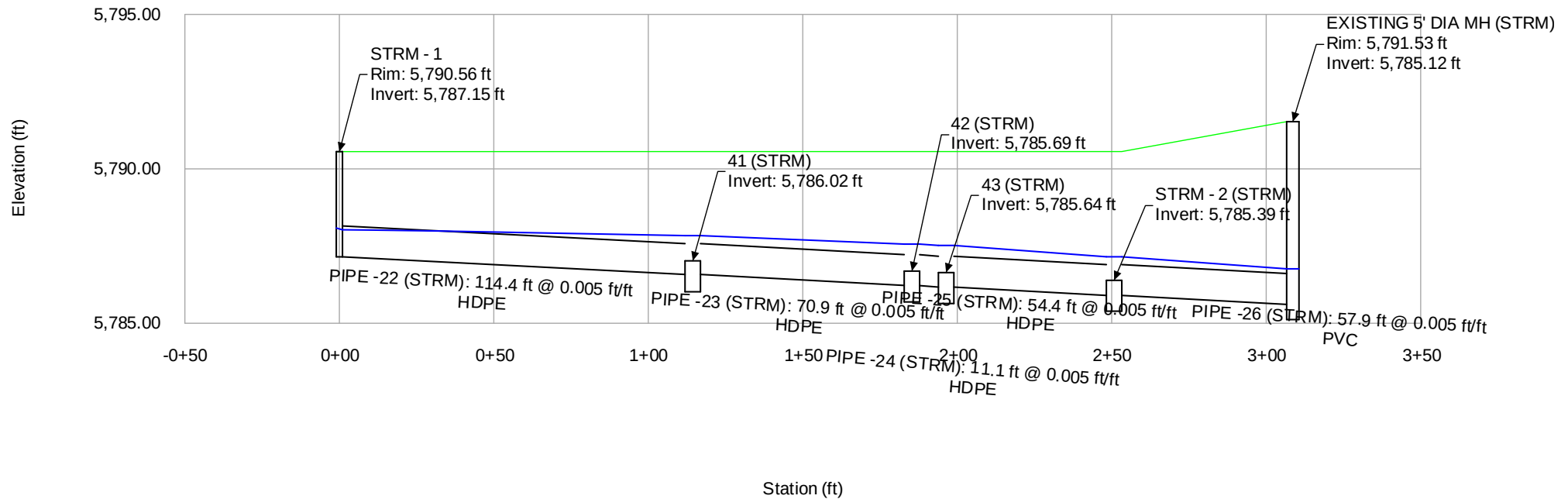
### 100 - YEAR



# Profile Report

## Engineering Profile - STRM-1 to EX MH (Lot 6.stsw)

### 100 - YEAR



# 5 - YEAR

## FlexTable: Conduit Table

| Start Node                   | Stop Node                       | Length<br>(User<br>Defined)<br>(ft) | Slope<br>(Calculated<br>)<br>(ft/ft) | Capacity<br>(Full Flow)<br>(cfs) | Flow<br>(cfs) | Velocity<br>(ft/s) | Headloss<br>(ft) | Hydraulic<br>Grade Line (In)<br>(ft) | Hydraulic<br>Grade Line<br>(Out)<br>(ft) | Invert<br>(Start)<br>(ft) | Invert<br>(Stop)<br>(ft) | Flow / Capacity<br>(Design)<br>(%) |
|------------------------------|---------------------------------|-------------------------------------|--------------------------------------|----------------------------------|---------------|--------------------|------------------|--------------------------------------|------------------------------------------|---------------------------|--------------------------|------------------------------------|
| STRM - 2 (STRM)              | EXISTING<br>5' DIA MH<br>(STRM) | 57.9                                | 0.005                                | 3.28                             | 1.82          | 4.28               | 0.06             | 5,786.47                             | 5,786.41                                 | 5,785.90                  | 5,785.61                 | 55.5                               |
| STRM - 4                     | EXISTING<br>5' DIA MH<br>(STRM) | 69.9                                | 0.010                                | 10.51                            | 2.54          | 4.90               | 0.50             | 5,786.91                             | 5,786.41                                 | 5,786.31                  | 5,785.61                 | 24.2                               |
| EXISTING 5' DIA MH<br>(STRM) | O-1                             | 12.6                                | 0.009                                | 13.17                            | 4.36          | 6.69               | 0.25             | 5,786.41                             | 5,786.16                                 | 5,785.61                  | 5,785.49                 | 33.1                               |
| CB-4                         | STRM - 9<br>(STRM)              | 10.3                                | 0.046                                | 0.53                             | 0.47          | 6.89               | 0.54             | 5,790.80                             | 5,790.25                                 | 5,790.47                  | 5,789.99                 | 88.1                               |
| CB-3                         | STRM - 7<br>(STRM)              | 9.5                                 | 0.061                                | 0.61                             | 0.47          | 7.72               | 0.66             | 5,790.80                             | 5,790.13                                 | 5,790.47                  | 5,789.89                 | 77.0                               |
| CB-2                         | STRM - 8<br>(STRM)              | 4.0                                 | 0.014                                | 0.30                             | 0.47          | 5.39               | 0.15             | 5,790.84                             | 5,790.69                                 | 5,790.42                  | 5,790.36                 | 159.1                              |
| STRM - 8 (STRM)              | 52 (STRM)                       | 58.8                                | 0.014                                | 0.87                             | 0.47          | 4.52               | 0.93             | 5,790.54                             | 5,789.61                                 | 5,790.19                  | 5,789.35                 | 53.9                               |
| STRM - 1                     | 41 (STRM)                       | 114.4                               | 0.005                                | 3.27                             | 0.88          | 3.53               | 0.47             | 5,787.54                             | 5,787.07                                 | 5,787.15                  | 5,786.58                 | 26.9                               |
| 58 (STRM)                    | 59 (STRM)                       | 10.3                                | 0.037                                | 0.48                             | 0.00          | 0.00               | 0.20             | 5,790.11                             | 5,789.91                                 | 5,790.11                  | 5,789.73                 | 0.0                                |
| STRM - 7 (STRM)              | STRM - 3<br>(STRM)              | 164.8                               | 0.012                                | 0.79                             | 0.47          | 4.20               | 2.01             | 5,790.08                             | 5,788.07                                 | 5,789.73                  | 5,787.79                 | 59.4                               |
| STRM - 3 (STRM)              | STRM - 4                        | 83.0                                | 0.012                                | 0.79                             | 0.47          | 4.21               | 1.05             | 5,788.14                             | 5,787.09                                 | 5,787.79                  | 5,786.81                 | 59.3                               |
| 52 (STRM)                    | STRM - 5<br>(STRM)              | 10.8                                | 0.015                                | 0.89                             | 0.47          | 4.59               | 0.24             | 5,789.70                             | 5,789.46                                 | 5,789.35                  | 5,789.19                 | 52.9                               |
| STRM - 5 (STRM)              | STRM - 6<br>(STRM)              | 73.0                                | 0.014                                | 0.87                             | 0.47          | 4.54               | 1.14             | 5,789.54                             | 5,788.40                                 | 5,789.19                  | 5,788.14                 | 53.7                               |
| STRM - 6 (STRM)              | 41 (STRM)                       | 74.1                                | 0.014                                | 0.87                             | 0.47          | 4.53               | 1.15             | 5,788.49                             | 5,787.34                                 | 5,788.14                  | 5,787.08                 | 53.9                               |
| 41 (STRM)                    | 42 (STRM)                       | 70.9                                | 0.005                                | 3.28                             | 1.35          | 3.97               | 0.35             | 5,787.07                             | 5,786.72                                 | 5,786.58                  | 5,786.22                 | 41.1                               |
| STRM - 9 (STRM)              | 59 (STRM)                       | 51.3                                | 0.005                                | 0.52                             | 0.47          | 2.99               | 0.28             | 5,790.19                             | 5,789.91                                 | 5,789.82                  | 5,789.56                 | 90.5                               |
| 42 (STRM)                    | 43 (STRM)                       | 11.1                                | 0.005                                | 3.11                             | 1.35          | 3.83               | -0.03            | 5,786.72                             | 5,786.74                                 | 5,786.22                  | 5,786.17                 | 43.3                               |
| 43 (STRM)                    | STRM - 2<br>(STRM)              | 54.4                                | 0.005                                | 3.26                             | 1.82          | 4.27               | 0.31             | 5,786.74                             | 5,786.43                                 | 5,786.17                  | 5,785.90                 | 55.8                               |
| 59 (STRM)                    | 43 (STRM)                       | 71.3                                | 0.041                                | 1.47                             | 0.47          | 6.66               | 3.04             | 5,789.91                             | 5,786.86                                 | 5,789.56                  | 5,786.67                 | 32.0                               |

**100 - YEAR**  
**FlexTable: Conduit Table**

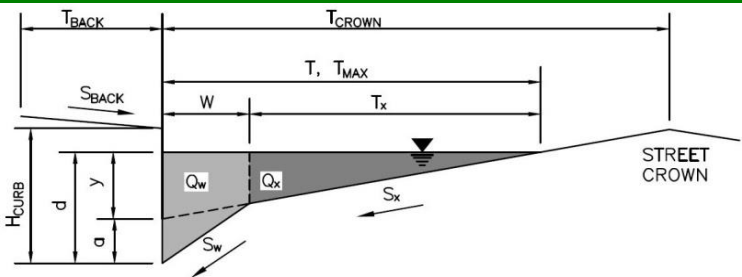
| Start Node                   | Stop Node                       | Length<br>(User<br>Defined)<br>(ft) | Slope<br>(Calculated<br>)<br>(ft/ft) | Capacity<br>(Full Flow)<br>(cfs) | Flow<br>(cfs) | Velocity<br>(ft/s) | Headloss<br>(ft) | Hydraulic<br>Grade Line (In)<br>(ft) | Hydraulic<br>Grade Line<br>(Out)<br>(ft) | Invert<br>(Start)<br>(ft) | Invert<br>(Stop)<br>(ft) | Flow / Capacity<br>(Design)<br>(%) |
|------------------------------|---------------------------------|-------------------------------------|--------------------------------------|----------------------------------|---------------|--------------------|------------------|--------------------------------------|------------------------------------------|---------------------------|--------------------------|------------------------------------|
| STRM - 2 (STRM)              | EXISTING<br>5' DIA MH<br>(STRM) | 57.9                                | 0.005                                | 3.28                             | 3.80          | 4.84               | 0.39             | 5,787.15                             | 5,786.76                                 | 5,785.90                  | 5,785.61                 | 115.9                              |
| STRM - 4                     | EXISTING<br>5' DIA MH<br>(STRM) | 69.9                                | 0.010                                | 10.51                            | 5.07          | 5.90               | 0.41             | 5,787.18                             | 5,786.76                                 | 5,786.31                  | 5,785.61                 | 48.2                               |
| EXISTING 5' DIA MH<br>(STRM) | O-1                             | 12.6                                | 0.009                                | 13.17                            | 8.87          | 8.00               | 0.26             | 5,786.76                             | 5,786.51                                 | 5,785.61                  | 5,785.49                 | 67.4                               |
| CB-4                         | STRM - 9<br>(STRM)              | 10.3                                | 0.046                                | 0.53                             | 0.91          | 10.43              | 1.40             | 5,792.24                             | 5,790.84                                 | 5,790.47                  | 5,789.99                 | 170.7                              |
| CB-3                         | STRM - 7<br>(STRM)              | 9.5                                 | 0.061                                | 0.61                             | 0.91          | 10.43              | 1.29             | 5,792.61                             | 5,791.32                                 | 5,790.47                  | 5,789.89                 | 149.0                              |
| CB-2                         | STRM - 8<br>(STRM)              | 4.0                                 | 0.014                                | 0.30                             | 0.91          | 10.43              | 0.54             | 5,791.75                             | 5,791.21                                 | 5,790.42                  | 5,790.36                 | 308.1                              |
| STRM - 8 (STRM)              | 52 (STRM)                       | 58.8                                | 0.014                                | 0.87                             | 0.91          | 4.63               | 0.92             | 5,791.21                             | 5,790.30                                 | 5,790.19                  | 5,789.35                 | 104.4                              |
| STRM - 1                     | 41 (STRM)                       | 114.4                               | 0.005                                | 3.27                             | 1.98          | 4.36               | 0.19             | 5,788.03                             | 5,787.84                                 | 5,787.15                  | 5,786.58                 | 60.6                               |
| 58 (STRM)                    | 59 (STRM)                       | 10.3                                | 0.037                                | 0.48                             | 0.00          | 0.00               | 0.09             | 5,790.11                             | 5,790.02                                 | 5,790.11                  | 5,789.73                 | 0.0                                |
| STRM - 7 (STRM)              | STRM - 3<br>(STRM)              | 164.8                               | 0.012                                | 0.79                             | 0.91          | 4.63               | 2.56             | 5,791.32                             | 5,788.75                                 | 5,789.73                  | 5,787.79                 | 115.0                              |
| STRM - 3 (STRM)              | STRM - 4                        | 83.0                                | 0.012                                | 0.79                             | 0.91          | 4.63               | 1.29             | 5,788.75                             | 5,787.46                                 | 5,787.79                  | 5,786.81                 | 114.8                              |
| 52 (STRM)                    | STRM - 5<br>(STRM)              | 10.8                                | 0.015                                | 0.89                             | 0.91          | 4.63               | 0.17             | 5,790.30                             | 5,790.13                                 | 5,789.35                  | 5,789.19                 | 102.4                              |
| STRM - 5 (STRM)              | STRM - 6<br>(STRM)              | 73.0                                | 0.014                                | 0.87                             | 0.91          | 4.63               | 1.14             | 5,790.13                             | 5,788.99                                 | 5,789.19                  | 5,788.14                 | 104.0                              |
| STRM - 6 (STRM)              | 41 (STRM)                       | 74.1                                | 0.014                                | 0.87                             | 0.91          | 4.63               | 1.15             | 5,788.99                             | 5,787.84                                 | 5,788.14                  | 5,787.08                 | 104.3                              |
| 41 (STRM)                    | 42 (STRM)                       | 70.9                                | 0.005                                | 3.28                             | 2.89          | 3.68               | 0.28             | 5,787.84                             | 5,787.56                                 | 5,786.58                  | 5,786.22                 | 88.1                               |
| STRM - 9 (STRM)              | 59 (STRM)                       | 51.3                                | 0.005                                | 0.52                             | 0.91          | 4.63               | 0.82             | 5,790.84                             | 5,790.02                                 | 5,789.82                  | 5,789.56                 | 175.3                              |
| 42 (STRM)                    | 43 (STRM)                       | 11.1                                | 0.005                                | 3.11                             | 2.89          | 3.68               | 0.04             | 5,787.56                             | 5,787.52                                 | 5,786.22                  | 5,786.17                 | 92.8                               |
| 43 (STRM)                    | STRM - 2<br>(STRM)              | 54.4                                | 0.005                                | 3.26                             | 3.80          | 4.84               | 0.37             | 5,787.52                             | 5,787.15                                 | 5,786.17                  | 5,785.90                 | 116.4                              |
| 59 (STRM)                    | 43 (STRM)                       | 71.3                                | 0.041                                | 1.47                             | 0.91          | 7.88               | 2.50             | 5,790.02                             | 5,787.52                                 | 5,789.56                  | 5,786.67                 | 62.0                               |



ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Everbrook Broomfield  
Inlet ID: SB-15



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb  
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)  
  
Height of Curb at Gutter Flow Line  
Distance from Curb Face to Street Crown  
Gutter Width  
Street Transverse Slope  
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
Street Longitudinal Slope - Enter 0 for sump condition  
Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T<sub>BACK</sub> = 14.0 ft  
S<sub>BACK</sub> = ft/ft  
n<sub>BACK</sub> = 0.013

H<sub>CURB</sub> = 6.00 inches  
T<sub>CROWN</sub> = 42.0 ft  
W = 2.00 ft  
S<sub>x</sub> = 0.024 ft/ft  
S<sub>w</sub> = 0.083 ft/ft  
S<sub>O</sub> = 0.000 ft/ft  
n<sub>STREET</sub> = 0.013

Max. Allowable Spread for Minor & Major Storm  
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
Check boxes are not applicable in SUMP conditions

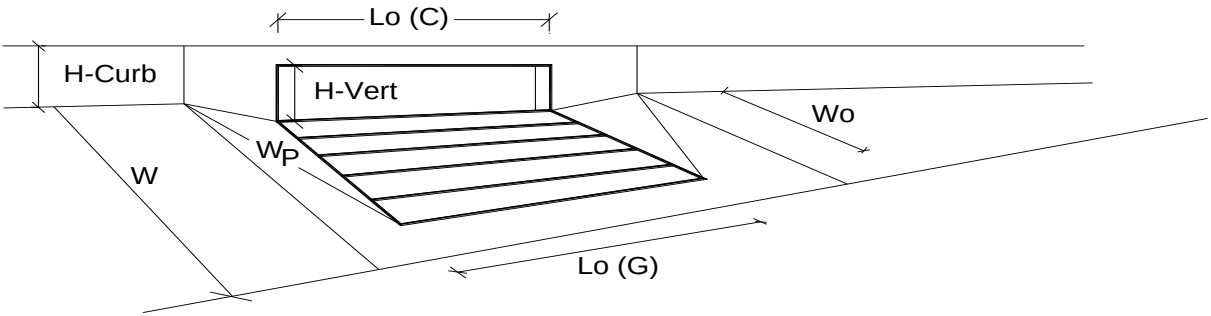
|                  | Minor Storm              | Major Storm              |        |
|------------------|--------------------------|--------------------------|--------|
| T <sub>MAX</sub> | 14.0                     | 14.0                     | ft     |
| d <sub>MAX</sub> | 6.0                      | 6.0                      | inches |
|                  | <input type="checkbox"/> | <input type="checkbox"/> |        |

MINOR STORM Allowable Capacity is based on Depth Criterion  
MAJOR STORM Allowable Capacity is based on Depth Criterion

Q<sub>allow</sub> = SUMP SUMP cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   |                          | MINOR                           |       | MAJOR |         |
|------------------------------------------------------------------------------|--------------------------|---------------------------------|-------|-------|---------|
| Type of Inlet                                                                | CDOT Type R Curb Opening | Type = CDOT Type R Curb Opening |       |       |         |
| Local Depression (additional to continuous gutter depression 'a' from above) |                          | a <sub>local</sub> =            | 3.00  | 3.00  | inches  |
| Number of Unit Inlets (Grate or Curb Opening)                                |                          | No =                            | 1     | 1     |         |
| Water Depth at Flowline (outside of local depression)                        |                          | Ponding Depth =                 | 5.4   | 5.4   | inches  |
| <b>Grate Information</b>                                                     |                          | MINOR                           |       | MAJOR |         |
| Length of a Unit Grate                                                       |                          | L <sub>o</sub> (G) =            | N/A   | N/A   | feet    |
| Width of a Unit Grate                                                        |                          | W <sub>o</sub> =                | N/A   | N/A   | feet    |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    |                          | A <sub>ratio</sub> =            | N/A   | N/A   |         |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               |                          | C <sub>f</sub> (G) =            | N/A   | N/A   |         |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           |                          | C <sub>w</sub> (G) =            | N/A   | N/A   |         |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        |                          | C <sub>o</sub> (G) =            | N/A   | N/A   |         |
| <b>Curb Opening Information</b>                                              |                          | MINOR                           |       | MAJOR |         |
| Length of a Unit Curb Opening                                                |                          | L <sub>o</sub> (C) =            | 5.00  | 5.00  | feet    |
| Height of Vertical Curb Opening in Inches                                    |                          | H <sub>vert</sub> =             | 6.00  | 6.00  | inches  |
| Height of Curb Orifice Throat in Inches                                      |                          | H <sub>throat</sub> =           | 6.00  | 6.00  | inches  |
| Angle of Throat (see USDCM Figure ST-5)                                      |                          | Theta =                         | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         |                          | W <sub>p</sub> =                | 2.00  | 2.00  | feet    |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               |                          | C <sub>f</sub> (C) =            | 0.10  | 0.10  |         |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        |                          | C <sub>w</sub> (C) =            | 3.60  | 3.60  |         |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 |                          | C <sub>o</sub> (C) =            | 0.67  | 0.67  |         |
| <b>Low Head Performance Reduction (Calculated)</b>                           |                          | MINOR                           |       | MAJOR |         |
| Depth for Grate Midwidth                                                     |                          | d <sub>Grate</sub> =            | N/A   | N/A   | ft      |
| Depth for Curb Opening Weir Equation                                         |                          | d <sub>Curb</sub> =             | 0.29  | 0.29  | ft      |
| Combination Inlet Performance Reduction Factor for Long Inlets               |                          | RF <sub>Combination</sub> =     | 0.70  | 0.70  |         |
| Curb Opening Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Curb</sub> =            | 1.00  | 1.00  |         |
| Grated Inlet Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Grate</sub> =           | N/A   | N/A   |         |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         |                          | MINOR                           |       | MAJOR |         |
|                                                                              |                          | Q <sub>a</sub> =                | 4.3   | 4.3   | cfs     |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)                   |                          | Q <sub>PEAK REQUIRED</sub> =    | 2.1   | 4.2   | cfs     |



## Nyloplast Inlet Capacity Table

DISCLAIMER: SAFETY FACTORS ARE NOT INCLUDED IN THESE CALCULATIONS. ACTUAL CALCULATIONS SHOULD BE CARRIED OUT AND VERIFIED BY THE DESIGN ENGINEER TAKING INTO ACCOUNT ALL LOCAL CONDITIONS. NYLOPLAST RECOMMENDS USING A MINIMUM SAFETY FACTOR OF 1.25 FOR PAVED AREAS AND 2.0 FOR TURF AREAS. ADS/NYLOPLAST IS NOT RESPONSIBLE FOR MISUSE OF THIS TOOL.

| Input                    |          |
|--------------------------|----------|
| Type of Grate            | 18" Dome |
| Head (ft)                | 0.5      |
| Properties               |          |
| Orifice Flow Area (in)   | 170.74   |
| Orifice Flow Area (ft)   | 1.18     |
| Weir Flow Perimeter (in) | 53.85    |
| Weir Flow Perimeter (ft) | 4.49     |
| Solution                 |          |
| Capacity (cfs)           | 4.01     |
| Capacity (gpm)           | 1799.46  |

$$Q_{weir} = CLH^{3/2}$$

$C = 3.33$  Weir Discharge Coefficient

$L$  = Perimeter of Grate Opening (ft)

$H$  = Flow Height of Water Surface Above Weir (ft)

$$Q_{orifice} = CA\sqrt{2gh}$$

$C = 0.60$  Orifice Discharge Coefficient

$A$  = Area of the Orifice (ft<sup>2</sup>)

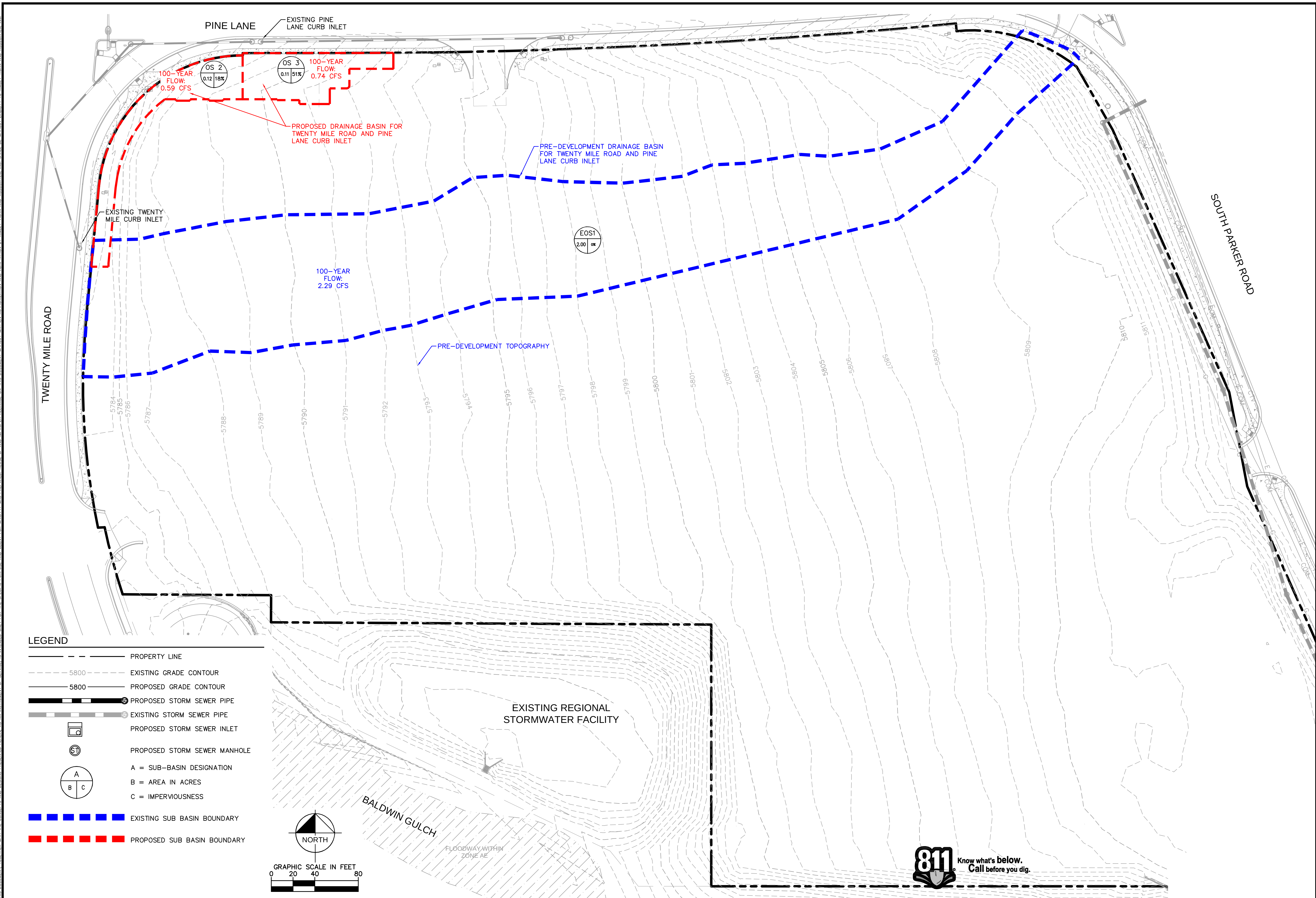
$g$  = Gravitational Constant  $\left(32.2 \frac{ft}{s^2}\right)$

$H$  = Depth of Water Above Center of Orifice (ft)

REV 5.4.12



K:\DEV\096895001 - Lot 6, Parker & Pine\CAD\EXHIBIT 2021\_0322\Drawings\Map\096895001.DWG - Henry, Nicole  
THIS DOCUMENT, TOGETHER WITH THE CONCEPTS AND DESIGNS PRESENTED HEREIN, IS AN INSTRUMENT OF SERVICE, AS AN INSTRUMENT OF SERVICE, IS PREPARED, ISSUED, AND FOR WHICH IT WAS PREPARED, BY KIMLEY-HORN AND ASSOCIATES, INC. SHALL BE WITHOUT LIABILITY TO KIMLEY-HORN AND ASSOCIATES, INC.

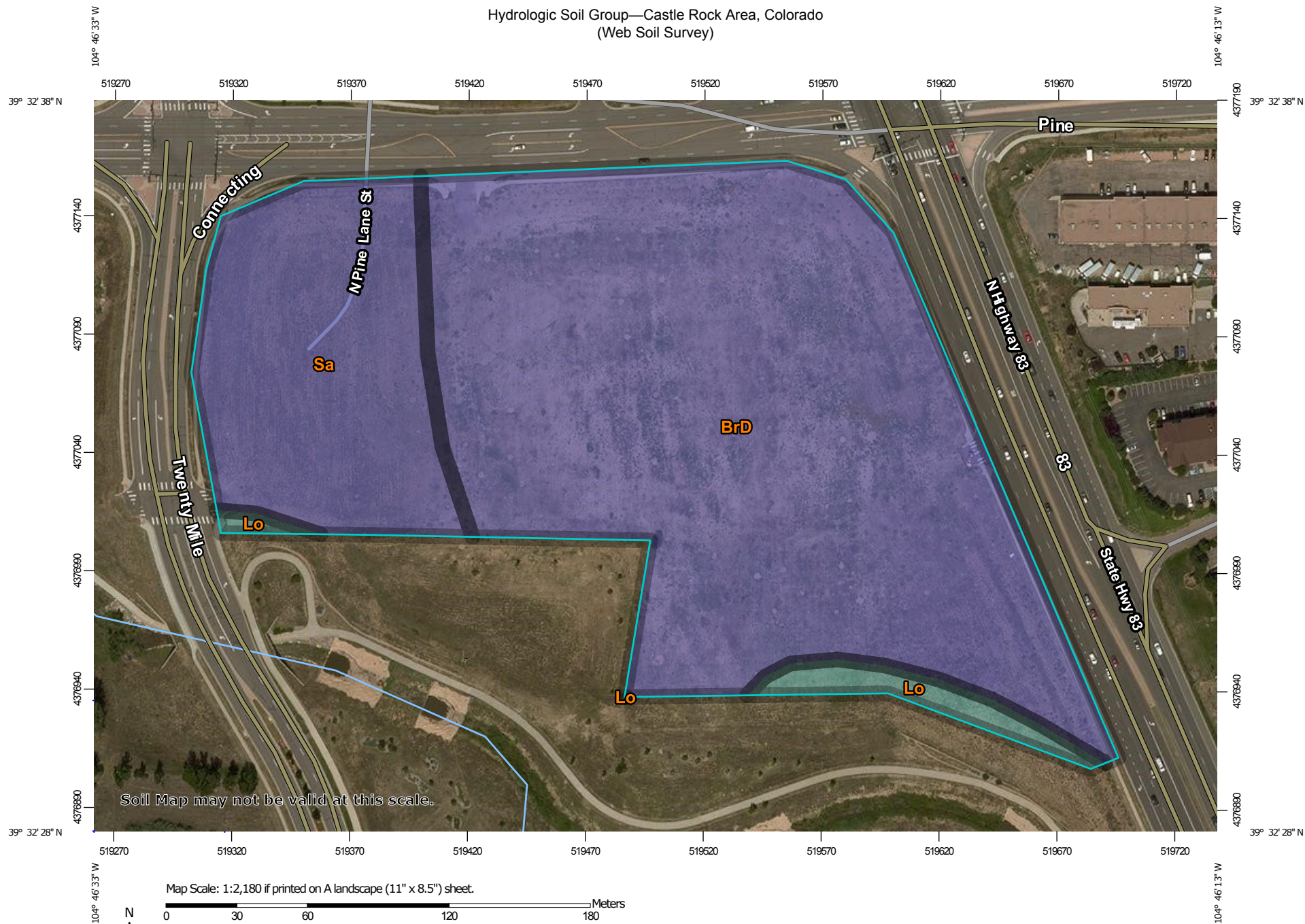


|                                                                                                                                |  |
|--------------------------------------------------------------------------------------------------------------------------------|--|
| KIMLEY-HORN AND ASSOCIATES, INC.<br>4582 South Ute Street, Suite 1500<br>Denver, Colorado 80237 (303) 228-2300                 |  |
| DESIGNED BY: MCN<br>DRAWN BY: NMH<br>CHECKED BY: DLS<br>DATE: 12/23/2020                                                       |  |
| LOT 6 PARKER AND PINE FILING 1<br>PARKER, CO<br>EVERBROOK ACADEMY CONSTRUCTION DOCUMENTS<br>TWENTY MILE EXISTING INLET EXHIBIT |  |
| PRELIMINARY<br>FOR REVIEW ONLY<br>NOT FOR<br>CONSTRUCTION<br>Kimley-Horn and Associates, Inc.                                  |  |
| PROJECT NO.<br>096895001                                                                                                       |  |
| DRAWING NAME                                                                                                                   |  |
| EX 1                                                                                                                           |  |

## APPENDIX C



# Hydrologic Soil Group—Castle Rock Area, Colorado (Web Soil Survey)



# Hydrologic Soil Group—Castle Rock Area, Colorado (Web Soil Survey)

## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

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

#### Soil Rating Lines

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

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado  
 Survey Area Data: Version 9, Sep 22, 2016

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

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

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

| Hydrologic Soil Group— Summary by Map Unit — Castle Rock Area, Colorado (CO622) |                                                 |        |              |                |
|---------------------------------------------------------------------------------|-------------------------------------------------|--------|--------------|----------------|
| Map unit symbol                                                                 | Map unit name                                   | Rating | Acres in AOI | Percent of AOI |
| BrD                                                                             | Bresser sandy loam, cool, 5 to 9 percent slopes | B      | 11.2         | 73.8%          |
| Lo                                                                              | Loamy alluvial land                             | C      | 0.5          | 3.3%           |
| Sa                                                                              | Sampson loam                                    | B      | 3.5          | 22.9%          |
| <b>Totals for Area of Interest</b>                                              |                                                 |        | <b>15.2</b>  | <b>100.0%</b>  |

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

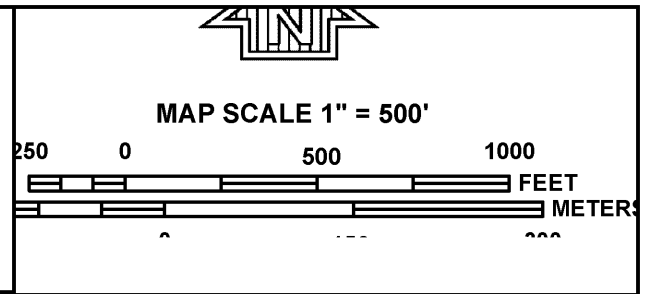
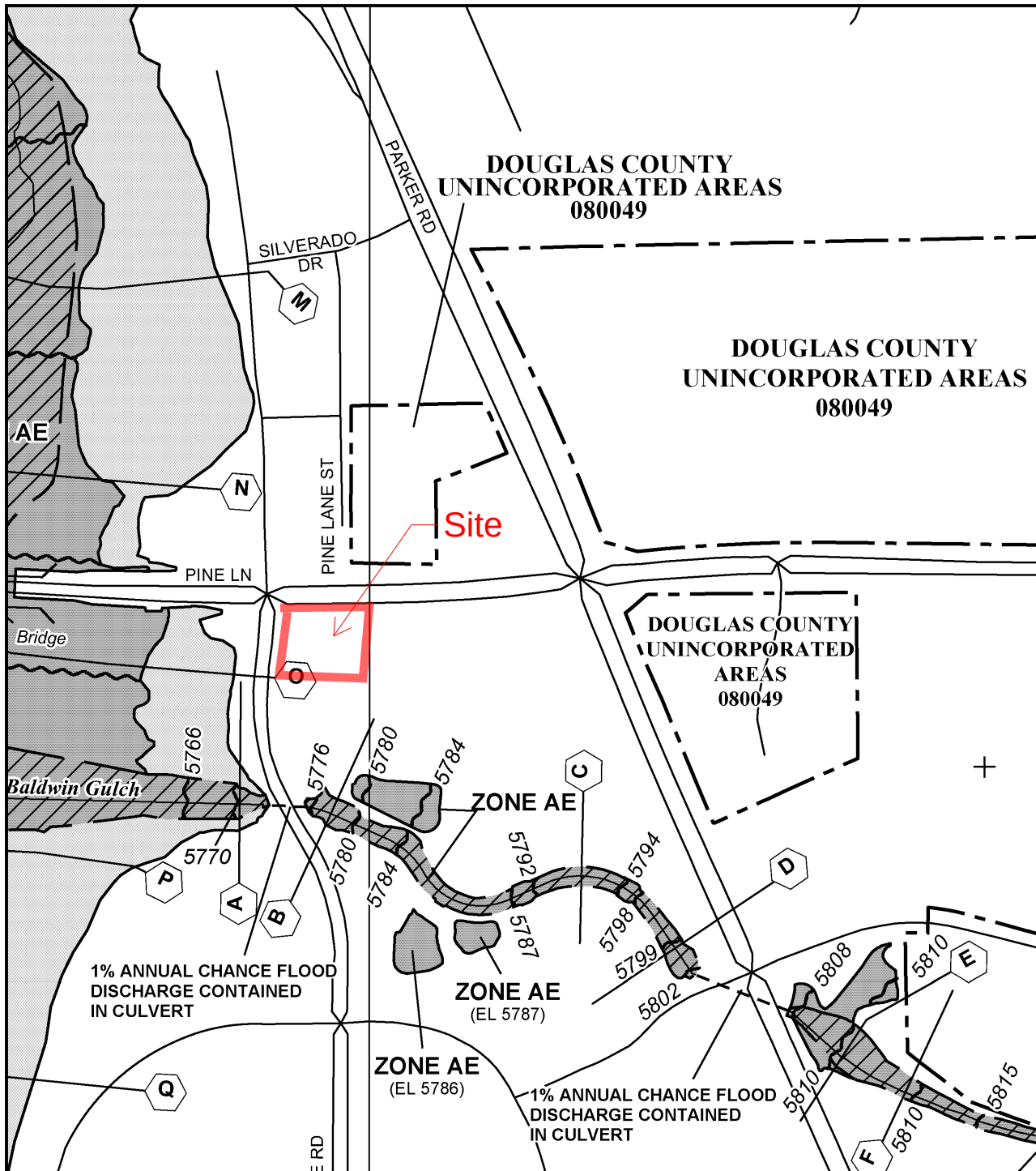


## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0067G

# FIRM

## FLOOD INSURANCE RATE MAP

### DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

**PANEL 67 OF 495**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

| COMMUNITY       | NUMBER | PANEL | SUFFIX |
|-----------------|--------|-------|--------|
| DOUGLAS COUNTY  | 080049 | 0067  | G      |
| PARKER, TOWN OF | 080310 | 0067  | G      |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



**MAP NUMBER**  
**08035C0067G**  
**MAP REVISED**  
**MARCH 16, 2016**

Federal Emergency Management Agency

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

## APPENDIX D

## FINAL DRAINAGE REPORT AMENDMENT

To: Town of Parker  
From: Dan Skeehan, P.E.  
Kimley-Horn and Associates, Inc  
Date: April 19, 2021  
Subject: Parker and Pine Multi-Family Final Drainage Report Amendment  
Lots 1 -3, Tract A-B-C, Parker and Pine Filing 2

---

Kimley-Horn and Associates, Inc. (Kimley-Horn) is submitting this Final Drainage Report Amendment for the above referenced project as required by the Town of Parker for Construction Development approval. The purpose of this letter is to demonstrate that the proposed improvements for this project will improve the existing drainage conditions for the overall development site to account for un-detained flows from future lot development. The previously approved drainage reports for the development are below:

- "Parker and Pine Filing No. 1 - Final Drainage Report" prepared by Kimley-Horn and Associates, Inc. Dated April 2020 (the "Existing Report")
- "Parker Auto Plaza Final Drainage Report" prepared by Kiowa Engineering Corporation dated July 12, 2004 (the "Master Report")

## PROJECT DESCRIPTION

The proposed multifamily development on Lots 1, 2, and 3, Parker and Pine Filing 2 (the "Site") is located near the corner of Pine Lane and Parker Road in the Town of Parker, Colorado ("the Town"). The project is the second phase in a multi-phase mixed used development. As part of phase 1, the overall developer graded the site, installed private drives and utility mains across the site, and made improvements to the existing shared detention pond. The multi-family project consists of a development plan of three vacant parcels consisting of approximately 6.44 acres and includes site grading, utility service installation, new building construction, parking and sidewalk improvements, and landscaping. The site is bordered to the north by undeveloped lots and a private drive, east by undeveloped lots and a private drive, south by Baldwin Gulch and an existing detention pond, and west by Twenty Mile Road.

## EXISTING DRAINAGE INFORMATION

Per the "Parker and Pine Filing No. 1 - Final Drainage Report," the existing overall development consists of interior streets, vacant lots with native seeding, and utility mains including storm sewer infrastructure intended to convey flows for the phased site development.

The overall development project provided water quality treatment by means of modifying the existing water quality outlet structure and detention through the existing surface detention pond for most of the site. The detention pond outfalls to Baldwin Gulch. Improvements to the regional pond constructed during the overall development project included forebays, trickle channels, and an access road.

The overall development project was divided into twenty-two (22) sub-basins, sub-basins 1.1 through 20.0. Ultimately the developed runoff is conveyed downstream to the existing detention pond for sub-basins 1.1 through

18.0. Sub-basins 19.0 and 20.0 bypass the regional pond and account for 1.00 CFS of un-detained flows. With the previously calculated 100-year peak discharge rate of the regional pond equal to 9.70 CFS, the total 100-year peak discharge rate for the overall development is 10.70 CFS.

The Master Report had a regional pond peak discharge rate of 13.1 CFS in the 100-year storm event. Pond discharge calculations were included in the Existing Report to demonstrate the 100-year storm event peak discharge rate did not exceed the Master Report peak discharge rate.

Per discussions with Town Staff, it was determined that the Existing Report peak discharge is the governing historic peak discharge rate for the development. Therefore, the Existing Report required this amendment to account for the un-detained flows for the all lots in the overall development. The maximum proposed 100-year design discharge rate for the overall development (90% of the historical peak discharge rate of 10.70 CFS) is therefore 9.63 CFS. Further information regarding the detention calculations and drainage patterns can be found in the Existing Report and Master Report provided in Appendix B.

## PROPOSED DRAINAGE INFORMATION

Drainage patterns proposed in the Existing Report were utilized for this Final Drainage Report Amendment. This amendment proposes to replace the existing outlet orifice plate and restrictor plate to optimize the regional pond outlet structure design. The proposed changes result in a lower 100-year peak discharge rate for the overall development regional pond therefore provide additional compensatory storage for future lot development. With the 100-year design peak discharge rate calculated as 5.50 CFS, a net flow of 4.13 CFS can be utilized for un-detained flows of future lot build outs in the overall development. Pond discharge calculations from the Existing Report and the Existing Report Amendment can be found in Appendix A and B. The Master Report pond discharge calculations can be found in Appendix B.

This Final Drainage Report Amendment proposes modifications to the regional pond outlet structure from the Existing Report and will be completed as part of the Multi-Family development construction. Table 1 below demonstrates that the compensatory storage requirements are maximized for the overall development.

Table 1: Peak Discharge Rate Comparison

|                                                                                                                                                  | Master Report | Existing Report | Existing Report Amendment |
|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|---------------------------|
| Regional Pond Peak Discharge Rate                                                                                                                | 13.1 CFS      | 9.70 CFS        | 4.50 CFS                  |
| Un-detained Flows for 100-Year Storm Event                                                                                                       | N/A           | 1.00 CFS        | 1.00 CFS                  |
| Total Peak Discharge Rate                                                                                                                        | 13.1 CFS      | 10.70 CFS       | 5.50 CFS                  |
| Net Compensatory Storage *                                                                                                                       | N/A           | N/A             | 4.13 CFS                  |
| *Net compensatory storage is calculated by subtracting the 90% historical peak discharge rate (9.63 CFS) by the total design peak discharge rate |               |                 |                           |

## CONCLUSION

This Final Drainage Report Amendment proposes to reduce the 100-year peak discharge rate for the overall development. Our design conforms to the Existing Report and maintains the existing drainage patterns therein.

## APPENDICES:

- Appendix A: Detention Basin Calculations
- Appendix B: Parker and Pine Filing No. 1 – Final Drainage Report
  - o Includes “Parker Auto Plaza Final Drainage Report” prepared by Kiowa Engineering Corporation dated July 12, 2004 as an appendix

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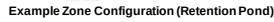
By: Daniel L. Skeeahan, P.E.  
Licensed Professional Engineer  
State of Colorado No. 46391

## APPENDIX A



## MHFD-Detention, Version 4.02 (February 2020)

Basin ID:



Note:  $L_c/L$  Ratio  $> 0.9$   
 $L_c / L$  Ratio = 5

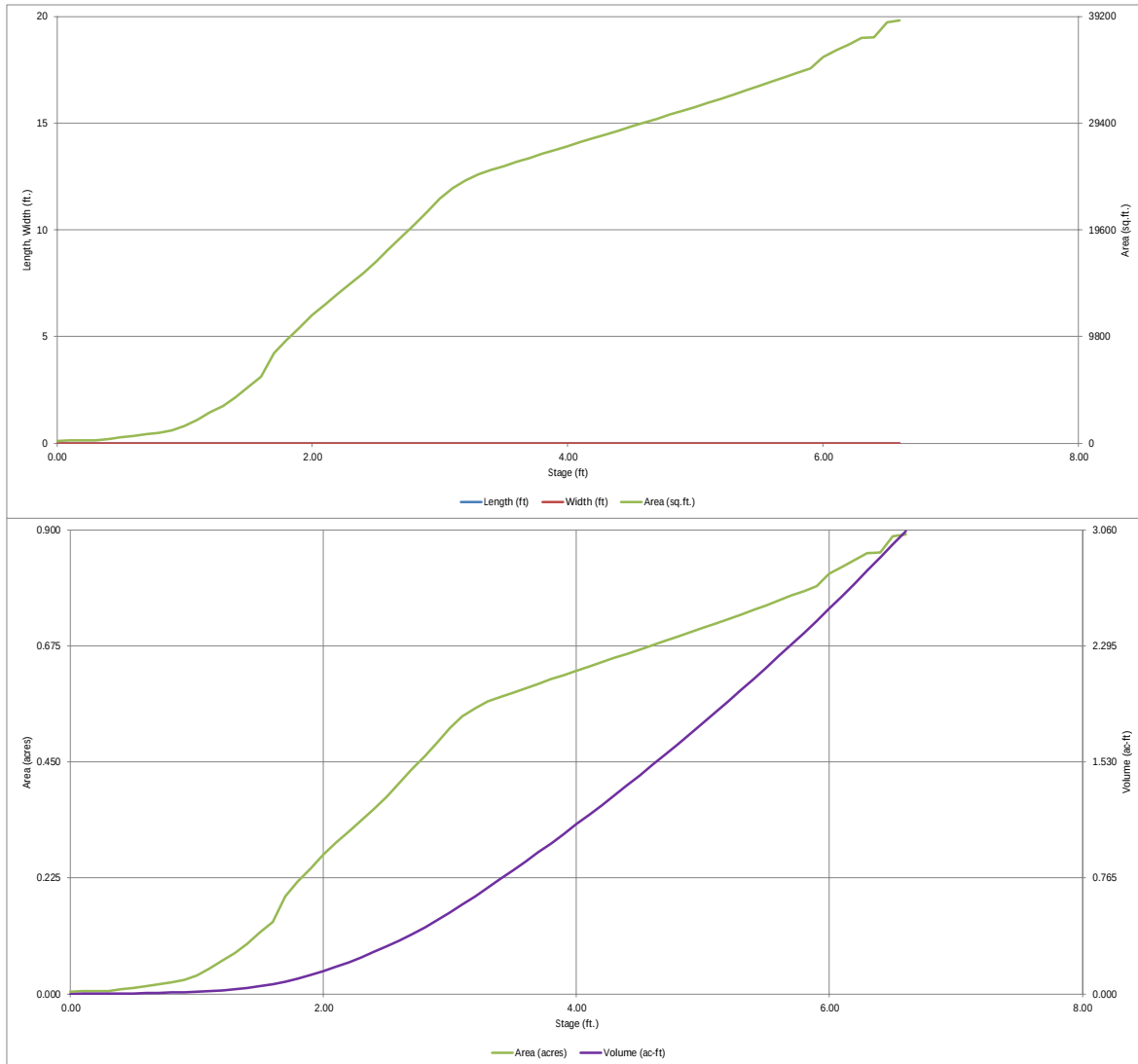
### Optional User Overrides

|      |           |
|------|-----------|
|      | acre-feet |
|      | acre-feet |
| 0.99 | inches    |
| 1.39 | inches    |
| 1.64 | inches    |
| 1.98 | inches    |
| 2.31 | inches    |
| 2.60 | inches    |
|      | inches    |

Calculated Total Basin Volume ( $V_{total}$ ) =  acre-feet

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

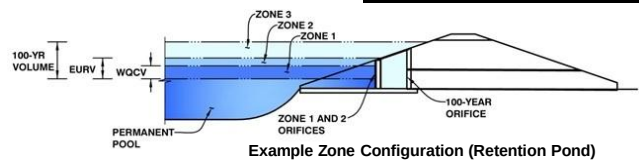


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Parker Mixed-Use - Parker and Pine

Basin ID:



|                   | Estimated<br>Stage (ft) | Estimated<br>Volume (ac-ft) | Outlet Type       |
|-------------------|-------------------------|-----------------------------|-------------------|
| Zone 1 (WQCV)     | 2.90                    | 0.481                       | Orifice Plate     |
| Zone 2 (EURV)     | 4.61                    | 1.031                       | Circular Orifice  |
| Zone 3 (100-year) | 5.75                    | 0.826                       | Weir&Pipe (Rect.) |
| Total (all zones) |                         | 2.339                       |                   |

User Input: Orifice at Underdrain Outlet (typically used to drain WOCV in a Filtration BMP)

Underdrain Orifice Invert Depth = N/A ft (distance below the filtration media surface)  
Underdrain Orifice Diameter = N/A inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = N/A ft<sup>2</sup>  
Underdrain Orifice Centroid = N/A feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WOCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate = 2.35 ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing = N/A inches  
Orifice Plate: Orifice Area per Row = 1.25 sq. inches (diameter = 1-1/4 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row = 8.681E-03 ft<sup>2</sup>  
Elliptical Half-Width = N/A feet  
Elliptical Slot Centroid = N/A feet  
Elliptical Slot Area = N/A ft<sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

|                                | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Stage of Orifice Centroid (ft) | 0.00             | 1.03             | 2.07             |                  |                  |                  |                  |                  |
| Orifice Area (sq. inches)      | 1.25             | 1.25             | 1.25             |                  |                  |                  |                  |                  |

|                                | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
|--------------------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Stage of Orifice Centroid (ft) |                  |                   |                   |                   |                   |                   |                   |                   |
| Orifice Area (sq. inches)      |                  |                   |                   |                   |                   |                   |                   |                   |

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = 2.35 ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Vertical Orifice = 4.15 ft (relative to basin bottom at Stage = 0 ft)  
Vertical Orifice Diameter = 8.00 inches

Calculated Parameters for Vertical Orifice

Zone 2 Circular Not Selected  
Vertical Orifice Area = 0.35 ft<sup>2</sup>  
Vertical Orifice Centroid = 0.33 feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

Overflow Weir Front Edge Height, Ho = 4.15 ft (relative to basin bottom at Stage = 0 ft)  
Overflow Weir Front Edge Length = 4.20 feet  
Overflow Weir Gate Slope = 4.00 H:V  
Horiz. Length of Weir Sides = 2.00 feet  
Overflow Gate Open Area % = 70%  
Debris Clogging % = 50%

Height of Gate Upper Edge, H<sub>u</sub> = 4.65 feet  
Overflow Weir Slope Length = 2.06 feet  
Gate Open Area / 100-yr Orifice Area = 17.20  
Overflow Gate Open Area w/o Debris = 6.06 ft<sup>2</sup>  
Overflow Gate Open Area w/ Debris = 3.03 ft<sup>2</sup>

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe = 1.13 ft (distance below basin bottom at Stage = 0 ft)  
Rectangular Orifice Width = 7.25 inches  
Rectangular Orifice Height = 7.00 inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Zone 3 Rectangular Not Selected  
Outlet Orifice Area = 0.35 ft<sup>2</sup>  
Outlet Orifice Centroid = 0.29 feet  
Half-Central Angle of Restrictor Plate on Pipe = N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = 6.20 ft (relative to basin bottom at Stage = 0 ft)  
Spillway Crest Length = 26.00 feet  
Spillway End Slopes = 4.00 H:V  
Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway

Spillway Design Flow Depth = 0.55 feet  
Stage at Top of Freeboard = 7.75 feet  
Basin Area at Top of Freeboard = 0.89 acres  
Basin Volume at Top of Freeboard = 3.05 acre-ft

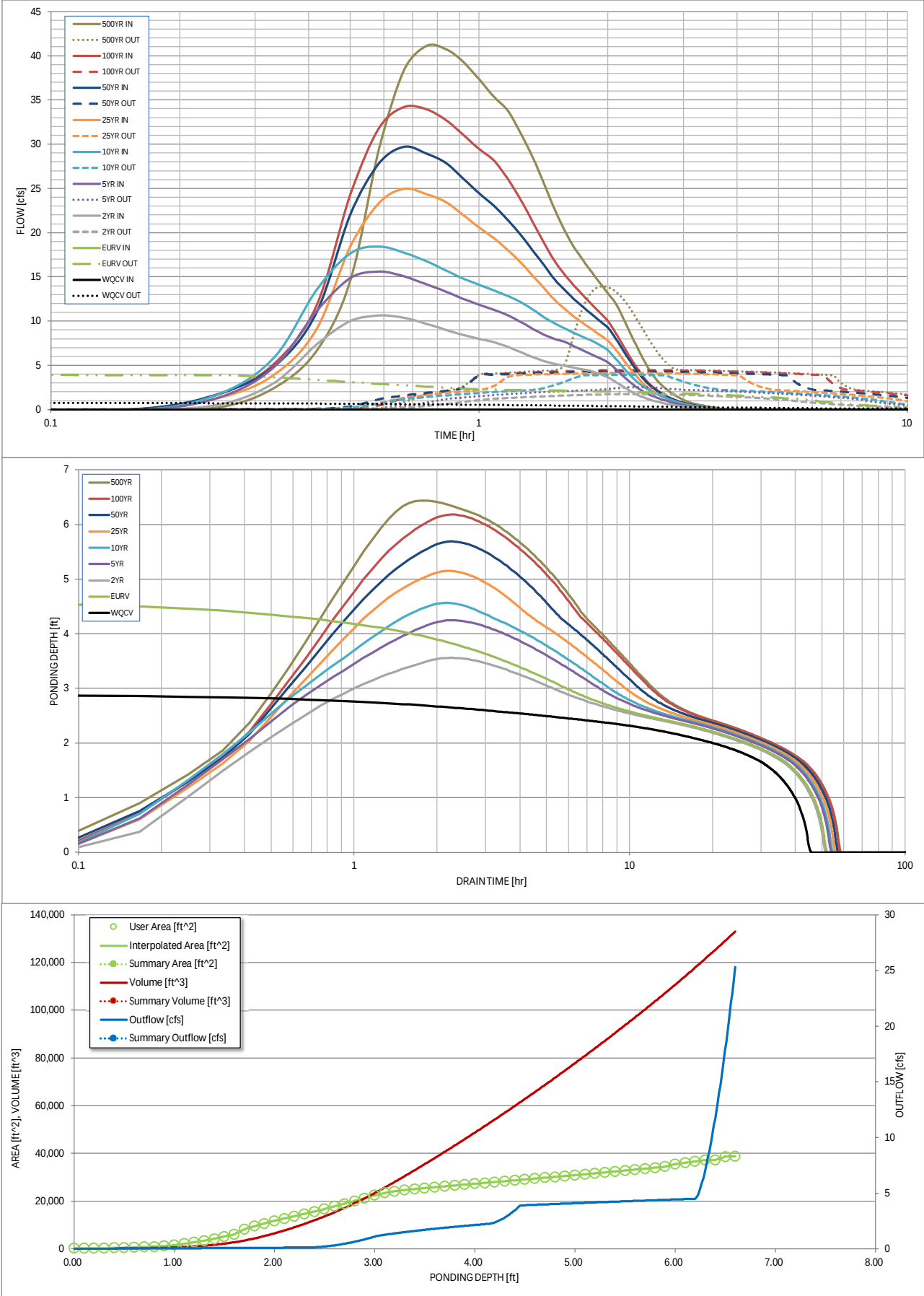
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

|                                                 | WQCV               | EURV           | 2 Year             | 5 Year          | 10 Year        | 25 Year        | 50 Year        | 100 Year       | 500 Year |
|-------------------------------------------------|--------------------|----------------|--------------------|-----------------|----------------|----------------|----------------|----------------|----------|
| Design Storm Return Period =                    | N/A                | N/A            | 0.99               | 1.39            | 1.64           | 1.98           | 2.31           | 2.60           | 3.08     |
| One-Hour Rainfall Depth (in) =                  | 0.481              | 1.512          | 1.094              | 1.632           | 1.976          | 2.479          | 2.950          | 3.380          | 4.070    |
| CUHP Runoff Volume (acre-ft) =                  | N/A                | N/A            | 1.094              | 1.632           | 1.976          | 2.479          | 2.950          | 3.380          | 4.070    |
| Inflow Hydrograph Volume (acre-ft) =            | N/A                | N/A            | 0.1                | 1.5             | 2.6            | 5.9            | 8.0            | 10.7           | 14.0     |
| CUHP Predevelopment Peak Q (cfs) =              | N/A                | N/A            |                    |                 |                |                |                |                |          |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A                | N/A            |                    |                 |                |                |                |                |          |
| Predevelopment Unit Peak Flow, q (cfs/acre) =   | N/A                | N/A            | 0.01               | 0.09            | 0.16           | 0.37           | 0.50           | 0.67           | 0.87     |
| Peak Inflow Q (cfs) =                           | N/A                | N/A            | 10.6               | 15.6            | 18.4           | 25.0           | 29.7           | 34.2           | 41.1     |
| Peak Outflow Q (cfs) =                          | 0.8                | 4.0            | 1.8                | 2.6             | 3.9            | 4.2            | 4.3            | 4.5            | 13.9     |
| Ratio Peak Outflow to Predevelopment Q =        | N/A                | N/A            | N/A                | 1.7             | 1.5            | 0.7            | 0.5            | 0.4            | 1.0      |
| Structure Controlling Flow =                    | Vertical Orifice 1 | Outlet Plate 1 | Vertical Orifice 1 | Overflow Weir 1 | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 1 | Spillway |
| Max Velocity through Gate 1 (fps) =             | N/A                | 0.23           | N/A                | 0.0             | 0.2            | 0.2            | 0.2            | 0.2            | 0.2      |
| Max Velocity through Gate 2 (fps) =             | N/A                | N/A            | N/A                | N/A             | N/A            | N/A            | N/A            | N/A            | N/A      |
| Time to Drain 97% of Inflow Volume (hours) =    | 40                 | 41             | 42                 | 42              | 41             | 40             | 39             | 39             | 36       |
| Time to Drain 99% of Inflow Volume (hours) =    | 43                 | 46             | 47                 | 48              | 48             | 48             | 48             | 49             | 48       |
| Maximum Ponding Depth (ft) =                    | 2.89               | 4.61           | 3.56               | 4.25            | 4.57           | 5.16           | 5.69           | 6.18           | 6.44     |
| Area at Maximum Ponding Depth (acres) =         | 0.49               | 0.68           | 0.59               | 0.65            | 0.67           | 0.72           | 0.77           | 0.84           | 0.87     |
| Maximum Volume Stored (acre-ft) =               | 0.481              | 1.515          | 0.850              | 1.277           | 1.488          | 1.893          | 2.296          | 2.689          | 2.902    |

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|-----------------------------|--------|-------------|--------------|
| minimum bound               |        |             |              |
| maximum bound               |        |             |              |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

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### Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

|               | SOURCE  | CUHP       | CUHP       | CUHP         | CUHP         | CUHP          | CUHP          | CUHP          | CUHP           | CUHP           |
|---------------|---------|------------|------------|--------------|--------------|---------------|---------------|---------------|----------------|----------------|
| Time Interval | TIME    | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min      | 0:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 0:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 0:10:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.16          | 0.06           | 0.35           |
|               | 0:15:00 | 0.00       | 0.00       | 0.63         | 1.49         | 1.91          | 1.40          | 1.92          | 1.86           | 2.53           |
|               | 0:20:00 | 0.00       | 0.00       | 3.10         | 4.93         | 6.00          | 4.02          | 4.98          | 5.28           | 6.67           |
|               | 0:25:00 | 0.00       | 0.00       | 7.35         | 11.15        | 13.54         | 9.09          | 10.98         | 11.78          | 14.56          |
|               | 0:30:00 | 0.00       | 0.00       | 10.01        | 14.88        | 17.68         | 18.42         | 22.05         | 24.26          | 29.39          |
|               | 0:35:00 | 0.00       | 0.00       | 10.64        | 15.62        | 18.44         | 23.34         | 27.83         | 31.82          | 38.32          |
|               | 0:40:00 | 0.00       | 0.00       | 10.42        | 15.10        | 17.79         | 24.98         | 29.71         | 34.21          | 41.10          |
|               | 0:45:00 | 0.00       | 0.00       | 9.75         | 14.21        | 16.82         | 24.40         | 28.99         | 33.98          | 40.80          |
|               | 0:50:00 | 0.00       | 0.00       | 9.07         | 13.40        | 15.79         | 23.51         | 27.92         | 32.79          | 39.35          |
|               | 0:55:00 | 0.00       | 0.00       | 8.48         | 12.56        | 14.84         | 22.04         | 26.18         | 31.10          | 37.32          |
|               | 1:00:00 | 0.00       | 0.00       | 8.02         | 11.88        | 14.12         | 20.58         | 24.44         | 29.45          | 35.34          |
|               | 1:05:00 | 0.00       | 0.00       | 7.64         | 11.28        | 13.49         | 19.39         | 23.03         | 28.16          | 33.79          |
|               | 1:10:00 | 0.00       | 0.00       | 7.10         | 10.68        | 12.85         | 18.05         | 21.43         | 26.06          | 31.27          |
|               | 1:15:00 | 0.00       | 0.00       | 6.53         | 9.95         | 12.18         | 16.68         | 19.82         | 23.78          | 28.56          |
|               | 1:20:00 | 0.00       | 0.00       | 5.97         | 9.17         | 11.36         | 15.18         | 18.03         | 21.25          | 25.53          |
|               | 1:25:00 | 0.00       | 0.00       | 5.51         | 8.49         | 10.46         | 13.76         | 16.33         | 18.87          | 22.67          |
|               | 1:30:00 | 0.00       | 0.00       | 5.20         | 8.02         | 9.77          | 12.41         | 14.74         | 16.82          | 20.21          |
|               | 1:35:00 | 0.00       | 0.00       | 4.96         | 7.66         | 9.20          | 11.38         | 13.52         | 15.27          | 18.36          |
|               | 1:40:00 | 0.00       | 0.00       | 4.75         | 7.19         | 8.69          | 10.52         | 12.49         | 14.02          | 16.85          |
|               | 1:45:00 | 0.00       | 0.00       | 4.56         | 6.70         | 8.21          | 9.77          | 11.59         | 12.90          | 15.50          |
|               | 1:50:00 | 0.00       | 0.00       | 4.36         | 6.23         | 7.77          | 9.08          | 10.77         | 11.88          | 14.28          |
|               | 1:55:00 | 0.00       | 0.00       | 4.01         | 5.80         | 7.28          | 8.43          | 9.99          | 10.92          | 13.12          |
|               | 2:00:00 | 0.00       | 0.00       | 3.64         | 5.33         | 6.70          | 7.80          | 9.25          | 10.01          | 12.02          |
|               | 2:05:00 | 0.00       | 0.00       | 3.14         | 4.61         | 5.78          | 6.78          | 8.03          | 8.67           | 10.41          |
|               | 2:10:00 | 0.00       | 0.00       | 2.63         | 3.85         | 4.83          | 5.70          | 6.75          | 7.28           | 8.74           |
|               | 2:15:00 | 0.00       | 0.00       | 2.15         | 3.14         | 3.95          | 4.67          | 5.53          | 5.96           | 7.15           |
|               | 2:20:00 | 0.00       | 0.00       | 1.73         | 2.53         | 3.21          | 3.76          | 4.44          | 4.77           | 5.72           |
|               | 2:25:00 | 0.00       | 0.00       | 1.40         | 2.05         | 2.62          | 2.96          | 3.50          | 3.72           | 4.47           |
|               | 2:30:00 | 0.00       | 0.00       | 1.15         | 1.70         | 2.19          | 2.35          | 2.78          | 2.91           | 3.50           |
|               | 2:35:00 | 0.00       | 0.00       | 0.96         | 1.42         | 1.83          | 1.91          | 2.26          | 2.32           | 2.79           |
|               | 2:40:00 | 0.00       | 0.00       | 0.80         | 1.19         | 1.53          | 1.55          | 1.84          | 1.86           | 2.23           |
|               | 2:45:00 | 0.00       | 0.00       | 0.66         | 0.98         | 1.26          | 1.26          | 1.49          | 1.48           | 1.78           |
|               | 2:50:00 | 0.00       | 0.00       | 0.55         | 0.81         | 1.04          | 1.02          | 1.20          | 1.17           | 1.41           |
|               | 2:55:00 | 0.00       | 0.00       | 0.45         | 0.66         | 0.85          | 0.82          | 0.97          | 0.92           | 1.11           |
|               | 3:00:00 | 0.00       | 0.00       | 0.37         | 0.54         | 0.69          | 0.66          | 0.78          | 0.73           | 0.88           |
|               | 3:05:00 | 0.00       | 0.00       | 0.31         | 0.44         | 0.56          | 0.54          | 0.64          | 0.59           | 0.72           |
|               | 3:10:00 | 0.00       | 0.00       | 0.25         | 0.35         | 0.45          | 0.44          | 0.52          | 0.48           | 0.58           |
|               | 3:15:00 | 0.00       | 0.00       | 0.20         | 0.28         | 0.36          | 0.35          | 0.41          | 0.39           | 0.47           |
|               | 3:20:00 | 0.00       | 0.00       | 0.15         | 0.21         | 0.28          | 0.27          | 0.32          | 0.31           | 0.37           |
|               | 3:25:00 | 0.00       | 0.00       | 0.11         | 0.16         | 0.21          | 0.21          | 0.24          | 0.23           | 0.28           |
|               | 3:30:00 | 0.00       | 0.00       | 0.08         | 0.11         | 0.15          | 0.15          | 0.18          | 0.17           | 0.21           |
|               | 3:35:00 | 0.00       | 0.00       | 0.05         | 0.08         | 0.10          | 0.11          | 0.12          | 0.12           | 0.14           |
|               | 3:40:00 | 0.00       | 0.00       | 0.03         | 0.05         | 0.06          | 0.07          | 0.08          | 0.08           | 0.09           |
|               | 3:45:00 | 0.00       | 0.00       | 0.02         | 0.03         | 0.03          | 0.04          | 0.04          | 0.04           | 0.05           |
|               | 3:50:00 | 0.00       | 0.00       | 0.01         | 0.01         | 0.01          | 0.02          | 0.02          | 0.02           | 0.02           |
|               | 3:55:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.01           |
|               | 4:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:10:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
| 4:15:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:20:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:25:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:30:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:35:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:40:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:45:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:50:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:55:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:00:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:05:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:10:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:15:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:20:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:25:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:30:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:35:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:40:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:45:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:50:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:55:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 6:00:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |

## APPENDIX B

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Town of Parker

Parker and Pine

Filing 1

Parker and Pine  
Final Drainage Report

APRIL 2020 | VERSION 1

Prepared By:

**Kimley»Horn**

4582 South Ulster Street, Suite 1500

Denver, CO 80237

## CERTIFICATION

### ENGINEERS STATEMENT

*This report for the final design of Parker and Pine Development was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.*



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Signature

*Daniel L. Skeehan, P.E.*

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Colorado P.E. License No. 46391



04/24/2020

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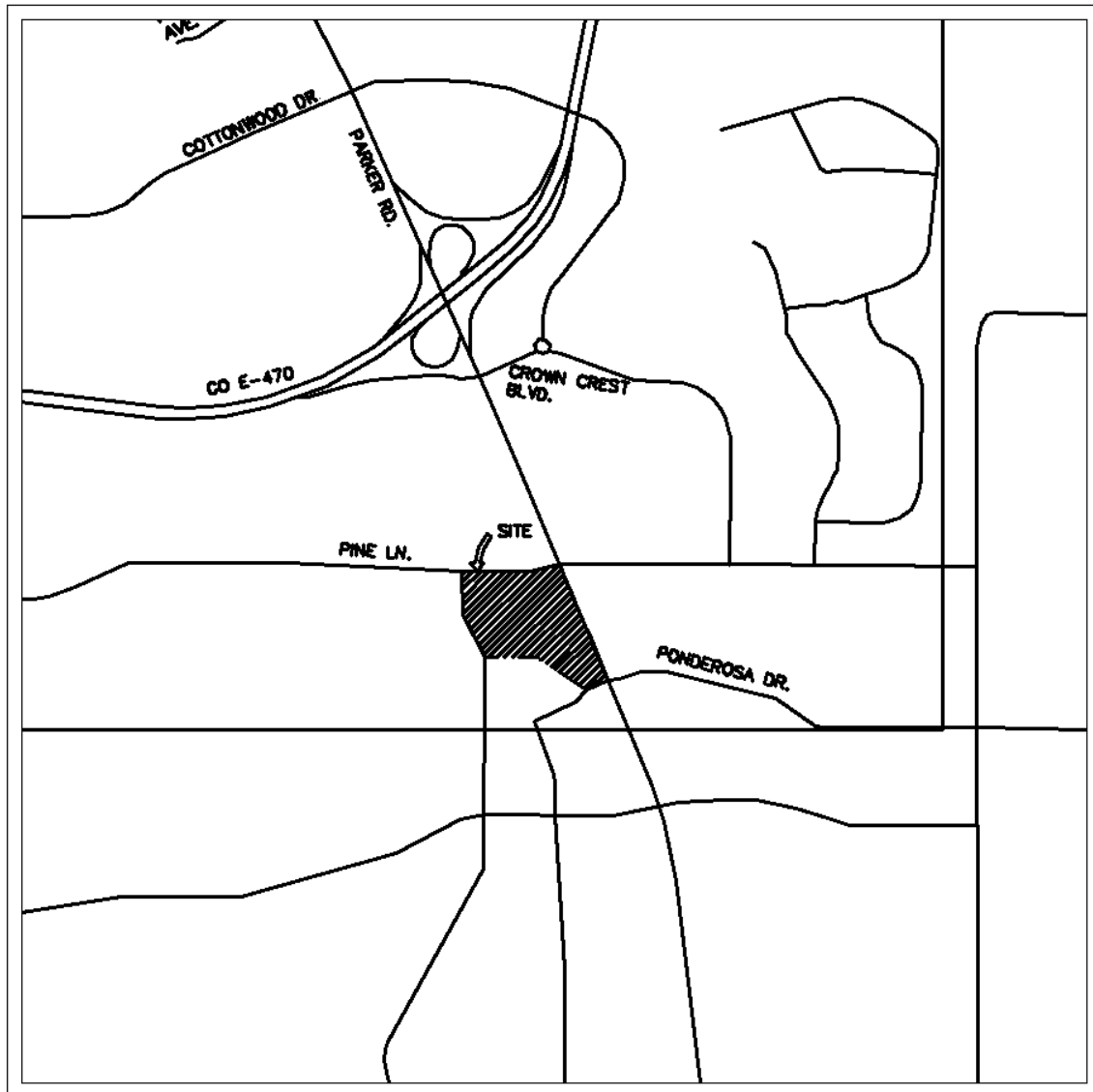
Seal and Date



## TABLE OF CONTENTS

|                                                            |           |
|------------------------------------------------------------|-----------|
| <b>CERTIFICATION .....</b>                                 | <b>1</b>  |
| ENGINEERS STATEMENT .....                                  | 1         |
| <b>VICINITY MAP.....</b>                                   | <b>3</b>  |
| <b>GENERAL LOCATION AND DESCRIPTION.....</b>               | <b>3</b>  |
| LOCATION.....                                              | 4         |
| DESCRIPTION OF PROPERTY .....                              | 4         |
| DESCRIPTION OF PROJECT.....                                | 4         |
| <b>DRAINAGE BASINS AND SUB-BASINS.....</b>                 | <b>4</b>  |
| MAJOR DRAINAGE BASIN DESCRIPTION .....                     | 5         |
| <b>DRAINAGE DESIGN CRITERIA .....</b>                      | <b>5</b>  |
| REGULATIONS.....                                           | 5         |
| DEVELOPMENT DESIGN CRITERIA REFERENCE AND CONSTRAINTS..... | 5         |
| HYDROLOGIC CRITERIA.....                                   | 6         |
| HYDRAULIC CRITERIA.....                                    | 6         |
| <b>DRAINAGE FACILITY DESIGN.....</b>                       | <b>6</b>  |
| GENERAL CONCEPT.....                                       | 6         |
| SUB-BASIN DESCRIPTION .....                                | 7         |
| DETAINED SUB-BASINS .....                                  | 9         |
| <i>Sub-Basins 1.1 – 18</i> .....                           | 9         |
| UNDETAINED SUB-BASINS.....                                 | 10        |
| <i>Sub-Basins 19, 20</i> .....                             | 10        |
| PARKER AUTO PLAZA FINAL DRAINAGE REPORT COMPLIANCE .....   | 11        |
| FLOODPLAIN DEVELOPMENT PERMIT .....                        | 11        |
| <b>ENVIRONMENTAL PROTECTION CRITERIA .....</b>             | <b>11</b> |
| GENERAL.....                                               | 11        |
| CONSTRUCTION BMP PLAN.....                                 | 11        |
| PERMANENT BMP PLAN .....                                   | 11        |
| <b>CONCLUSIONS .....</b>                                   | <b>12</b> |
| COMPLIANCE WITH STANDARDS .....                            | 12        |
| DRAINAGE CONCEPT .....                                     | 12        |
| SEDIMENT AND EROSION CONTROL CONCEPT .....                 | 12        |
| <b>REFERENCES.....</b>                                     | <b>13</b> |
| <b>APPENDIX.....</b>                                       | <b>14</b> |

## VICINITY MAP



## VICINITY MAP

1"=2,000'

## GENERAL LOCATION AND DESCRIPTION

The purpose of this report is to outline the drainage plan for the Parker and Pine Development located between Twenty Mile Road and Parker Road, south of Pine Lane in the Town of Parker, County of Douglas, State of Colorado (herein the "Project").

## **LOCATION**

The proposed Parker and Pine Development lies within 1 parcel of land, located in the southeast quarter of Section 9 and a part of the northeast quarter of section 16 within Township 6 South, Range 66 West of the Sixth Principal Meridian, Town of Parker, County of Douglas, State of Colorado (see Vicinity Map). South Parker Road (State Highway No. 83) borders the project to the east, Pine Lane borders the project to the north, and Twenty Mile Road to the west. An existing detention pond and Baldwin Gulch abut the project to the south. The Site is currently vacant.

## **DESCRIPTION OF PROPERTY**

The Project Site is 15.952 acres in size, a majority of which is currently native grass and overgrown vegetation. The project slopes from east to west from an elevation of  $\pm 5820$  feet on the east side to an elevation of  $\pm 5783$  feet on the west side at a slope of about 3.5%. There is a flat area in the southeast corner of the property at an elevation of  $\pm 5811$  feet that prevents a portion of the site from flowing west. This southeast corner of the site flows south, directly into Baldwin Gulch.

Soils onsite are generally USCS Type BrD, Lo, and Sa as verified by the soil survey included in Appendix A. There are 4 existing storm sewer inlets adjacent to the property. The proposed site conditions will convey stormwater to the existing detention pond via overland sheet flows and a proposed underground storm drain system. Currently, there are no storm inlets or detention facility improvements located on the site. The existing site conditions sheet flow to an existing off-site detention basin and ultimately discharge into Baldwin Gulch.

Water quality treatment is provided by means of an extended detention basin with a water quality outlet structure. The existing detention basin is located adjacent to Baldwin Gulch on the southwest side of the Site. The controlled WQCV, EURV, and 100-year release will outfall to Baldwin Gulch.

## **DESCRIPTION OF PROJECT**

The Project involves the construction of interior streets, vacant lots with native seeding, and utility mains including storm sewer infrastructure intended to convey flows for the phased site development. Modifications to an existing stormwater pond south of the site to current code is also in the scope of the project.

## **DRAINAGE BASINS AND SUB-BASINS**

The Project falls within the limits of the “Parker Auto Plaza Final Drainage Report” (FDR), prepared by Kiowa Engineering Corporation dated July 12, 2004 and included in Appendix F, as part of the Parker Auto Plaza development. The Project will ensure that the requirements of the FDR are met. For a detailed look at the requirements and how they are met, refer to the “Existing Parker Auto Plaza Storm Sewer Requirements” of this report.

The FDR provides design for the overall development of approximately 52.7 acres. The Project includes sub-basins 1A, 2A, 3A and 4A from the FDR which total to 13.95 acres. The drainage map from the Parker Auto Plaza FDR is included in Appendix F. Portions of sub-basins 1C and 5C from the FDR are also included in the Project site as part of detained sub-basins. The Project also captures offsite runoff from approximately 0.33 acres between the property line on the east

side of the Project and the existing sidewalk in the right of way along South Parker Road. Runoff from basins 1A-4A were planned to be conveyed to the detention basin (noted as sub-basin 5A in the FDR) via an underground storm sewer system that has not been implemented. Sub-basins 1C and 5C were planned to flow directly into Baldwin Gulch via grassed swales and a separate storm sewer system. The Project detains runoff from a total of 15.81 acres, which includes the entirety of FDR sub-basins 1A, 2A, 3A and 5A, a majority of FDR sub-basins 4A and 1C, and approximately a third of FDR sub-basin 5C.

### **MAJOR DRAINAGE BASIN DESCRIPTION**

Baldwin Gulch is mapped as a Zone AE, which is defined by FEMA as 'Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods' The existing FEMA Flood Insurance Rate Map (FIRM) is number 08035C0067G, effective date March 16, 2016.

The current FIRM Panel shows no portion of the subject property to be located within the 100-year floodplain; however, Baldwin Gulch is designated as a major drainageway by UDFCD. There are no planned improvements to the existing Baldwin Gulch.

The FIRM panel referenced above is included in Appendix B1. The overall drainage basin is mostly developed. The proposed development is ultimately tributary to Cherry Creek. Drainage facilities are provided to allow drainage into the detention pond on the southwest corner of the Site and ultimately discharging into Baldwin Gulch. The proposed Site consists of twenty-two (22) on-site drainage basins. Twenty (20) drainage basins are conveyed to the detention pond via overland flow or by storm sewer. There are 0.34 acres of off-site runoff included within the twenty (20) on-site basins that drain onsite and are conveyed to the existing detention pond via storm sewer. More specifically, sub-basins 3.0, 5.0, 7.0, 8.0, and 15.0 all account for portions of the off-site runoff totaling to 0.34 acres. Two (2) of the twenty-two (22) onsite drainage basins (sub-basins 19.0 and 20.0) drain overland into Pine Lane and Twenty Mile Road, mimicking conditions which currently exist onsite. One (1) of the twenty-two (22) drainage basins (sub-basin 18.0) drains directly into Baldwin Gulch, mimicking conditions which currently exist onsite. The existing detention pond discharges into Baldwin Gulch.

## **DRAINAGE DESIGN CRITERIA**

### **REGULATIONS**

There are no deviations from the Town of Parker and UDFCD floodplain regulations.

### **COMPLIANCE WITH TOWN'S STREAM PRESERVATION STANDARDS**

There are no existing stream buffers within the Project area. Baldwin Gulch is preserved with no drainage upgrades required to maintain compliance with Town of Parker and UDFCD regulations.

### **DEVELOPMENT DESIGN CRITERIA REFERENCE AND CONSTRAINTS**

The FIRM panel cited in the Major Drainage Basin Description Section shows no portion of the

Site to be located within the 100-year floodplain. The proposed storm facilities are in compliance with the Town of Parker Storm Drainage and Environmental Criteria Manual (the "CRITERIA") and the Urban Storm Drainage Criteria Manual (the "MANUAL"). Site drainage is not significantly impacted by such constraints as utilities or existing development.

The proposed approach includes pipe flow into an existing detention pond. Additional detail regarding onsite drainage patterns is provided in the Drainage Facility Design Section.

### **HYDROLOGIC CRITERIA**

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per Table 2.3 of the CRITERIA. Table 5.1 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table RO-5 of the MANUAL by calculating weighted impervious values for each specific site basin. The detention storage requirement was calculated using the same method and formulae used by Kiowa Engineering Corporation in the Parker Auto Plaza FDR.

An existing orifice plate placed in the first bay of a drop box outlet (Figure 2 of the Parker Auto Plaza FDR, UDFCD, Typical WQCV Outlet Structure Profiles) controls the release rate for the 10-year event. An orifice plate mounted to the second bay wall of the detention basin outlet structure controls the 100-year release rate. The release of flow is limited to 3.6 cubic feet per second (cfs) in the 10-year event and 13.1 cfs in the 100-year event. Flows from this existing detention basin discharge directly into Baldwin Gulch, and limited modifications (replacing existing orifice plate) to the existing outlet structure are being proposed.

### **HYDRAULIC CRITERIA**

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA.

Hydrologic and hydraulic calculations are summarized in Appendix D.

## **DRAINAGE FACILITY DESIGN**

### **GENERAL CONCEPT**

The Project consists of interior streets, vacant lots with native seeding, and utility mains including storm sewer infrastructure intended to convey flows for the phased site development.

The Project provides water quality treatment by means of an existing water quality outlet structure and detention through an existing surface detention pond for the entirety of the site. The detention pond outfalls to Baldwin Gulch. Improvements to the pond will consist of a proposed forebay, trickle channel, and access road.

The Site has been divided into twenty-two (22) sub-basins, sub-basins 1.1 through 20.0, which represent small sub-basins that are tributary to the adjacent right-of-way and Baldwin Gulch which mimics current site conditions. Ultimately the developed runoff is conveyed downstream to the existing detention pond. Further information regarding the basins and drainage patterns

can be found in Appendix C.

### ***SUB-BASIN DESCRIPTION***

Sub-basin 1.1 is 1.43 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter Storm Stub 1.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 4.93 and 10.37 for the 5-year and 100-year storm, respectively. If Storm Stub 1.1 were to plug, the runoff for the basin would flow east onto sub-basin 9.0 and drain into inlet A04.

Sub-basin 1.2 is 1.97 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B01 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 6.77 and 14.25 for the 5-year and 100-year storm, respectively. If inlet B01 were to plug, the runoff for the basin would flow south onto sub-basin 13.0 and drain into inlet B00.

Sub-basin 2.0 is 0.88 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet C00.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.00 and 6.33 for the 5-year and 100-year storm, respectively. If inlet C00.1 were to plug, the runoff for the basin would flow south onto sub-basin 10.0 and drain into inlet C00.

Sub-basin 3.0 is 1.97 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet C01.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 6.80 and 14.29 for the 5-year and 100-year storm, respectively. If inlet C01.1 were to plug, the runoff for the basin would flow south and drain onto sub-basin 11.0 and drain into inlet C01.

Sub-basin 4.1 is 1.14 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B02 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.91 and 8.23 for the 5-year and 100-year storm, respectively. If inlet B02 were to plug, the runoff for the basin would flow south onto sub-basin 16.0 and drain into inlet A01.

Sub-basin 4.2 is 0.77 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter Storm Stub 4.2 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 2.65 and 5.56 for the 5-year and 100-year storm, respectively. If inlet Storm Stub 4.2 were to plug, the runoff for the basin would flow south onto sub-basin 14.0 and drain into inlet B03.

Sub-basin 5.0 is 1.13 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B05.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.89 and 8.18 for the 5-year and 100-year storm, respectively. If inlet B05.1 were to plug, the runoff for the basin would flow south onto sub-basin 15 and drain into inlet B05.

Sub-basin 6.0 is 2.22 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter via a connection to manhole D01 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 7.62 and 16.06 for the 5-year and 100-year storm, respectively. If the connection to manhole D01 were to clog, the runoff for the basin would flow south directly into Baldwin Gulch.

Sub-basin 7.0 is 1.02 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B07.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.48 and 7.35 for the 5-year and 100-year storm, respectively. If inlet B07.1 were to plug, the runoff for the basin would flow south onto sub-basin 17 and drain into inlet B08.

Sub-basin 8.0 is 1.94 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B08.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 6.13 and 12.90 for the 5-year and 100-year storm, respectively. If inlet B08.1 were to plug, the runoff for the basin would flow west onto sub-basin 17 and drain into inlet B08.

Sub-basin 9.0 is 0.10 acres consisting of streets, curb, and gutter. Runoff will enter inlet A04 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.42 and 0.81 for the 5-year and 100-year storm, respectively. If the inlet were to plug, the runoff for the basin would flow south onto sub-basin 12 and drain into inlet A02.

Sub-basin 10.0 is 0.16 acres consisting of streets, curb, and gutter. Runoff will enter inlet C00 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.65 and 1.26 for the 5-year and 100-year storm, respectively. If inlet C00 were to plug, the runoff for the basin would flow west onto sub-basin 12 and drain into inlet A02.

Sub-basin 11.0 is 0.21 acres consisting of streets, curb, and gutter. Runoff will enter inlet C01 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.86 and 1.66 for the 5-year and 100-year storm, respectively. If inlet C01 were to plug, the runoff for the basin would flow west onto sub-basin 10 and drain into inlet C00.

Sub-basin 12.0 is 0.14 acres consisting of streets, curb, and gutter. Runoff will enter inlet A02 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.57 and 1.09 for the 5-year and 100-year storm, respectively. If inlet A02 were to plug, the runoff for the basin would flow south into sub-basin 16.0 and drain into inlet A01.

Sub-basin 13.0 is 0.08 acres consisting of streets, curb, and gutter. Runoff will enter inlet B00 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.32 and 0.62 for the 5-year and 100-year storm, respectively. If inlet B00 were to plug, the runoff for the basin would flow south and west onto sub-basin 19, flowing offsite following its historic path.

Sub-basin 14.0 is 0.17 acres consisting of streets, curb, and gutter. Runoff will enter inlet B03 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.67 and 1.30 for the 5-year and 100-year storm, respectively. If inlet B03 were to plug, the runoff for the basin would flow west onto sub-basin 16.0 and drain into inlet A01.

Sub-basin 15.0 is 0.18 acres consisting of streets, curb, and gutter. Runoff will enter inlet B05 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.72 and 1.40 for the 5-year and 100-year storm, respectively. If inlet B05 were to plug, the runoff for the basin would flow west onto sub-basin 17 and drain into inlet B08.

Sub-basin 16.0 is 0.17 acres consisting of streets, curb, and gutter. Runoff will be conveyed to



inlet A01 and outfall into Pond 1 through future private underground storm sewer. The runoff coefficients for this sub-basin are 0.67 and 1.30 for the 5-year and 100-year storm, respectively. This sub-basin will sheet flow directly into Pond 1.

Sub-basin 17.0 is 0.11 acres consisting of streets, curb, and gutter. Runoff will enter inlet B08 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.45 and 0.87 for the 5-year and 100-year storm, respectively.

Sub-basin 18.0 is 0.39 acres consisting of landscaping. Runoff will sheet flow to Baldwin Gulch, following its historic path. The runoff coefficients for this sub-basin are 1.59 and 3.09 for the 5-year and 100-year storm, respectively.

Sub-basin 19.0 is 0.11 acres consisting of streets, curb, and gutter. Runoff will flow onto Twenty Mile Road, following its historic path. The runoff coefficients for this sub-basin are 0.45 and 0.88 for the 5-year and 100-year storm, respectively.

Sub-basin 20.0 is 0.03 acres consisting of streets, curb, and gutter. Runoff will flow onto Pine Lane, following its historic path. The runoff coefficients for this sub-basin are 0.11 and 0.22 for the 5-year and 100-year storm, respectively.

Runoff from the proposed development will generally be collected by means of curb and gutter in the paved driveways and access roads within each delineated basin area. The runoff collected from each basin will be conveyed to the existing detention pond at the southwest corner of the Site. The controlled stormwater release from the detention and water quality structures will be conveyed through the existing outlet structure into Baldwin Gulch.

There are two (2) drainage basins (0.14 acres) of the Project Site that drain off-site, following their historic paths. Sub-basins 19.0 & 20.0 drain into the adjacent right-of way to the North and West. These drainage basins represent the landscape area between the perimeter buildings and the adjacent roadways (Twenty Mile Road to the west and Pine Lane to the north).

## ***DETAINED SUB-BASINS***

### **Sub-Basins 1.1 – 18.0**

Sub-basins 1.1-18.0 are bound between Twenty Mile Road, Pine Lane and Baldwin Gulch. Some sub-basins being detained on-site include a total of 0.34 acres of off-site runoff. Sub-basins 3.0, 5.0, 7.0, 8.0, and 15.0 all account for portions of the off-site runoff being detained on-site. Each sub-basin contains a combination of paved areas, landscaping and streets. Overland flows will be directed to catch basins throughout the site. Curb inlets and grate inlets have been designed to accommodate the 100-yr storm. The landscaping areas overland flow to grate inlets or curb and gutter within each respective sub-basin. Runoff from the sub-basins is conveyed through an underground storm sewer system to the existing detention pond on the southwest corner of the site.

Refer to Table 1 for a summary of areas and post-development flows for the detained sub-basins.



**Table 1. Runoff Summary for All Detained Sub-Basins**

| <b>Runoff Summary</b> |      |                |                  |
|-----------------------|------|----------------|------------------|
| BASIN ID              | AREA | Q <sub>5</sub> | Q <sub>100</sub> |
|                       | Ac   | CFS            | CFS              |
| 1.1                   | 1.43 | 4.93           | 10.37            |
| 1.2                   | 1.97 | 6.77           | 14.25            |
| 2.0                   | 0.88 | 3.00           | 6.33             |
| 3.0                   | 1.97 | 6.80           | 14.29            |
| 4.1                   | 1.14 | 3.91           | 8.23             |
| 4.2                   | 0.77 | 2.65           | 5.56             |
| 5.0                   | 1.13 | 3.89           | 8.18             |
| 6.0                   | 2.22 | 7.62           | 16.06            |
| 7.0                   | 1.02 | 3.48           | 7.35             |
| 8.0                   | 1.94 | 6.13           | 12.90            |
| 9.0                   | 0.10 | 0.42           | 0.81             |
| 10.0                  | 0.16 | 0.65           | 1.26             |
| 11.0                  | 0.21 | 0.86           | 1.66             |
| 12.0                  | 0.14 | 0.57           | 1.09             |
| 13.0                  | 0.08 | 0.32           | 0.62             |
| 14.0                  | 0.17 | 0.67           | 1.30             |
| 15.0                  | 0.18 | 0.72           | 1.40             |
| 16.0                  | 0.17 | 0.67           | 1.30             |
| 17.0                  | 0.11 | 0.45           | 0.87             |
| 18.0                  | 0.39 | 1.59           | 3.09             |

## **UNDETAINED SUB-BASINS**

### **Sub-Basins 19.0, and 20.0**

Sub-basins 19.0, and 20.0 are a total of 0.14 acres in size and are not detained. These sub-basins follow their historic flows onto the public right of way and into Baldwin Gulch.

**Table 2. Runoff Summary for Undetained Sub-Basins**

| <b>Runoff Summary</b> |      |                |                  |
|-----------------------|------|----------------|------------------|
| BASIN ID              | AREA | Q <sub>5</sub> | Q <sub>100</sub> |
|                       | Ac   | CFS            | CFS              |
| 19.0                  | 0.11 | 0.45           | 0.88             |
| 20.0                  | 0.03 | 0.11           | 0.22             |

## ***PARKER AUTO PLAZA FINAL DRAINAGE REPORT COMPLIANCE***

The Parker Auto Plaza Final Drainage Report, dated July 12, 2004 was prepared as part of the Parker Auto Plaza Development by Kiowa Engineering Corporation.

The FDR extended detention basin is sized to store 15.45 acres of a proposed 95% impervious site. The Project extended detention basin will actually detain 15.81 acres of the proposed 85% impervious site.

The existing detention basin was sized based on a required 10-year and 100-year capacity of 2.06 ac-ft and 2.97 ac-ft, respectively. The Project site only requires 1.26 ac-ft and 2.13 ac-ft for the 10-year and 100-year capacities, respectively. The Project's required volumes were calculated to include WQCV capture volume. Based on this approach, the drainage design provided for the Project is in keeping with the Parker Auto Plaza FDR. Appendix D5 shows the calculations for the required 10-year and 100-year storage capacities for proposed development configuration.

## ***FLOODPLAIN DEVELOPMENT PERMIT***

A floodplain development permit from the Town of Parker is not required.

## **ENVIRONMENTAL PROTECTION CRITERIA**

### ***GENERAL***

The Site is influenced by Baldwin Gulch. Baldwin Gulch is in the Town of Parker and Urban Drainage and Flood Control District jurisdictions. No impacts to threatened or endangered species are anticipated as a result of the Project, and the Project is understood to comply with the State and Federal environmental permitting regulations.

### ***CONSTRUCTION BMP PLAN***

Construction BMPs will be used throughout the redevelopment of the Site in order to comply with section 8.2 of the CRITERIA. Construction BMPs implemented onsite include temporary sediment basins, diversion ditches, silt fence and construction fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area. The full list of construction BMPs to be implemented is shown on sheets C3.0- C3.11 of the Project's Civil Construction Documents.

### ***PERMANENT BMP PLAN***

The permanent plan to implement BMPs was designed in accordance with section 8.3 of the CRITERIA. For this Tier 3 redevelopment according to the CRITERIA, the primary permanent BMP that will be implemented is the existing detention pond for the Site drainage. The pond will satisfy the requirements for the permanent BMPs onsite.

## **CONCLUSIONS**

### ***COMPLIANCE WITH STANDARDS***

The drainage design presented within this report conforms to the Town of Parker Storm Drainage and Environmental Criteria Manual. The major drainageway in the area, Baldwin Gulch, will not be adversely affected by the Project, and the Project meets Urban Drainage and Flood Control District requirements.

### ***DRAINAGE CONCEPT***

The drainage design discussed herein effectively controls the storm runoff from the Project by conveying developed runoff to the detention pond at the southwest portion of the Site. The proposed 10-year and 100-year volume requirements fall below the Parker Auto Plaza FDR's 10-year and 100-year volume requirements, to which the existing detention pond was designed. The existing outlet structure and release rates will not be modified as part of the proposed development. The released drainage from the pond is carried through a storm sewer and outfalls into Baldwin Gulch.

### ***SEDIMENT AND EROSION CONTROL CONCEPT***

The Construction BMP plans are designed to prevent erosion within the Site during and after construction. BMPs are in place to prevent erosion during construction including a temporary sediment basin, diversion ditch, silt fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area. The forebay structure will prevent erosion at the bottom of the pond. Furthermore, the proposed concrete trickle channels within the pond will prevent erosion in the permanent condition.

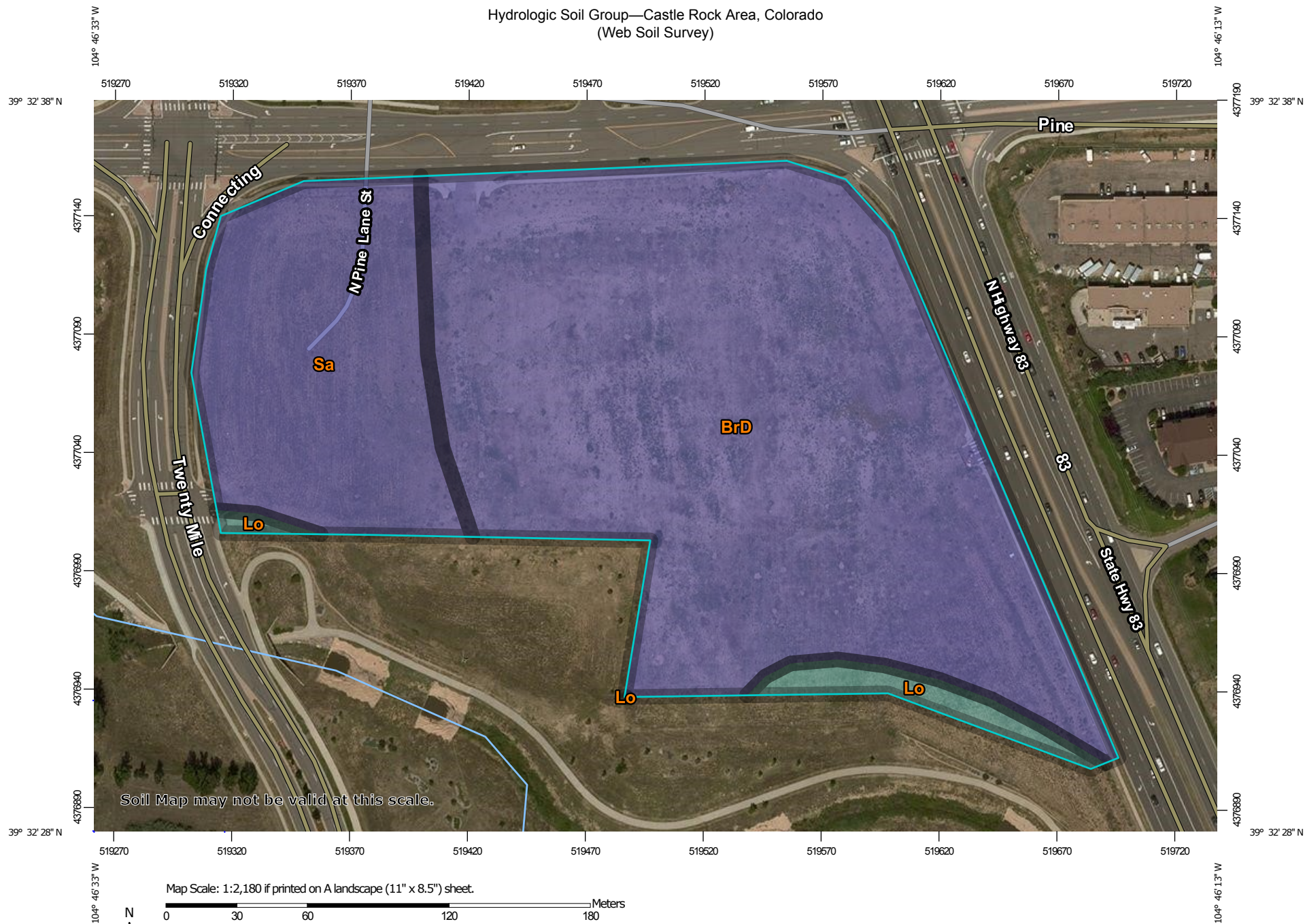
## REFERENCES

1. Town of Parker Storm Drainage and Environmental Criteria Manual, February 1996, Revised and Adopted February 2014.
2. Urban Drainage and Flood Control District Drainage Criteria Manual (UDFCDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.
3. Flood Insurance Rate Map, Douglas County, Colorado and Incorporated Areas, Map Number 08035C0067G, Revised March 16, 2016, prepared by the Federal Emergency Management Agency (FEMA).
4. Parker Auto Plaza Final Drainage Report, July 12, 2004, prepared by Kiowa Engineering Corporation.

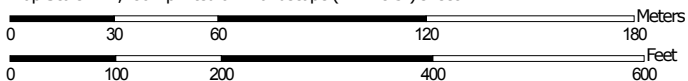
## APPENDIX

***APPENDIX A - HYDROLOGIC SOIL GROUP MAP***

# Hydrologic Soil Group—Castle Rock Area, Colorado (Web Soil Survey)



Map Scale: 1:2,180 if printed on A landscape (11" x 8.5") sheet.



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



**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

7/5/2017  
Page 1 of 4



# Hydrologic Soil Group—Castle Rock Area, Colorado (Web Soil Survey)

## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

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

#### Soil Rating Lines

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

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado  
 Survey Area Data: Version 9, Sep 22, 2016

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

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

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



## Hydrologic Soil Group

| Hydrologic Soil Group— Summary by Map Unit — Castle Rock Area, Colorado (CO622) |                                                 |        |              |                |
|---------------------------------------------------------------------------------|-------------------------------------------------|--------|--------------|----------------|
| Map unit symbol                                                                 | Map unit name                                   | Rating | Acres in AOI | Percent of AOI |
| BrD                                                                             | Bresser sandy loam, cool, 5 to 9 percent slopes | B      | 11.2         | 73.8%          |
| Lo                                                                              | Loamy alluvial land                             | C      | 0.5          | 3.3%           |
| Sa                                                                              | Sampson loam                                    | B      | 3.5          | 22.9%          |
| <b>Totals for Area of Interest</b>                                              |                                                 |        | <b>15.2</b>  | <b>100.0%</b>  |

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

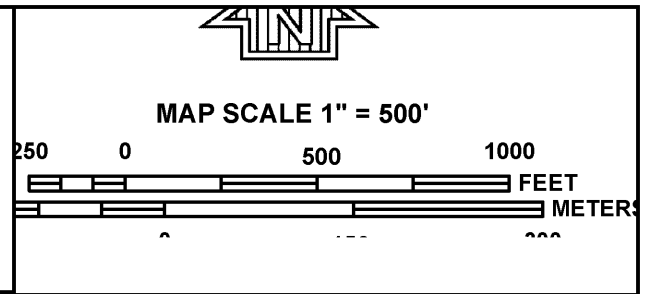
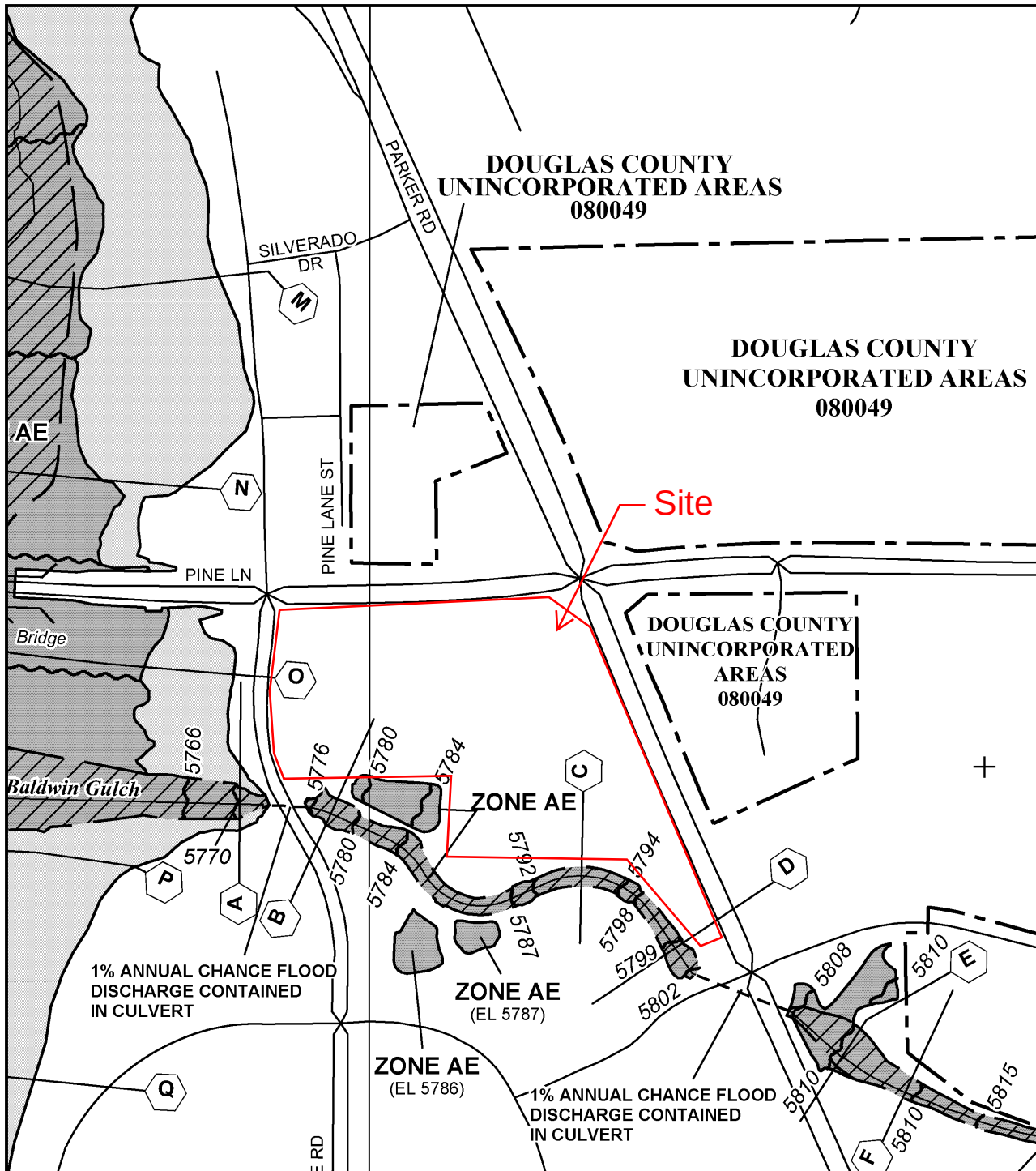
## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

***APPENDIX B1 - FEMA FIRM PANEL***



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0067G

# FIRM

## FLOOD INSURANCE RATE MAP

### DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

**PANEL 67 OF 495**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY       | NUMBER | PANEL | SUFFIX |
|-----------------|--------|-------|--------|
| DOUGLAS COUNTY  | 080049 | 0067  | G      |
| PARKER, TOWN OF | 080310 | 0067  | G      |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



**MAP NUMBER**  
**08035C0067G**  
**MAP REVISED**  
**MARCH 16, 2016**

Federal Emergency Management Agency

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

***APPENDIX B2 – RAINFALL DATA***

## 5. HYDROLOGIC CRITERIA

### 5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general, hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions is required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (UDFCD) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this manual.

### 5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation—Frequency Atlas of the Western United States, Volume III—Colorado. The design storm events developed and utilized are the same as those used by UDFCD.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where,  $I$  = rainfall intensity (in/hr)  
 $P_1$  = one-hour point rainfall depth (in)  
 $t_c$  = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1 herein. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

**TABLE 5.1**  
**ONE-HOUR POINT RAINFALL**

| <b>Frequency of Design<br/>Event<br/>(yr)</b> | <b>One-hour Point<br/>Rainfall, <math>P_1</math><br/>(in)</b> |
|-----------------------------------------------|---------------------------------------------------------------|
| 2                                             | 0.99                                                          |
| 5                                             | 1.39                                                          |
| 10                                            | 1.64                                                          |
| 25                                            | 1.98                                                          |
| 50                                            | 2.31                                                          |
| 100                                           | 2.60                                                          |

## 5.3 FLOOD HYDROLOGY OVERVIEW

Various methods exist to determine appropriate flood peaks or hydrographs for storm drainage planning and design. Methods for determining flood peaks or hydrographs are the Rational Method, the Colorado Urban Hydrograph Procedure (CUHP), and Urban Drainage Stormwater Management (UDSWM) model. The Town of Parker discourages the use of computer models other than CUHP and UDSWM since these programs are preferred, if not required, by UDFCD for studies involving major drainageways where UDFCD approval is sought or where maintenance eligibility is requested.

The three methods are briefly described in this section, and a discussion of their applicability to the Town of Parker is discussed. UDSWM is mostly used to combine and route the hydrographs generated using CUHP.

In general, the Rational Method is the most widely used and accepted technique for determining peak flows in urban areas for small basins. Within the constraints outlined in the MANUAL, use of the Rational Method provides a relatively simple but effective way to analyze storm runoff.

CUHP is somewhat more complicated than the Rational Method. It allows a manual computation of a runoff hydrograph which may be used for further hydraulic routing through channels and/or detention ponds. Historically, CUHP is best used in urban areas for which runoff coefficients have been derived. However, recent improvements by UDFCD include consideration for different soil types, thus CUHP is now more applicable to rural areas. The reader is referred to UDFCD for the latest version of CUHP.

UDSWM is a computer model that generates runoff hydrographs and routes and combines these hydrographs. UDSWM is a modified version of the Runoff Block of the Environmental Protection Agency's Storm Water Management Model (SWMM). It has been modified to be used in conjunction with CUHP. Table 5.2 herein provides guidance on selecting the appropriate method for a given project.

***APPENDIX B3 - C-VALUES***

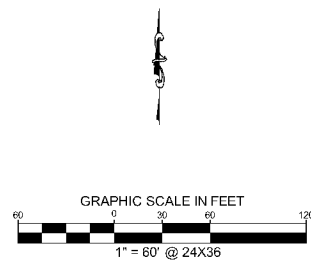
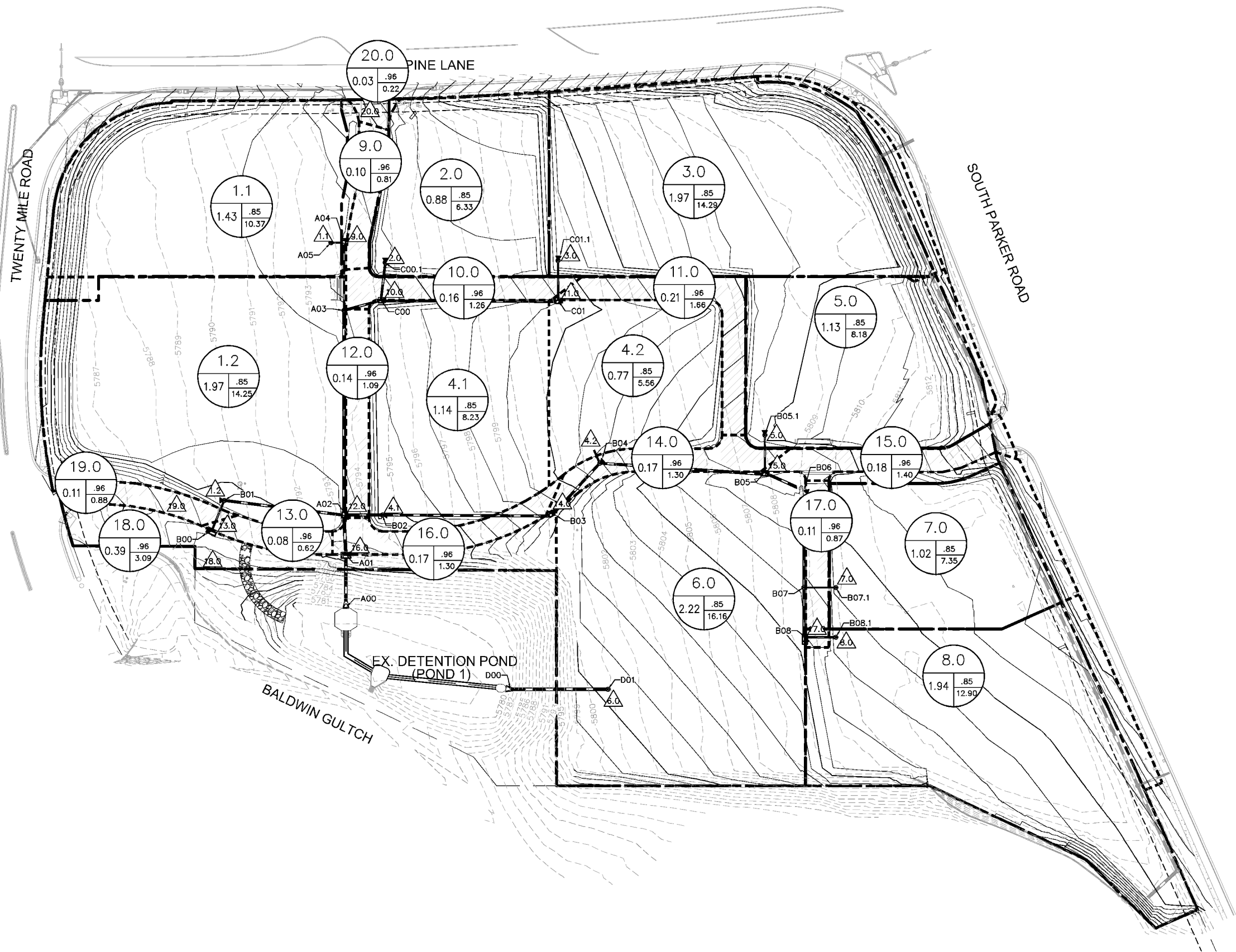


Table 6-5. Runoff coefficients, *c*

| Total or Effective<br>% Impervious | NRCS Hydrologic Soil Group A |        |         |         |         |          |          |
|------------------------------------|------------------------------|--------|---------|---------|---------|----------|----------|
|                                    | 2-Year                       | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year | 500-Year |
| 2%                                 | 0.01                         | 0.01   | 0.01    | 0.01    | 0.04    | 0.13     | 0.27     |
| 5%                                 | 0.02                         | 0.02   | 0.02    | 0.03    | 0.07    | 0.15     | 0.29     |
| 10%                                | 0.04                         | 0.05   | 0.05    | 0.07    | 0.11    | 0.19     | 0.32     |
| 15%                                | 0.07                         | 0.08   | 0.08    | 0.1     | 0.15    | 0.23     | 0.35     |
| 20%                                | 0.1                          | 0.11   | 0.12    | 0.14    | 0.2     | 0.27     | 0.38     |
| 25%                                | 0.14                         | 0.15   | 0.16    | 0.19    | 0.24    | 0.3      | 0.42     |
| 30%                                | 0.18                         | 0.19   | 0.2     | 0.23    | 0.28    | 0.34     | 0.45     |
| 35%                                | 0.21                         | 0.23   | 0.24    | 0.27    | 0.32    | 0.38     | 0.48     |
| 40%                                | 0.25                         | 0.27   | 0.28    | 0.32    | 0.37    | 0.42     | 0.51     |
| 45%                                | 0.3                          | 0.31   | 0.33    | 0.36    | 0.41    | 0.46     | 0.54     |
| 50%                                | 0.34                         | 0.36   | 0.37    | 0.41    | 0.45    | 0.5      | 0.58     |
| 55%                                | 0.39                         | 0.4    | 0.42    | 0.45    | 0.49    | 0.54     | 0.61     |
| 60%                                | 0.43                         | 0.45   | 0.47    | 0.5     | 0.54    | 0.58     | 0.64     |
| 65%                                | 0.48                         | 0.5    | 0.51    | 0.54    | 0.58    | 0.62     | 0.67     |
| 70%                                | 0.53                         | 0.55   | 0.56    | 0.59    | 0.62    | 0.65     | 0.71     |
| 75%                                | 0.58                         | 0.6    | 0.61    | 0.64    | 0.66    | 0.69     | 0.74     |
| 80%                                | 0.63                         | 0.65   | 0.66    | 0.69    | 0.71    | 0.73     | 0.77     |
| 85%                                | 0.68                         | 0.7    | 0.71    | 0.74    | 0.75    | 0.77     | 0.8      |
| 90%                                | 0.73                         | 0.75   | 0.77    | 0.79    | 0.79    | 0.81     | 0.84     |
| 95%                                | 0.79                         | 0.81   | 0.82    | 0.83    | 0.84    | 0.85     | 0.87     |
| 100%                               | 0.84                         | 0.86   | 0.87    | 0.88    | 0.88    | 0.89     | 0.9      |
| Total or Effective<br>% Impervious | NRCS Hydrologic Soil Group B |        |         |         |         |          |          |
|                                    | 2-Year                       | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year | 500-Year |
| 2%                                 | 0.01                         | 0.01   | 0.07    | 0.26    | 0.34    | 0.44     | 0.54     |
| 5%                                 | 0.03                         | 0.03   | 0.1     | 0.28    | 0.36    | 0.45     | 0.55     |
| 10%                                | 0.06                         | 0.07   | 0.14    | 0.31    | 0.38    | 0.47     | 0.57     |
| 15%                                | 0.09                         | 0.11   | 0.18    | 0.34    | 0.41    | 0.5      | 0.59     |
| 20%                                | 0.13                         | 0.15   | 0.22    | 0.38    | 0.44    | 0.52     | 0.61     |
| 25%                                | 0.17                         | 0.19   | 0.26    | 0.41    | 0.47    | 0.54     | 0.63     |
| 30%                                | 0.2                          | 0.23   | 0.3     | 0.44    | 0.49    | 0.57     | 0.65     |
| 35%                                | 0.24                         | 0.27   | 0.34    | 0.47    | 0.52    | 0.59     | 0.66     |
| 40%                                | 0.29                         | 0.32   | 0.38    | 0.5     | 0.55    | 0.61     | 0.68     |
| 45%                                | 0.33                         | 0.36   | 0.42    | 0.53    | 0.58    | 0.64     | 0.7      |
| 50%                                | 0.37                         | 0.4    | 0.46    | 0.56    | 0.61    | 0.66     | 0.72     |
| 55%                                | 0.42                         | 0.45   | 0.5     | 0.6     | 0.63    | 0.68     | 0.74     |
| 60%                                | 0.46                         | 0.49   | 0.54    | 0.63    | 0.66    | 0.71     | 0.76     |
| 65%                                | 0.5                          | 0.54   | 0.58    | 0.66    | 0.69    | 0.73     | 0.77     |
| 70%                                | 0.55                         | 0.58   | 0.62    | 0.69    | 0.72    | 0.75     | 0.79     |
| 75%                                | 0.6                          | 0.63   | 0.66    | 0.72    | 0.75    | 0.78     | 0.81     |
| 80%                                | 0.64                         | 0.67   | 0.7     | 0.75    | 0.77    | 0.8      | 0.83     |
| 85%                                | 0.69                         | 0.72   | 0.74    | 0.78    | 0.8     | 0.82     | 0.85     |
| 90%                                | 0.74                         | 0.76   | 0.78    | 0.81    | 0.83    | 0.84     | 0.87     |
| 95%                                | 0.79                         | 0.81   | 0.82    | 0.85    | 0.86    | 0.87     | 0.88     |
| 100%                               | 0.84                         | 0.86   | 0.86    | 0.88    | 0.89    | 0.89     | 0.9      |

***APPENDIX C - OVERALL DRAINAGE MAP***

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### LEGEND

- |  |                                                                                                              |
|--|--------------------------------------------------------------------------------------------------------------|
|  | A = BASIN DESIGNATION<br>B = AREA (ACRES)<br>C = BASIN IMPERVIOUSNESS<br>D = 100YR DESIGN STORM RUNOFF (CFS) |
|  | FLOW DIRECTION                                                                                               |
|  | DRAINAGE BASIN BOUNDARY                                                                                      |
|  | EXISTING PROPERTY LINE                                                                                       |
|  | EXISTING CONTOUR                                                                                             |
|  | PROPOSED CONTOUR                                                                                             |
|  | EXISTING STORM SEWER                                                                                         |
|  | PROPOSED STORM SEWER                                                                                         |
|  | PROPOSED STORM INLET                                                                                         |

DESIGNED BY: DLS  
DRAWN BY: ECZ  
CHECKED BY: DLS  
DATE: 11/11/19

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PRELIMINARY DRAINAGE AREA MAP

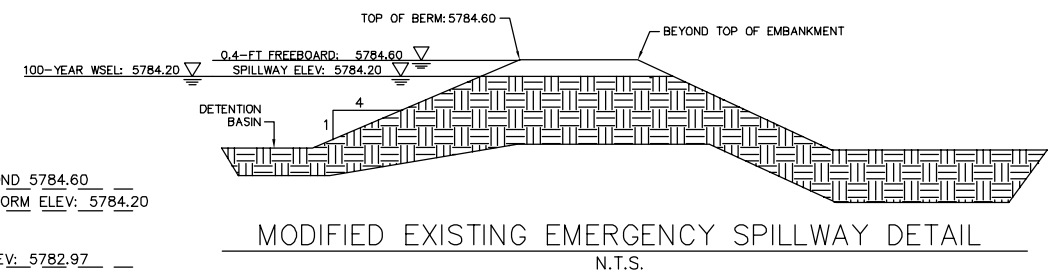
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DRAINAGE





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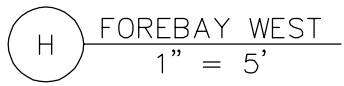
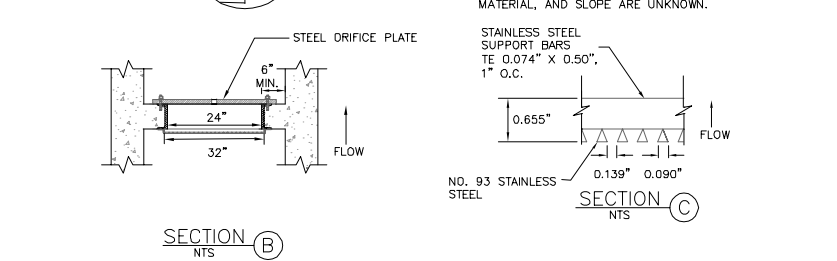
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**PARKER, CO**  
**CONSTRUCTION DOCUMENTS**  
**POND PLANS AND PROFILES**

### C6.3

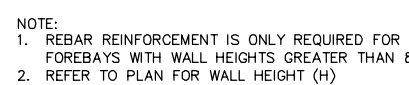
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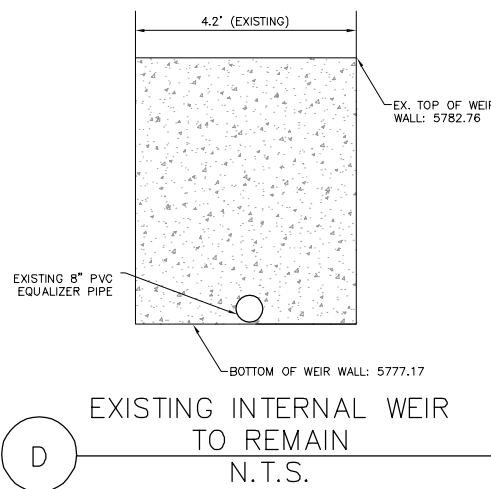


N FOREBAY WALL SECTION TYPICAL DETAIL  
NTS



- ORIFICE PLATE NOTES:
1. PROVIDE CONTINUOUS NEOPRENE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND THE CONCRETE.
  2. BOLT PLATE TO CONCRETE 12" MAX ON CENTER.

1. WELL-SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
2. BAR GATE TRASH RACKS SHALL BE ALUMINUM AND SHALL BE BOLTED USING STAINLESS STEEL HARDWARE.
3. TRASH RACKS SHALL BE SPECIFIED FOR SPECIFIED TRASH RACK MATERIALS. TOTAL TRASH RACK SIZE MAY NEED TO BE ADJUSTED FOR MATERIALS HAVING DIFFERENT OPEN AREA/GROSS AREA RATIO.
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

[illegible]

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DESIGNED BY: DLS  
DRAWN BY: JRK  
CHECKED BY: DLS  
DATE: 04/24/20

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PARKER, CO  
CONSTRUCTION DOCUMENTS  
POND DETAILS

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PROJECT NO.  
006500001

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| DRAWING NAME<br>096502001ST_DET |

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| C6.4 |
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***APPENDIX D - RATIONAL METHOD CALCULATIONS, INLET CALCULATIONS***

## Rainfall Intensity

### IDF - Intensity, Duration, Frequency Data

| Time Intensity Frequency Tabulation |      |      |       |        |
|-------------------------------------|------|------|-------|--------|
| TIME                                | 2 YR | 5 YR | 10 YR | 100 YR |
| 5                                   | 3.36 | 4.71 | 5.56  | 8.82   |
| 6                                   | 3.19 | 4.48 | 5.29  | 8.38   |
| 7                                   | 3.04 | 4.27 | 5.04  | 7.99   |
| 8                                   | 2.91 | 4.09 | 4.82  | 7.64   |
| 9                                   | 2.79 | 3.92 | 4.62  | 7.32   |
| 10                                  | 2.68 | 3.76 | 4.44  | 7.03   |
| 11                                  | 2.58 | 3.62 | 4.27  | 6.77   |
| 12                                  | 2.49 | 3.49 | 4.12  | 6.53   |
| 13                                  | 2.40 | 3.37 | 3.98  | 6.30   |
| 14                                  | 2.32 | 3.26 | 3.84  | 6.09   |
| 15                                  | 2.25 | 3.16 | 3.72  | 5.90   |
| 16                                  | 2.18 | 3.06 | 3.61  | 5.72   |
| 17                                  | 2.12 | 2.97 | 3.50  | 5.56   |
| 18                                  | 2.06 | 2.89 | 3.41  | 5.40   |
| 19                                  | 2.00 | 2.81 | 3.31  | 5.25   |
| 20                                  | 1.95 | 2.73 | 3.23  | 5.11   |
| 21                                  | 1.90 | 2.66 | 3.14  | 4.98   |
| 22                                  | 1.85 | 2.60 | 3.07  | 4.86   |
| 23                                  | 1.81 | 2.54 | 2.99  | 4.75   |
| 24                                  | 1.76 | 2.48 | 2.92  | 4.64   |
| 25                                  | 1.73 | 2.42 | 2.86  | 4.53   |
| 26                                  | 1.69 | 2.37 | 2.80  | 4.43   |
| 27                                  | 1.65 | 2.32 | 2.74  | 4.34   |
| 28                                  | 1.62 | 2.27 | 2.68  | 4.25   |
| 29                                  | 1.58 | 2.22 | 2.62  | 4.16   |
| 30                                  | 1.55 | 2.18 | 2.57  | 4.08   |
| 31                                  | 1.52 | 2.14 | 2.52  | 4.00   |
| 32                                  | 1.49 | 2.10 | 2.48  | 3.93   |
| 33                                  | 1.47 | 2.06 | 2.43  | 3.85   |
| 34                                  | 1.44 | 2.02 | 2.39  | 3.78   |
| 35                                  | 1.42 | 1.99 | 2.35  | 3.72   |
| 36                                  | 1.39 | 1.95 | 2.31  | 3.66   |
| 37                                  | 1.37 | 1.92 | 2.27  | 3.59   |
| 38                                  | 1.35 | 1.89 | 2.23  | 3.53   |
| 39                                  | 1.32 | 1.86 | 2.19  | 3.48   |
| 40                                  | 1.30 | 1.83 | 2.16  | 3.42   |
| 41                                  | 1.28 | 1.80 | 2.13  | 3.37   |
| 42                                  | 1.26 | 1.77 | 2.09  | 3.32   |
| 43                                  | 1.25 | 1.75 | 2.06  | 3.27   |
| 44                                  | 1.23 | 1.72 | 2.03  | 3.22   |
| 45                                  | 1.21 | 1.70 | 2.00  | 3.18   |
| 46                                  | 1.19 | 1.67 | 1.98  | 3.13   |
| 47                                  | 1.18 | 1.65 | 1.95  | 3.09   |
| 48                                  | 1.16 | 1.63 | 1.92  | 3.05   |
| 49                                  | 1.14 | 1.61 | 1.90  | 3.01   |
| 50                                  | 1.13 | 1.59 | 1.87  | 2.97   |
| 51                                  | 1.11 | 1.57 | 1.85  | 2.93   |
| 52                                  | 1.10 | 1.55 | 1.82  | 2.89   |
| 53                                  | 1.09 | 1.53 | 1.80  | 2.85   |
| 54                                  | 1.07 | 1.51 | 1.78  | 2.82   |
| 55                                  | 1.06 | 1.49 | 1.76  | 2.79   |
| 56                                  | 1.05 | 1.47 | 1.74  | 2.75   |
| 57                                  | 1.04 | 1.45 | 1.72  | 2.72   |
| 58                                  | 1.02 | 1.44 | 1.70  | 2.69   |
| 59                                  | 1.01 | 1.42 | 1.68  | 2.66   |
| 60                                  | 1.00 | 1.40 | 1.66  | 2.63   |

**Note:**

Intensity values utilized as published within the Town of Parker  
Storm Drainage Criteria Manual, Table 5.1

## Time Intensity Frequency Tabulation

| TIME | 2 YR | 5 YR | 10 YR | 100 YR |
|------|------|------|-------|--------|
| 5    | 3.36 | 4.71 | 5.56  | 8.82   |
| 6    | 3.19 | 4.48 | 5.29  | 8.38   |
| 7    | 3.04 | 4.27 | 5.04  | 7.99   |
| 8    | 2.91 | 4.09 | 4.82  | 7.64   |
| 9    | 2.79 | 3.92 | 4.62  | 7.32   |
| 10   | 2.68 | 3.76 | 4.44  | 7.03   |
| 11   | 2.58 | 3.62 | 4.27  | 6.77   |
| 12   | 2.49 | 3.49 | 4.12  | 6.53   |
| 13   | 2.40 | 3.37 | 3.98  | 6.30   |
| 14   | 2.32 | 3.26 | 3.84  | 6.09   |
| 15   | 2.25 | 3.16 | 3.72  | 5.90   |
| 16   | 2.18 | 3.06 | 3.61  | 5.72   |
| 17   | 2.12 | 2.97 | 3.50  | 5.56   |
| 18   | 2.06 | 2.89 | 3.41  | 5.40   |
| 19   | 2.00 | 2.81 | 3.31  | 5.25   |
| 20   | 1.95 | 2.73 | 3.23  | 5.11   |
| 21   | 1.90 | 2.66 | 3.14  | 4.98   |
| 22   | 1.85 | 2.60 | 3.07  | 4.86   |
| 23   | 1.81 | 2.54 | 2.99  | 4.75   |
| 24   | 1.76 | 2.48 | 2.92  | 4.64   |
| 25   | 1.73 | 2.42 | 2.86  | 4.53   |
| 26   | 1.69 | 2.37 | 2.80  | 4.43   |
| 27   | 1.65 | 2.32 | 2.74  | 4.34   |
| 28   | 1.62 | 2.27 | 2.68  | 4.25   |
| 29   | 1.58 | 2.22 | 2.62  | 4.16   |
| 30   | 1.55 | 2.18 | 2.57  | 4.08   |
| 31   | 1.52 | 2.14 | 2.52  | 4.00   |
| 32   | 1.49 | 2.10 | 2.48  | 3.93   |
| 33   | 1.47 | 2.06 | 2.43  | 3.85   |
| 34   | 1.44 | 2.02 | 2.39  | 3.78   |
| 35   | 1.42 | 1.99 | 2.35  | 3.72   |
| 36   | 1.39 | 1.95 | 2.31  | 3.66   |
| 37   | 1.37 | 1.92 | 2.27  | 3.59   |
| 38   | 1.35 | 1.89 | 2.23  | 3.53   |
| 39   | 1.32 | 1.86 | 2.19  | 3.48   |
| 40   | 1.30 | 1.83 | 2.16  | 3.42   |
| 41   | 1.28 | 1.80 | 2.13  | 3.37   |
| 42   | 1.26 | 1.77 | 2.09  | 3.32   |
| 43   | 1.25 | 1.75 | 2.06  | 3.27   |
| 44   | 1.23 | 1.72 | 2.03  | 3.22   |
| 45   | 1.21 | 1.70 | 2.00  | 3.18   |
| 46   | 1.19 | 1.67 | 1.98  | 3.13   |
| 47   | 1.18 | 1.65 | 1.95  | 3.09   |
| 48   | 1.16 | 1.63 | 1.92  | 3.05   |
| 49   | 1.14 | 1.61 | 1.90  | 3.01   |
| 50   | 1.13 | 1.59 | 1.87  | 2.97   |
| 51   | 1.11 | 1.57 | 1.85  | 2.93   |
| 52   | 1.10 | 1.55 | 1.82  | 2.89   |
| 53   | 1.09 | 1.53 | 1.80  | 2.85   |
| 54   | 1.07 | 1.51 | 1.78  | 2.82   |
| 55   | 1.06 | 1.49 | 1.76  | 2.79   |
| 56   | 1.05 | 1.47 | 1.74  | 2.75   |
| 57   | 1.04 | 1.45 | 1.72  | 2.72   |
| 58   | 1.02 | 1.44 | 1.70  | 2.69   |
| 59   | 1.01 | 1.42 | 1.68  | 2.66   |
| 60   | 1.00 | 1.40 | 1.66  | 2.63   |



## BASIN IMPERVIOUSNESS AND RUNOFF COEFFICIENT

| Landuse                  | I    | C <sub>2</sub> | C <sub>5</sub> | C <sub>10</sub> | C <sub>100</sub> |
|--------------------------|------|----------------|----------------|-----------------|------------------|
| Landscape                | 2%   | 0.01           | 0.01           | 0.07            | 0.44             |
| Roof                     | 90%  | 0.74           | 0.76           | 0.78            | 0.84             |
| Streets/Drives and Walks | 100% | 0.84           | 0.86           | 0.86            | 0.89             |

## All Basins

| Basin Designation | A <sub>TOTAL</sub> (AC) | A <sub>TOTAL</sub> (SF) | A <sub>LANDSCAPE</sub> (SF) | A <sub>ROOF</sub> (SF) | A <sub>STREETS/DRIVES &amp; WALKS</sub> (SF) | I <sub>WEIGHTED</sub> | C <sub>2</sub> | C <sub>5</sub> | C <sub>100</sub> | SIGN POI | INLET |
|-------------------|-------------------------|-------------------------|-----------------------------|------------------------|----------------------------------------------|-----------------------|----------------|----------------|------------------|----------|-------|
| 1.1               | 1.43                    | 62,381                  | 9,500                       | 0                      | 52,881                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 1.2               | 1.97                    | 85,635                  | 13,000                      | 0                      | 72,635                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 2.0               | 0.88                    | 38,143                  | 6,000                       | 0                      | 32,143                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 3.0               | 1.97                    | 85,881                  | 13,000                      | 0                      | 72,881                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 4.1               | 1.14                    | 49,452                  | 7,500                       | 0                      | 41,952                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 4.2               | 0.77                    | 33,396                  | 5,000                       | 0                      | 28,396                                       | 85%                   | 0.72           | 0.73           | 0.82             |          |       |
| 5.0               | 1.13                    | 49,201                  | 7,500                       | 0                      | 41,701                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 6.0               | 2.22                    | 96,743                  | 15,000                      | 0                      | 81,743                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 7.0               | 1.02                    | 44,356                  | 7,000                       | 0                      | 37,356                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 8.0               | 1.94                    | 84,345                  | 13,000                      | 0                      | 71,345                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 9.0               | 0.10                    | 4,470                   | 0                           | 0                      | 4,470                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 10.0              | 0.16                    | 6,975                   | 0                           | 0                      | 6,975                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 11.0              | 0.21                    | 9,219                   | 0                           | 0                      | 9,219                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 12.0              | 0.14                    | 6,073                   | 0                           | 0                      | 6,073                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 13.0              | 0.08                    | 3,465                   | 0                           | 0                      | 3,465                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 14.0              | 0.17                    | 7,207                   | 0                           | 0                      | 7,207                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 15.0              | 0.18                    | 7,746                   | 0                           | 0                      | 7,746                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 16.0              | 0.17                    | 7,231                   | 0                           | 0                      | 7,231                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 17.0              | 0.11                    | 4,854                   | 0                           | 0                      | 4,854                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 18.0              | 0.39                    | 17,130                  | 0                           | 0                      | 17,130                                       | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 19.0              | 0.11                    | 4,871                   | 0                           | 0                      | 4,871                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 20.0              | 0.03                    | 1,228                   | 0                           | 0                      | 1,228                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
|                   | 16.30                   | 710,001                 | 96,500                      | -                      | 613,501                                      | 87%                   | 0.73           | 0.74           | 0.83             |          |       |

## Detained Basins

| Basin Designation | A <sub>TOTAL</sub> (AC) | A <sub>TOTAL</sub> (SF) | A <sub>LANDSCAPE</sub> (SF) | A <sub>ROOF</sub> (SF) | A <sub>DRIVES &amp; WALKS</sub> (SF) | I <sub>WEIGHTED</sub> | C <sub>2</sub> | C <sub>5</sub> | C <sub>100</sub> |
|-------------------|-------------------------|-------------------------|-----------------------------|------------------------|--------------------------------------|-----------------------|----------------|----------------|------------------|
| 1                 | 1.43                    | 62,381                  | 9,500                       | 0                      | 52,881                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 2                 | 1.97                    | 85,635                  | 13,000                      | 0                      | 72,635                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 3                 | 0.88                    | 38,143                  | 6,000                       | 0                      | 32,143                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 4                 | 1.97                    | 85,881                  | 13,000                      | 0                      | 72,881                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 5                 | 1.14                    | 49,452                  | 7,500                       | 0                      | 41,952                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 6                 | 0.77                    | 33,396                  | 5,000                       | 0                      | 28,396                               | 85%                   | 0.72           | 0.73           | 0.82             |
| 7                 | 1.13                    | 49,201                  | 7,500                       | 0                      | 41,701                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 8                 | 2.22                    | 96,743                  | 15,000                      | 0                      | 81,743                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 9                 | 1.02                    | 44,356                  | 7,000                       | 0                      | 37,356                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 10                | 1.94                    | 84,345                  | 13,000                      | 0                      | 71,345                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 11                | 0.10                    | 4,470                   | 0                           | 0                      | 4,470                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 12                | 0.16                    | 6,975                   | 0                           | 0                      | 6,975                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 13                | 0.21                    | 9,219                   | 0                           | 0                      | 9,219                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 14                | 0.14                    | 6,073                   | 0                           | 0                      | 6,073                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 15                | 0.08                    | 3,465                   | 0                           | 0                      | 3,465                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 16                | 0.17                    | 7,207                   | 0                           | 0                      | 7,207                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 17                | 0.18                    | 7,746                   | 0                           | 0                      | 7,746                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 18                | 0.39                    | 17,130                  | 0                           | 0                      | 17,130                               | 100%                  | 0.84           | 0.86           | 0.89             |
|                   | 15.88                   | 691,818                 | 96,500                      | -                      | 595,318                              | 86%                   | 0.72           | 0.74           | 0.83             |

## Undetained Basins

| Basin Designation | A <sub>TOTAL</sub> (AC) | A <sub>TOTAL</sub> (SF) | A <sub>LANDSCAPE</sub> (SF) | A <sub>ROOF</sub> (SF) | A <sub>DRIVES &amp; WALKS</sub> (SF) | I <sub>WEIGHTED</sub> | C <sub>2</sub> | C <sub>5</sub> | C <sub>100</sub> |
|-------------------|-------------------------|-------------------------|-----------------------------|------------------------|--------------------------------------|-----------------------|----------------|----------------|------------------|
| 19                | 0.11                    | 4,871                   | 0                           | 0                      | 4,871                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 20                | 0.03                    | 1,228                   | 0                           | 0                      | 1,228                                | 100%                  | 0.84           | 0.86           | 0.89             |
|                   | 0.14                    | 6,099                   | -                           | -                      | 6,099                                | 100%                  | 0.84           | 0.86           | 0.89             |

## Time of Concentration

| DESIGN POINT | SUB-BASIN DATA |         |         |                |      |      | INITIAL / OVERLAND TIME T(i) |         |          | TRAVEL TIME T(t) |         |             |              |          | T(c) CHECK (URBANIZED BASINS) |              |          | FINAL T(c) (MIN) |
|--------------|----------------|---------|---------|----------------|------|------|------------------------------|---------|----------|------------------|---------|-------------|--------------|----------|-------------------------------|--------------|----------|------------------|
|              | DRAIN BASIN    | AREA SF | AREA AC | NRCS Soil Type | I %  | C(5) | Length FT                    | Slope % | T(i) MIN | Length FT        | Slope % | Coefficient | Velocity FPS | T(t) MIN | T(c) (MIN)                    | TOTAL LENGTH | L/180+10 |                  |
| 1.1          | 1.1            | 62,381  | 1.43    | B              | 85%  | 0.73 | 45                           | 2.0%    | 3.6      | -                | -       | 20          | 0.0          | 0.0      | 5.0                           | 45           | 10.3     | 5.0              |
| 1.2          | 1.2            | 85,635  | 1.97    | B              | 85%  | 0.73 | 41                           | 21.0%   | 1.6      | 450              | 3.1%    | 15          | 2.6          | 2.8      | 5.0                           | 491          | 12.7     | 5.0              |
| 2.0          | 2.0            | 38,143  | 0.88    | B              | 85%  | 0.73 | 40                           | 5.6%    | 2.4      | 60               | 3.3%    | 20          | 3.6          | 0.3      | 5.0                           | 100          | 10.6     | 5.0              |
| 3.0          | 3.0            | 85,881  | 1.97    | B              | 85%  | 0.73 | 69                           | 4.3%    | 3.5      | 97               | 1.3%    | 20          | 2.2          | 0.7      | 5.0                           | 166          | 10.9     | 5.0              |
| 4.1          | 4.1            | 49,452  | 1.14    | B              | 85%  | 0.73 | 170                          | 7.0%    | 4.6      | 50               | 2.7%    | 20          | 3.3          | 0.3      | 5.0                           | 220          | 11.2     | 5.0              |
| 4.2          | 4.2            | 33,396  | 0.77    | B              | 85%  | 0.73 | 93                           | 9.2%    | 3.1      | 163              | 3.7%    | 20          | 3.8          | 0.7      | 5.0                           | 256          | 11.4     | 5.0              |
| 5.0          | 5.0            | 49,201  | 1.13    | B              | 85%  | 0.73 | 0                            | 0.0%    |          | 230              | 1.0%    | 21          | 2.1          | 1.8      | 5.0                           | 230          | 11.3     | 5.0              |
| 6.0          | 6.0            | 96,743  | 2.22    | B              | 85%  | 0.73 | 50                           | 2.0%    | 3.8      | 150              | 3.0%    | 20          | 3.5          | 0.7      | 5.0                           | 200          | 11.1     | 5.0              |
| 7.0          | 7.0            | 44,356  | 1.02    | B              | 85%  | 0.73 | 35                           | 1.5%    | 3.5      | 105              | 2.0%    | 20          | 2.8          | 0.6      | 5.0                           | 140          | 10.8     | 5.0              |
| 8.0          | 8.0            | 84,345  | 1.94    | B              | 85%  | 0.73 | 100                          | 1.0%    | 6.8      | 10               | 15.0%   | 20          | 7.7          | 0.0      | 6.8                           | 110          | 10.6     | 6.8              |
| 9.0          | 9.0            | 4,470   | 0.10    | B              | 100% | 0.86 | 101                          | 101.0%  | 0.9      | 11               | 115.0%  | 21          | 22.5         | 0.0      | 5.0                           | 112          | 10.6     | 5.0              |
| 10.0         | 10.0           | 6,975   | 0.16    | B              | 100% | 0.86 | 75                           | 5.0%    | 2.2      | 130              | 2.5%    | 20          | 3.2          | 0.7      | 5.0                           | 205          | 11.1     | 5.0              |
| 11.0         | 11.0           | 9,219   | 0.21    | B              | 100% | 0.86 | 45                           | 4.3%    | 1.8      | 500              | 3.6%    | 20          | 3.8          | 2.2      | 5.0                           | 545          | 13.0     | 5.0              |
| 12.0         | 12.0           | 6,073   | 0.14    | B              | 100% | 0.86 | 100                          | 1.0%    | 4.4      | 10               | 15.0%   | 20          | 7.7          | 0.0      | 5.0                           | 110          | 10.6     | 5.0              |
| 13.0         | 13.0           | 3,465   | 0.08    | B              | 100% | 0.86 | 101                          | 101.0%  | 0.9      | 11               | 115.0%  | 21          | 22.5         | 0.0      | 5.0                           | 112          | 10.6     | 5.0              |
| 14.0         | 14.0           | 7,207   | 0.17    | B              | 100% | 0.86 | 63                           | 2.0%    | 2.8      | 98               | 0.7%    | 20          | 1.7          | 1.0      | 5.0                           | 161          | 10.9     | 5.0              |
| 15.0         | 15.0           | 7,746   | 0.18    | B              | 100% | 0.86 | 35                           | 17.0%   | 1.0      | 72               | 1.2%    | 20          | 2.2          | 0.5      | 5.0                           | 107          | 10.6     | 5.0              |
| 16.0         | 16.0           | 7,231   | 0.17    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 50               | 3.0%    | 20          | 3.5          | 0.2      | 5.0                           | 140          | 10.8     | 5.0              |
| 17.0         | 17.0           | 4,854   | 0.11    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 51               | 3.0%    | 20          | 3.5          | 0.2      | 5.0                           | 141          | 10.8     | 5.0              |
| 18.0         | 18.0           | 17,130  | 0.39    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 52               | 3.0%    | 20          | 3.5          | 0.3      | 5.0                           | 142          | 10.8     | 5.0              |
| 19.0         | 19.0           | 4,871   | 0.11    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 53               | 3.0%    | 20          | 3.5          | 0.3      | 5.0                           | 143          | 10.8     | 5.0              |
| 20.0         | 20.0           | 1,228   | 0.03    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 54               | 3.0%    | 20          | 3.5          | 0.3      | 5.0                           | 144          | 10.8     | 5.0              |

## Watercourse Coefficient

|                               |      |
|-------------------------------|------|
| Forest & Meadow               | 2.5  |
| Fallow or Cultivation         | 5.0  |
| Short Grass Pasture & Lawns   | 7.0  |
| Nearly Bare Ground            | 10.0 |
| Grassed Waterway              | 15.0 |
| Paved Area and Shallow Gutter | 20.0 |

## CIA Runoff Calculations

## 2-Year Design Storm Runoff Calculations

(Rational Method Procedure)

| BASIN INFORMATION |             |         |              | DIRECT RUNOFF |       |         |       | TOTAL RUNOFF |           |         |       | REMARKS |
|-------------------|-------------|---------|--------------|---------------|-------|---------|-------|--------------|-----------|---------|-------|---------|
| DESIGN POINT      | DRAIN BASIN | AREA Ac | RUNOFF COEFF | T(c) Min      | C x A | I In/Hr | Q CFS | T(c) Min     | SUM C x A | I In/Hr | Q CFS |         |
| 1                 | 1.1         | 1.43    | 0.71         | 5.0           | 1.02  | 3.36    | 3.43  | 5.0          | 1.02      | 3.4     | 3.43  |         |
| 1                 | 1.2         | 1.97    | 0.71         | 5.0           | 1.40  | 3.36    | 4.71  | 5.0          | 2.4       | 3.4     | 8.14  |         |
| 1                 | 2.0         | 0.88    | 0.71         | 5.0           | 0.62  | 3.36    | 2.09  | 5.0          | 3.0       | 3.4     | 10.23 |         |
| 1                 | 3.0         | 1.97    | 0.71         | 5.0           | 1.41  | 3.36    | 4.73  | 5.0          | 4.5       | 3.4     | 14.96 |         |
| 1                 | 4.1         | 1.14    | 0.71         | 5.0           | 0.81  | 3.36    | 2.72  | 5.0          | 5.3       | 3.4     | 17.68 |         |
| 1                 | 4.2         | 0.77    | 0.72         | 5.0           | 0.549 | 3.36    | 1.84  | 5.0          | 5.8       | 3.4     | 19.53 |         |
| 1                 | 5.0         | 1.13    | 0.71         | 5.0           | 0.806 | 3.36    | 2.71  | 5.0          | 6.6       | 3.4     | 22.23 |         |
| 1                 | 6.0         | 2.22    | 0.71         | 5.0           | 1.580 | 3.36    | 5.30  | 5.0          | 8.2       | 3.4     | 27.54 |         |
| 1                 | 7.0         | 1.02    | 0.71         | 5.0           | 0.722 | 3.36    | 2.42  | 5.0          | 8.9       | 3.4     | 29.96 |         |
| 1                 | 8.0         | 1.94    | 0.71         | 6.8           | 1.379 | 3.09    | 4.26  | 5.0          | 10.3      | 3.4     | 34.59 |         |
| 1                 | 9.0         | 0.10    | 0.84         | 5.0           | 0.086 | 3.36    | 0.29  | 5.0          | 10.4      | 3.4     | 34.88 |         |
| 1                 | 10.0        | 0.16    | 0.84         | 5.0           | 0.135 | 3.36    | 0.45  | 5.0          | 10.5      | 3.4     | 35.33 |         |
| 1                 | 11.0        | 0.21    | 0.84         | 5.0           | 0.178 | 3.36    | 0.60  | 5.0          | 10.7      | 3.4     | 35.93 |         |
| 1                 | 12.0        | 0.14    | 0.84         | 5.0           | 0.117 | 3.36    | 0.39  | 5.0          | 10.8      | 3.4     | 36.32 |         |
| 1                 | 13.0        | 0.08    | 0.84         | 5.0           | 0.067 | 3.36    | 0.22  | 5.0          | 10.9      | 3.4     | 36.55 |         |
| 1                 | 14.0        | 0.17    | 0.84         | 5.0           | 0.139 | 3.36    | 0.47  | 5.0          | 11.0      | 3.4     | 37.01 |         |
| 1                 | 15.0        | 0.18    | 0.84         | 5.0           | 0.149 | 3.36    | 0.50  | 5.0          | 11.2      | 3.4     | 37.51 |         |
| 1                 | 16.0        | 0.17    | 0.84         | 5.0           | 0.139 | 3.36    | 0.47  | 5.0          | 11.3      | 3.4     | 37.98 |         |
| 1                 | 17.0        | 0.11    | 0.84         | 5.0           | 0.094 | 3.36    | 0.31  | 5.0          | 11.4      | 3.4     | 38.30 |         |
| 1                 | 18.0        | 0.39    | 0.84         | 5.0           | 0.330 | 3.36    | 1.11  | 5.0          | 11.7      | 3.4     | 39.41 |         |
| 1                 | 19.0        | 0.11    | 0.84         | 5.0           | 0.094 | 3.36    | 0.32  | 5.0          | 11.8      | 3.4     | 39.72 |         |
| 1                 | 20.0        | 0.03    | 0.84         | 5.0           | 0.024 | 3.36    | 0.08  | 5.0          | 11.9      | 3.4     | 39.80 |         |

**5-Year Design Storm Runoff Calculations**

(Rational Method Procedure)

| BASIN INFORMATION |             |         |              | DIRECT RUNOFF |       |         |       | TOTAL RUNOFF |           |         |       | REMARKS |
|-------------------|-------------|---------|--------------|---------------|-------|---------|-------|--------------|-----------|---------|-------|---------|
| DESIGN POINT      | DRAIN BASIN | AREA Ac | RUNOFF COEFF | T(c) Min      | C x A | I In/Hr | Q CFS | T(c) Min     | SUM C x A | I In/Hr | Q CFS |         |
| 1                 | 1.1         | 1.43    | 0.73         | 5.0           | 1.05  | 4.71    | 4.93  | 5.0          | 1.05      | 4.7     | 4.93  |         |
| 1                 | 1.2         | 1.97    | 0.73         | 5.0           | 1.44  | 4.71    | 6.77  | 5.0          | 2.5       | 4.7     | 11.71 |         |
| 1                 | 2.0         | 0.88    | 0.73         | 5.0           | 0.64  | 4.71    | 3.00  | 5.0          | 3.1       | 4.7     | 14.71 |         |
| 1                 | 3.0         | 1.97    | 0.73         | 5.0           | 1.44  | 4.71    | 6.80  | 5.0          | 4.6       | 4.7     | 21.50 |         |
| 1                 | 4.1         | 1.14    | 0.73         | 5.0           | 0.83  | 4.71    | 3.91  | 5.0          | 5.4       | 4.7     | 25.42 |         |
| 1                 | 4.2         | 0.77    | 0.73         | 5.0           | 0.56  | 4.71    | 2.65  | 5.0          | 6.0       | 4.7     | 28.07 |         |
| 1                 | 5.0         | 1.13    | 0.73         | 5.0           | 0.83  | 4.71    | 3.89  | 5.0          | 6.8       | 4.7     | 31.96 |         |
| 1                 | 6.0         | 2.22    | 0.73         | 5.0           | 1.62  | 4.71    | 7.62  | 5.0          | 8.4       | 4.7     | 39.58 |         |
| 1                 | 7.0         | 1.02    | 0.73         | 5.0           | 0.74  | 4.71    | 3.48  | 5.0          | 9.1       | 4.7     | 43.06 |         |
| 1                 | 8.0         | 1.94    | 0.73         | 6.8           | 1.41  | 4.34    | 6.13  | 5.0          | 10.5      | 4.7     | 49.72 |         |
| 1                 | 9.0         | 0.10    | 0.86         | 5.0           | 0.09  | 4.71    | 0.42  | 5.0          | 10.6      | 4.7     | 50.14 |         |
| 1                 | 10.0        | 0.16    | 0.86         | 5.0           | 0.14  | 4.71    | 0.65  | 5.0          | 10.8      | 4.7     | 50.79 |         |
| 1                 | 11.0        | 0.21    | 0.86         | 5.0           | 0.18  | 4.71    | 0.86  | 5.0          | 11.0      | 4.7     | 51.64 |         |
| 1                 | 12.0        | 0.14    | 0.86         | 5.0           | 0.12  | 4.71    | 0.57  | 5.0          | 11.1      | 4.7     | 52.21 |         |
| 1                 | 13.0        | 0.08    | 0.86         | 5.0           | 0.07  | 4.71    | 0.32  | 5.0          | 11.1      | 4.7     | 52.53 |         |
| 1                 | 14.0        | 0.17    | 0.86         | 5.0           | 0.14  | 4.71    | 0.67  | 5.0          | 11.3      | 4.7     | 53.20 |         |
| 1                 | 15.0        | 0.18    | 0.86         | 5.0           | 0.15  | 4.71    | 0.72  | 5.0          | 11.4      | 4.7     | 53.92 |         |
| 1                 | 16.0        | 0.17    | 0.86         | 5.0           | 0.14  | 4.71    | 0.67  | 5.0          | 11.6      | 4.7     | 54.60 |         |
| 1                 | 17.0        | 0.11    | 0.86         | 5.0           | 0.10  | 4.71    | 0.45  | 5.0          | 11.7      | 4.7     | 55.05 |         |
| 1                 | 18.0        | 0.39    | 0.86         | 5.0           | 0.34  | 4.71    | 1.59  | 5.0          | 12.0      | 4.7     | 56.64 |         |
| 1                 | 19.0        | 0.11    | 0.86         | 5.0           | 0.10  | 4.71    | 0.45  | 5.0          | 12.1      | 4.7     | 57.10 |         |
| 1                 | 20.0        | 0.03    | 0.86         | 5.0           | 0.02  | 4.71    | 0.11  | 5.0          | 12.1      | 4.7     | 57.21 |         |

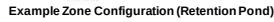
**100-Year Design Storm Runoff Calculations**

(Rational Method Procedure)

| BASIN INFORMATION |             |         |              | DIRECT RUNOFF |       |         |       | TOTAL RUNOFF |           |         |        | REMARKS |
|-------------------|-------------|---------|--------------|---------------|-------|---------|-------|--------------|-----------|---------|--------|---------|
| DESIGN POINT      | DRAIN BASIN | AREA Ac | RUNOFF COEFF | T(c) Min      | C x A | I In/Hr | Q CFS | T(c) Min     | SUM C x A | I In/Hr | Q CFS  |         |
| 1                 | 1.1         | 1.43    | 0.82         | 5.0           | 1.18  | 8.82    | 10.37 | 5.0          | 1.18      | 8.8     | 10.37  |         |
| 1                 | 1.2         | 1.97    | 0.82         | 5.0           | 1.62  | 8.82    | 14.25 | 5.0          | 2.8       | 8.8     | 24.62  |         |
| 1                 | 2.0         | 0.88    | 0.82         | 5.0           | 0.72  | 8.82    | 6.33  | 5.0          | 3.5       | 8.8     | 30.95  |         |
| 1                 | 3.0         | 1.97    | 0.82         | 5.0           | 1.62  | 8.82    | 14.29 | 5.0          | 5.1       | 8.8     | 45.24  |         |
| 1                 | 4.1         | 1.14    | 0.82         | 5.0           | 0.93  | 8.82    | 8.23  | 5.0          | 6.1       | 8.8     | 53.46  |         |
| 1                 | 4.2         | 0.77    | 0.82         | 5.0           | 0.631 | 8.82    | 5.56  | 5.0          | 6.7       | 8.8     | 59.03  |         |
| 1                 | 5.0         | 1.13    | 0.82         | 5.0           | 0.928 | 8.82    | 8.18  | 5.0          | 7.6       | 8.8     | 67.21  |         |
| 1                 | 6.0         | 2.22    | 0.82         | 5.0           | 1.822 | 8.82    | 16.06 | 5.0          | 9.4       | 8.8     | 83.27  |         |
| 1                 | 7.0         | 1.02    | 0.82         | 5.0           | 0.834 | 8.82    | 7.35  | 5.0          | 10.3      | 8.8     | 90.63  |         |
| 1                 | 8.0         | 1.94    | 0.82         | 6.8           | 1.589 | 8.12    | 12.90 | 5.0          | 11.9      | 8.8     | 104.64 |         |
| 1                 | 9.0         | 0.10    | 0.89         | 5.0           | 0.091 | 8.82    | 0.81  | 5.0          | 12.0      | 8.8     | 105.44 |         |
| 1                 | 10.0        | 0.16    | 0.89         | 5.0           | 0.143 | 8.82    | 1.26  | 5.0          | 12.1      | 8.8     | 106.70 |         |
| 1                 | 11.0        | 0.21    | 0.89         | 5.0           | 0.188 | 8.82    | 1.66  | 5.0          | 12.3      | 8.8     | 108.36 |         |
| 1                 | 12.0        | 0.14    | 0.89         | 5.0           | 0.124 | 8.82    | 1.09  | 5.0          | 12.4      | 8.8     | 109.46 |         |
| 1                 | 13.0        | 0.08    | 0.89         | 5.0           | 0.071 | 8.82    | 0.62  | 5.0          | 12.5      | 8.8     | 110.08 |         |
| 1                 | 14.0        | 0.17    | 0.89         | 5.0           | 0.147 | 8.82    | 1.30  | 5.0          | 12.6      | 8.8     | 111.38 |         |
| 1                 | 15.0        | 0.18    | 0.89         | 5.0           | 0.158 | 8.82    | 1.40  | 5.0          | 12.8      | 8.8     | 112.78 |         |
| 1                 | 16.0        | 0.17    | 0.89         | 5.0           | 0.148 | 8.82    | 1.30  | 5.0          | 12.9      | 8.8     | 114.08 |         |
| 1                 | 17.0        | 0.11    | 0.89         | 5.0           | 0.099 | 8.82    | 0.87  | 5.0          | 13.0      | 8.8     | 114.95 |         |
| 1                 | 18.0        | 0.39    | 0.89         | 5.0           | 0.350 | 8.82    | 3.09  | 5.0          | 13.4      | 8.8     | 118.04 |         |
| 1                 | 19.0        | 0.11    | 0.89         | 5.0           | 0.100 | 8.82    | 0.88  | 5.0          | 13.5      | 8.8     | 118.92 |         |
| 1                 | 20.0        | 0.03    | 0.89         | 5.0           | 0.025 | 8.82    | 0.22  | 5.0          | 13.5      | 8.8     | 119.14 |         |

MHFD-Detention, Version 4.02 (February 2020)

Basin ID:

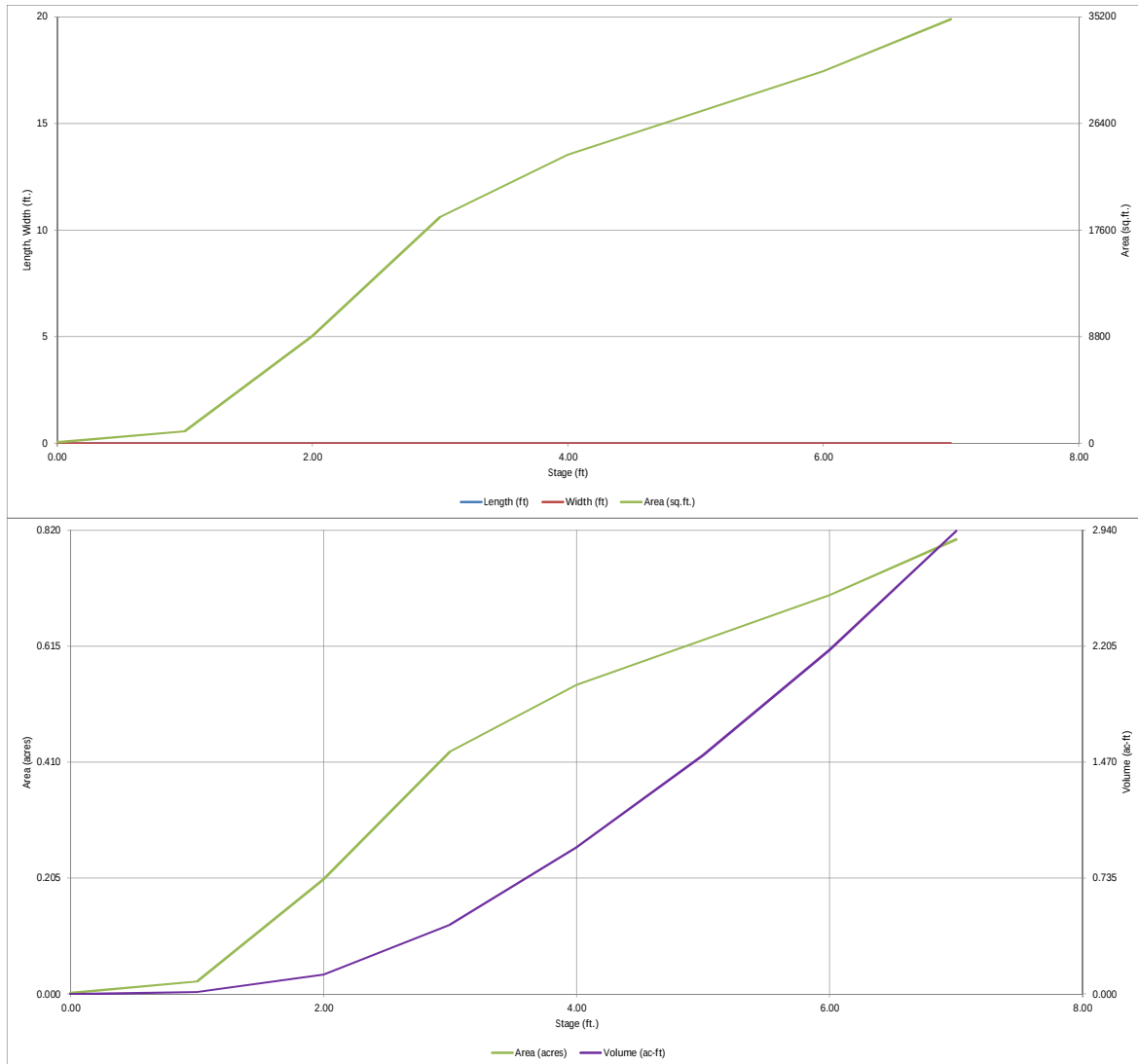


|      |           |
|------|-----------|
|      | acre-feet |
|      | acre-feet |
| 0.99 | inches    |
| 1.39 | inches    |
| 1.64 | inches    |
| 1.98 | inches    |
| 2.31 | inches    |
| 2.60 | inches    |
|      | inches    |

4/24/2020, 9:41 AM

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

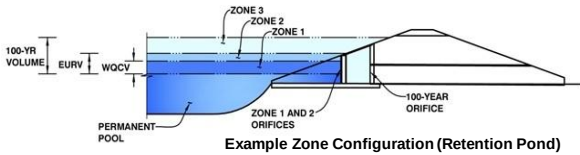


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-DETENTION, Version 4.02 (February 2020)

Project: Parker Mixed-Use - Parker and Pine

Basin ID: \_\_\_\_\_



Example Zone Configuration (Retention Pond)

|                   | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type       |
|-------------------|----------------------|--------------------------|-------------------|
| Zone 1 (WQCV)     | 3.10                 | 0.481                    | Orifice Plate     |
| Zone 2 (EURV)     | 5.00                 | 1.031                    | Circular Orifice  |
| Zone 3 (100-year) | 6.23                 | 0.826                    | Weir&Pipe (Rect.) |
| Total (all zones) |                      | 2.339                    |                   |

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

|                                   |     |                                                  |
|-----------------------------------|-----|--------------------------------------------------|
| Underdrain Orifice Invert Depth = | N/A | ft (distance below the filtration media surface) |
| Underdrain Orifice Diameter =     | N/A | inches                                           |

| Calculated Parameters for Underdrain |     |                 |
|--------------------------------------|-----|-----------------|
| Underdrain Orifice Area =            | N/A | ft <sup>2</sup> |
| Underdrain Orifice Centroid =        | N/A | feet            |

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

|                                            |       |                                               |
|--------------------------------------------|-------|-----------------------------------------------|
| Invert of Lowest Orifice =                 | 0.00  | ft (relative to basin bottom at Stage = 0 ft) |
| Depth at top of Zone using Orifice Plate = | 3.10  | ft (relative to basin bottom at Stage = 0 ft) |
| Orifice Plate: Orifice Vertical Spacing =  | 12.40 | inches                                        |
| Orifice Plate: Orifice Area per Row =      | 1.52  | sq. inches (diameter = 1-3/8 inches)          |

| <u>on BMP)</u>             |           | <u>Calculated Parameters for Plate</u> |
|----------------------------|-----------|----------------------------------------|
| WQ Orifice Area per Row =  | 1.056E-02 | ft <sup>2</sup>                        |
| Elliptical Half-Width =    | N/A       | feet                                   |
| Elliptical Slot Centroid = | N/A       | feet                                   |
| Elliptical Slot Area =     | N/A       | ft <sup>2</sup>                        |

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

|                                | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Stage of Orifice Centroid (ft) | 0.00             | 1.03             | 2.07             |                  |                  |                  |                  |                  |
| Orifice Area (sq. inches)      | 1.52             | 1.52             | 1.52             |                  |                  |                  |                  |                  |

|                                | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
|--------------------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Stage of Orifice Centroid (ft) |                  |                   |                   |                   |                   |                   |                   |                   |
| Orifice Area (sq. inches)      |                  |                   |                   |                   |                   |                   |                   |                   |

User Input: Vertical Orifice (Circular or Rectangular)

|                                               | Zone 2 Circular | Not Selected |                                               |
|-----------------------------------------------|-----------------|--------------|-----------------------------------------------|
| Invert of Vertical Orifice =                  | 3.10            | N/A          | ft (relative to basin bottom at Stage = 0 ft) |
| Depth at top of Zone using Vertical Orifice = | 5.00            | N/A          | ft (relative to basin bottom at Stage = 0 ft) |
| Vertical Orifice Diameter =                   | 8.00            | N/A          | inches                                        |

| Calculated Parameters for Vertical Orifice |                 |              |                 |
|--------------------------------------------|-----------------|--------------|-----------------|
|                                            | Zone 2 Circular | Not Selected |                 |
| Vertical Orifice Area =                    | 0.35            | N/A          | ft <sup>2</sup> |
| Vertical Orifice Centroid =                | 0.33            | N/A          | feet            |

User Input: Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

|                                                   | Zone 3 Weir | Not Selected |                                               |
|---------------------------------------------------|-------------|--------------|-----------------------------------------------|
| Overflow Weir Front Edge Height, H <sub>o</sub> = | 4.79        | N/A          | ft (relative to basin bottom at Stage = 0 ft) |
| Overflow Weir Front Edge Length =                 | 1.00        | N/A          | feet                                          |
| Overflow Weir Gate Slope =                        | 4.00        | N/A          | H:V                                           |
| Horiz. Length of Weir Sides =                     | 5.00        | N/A          | feet                                          |
| Overflow Gate Open Area % =                       | 70%         | N/A          | %, gate open area/total area                  |
| Debris Clogging % =                               | 50%         | N/A          | %                                             |

|                                        |                                             | Zone 3 Weir | Not Selected |                 |
|----------------------------------------|---------------------------------------------|-------------|--------------|-----------------|
| = 0 ft)                                | Height of Gate Upper Edge, H <sub>u</sub> = | 6.04        | N/A          | feet            |
|                                        | Overflow Weir Slope Length =                | 5.15        | N/A          | feet            |
| Gate Open Area / 100-yr Orifice Area = |                                             | 4.68        | N/A          |                 |
| Overflow Gate Open Area w/o Debris =   |                                             | 3.61        | N/A          | ft <sup>2</sup> |
| Overflow Gate Open Area w/ Debris =    |                                             | 1.80        | N/A          | ft <sup>2</sup> |

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

|                                  | Zone 3 Rectangular | Not Selected |                                                  |
|----------------------------------|--------------------|--------------|--------------------------------------------------|
| Depth to Invert of Outlet Pipe = | 1.10               | N/A          | ft (distance below basin bottom at Stage = 0 ft) |
| Rectangular Orifice Width =      | 10.10              | N/A          | inches                                           |
| Rectangular Orifice Height =     | 11.00              | N/A          | inches                                           |

| <u>Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate</u> |                    |              |                 |
|------------------------------------------------------------------------|--------------------|--------------|-----------------|
|                                                                        | Zone 3 Rectangular | Not Selected |                 |
| Outlet Orifice Area =                                                  | 0.77               | N/A          | ft <sup>2</sup> |
| Outlet Orifice Centroid =                                              | 0.46               | N/A          | feet            |
| Half-Central Angle of Restrictor Plate on Pipe =                       | N/A                | N/A          | radians         |

User Input: Emergency Spillway (Rectangular or Trapezoidal)

|                                     |       |                                               |
|-------------------------------------|-------|-----------------------------------------------|
| Spillway Invert Stage =             | 6.20  | ft (relative to basin bottom at Stage = 0 ft) |
| Spillway Crest Length =             | 26.00 | feet                                          |
| Spillway End Slopes =               | 4.00  | H:V                                           |
| Freeboard above Max Water Surface = | 0.25  | feet                                          |

| Calculated Parameters for Spillway |      |         |
|------------------------------------|------|---------|
| Spillway Design Flow Depth=        | 0.55 | feet    |
| Stage at Top of Freeboard =        | 7.00 | feet    |
| Basin Area at Top of Freeboard =   | 0.80 | acres   |
| Basin Volume at Top of Freeboard = | 2.93 | acre-ft |

## Routed Hydrograph Results

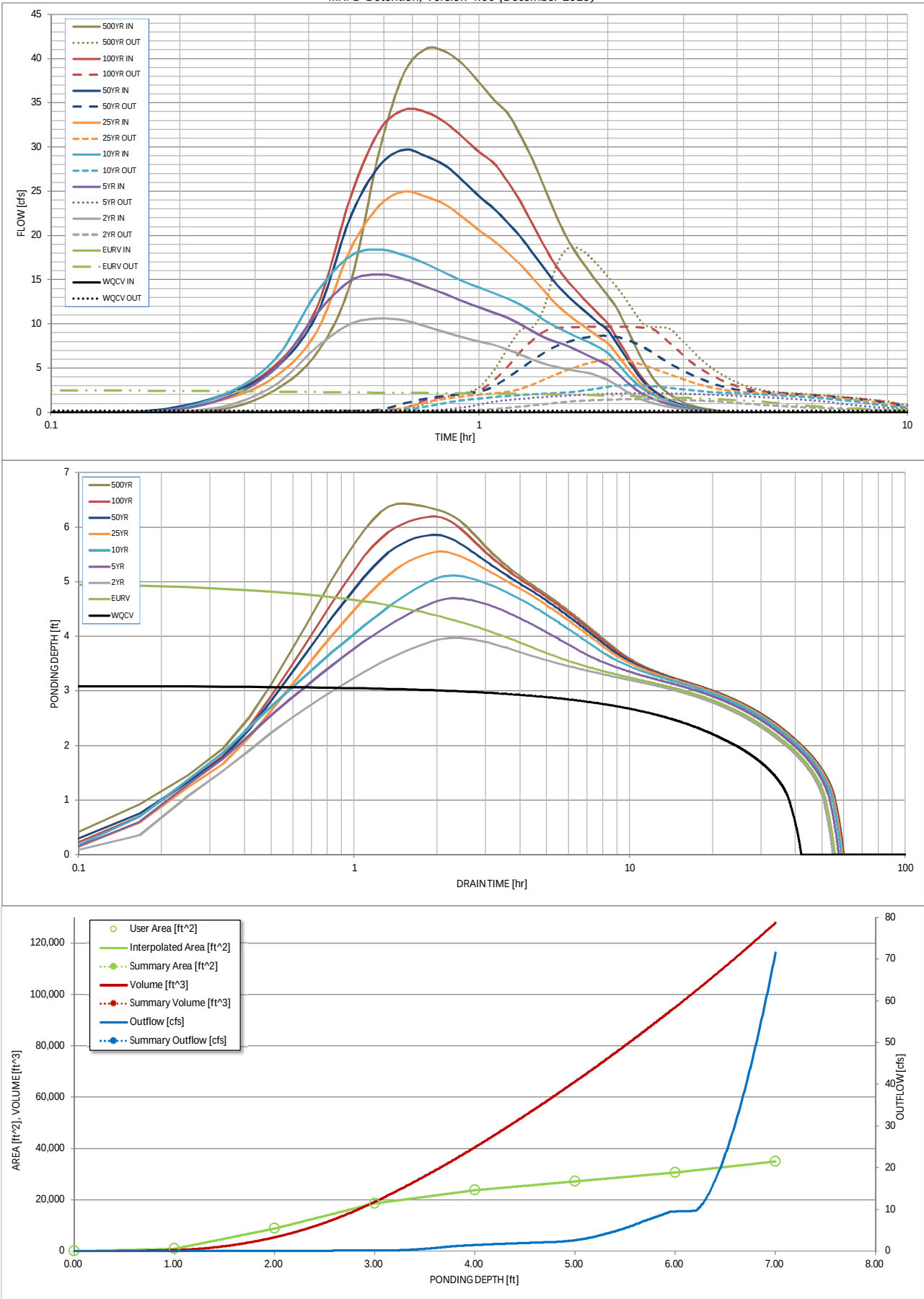
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

|                                               | WQCV  | EURV            | 2 Year             | 5 Year             | 10 Year         | 25 Year         | 50 Year         | 100 Year       | 500 Year |
|-----------------------------------------------|-------|-----------------|--------------------|--------------------|-----------------|-----------------|-----------------|----------------|----------|
| Design Storm Return Period                    |       |                 |                    |                    |                 |                 |                 |                |          |
| One-Hour Rainfall Depth (in)                  | N/A   | N/A             | 0.99               | 1.39               | 1.64            | 1.98            | 2.31            | 2.60           | 3.08     |
| CUHP Runoff Volume (acre-ft)                  | 0.481 | 1.512           | 1.094              | 1.632              | 1.976           | 2.479           | 2.950           | 3.380          | 4.070    |
| Inflow Hydrograph Volume (acre-ft)            | N/A   | N/A             | 1.094              | 1.632              | 1.976           | 2.479           | 2.950           | 3.380          | 4.070    |
| CUHP Predevelopment Peak Q (cfs)              | N/A   | N/A             | 0.1                | 1.5                | 2.6             | 5.9             | 8.0             | 10.7           | 14.0     |
| OPTIONAL Override Predevelopment Peak Q (cfs) | N/A   | N/A             |                    |                    |                 |                 |                 |                |          |
| Predevelopment Unit Peak Flow, q (cfs/acre)   | N/A   | N/A             | 0.01               | 0.09               | 0.16            | 0.37            | 0.50            | 0.67           | 0.87     |
| Peak Inflow Q (cfs)                           | N/A   | N/A             | 10.6               | 15.6               | 18.4            | 25.0            | 29.7            | 34.2           | 41.1     |
| Peak Outflow Q (cfs)                          | 0.2   | 2.6             | 1.5                | 2.2                | 3.1             | 6.0             | 8.7             | 9.7            | 18.7     |
| Ratio Peak Outflow to Predevelopment Q        | N/A   | N/A             | N/A                | 1.5                | 1.2             | 1.0             | 1.1             | 0.9            | 1.3      |
| Structure Controlling Flow                    | Plate | Overflow Weir 1 | Vertical Orifice 1 | Vertical Orifice 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Spillway |
| Max Velocity through Gate 1 (fps)             | N/A   | 0.07            | N/A                | N/A                | 0.2             | 0.9             | 1.6             | 1.8            | 1.8      |
| Max Velocity through Gate 2 (fps)             | N/A   | N/A             | N/A                | N/A                | N/A             | N/A             | N/A             | N/A            | N/A      |
| Time to Drain 97% of Inflow Volume (hours)    | 38    | 47              | 47                 | 48                 | 48              | 47              | 46              | 45             | 43       |
| Time to Drain 99% of Inflow Volume (hours)    | 40    | 51              | 51                 | 53                 | 53              | 53              | 53              | 52             | 52       |
| Maximum Ponding Depth (ft)                    | 3.10  | 5.00            | 3.97               | 4.70               | 5.11            | 5.55            | 5.86            | 6.19           | 6.43     |
| Area at Maximum Ponding Depth (acres)         | 0.44  | 0.63            | 0.54               | 0.60               | 0.63            | 0.67            | 0.69            | 0.72           | 0.75     |
| Maximum Volume Stored (acre-ft)               | 0.485 | 1.515           | 0.913              | 1.325              | 1.584           | 1.871           | 2.076           | 2.316          | 2.485    |



DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|-----------------------------|--------|-------------|--------------|
| minimum bound               |        |             |              |
| maximum bound               |        |             |              |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

### Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

|               | SOURCE  | CUHP       | CUHP       | CUHP         | CUHP         | CUHP          | CUHP          | CUHP          | CUHP           | CUHP           |
|---------------|---------|------------|------------|--------------|--------------|---------------|---------------|---------------|----------------|----------------|
| Time Interval | TIME    | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min      | 0:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 0:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 0:10:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.16          | 0.06           | 0.35           |
|               | 0:15:00 | 0.00       | 0.00       | 0.63         | 1.49         | 1.91          | 1.40          | 1.92          | 1.86           | 2.53           |
|               | 0:20:00 | 0.00       | 0.00       | 3.10         | 4.93         | 6.00          | 4.02          | 4.98          | 5.28           | 6.67           |
|               | 0:25:00 | 0.00       | 0.00       | 7.35         | 11.15        | 13.54         | 9.09          | 10.98         | 11.78          | 14.56          |
|               | 0:30:00 | 0.00       | 0.00       | 10.01        | 14.88        | 17.68         | 18.42         | 22.05         | 24.26          | 29.39          |
|               | 0:35:00 | 0.00       | 0.00       | 10.64        | 15.62        | 18.44         | 23.34         | 27.83         | 31.82          | 38.32          |
|               | 0:40:00 | 0.00       | 0.00       | 10.42        | 15.10        | 17.79         | 24.98         | 29.71         | 34.21          | 41.10          |
|               | 0:45:00 | 0.00       | 0.00       | 9.75         | 14.21        | 16.82         | 24.40         | 28.99         | 33.98          | 40.80          |
|               | 0:50:00 | 0.00       | 0.00       | 9.07         | 13.40        | 15.79         | 23.51         | 27.92         | 32.79          | 39.35          |
|               | 0:55:00 | 0.00       | 0.00       | 8.48         | 12.56        | 14.84         | 22.04         | 26.18         | 31.10          | 37.32          |
|               | 1:00:00 | 0.00       | 0.00       | 8.02         | 11.88        | 14.12         | 20.58         | 24.44         | 29.45          | 35.34          |
|               | 1:05:00 | 0.00       | 0.00       | 7.64         | 11.28        | 13.49         | 19.39         | 23.03         | 28.16          | 33.79          |
|               | 1:10:00 | 0.00       | 0.00       | 7.10         | 10.68        | 12.85         | 18.05         | 21.43         | 26.06          | 31.27          |
|               | 1:15:00 | 0.00       | 0.00       | 6.53         | 9.95         | 12.18         | 16.68         | 19.82         | 23.78          | 28.56          |
|               | 1:20:00 | 0.00       | 0.00       | 5.97         | 9.17         | 11.36         | 15.18         | 18.03         | 21.25          | 25.53          |
|               | 1:25:00 | 0.00       | 0.00       | 5.51         | 8.49         | 10.46         | 13.76         | 16.33         | 18.87          | 22.67          |
|               | 1:30:00 | 0.00       | 0.00       | 5.20         | 8.02         | 9.77          | 12.41         | 14.74         | 16.82          | 20.21          |
|               | 1:35:00 | 0.00       | 0.00       | 4.96         | 7.66         | 9.20          | 11.38         | 13.52         | 15.27          | 18.36          |
|               | 1:40:00 | 0.00       | 0.00       | 4.75         | 7.19         | 8.69          | 10.52         | 12.49         | 14.02          | 16.85          |
|               | 1:45:00 | 0.00       | 0.00       | 4.56         | 6.70         | 8.21          | 9.77          | 11.59         | 12.90          | 15.50          |
|               | 1:50:00 | 0.00       | 0.00       | 4.36         | 6.23         | 7.77          | 9.08          | 10.77         | 11.88          | 14.28          |
|               | 1:55:00 | 0.00       | 0.00       | 4.01         | 5.80         | 7.28          | 8.43          | 9.99          | 10.92          | 13.12          |
|               | 2:00:00 | 0.00       | 0.00       | 3.64         | 5.33         | 6.70          | 7.80          | 9.25          | 10.01          | 12.02          |
|               | 2:05:00 | 0.00       | 0.00       | 3.14         | 4.61         | 5.78          | 6.78          | 8.03          | 8.67           | 10.41          |
|               | 2:10:00 | 0.00       | 0.00       | 2.63         | 3.85         | 4.83          | 5.70          | 6.75          | 7.28           | 8.74           |
|               | 2:15:00 | 0.00       | 0.00       | 2.15         | 3.14         | 3.95          | 4.67          | 5.53          | 5.96           | 7.15           |
|               | 2:20:00 | 0.00       | 0.00       | 1.73         | 2.53         | 3.21          | 3.76          | 4.44          | 4.77           | 5.72           |
|               | 2:25:00 | 0.00       | 0.00       | 1.40         | 2.05         | 2.62          | 2.96          | 3.50          | 3.72           | 4.47           |
|               | 2:30:00 | 0.00       | 0.00       | 1.15         | 1.70         | 2.19          | 2.35          | 2.78          | 2.91           | 3.50           |
|               | 2:35:00 | 0.00       | 0.00       | 0.96         | 1.42         | 1.83          | 1.91          | 2.26          | 2.32           | 2.79           |
|               | 2:40:00 | 0.00       | 0.00       | 0.80         | 1.19         | 1.53          | 1.55          | 1.84          | 1.86           | 2.23           |
|               | 2:45:00 | 0.00       | 0.00       | 0.66         | 0.98         | 1.26          | 1.26          | 1.49          | 1.48           | 1.78           |
|               | 2:50:00 | 0.00       | 0.00       | 0.55         | 0.81         | 1.04          | 1.02          | 1.20          | 1.17           | 1.41           |
|               | 2:55:00 | 0.00       | 0.00       | 0.45         | 0.66         | 0.85          | 0.82          | 0.97          | 0.92           | 1.11           |
|               | 3:00:00 | 0.00       | 0.00       | 0.37         | 0.54         | 0.69          | 0.66          | 0.78          | 0.73           | 0.88           |
|               | 3:05:00 | 0.00       | 0.00       | 0.31         | 0.44         | 0.56          | 0.54          | 0.64          | 0.59           | 0.72           |
|               | 3:10:00 | 0.00       | 0.00       | 0.25         | 0.35         | 0.45          | 0.44          | 0.52          | 0.48           | 0.58           |
|               | 3:15:00 | 0.00       | 0.00       | 0.20         | 0.28         | 0.36          | 0.35          | 0.41          | 0.39           | 0.47           |
|               | 3:20:00 | 0.00       | 0.00       | 0.15         | 0.21         | 0.28          | 0.27          | 0.32          | 0.31           | 0.37           |
|               | 3:25:00 | 0.00       | 0.00       | 0.11         | 0.16         | 0.21          | 0.21          | 0.24          | 0.23           | 0.28           |
|               | 3:30:00 | 0.00       | 0.00       | 0.08         | 0.11         | 0.15          | 0.15          | 0.18          | 0.17           | 0.21           |
|               | 3:35:00 | 0.00       | 0.00       | 0.05         | 0.08         | 0.10          | 0.11          | 0.12          | 0.12           | 0.14           |
|               | 3:40:00 | 0.00       | 0.00       | 0.03         | 0.05         | 0.06          | 0.07          | 0.08          | 0.08           | 0.09           |
|               | 3:45:00 | 0.00       | 0.00       | 0.02         | 0.03         | 0.03          | 0.04          | 0.04          | 0.04           | 0.05           |
|               | 3:50:00 | 0.00       | 0.00       | 0.01         | 0.01         | 0.01          | 0.02          | 0.02          | 0.02           | 0.02           |
|               | 3:55:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.01           |
|               | 4:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
| 4:10:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:15:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:20:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:25:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:30:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:35:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:40:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:45:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:50:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:55:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:00:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:05:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:10:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:15:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:20:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:25:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:30:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:35:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:40:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:45:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:50:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:55:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 6:00:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.02 (February 2020)*

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

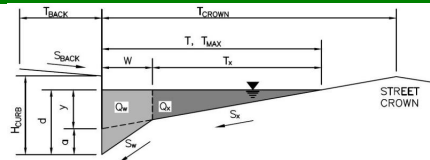
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet A04

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  0.000 ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.000 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm | Major Storm |        |
|-------------|-------------|-------------|--------|
| $T_{MAX} =$ | 13.0        | 13.0        | ft     |
| $d_{MAX} =$ | 6.0         | 6.0         | inches |

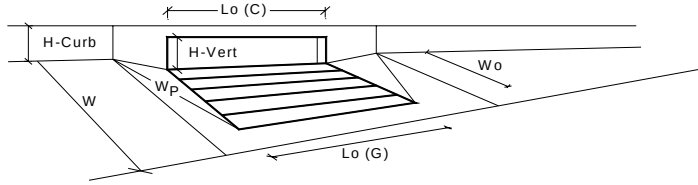
☐ ☐

$Q_{allow} =$ 

| Minor Storm | Major Storm |     |
|-------------|-------------|-----|
| SUMP        | SUMP        | cfs |

## INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   | MINOR                    | MAJOR        |                                          |
|------------------------------------------------------------------------------|--------------------------|--------------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening |              |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) | 3.00                     | 3.00         | inches                                   |
| Number of Unit Inlets (Grate or Curb Opening)                                | 1                        | 1            |                                          |
| Water Depth at Flowline (outside of local depression)                        | 3.9                      | 3.9          | inches                                   |
| <b>Grate Information</b>                                                     | <b>MINOR</b>             | <b>MAJOR</b> | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       | N/A                      | N/A          | feet                                     |
| Width of a Unit Grate                                                        | N/A                      | N/A          | feet                                     |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    | N/A                      | N/A          |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               | N/A                      | N/A          |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           | N/A                      | N/A          |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        | N/A                      | N/A          |                                          |
| <b>Curb Opening Information</b>                                              | <b>MINOR</b>             | <b>MAJOR</b> |                                          |
| Length of a Unit Curb Opening                                                | 5.00                     | 5.00         | feet                                     |
| Height of Vertical Curb Opening in Inches                                    | 6.00                     | 6.00         | inches                                   |
| Height of Curb Orifice Throat in Inches                                      | 6.00                     | 6.00         | inches                                   |
| Angle of Throat (see USDCM Figure ST-5)                                      | 63.40                    | 63.40        | degrees                                  |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         | 1.00                     | 1.00         | feet                                     |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               | 0.10                     | 0.10         |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        | 3.60                     | 3.60         |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 | 0.67                     | 0.67         |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           | <b>MINOR</b>             | <b>MAJOR</b> |                                          |
| Depth for Grate Midwidth                                                     | N/A                      | N/A          | ft                                       |
| Depth for Curb Opening Weir Equation                                         | 0.24                     | 0.24         | ft                                       |
| Combination Inlet Performance Reduction Factor for Long Inlets               | 0.50                     | 0.50         |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    | 1.00                     | 1.00         |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    | N/A                      | N/A          |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         | <b>MINOR</b>             | <b>MAJOR</b> |                                          |
| <b>Inlet Capacity IS GOOD for Minor and Major Storms(&gt;Q PEAK)</b>         | 2.6                      | 2.6          | cfs                                      |
| Q PEAK REQUIRED                                                              | 0.4                      | 0.8          | cfs                                      |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

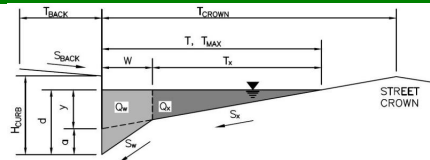
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet A02

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

$T_{BACK} = 0.0$  ft  
 $S_{BACK} = 0.000$  ft/ft  
 $n_{BACK} = 0.012$

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 13.0$  ft  
 $W = 1.00$  ft  
 $S_x = 0.015$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.006$  ft/ft  
 $n_{STREET} = 0.012$

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

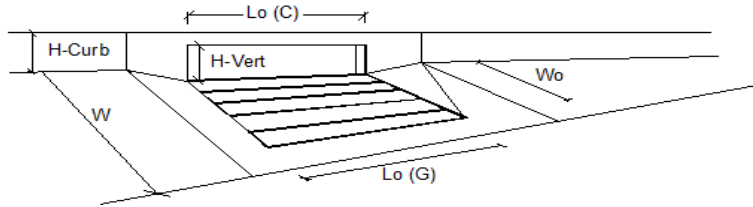
|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 3.2         | 3.2         | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          |                          | MINOR         | MAJOR                    |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL} =$ | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | $N_0 =$       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_0 =$       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than $W$ , Gutter Width)                   |                          | $W_0 =$       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G =$     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C =$     | 0.10 0.10                |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                                   |                          | $Q =$         | 0.6 1.4 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b =$       | 0.0 0.3 cfs              |
| Capture Percentage = $Q_i/Q_0 =$                                                    |                          | $C\% =$       | 100 80 %                 |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

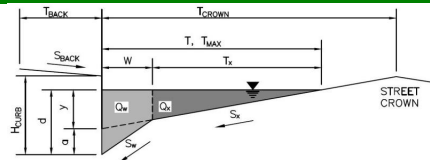
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet C00

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.000 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm | Major Storm |        |
|-------------|-------------|-------------|--------|
| $T_{MAX} =$ | 13.0        | 13.0        | ft     |
| $d_{MAX} =$ | 6.0         | 6.0         | inches |

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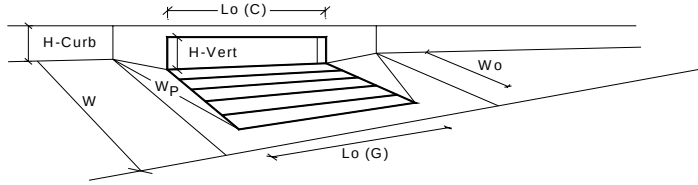
$Q_{allow} =$ 

| Minor Storm | Major Storm |     |
|-------------|-------------|-----|
| SUMP        | SUMP        | cfs |



# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   |                          | MINOR                        |                          | MAJOR |                                          |
|------------------------------------------------------------------------------|--------------------------|------------------------------|--------------------------|-------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening | Type =                       | CDOT Type R Curb Opening |       |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) |                          | a <sub>local</sub> =         | 3.00                     | 3.00  | inches                                   |
| Number of Unit Inlets (Grate or Curb Opening)                                |                          | No =                         | 1                        | 1     |                                          |
| Water Depth at Flowline (outside of local depression)                        |                          | Ponding Depth =              | 3.9                      | 3.9   | inches                                   |
| <b>Grate Information</b>                                                     |                          |                              | MINOR                    | MAJOR | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       |                          | L <sub>o</sub> (G) =         | N/A                      | N/A   | feet                                     |
| Width of a Unit Grate                                                        |                          | W <sub>o</sub> =             | N/A                      | N/A   | feet                                     |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    |                          | A <sub>ratio</sub> =         | N/A                      | N/A   |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               |                          | C <sub>l</sub> (G) =         | N/A                      | N/A   |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           |                          | C <sub>w</sub> (G) =         | N/A                      | N/A   |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        |                          | C <sub>o</sub> (G) =         | N/A                      | N/A   |                                          |
| <b>Curb Opening Information</b>                                              |                          |                              | MINOR                    | MAJOR |                                          |
| Length of a Unit Curb Opening                                                |                          | L <sub>o</sub> (C) =         | 5.00                     | 5.00  | feet                                     |
| Height of Vertical Curb Opening in Inches                                    |                          | H <sub>vert</sub> =          | 6.00                     | 6.00  | inches                                   |
| Height of Curb Orifice Throat in Inches                                      |                          | H <sub>throat</sub> =        | 6.00                     | 6.00  | inches                                   |
| Angle of Throat (see USDCM Figure ST-5)                                      |                          | Theta =                      | 63.40                    | 63.40 | degrees                                  |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         |                          | W <sub>p</sub> =             | 1.00                     | 1.00  | feet                                     |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               |                          | C <sub>l</sub> (C) =         | 0.10                     | 0.10  |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        |                          | C <sub>w</sub> (C) =         | 3.60                     | 3.60  |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 |                          | C <sub>o</sub> (C) =         | 0.67                     | 0.67  |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           |                          |                              | MINOR                    | MAJOR |                                          |
| Depth for Grate Midwidth                                                     |                          | d <sub>Grate</sub> =         | N/A                      | N/A   | ft                                       |
| Depth for Curb Opening Weir Equation                                         |                          | d <sub>Curb</sub> =          | 0.24                     | 0.24  | ft                                       |
| Combination Inlet Performance Reduction Factor for Long Inlets               |                          | RF <sub>Combination</sub> =  | 0.50                     | 0.50  |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Curb</sub> =         | 1.00                     | 1.00  |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Grate</sub> =        | N/A                      | N/A   |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         |                          |                              | MINOR                    | MAJOR |                                          |
|                                                                              |                          | Q <sub>a</sub> =             | 2.6                      | 2.6   | cfs                                      |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)                   |                          | Q <sub>PEAK REQUIRED</sub> = | 0.7                      | 1.3   | cfs                                      |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

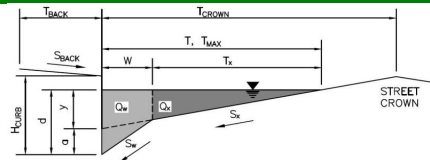
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet A01

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK}$  = 0.0 ft  
 $S_{BACK}$  = ft/ft  
 $n_{BACK}$  = 0.012

$H_{CURB}$  = 6.00 inches  
 $T_{CROWN}$  = 13.0 ft  
 $W$  = 1.00 ft  
 $S_x$  = 0.028 ft/ft  
 $S_w$  = 0.083 ft/ft  
 $S_o$  = 0.000 ft/ft  
 $n_{STREET}$  = 0.012

|           | Minor Storm | Major Storm |        |
|-----------|-------------|-------------|--------|
| $T_{MAX}$ | 13.0        | 13.0        | ft     |
| $d_{MAX}$ | 6.0         | 6.0         | inches |

☐ ☐

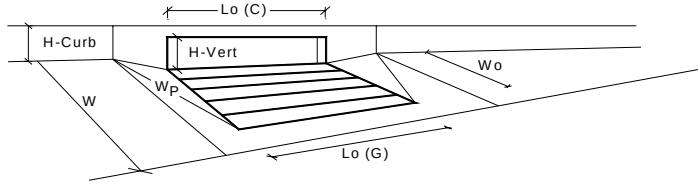
$Q_{allow}$  = 
 

| Minor Storm | Major Storm |
|-------------|-------------|
| SUMP        | SUMP        |

 cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   |                          | MINOR                        |                          | MAJOR |                                          |
|------------------------------------------------------------------------------|--------------------------|------------------------------|--------------------------|-------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening | Type =                       | CDOT Type R Curb Opening |       |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) |                          | a <sub>local</sub> =         | 3.00                     | 3.00  | inches                                   |
| Number of Unit Inlets (Grate or Curb Opening)                                |                          | No =                         | 1                        | 1     |                                          |
| Water Depth at Flowline (outside of local depression)                        |                          | Ponding Depth =              | 5.1                      | 5.1   | inches                                   |
| <b>Grate Information</b>                                                     |                          |                              | MINOR                    | MAJOR | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       |                          | L <sub>o</sub> (G) =         | N/A                      | N/A   | feet                                     |
| Width of a Unit Grate                                                        |                          | W <sub>o</sub> =             | N/A                      | N/A   | feet                                     |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    |                          | A <sub>ratio</sub> =         | N/A                      | N/A   |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               |                          | C <sub>l</sub> (G) =         | N/A                      | N/A   |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           |                          | C <sub>w</sub> (G) =         | N/A                      | N/A   |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        |                          | C <sub>o</sub> (G) =         | N/A                      | N/A   |                                          |
| <b>Curb Opening Information</b>                                              |                          |                              | MINOR                    | MAJOR |                                          |
| Length of a Unit Curb Opening                                                |                          | L <sub>o</sub> (C) =         | 5.00                     | 5.00  | feet                                     |
| Height of Vertical Curb Opening in Inches                                    |                          | H <sub>vert</sub> =          | 6.00                     | 6.00  | inches                                   |
| Height of Curb Orifice Throat in Inches                                      |                          | H <sub>throat</sub> =        | 6.00                     | 6.00  | inches                                   |
| Angle of Throat (see USDCM Figure ST-5)                                      |                          | Theta =                      | 63.40                    | 63.40 | degrees                                  |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         |                          | W <sub>p</sub> =             | 1.00                     | 1.00  | feet                                     |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               |                          | C <sub>l</sub> (C) =         | 0.10                     | 0.10  |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        |                          | C <sub>w</sub> (C) =         | 3.60                     | 3.60  |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 |                          | C <sub>o</sub> (C) =         | 0.67                     | 0.67  |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           |                          |                              | MINOR                    | MAJOR |                                          |
| Depth for Grate Midwidth                                                     |                          | d <sub>Grate</sub> =         | N/A                      | N/A   | ft                                       |
| Depth for Curb Opening Weir Equation                                         |                          | d <sub>Curb</sub> =          | 0.34                     | 0.34  | ft                                       |
| Combination Inlet Performance Reduction Factor for Long Inlets               |                          | RF <sub>Combination</sub> =  | 0.65                     | 0.65  |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Curb</sub> =         | 1.00                     | 1.00  |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Grate</sub> =        | N/A                      | N/A   |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         |                          |                              | MINOR                    | MAJOR |                                          |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)                   |                          | Q <sub>a</sub> =             | 4.3                      | 4.3   | cfs                                      |
|                                                                              |                          | Q <sub>PEAK REQUIRED</sub> = | 0.7                      | 2.2   | cfs                                      |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

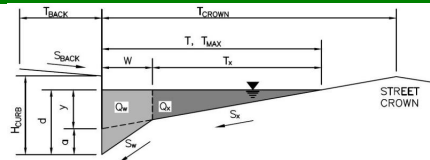
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B05

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.017 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

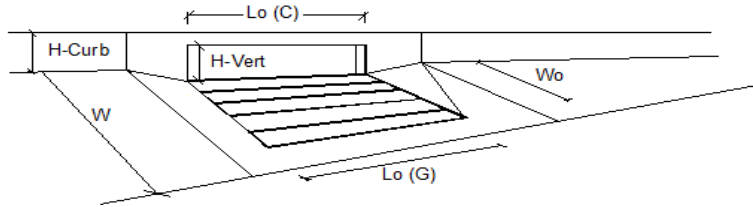
|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 8.7         | 8.7         | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          |                          | MINOR         | MAJOR                    |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL} =$ | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | $N_0 =$       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_0 =$       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than $W$ , Gutter Width)                   |                          | $W_0 =$       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G =$     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C =$     | 0.10 0.10                |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                                   |                          | $Q =$         | 0.7 1.3 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b =$       | 0.0 0.1 cfs              |
| Capture Percentage = $Q_i/Q_0 =$                                                    |                          | $C\% =$       | 100 90 %                 |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

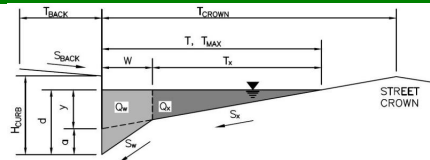
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B03

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.019 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.038 ft/ft  
 $n_{STREET} =$  0.012

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

**MINOR STORM** Allowable Capacity is based on Spread Criterion**MAJOR STORM** Allowable Capacity is based on Spread Criterion

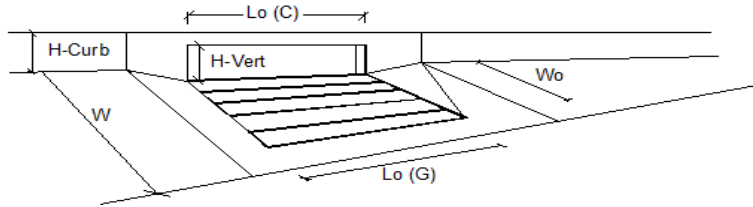
|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 12.0        | 12.0        | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          | CDOT Type R Curb Opening | MINOR         | MAJOR                    |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL}$ = | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | $N_0$ =       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_0$ =       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than W, Gutter Width)                      |                          | $W_0$ =       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G$ =     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C$ =     | 0.10 0.10                |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                                   |                          | $Q$ =         | 0.7 1.2 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b$ =       | 0.0 0.1 cfs              |
| Capture Percentage = $Q_i/Q_0$ =                                                    |                          | $C\%$ =       | 100 93 %                 |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

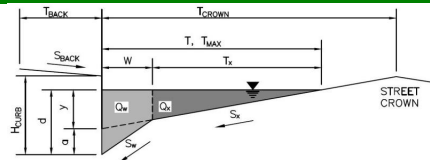
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B08

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.000 ft/ft  
 $n_{STREET} =$  0.012

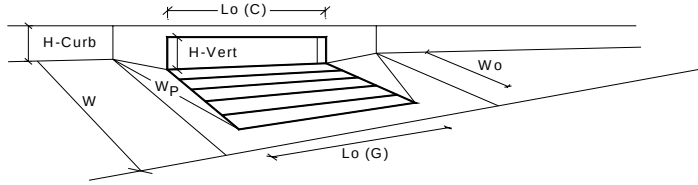
|             | Minor Storm              | Major Storm              |        |
|-------------|--------------------------|--------------------------|--------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft     |
| $d_{MAX} =$ | 6.0                      | 9.0                      | inches |
|             | <input type="checkbox"/> | <input type="checkbox"/> |        |

|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | SUMP        | SUMP        | cfs |



# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   |                          | MINOR                        |                          | MAJOR |         |                                          |
|------------------------------------------------------------------------------|--------------------------|------------------------------|--------------------------|-------|---------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening | Type =                       | CDOT Type R Curb Opening |       |         |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) |                          | a <sub>local</sub> =         | 3.00                     | 3.00  | inches  |                                          |
| Number of Unit Inlets (Grate or Curb Opening)                                |                          | No =                         | 1                        | 1     |         |                                          |
| Water Depth at Flowline (outside of local depression)                        |                          | Ponding Depth =              | 3.9                      | 3.9   | inches  |                                          |
| <b>Grate Information</b>                                                     |                          |                              | MINOR                    | MAJOR |         | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       |                          | L <sub>o</sub> (G) =         | N/A                      | N/A   | feet    |                                          |
| Width of a Unit Grate                                                        |                          | W <sub>o</sub> =             | N/A                      | N/A   | feet    |                                          |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    |                          | A <sub>ratio</sub> =         | N/A                      | N/A   |         |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               |                          | C <sub>l</sub> (G) =         | N/A                      | N/A   |         |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           |                          | C <sub>w</sub> (G) =         | N/A                      | N/A   |         |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        |                          | C <sub>o</sub> (G) =         | N/A                      | N/A   |         |                                          |
| <b>Curb Opening Information</b>                                              |                          |                              | MINOR                    | MAJOR |         |                                          |
| Length of a Unit Curb Opening                                                |                          | L <sub>o</sub> (C) =         | 5.00                     | 5.00  | feet    |                                          |
| Height of Vertical Curb Opening in Inches                                    |                          | H <sub>vert</sub> =          | 6.00                     | 6.00  | inches  |                                          |
| Height of Curb Orifice Throat in Inches                                      |                          | H <sub>throat</sub> =        | 6.00                     | 6.00  | inches  |                                          |
| Angle of Throat (see USDCM Figure ST-5)                                      |                          | Theta =                      | 63.40                    | 63.40 | degrees |                                          |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         |                          | W <sub>p</sub> =             | 1.00                     | 1.00  | feet    |                                          |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               |                          | C <sub>l</sub> (C) =         | 0.10                     | 0.10  |         |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        |                          | C <sub>w</sub> (C) =         | 3.60                     | 3.60  |         |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 |                          | C <sub>o</sub> (C) =         | 0.67                     | 0.67  |         |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           |                          |                              | MINOR                    | MAJOR |         |                                          |
| Depth for Grate Midwidth                                                     |                          | d <sub>Grate</sub> =         | N/A                      | N/A   | ft      |                                          |
| Depth for Curb Opening Weir Equation                                         |                          | d <sub>Curb</sub> =          | 0.24                     | 0.24  | ft      |                                          |
| Combination Inlet Performance Reduction Factor for Long Inlets               |                          | RF <sub>Combination</sub> =  | 0.50                     | 0.50  |         |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Curb</sub> =         | 1.00                     | 1.00  |         |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Grate</sub> =        | N/A                      | N/A   |         |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         |                          |                              | MINOR                    | MAJOR |         |                                          |
|                                                                              |                          | Q <sub>a</sub> =             | 2.6                      | 2.6   | cfs     |                                          |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)                   |                          | Q <sub>PEAK REQUIRED</sub> = | 0.5                      | 0.9   | cfs     |                                          |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

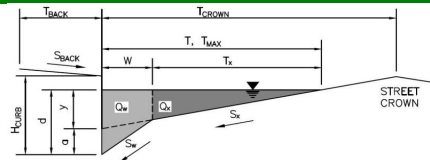
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B00

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.014 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.024 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

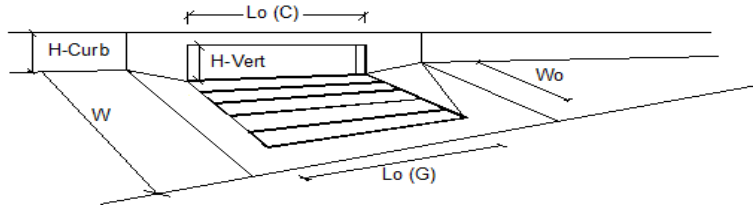
|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 5.9         | 5.9         | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          |                          | MINOR         |                          | MAJOR |        |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|-------|--------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |       |        |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL}$ = | 3.0                      | 3.0   | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | No =          | 1                        | 1     |        |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_o$ =       | 5.00                     | 5.00  | ft     |
| Width of a Unit Grate (cannot be greater than W, Gutter Width)                      |                          | $W_o$ =       | N/A                      | N/A   | ft     |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G$ =     | N/A                      | N/A   |        |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C$ =     | 0.10                     | 0.10  |        |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          |               |                          |       |        |
| Total Inlet Interception Capacity                                                   |                          | Q =           | 0.3                      | 1.6   | cfs    |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b$ =       | 0.0                      | 0.6   | cfs    |
| Capture Percentage = $Q_i/Q_o$ =                                                    |                          | C% =          | 100                      | 72    | %      |

# ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

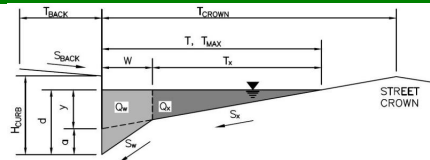
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet C01

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.028 ft/ft  
 $n_{STREET} =$  0.012

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

**MINOR STORM Allowable Capacity is based on Spread Criterion****MAJOR STORM Allowable Capacity is based on Spread Criterion**

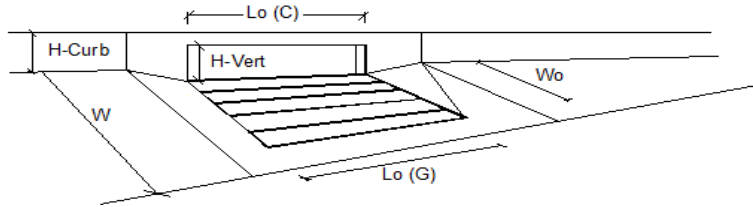
|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 11.3        | 11.3        | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

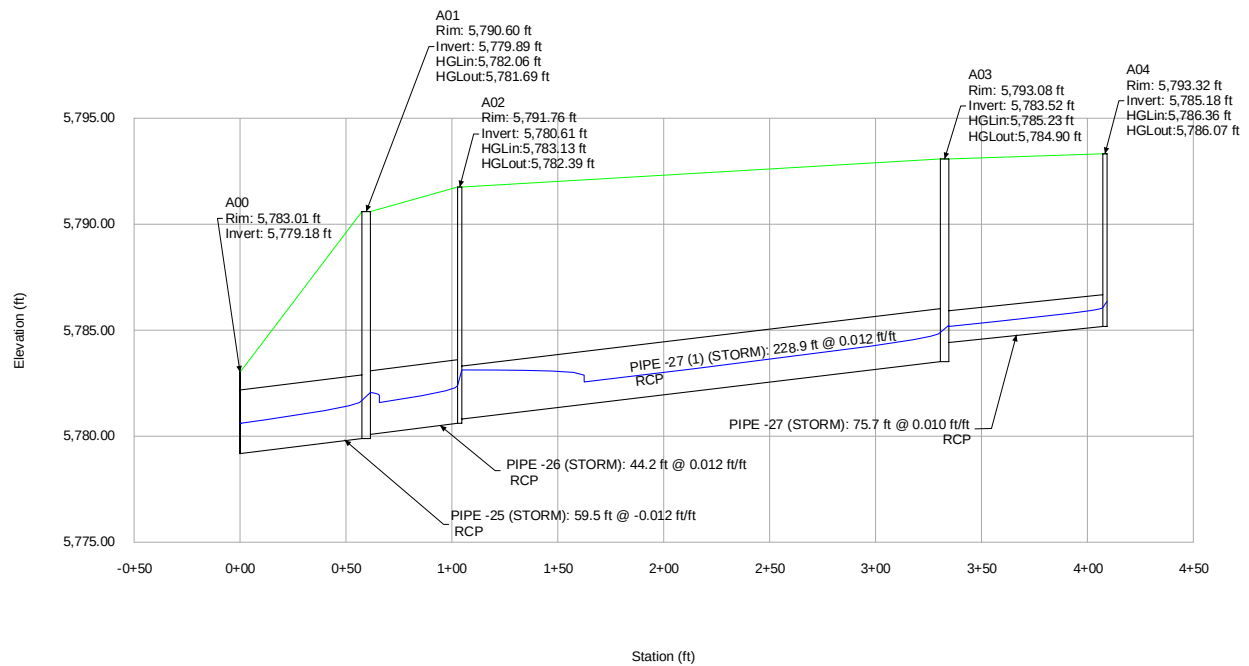
Version 4.05 Released March 2017



| Design Information (Input)                                                          |                          | MINOR         | MAJOR                    |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL} =$ | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | $N_0 =$       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_0 =$       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than $W$ , Gutter Width)                   |                          | $W_0 =$       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G =$     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C =$     | 0.10 0.10                |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                                   |                          | $Q =$         | 0.9 1.4 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b =$       | 0.0 0.2 cfs              |
| Capture Percentage = $Q_i/Q_0 =$                                                    |                          | $C\% =$       | 100 85 %                 |

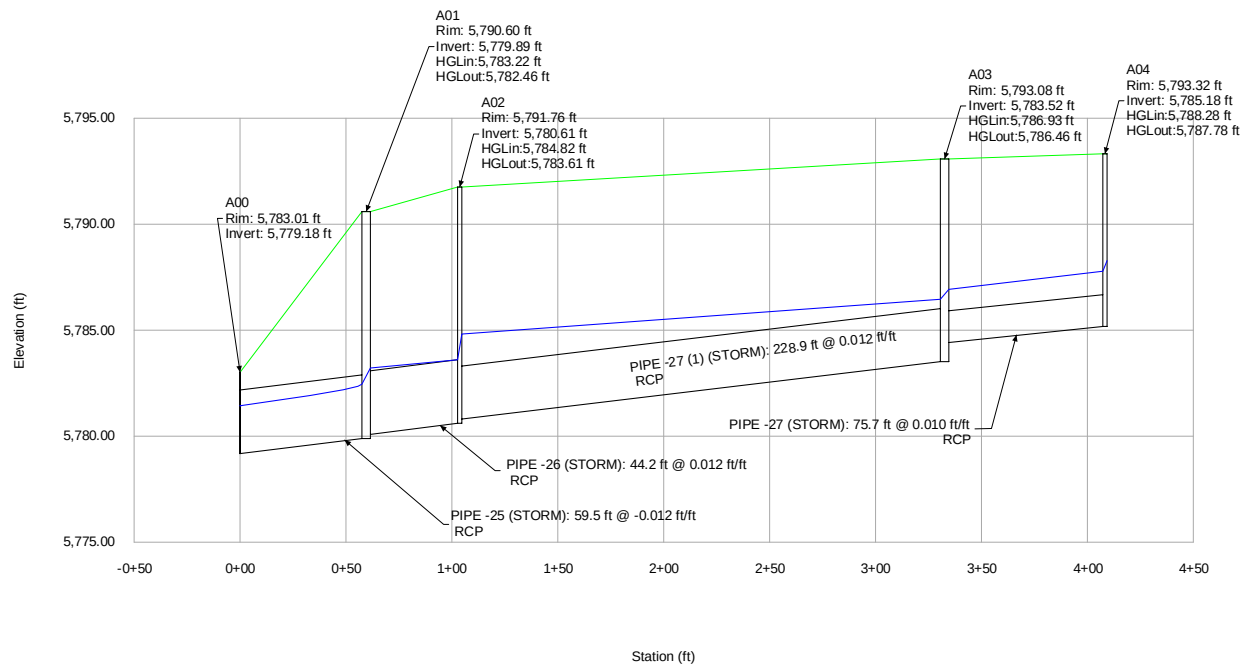
# Profile Report

## Profile Main A (5-Year)

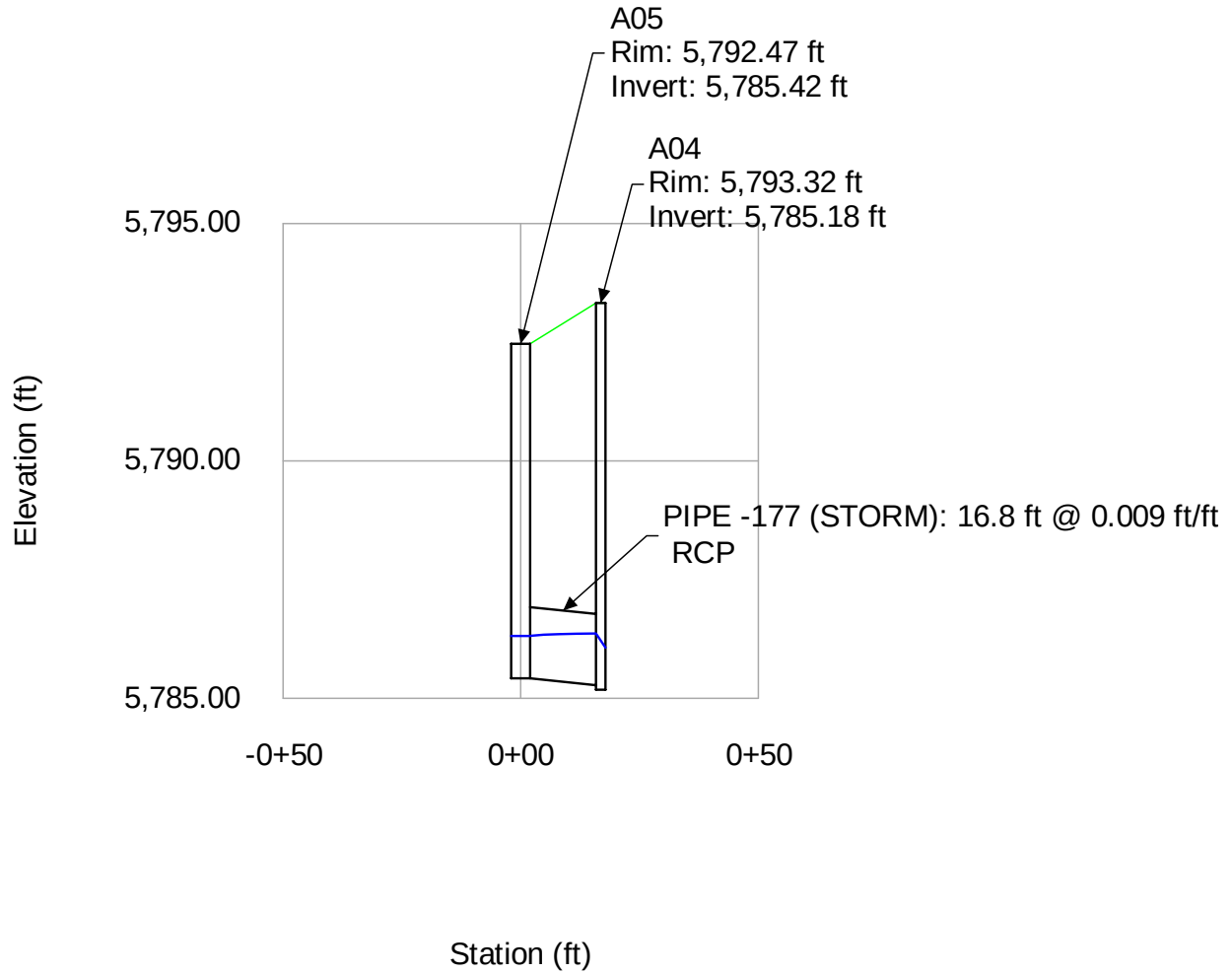


# Profile Report

## Profile Main A (100-Year)

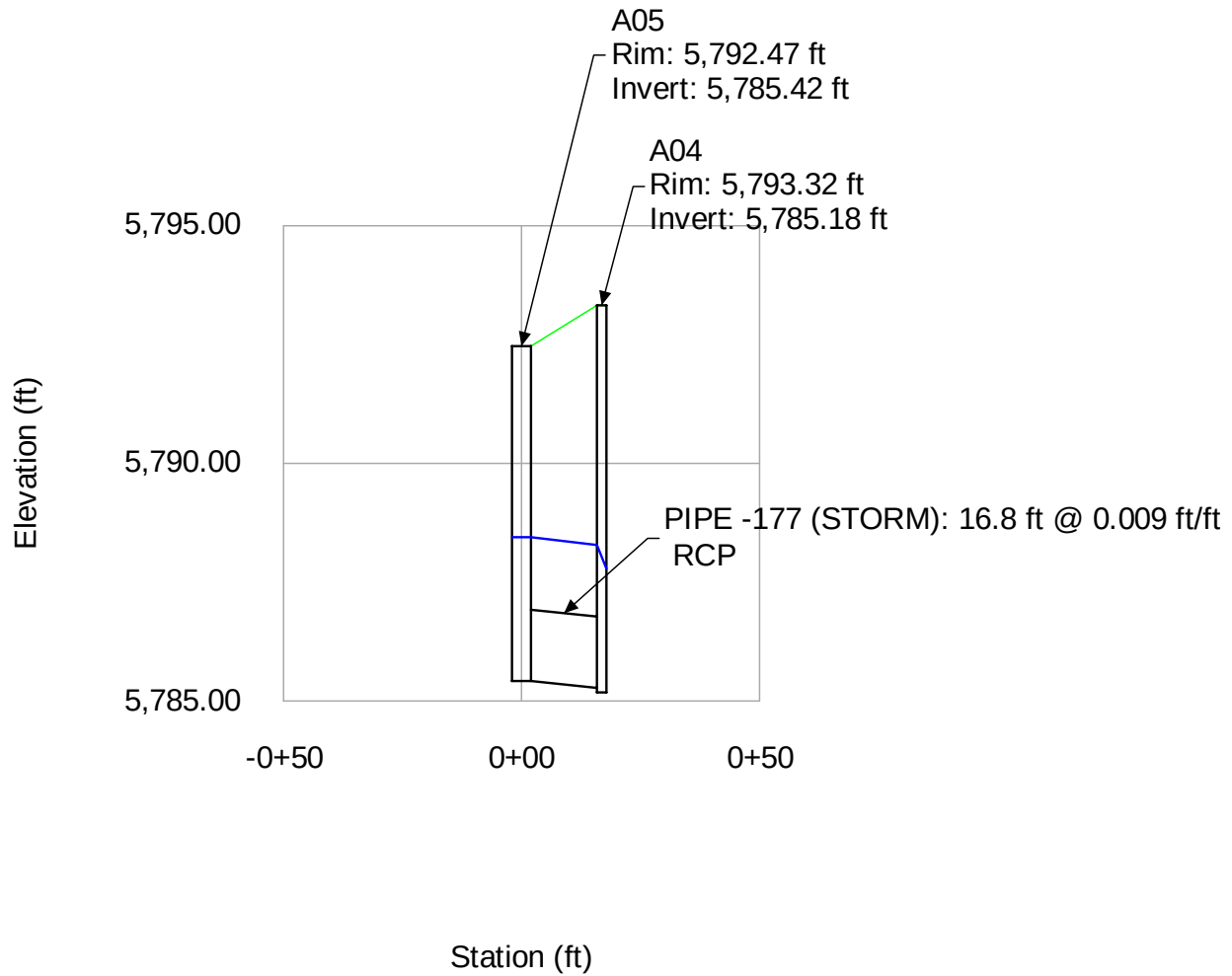


Profile Report  
Profile Lateral A.1 (5-Year)

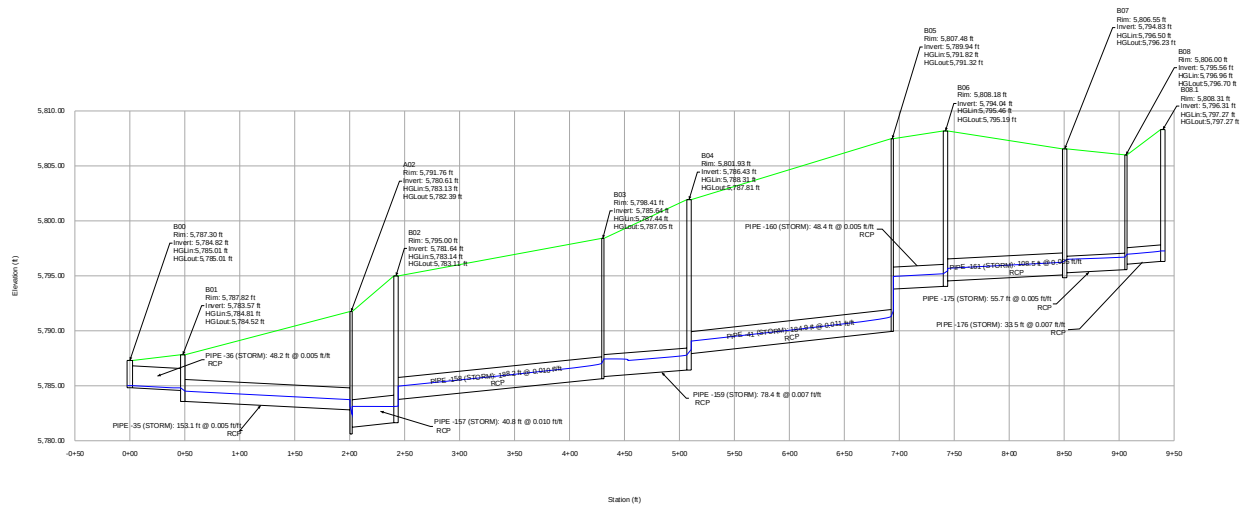




Profile Report  
Profile Lateral A.1 (100-Year)

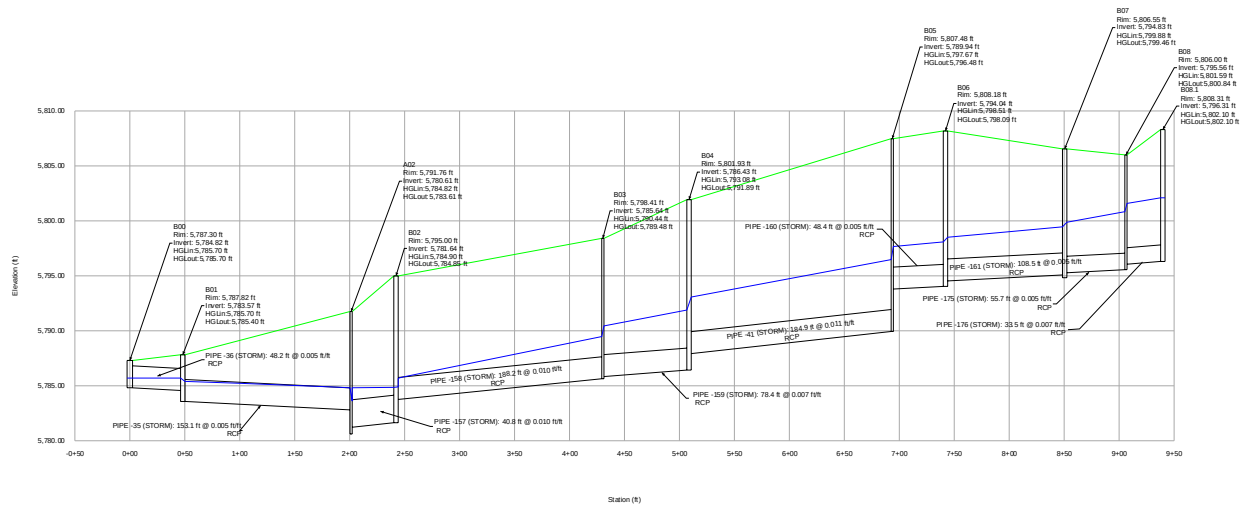


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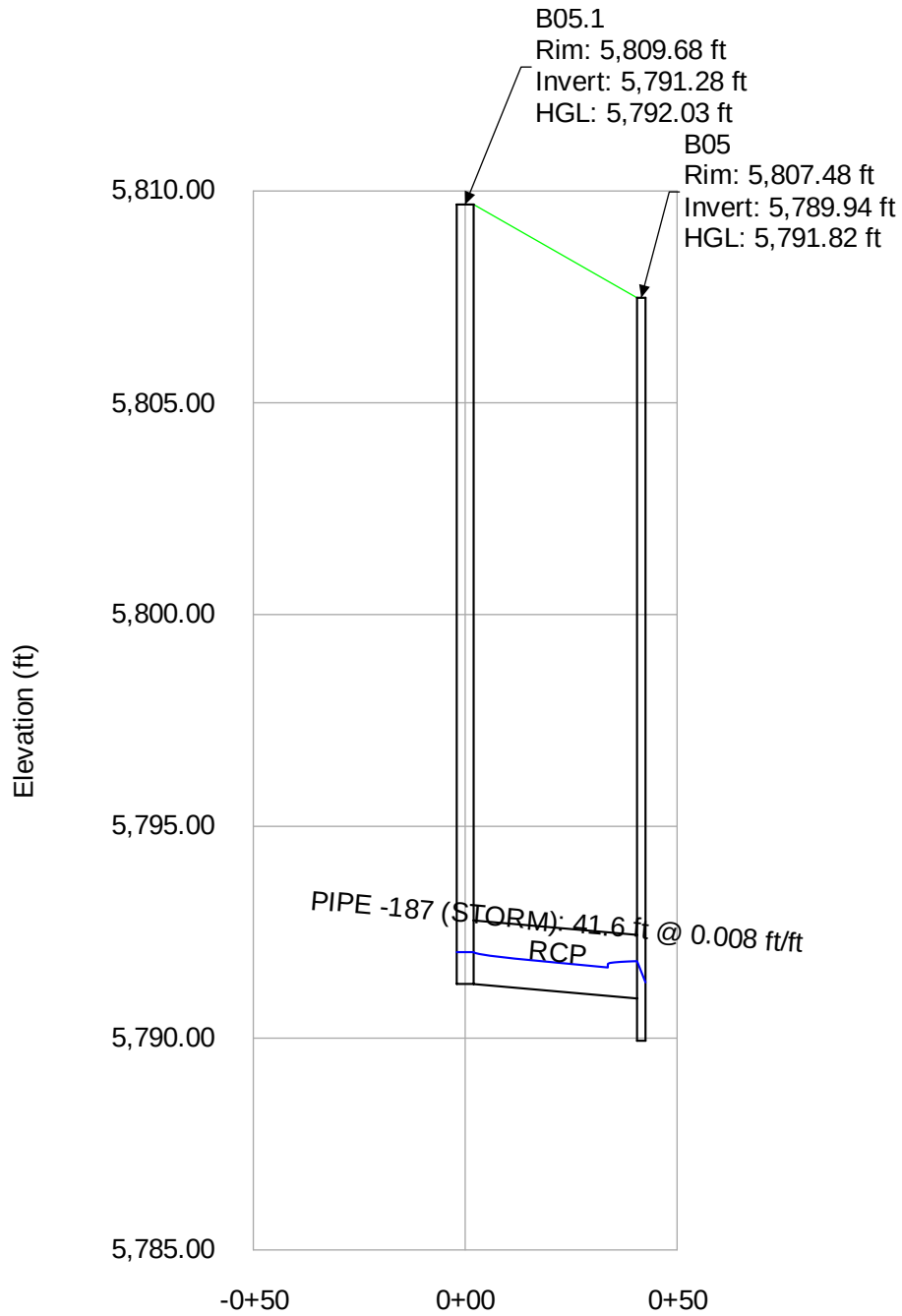


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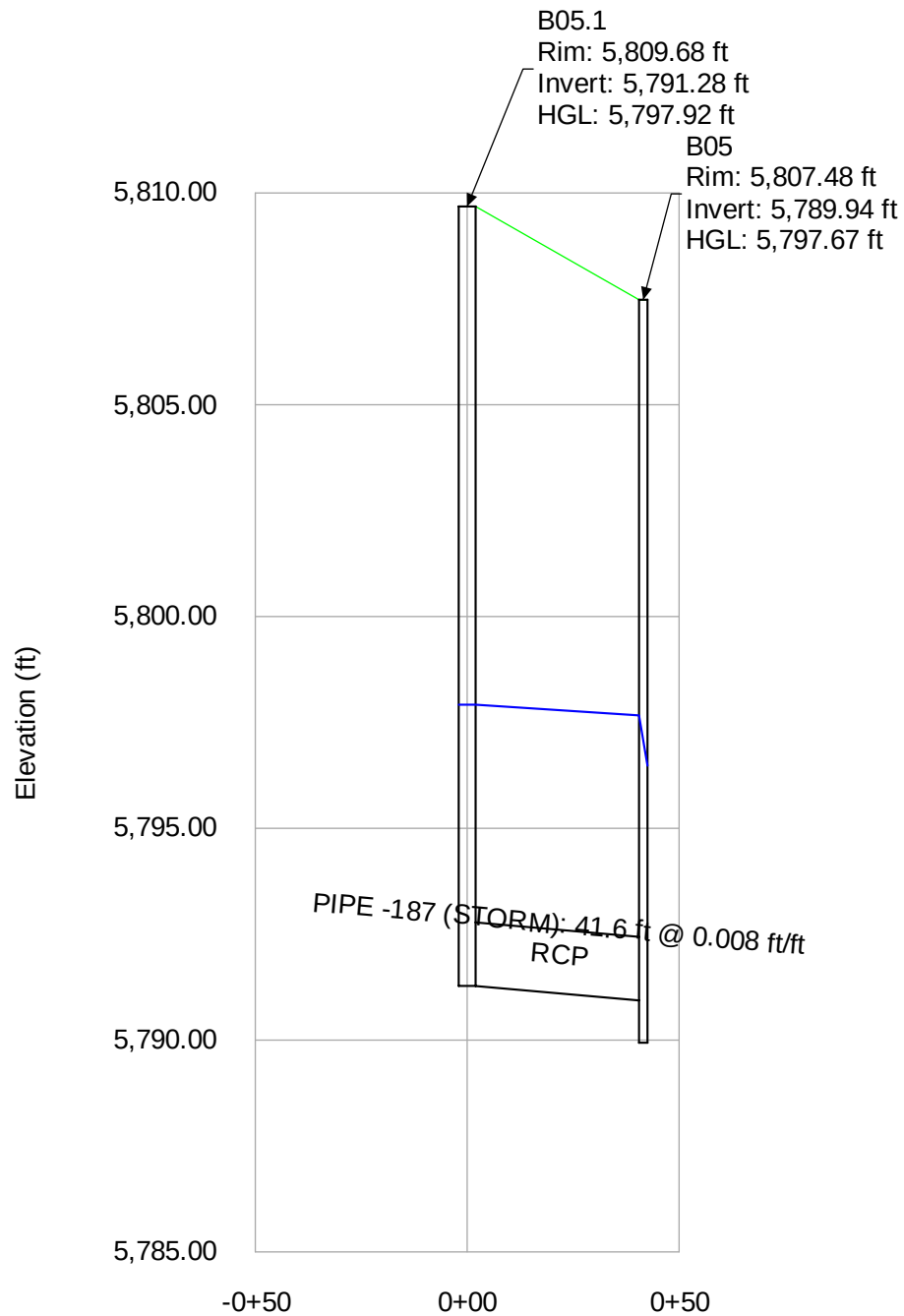
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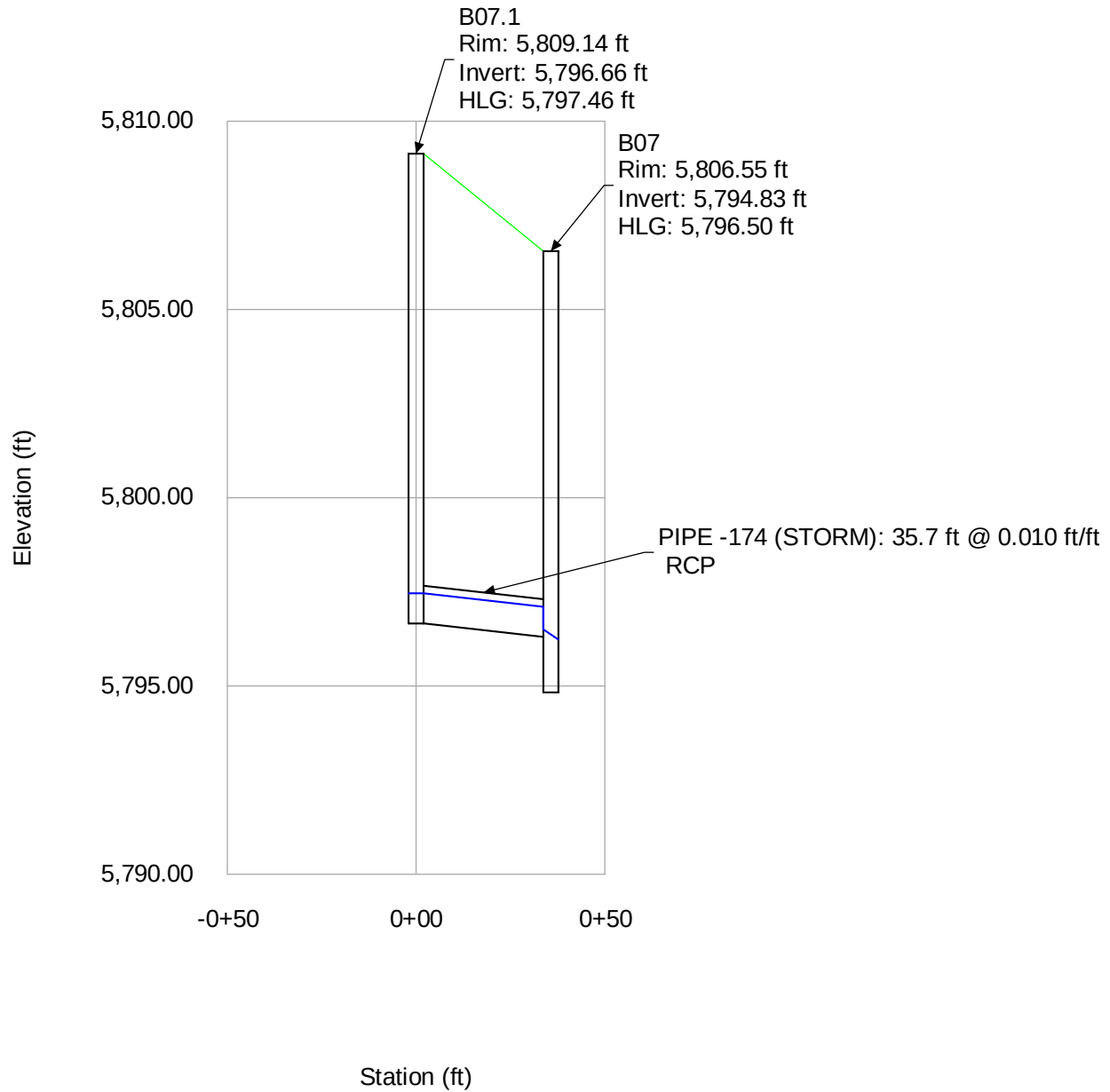
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# Profile Report Profile Lateral B.1 (100-Year)

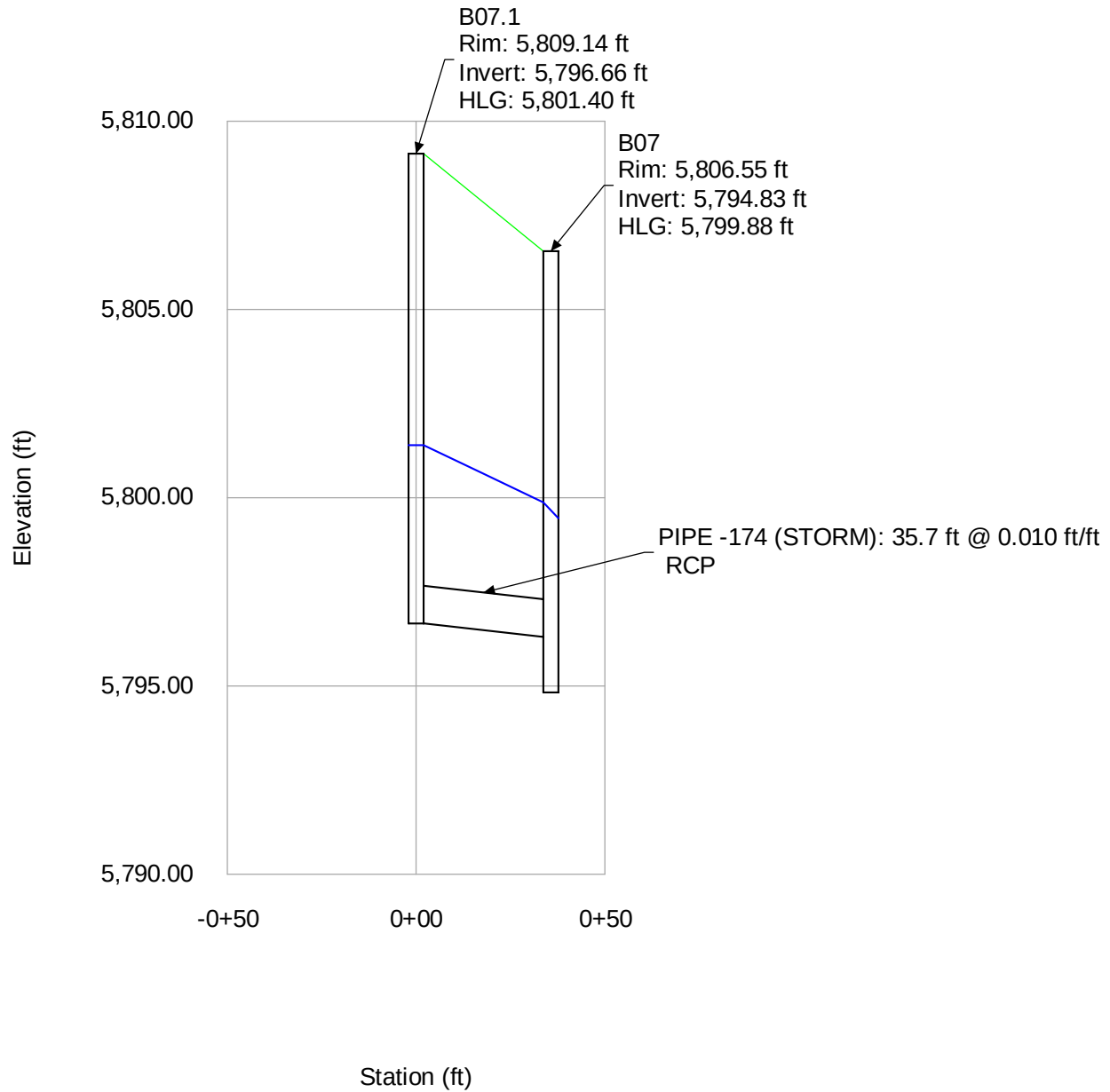


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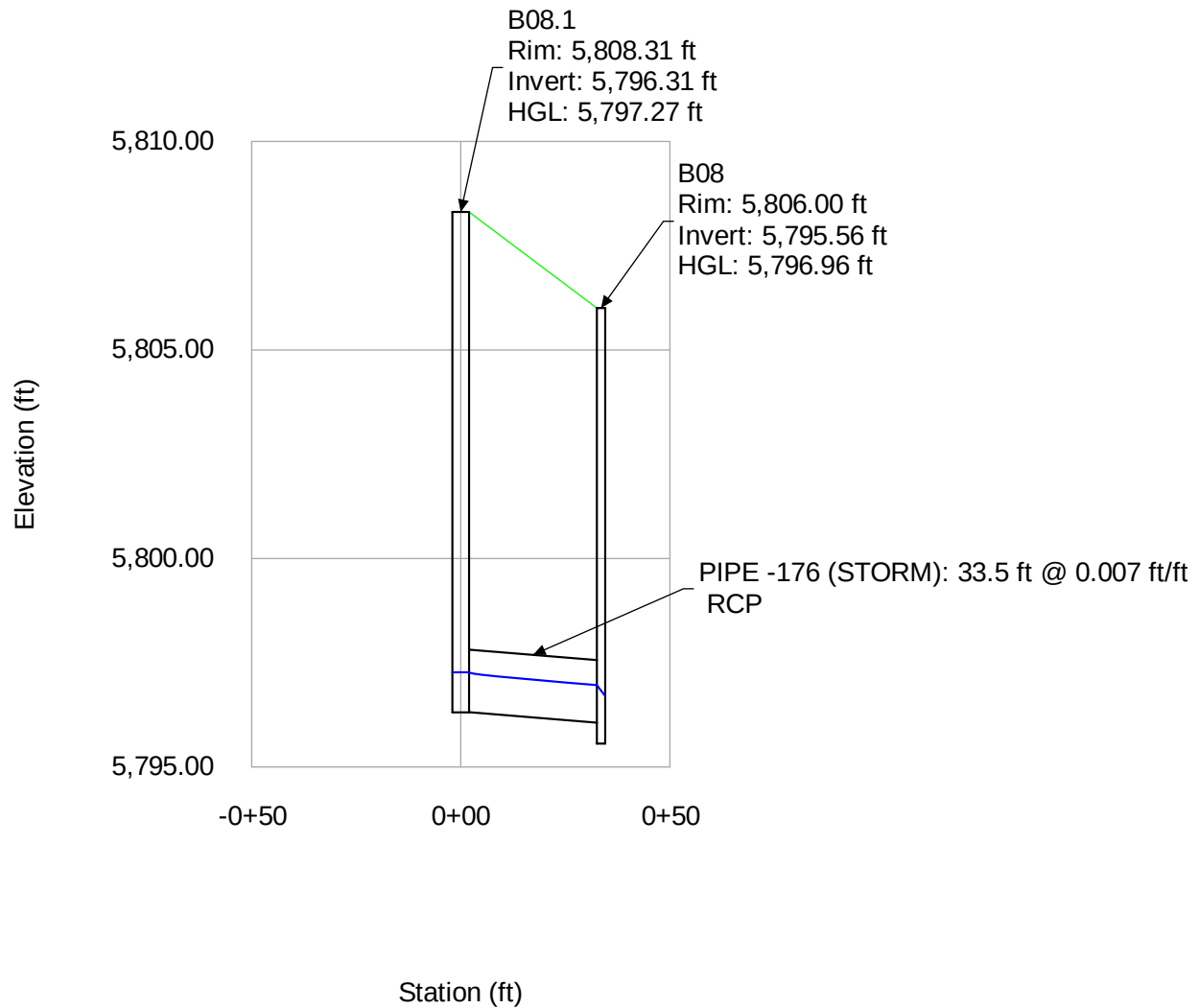


# Profile Report

## Profile Lateral B.2 (100-Year)

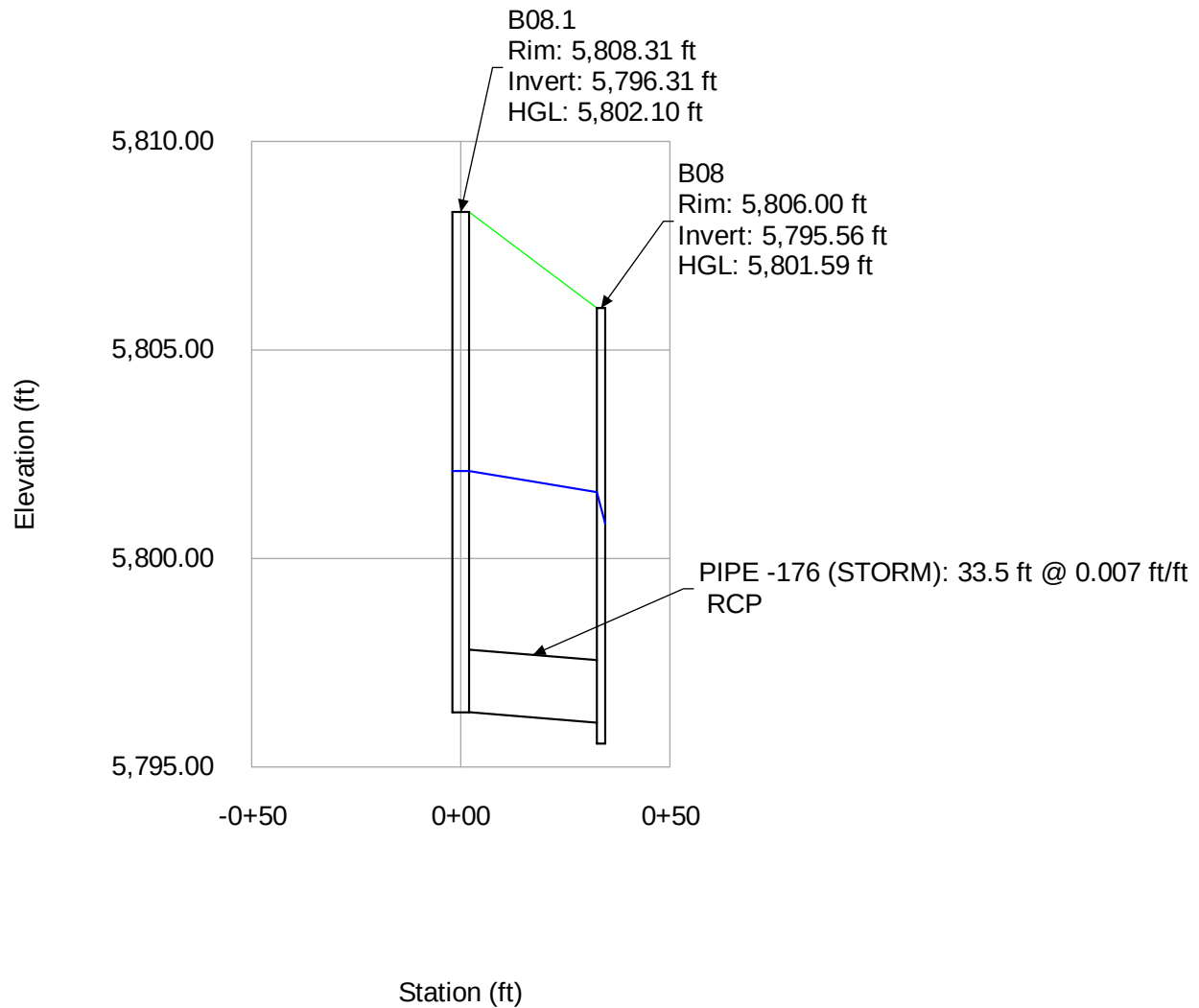


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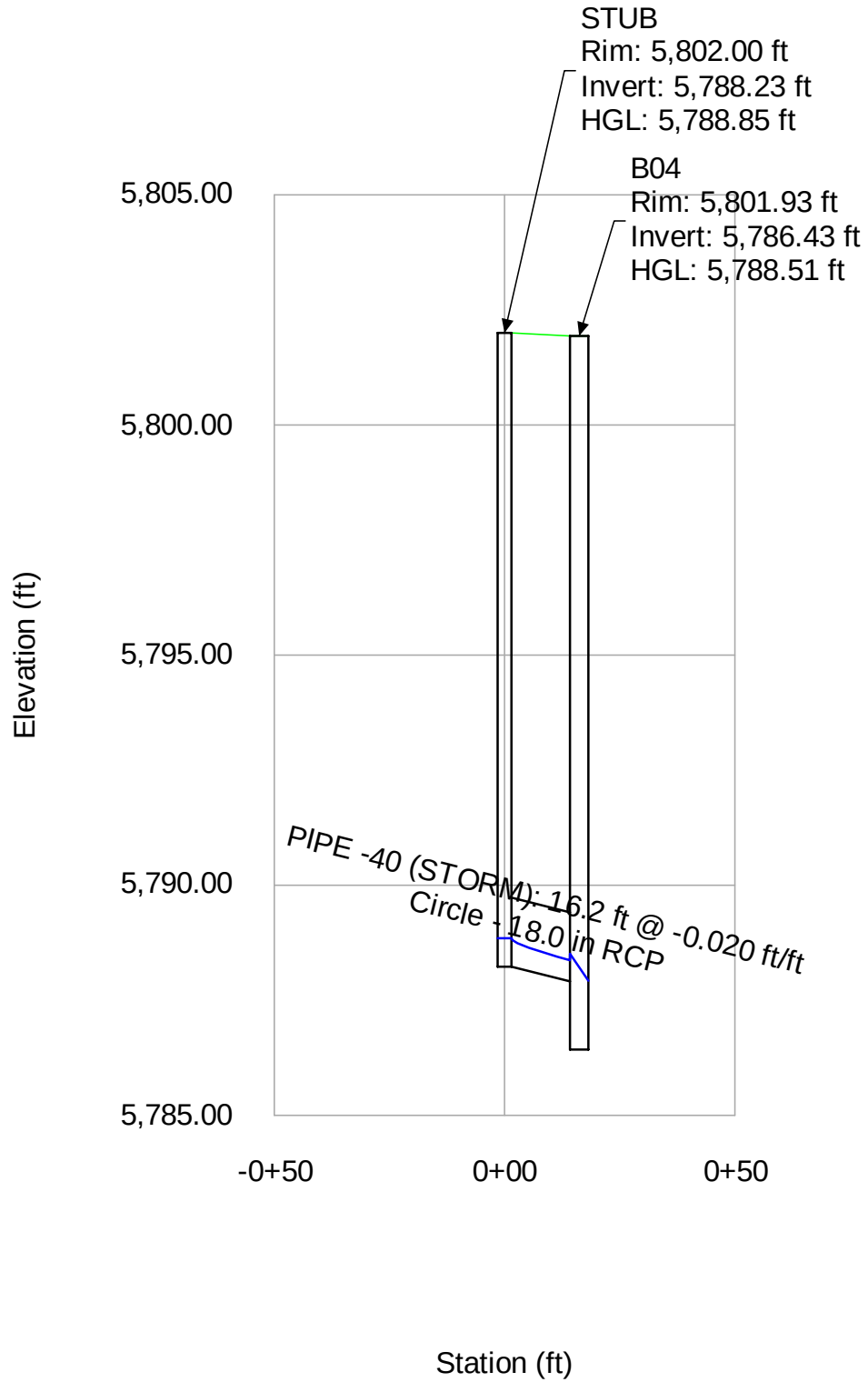




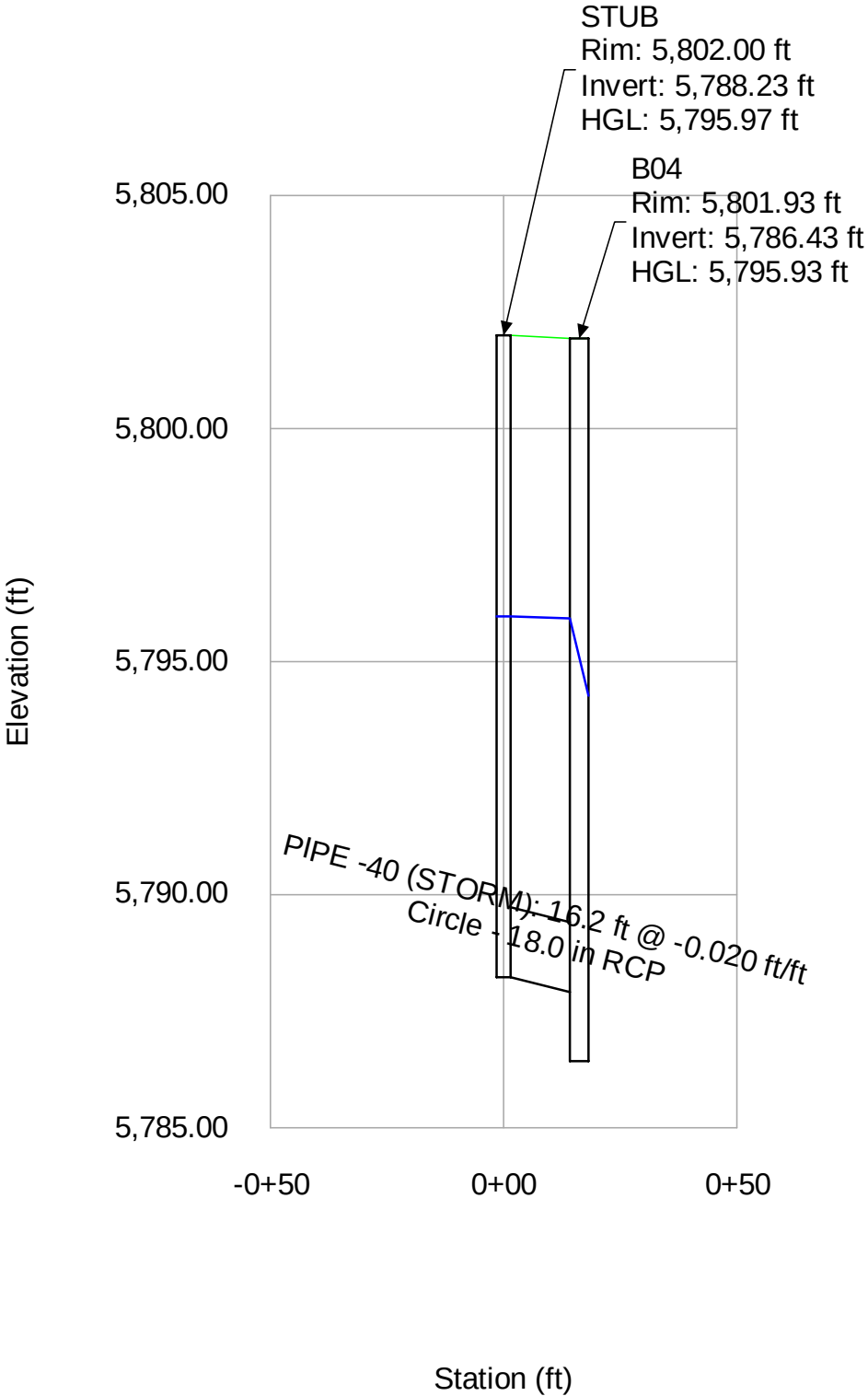
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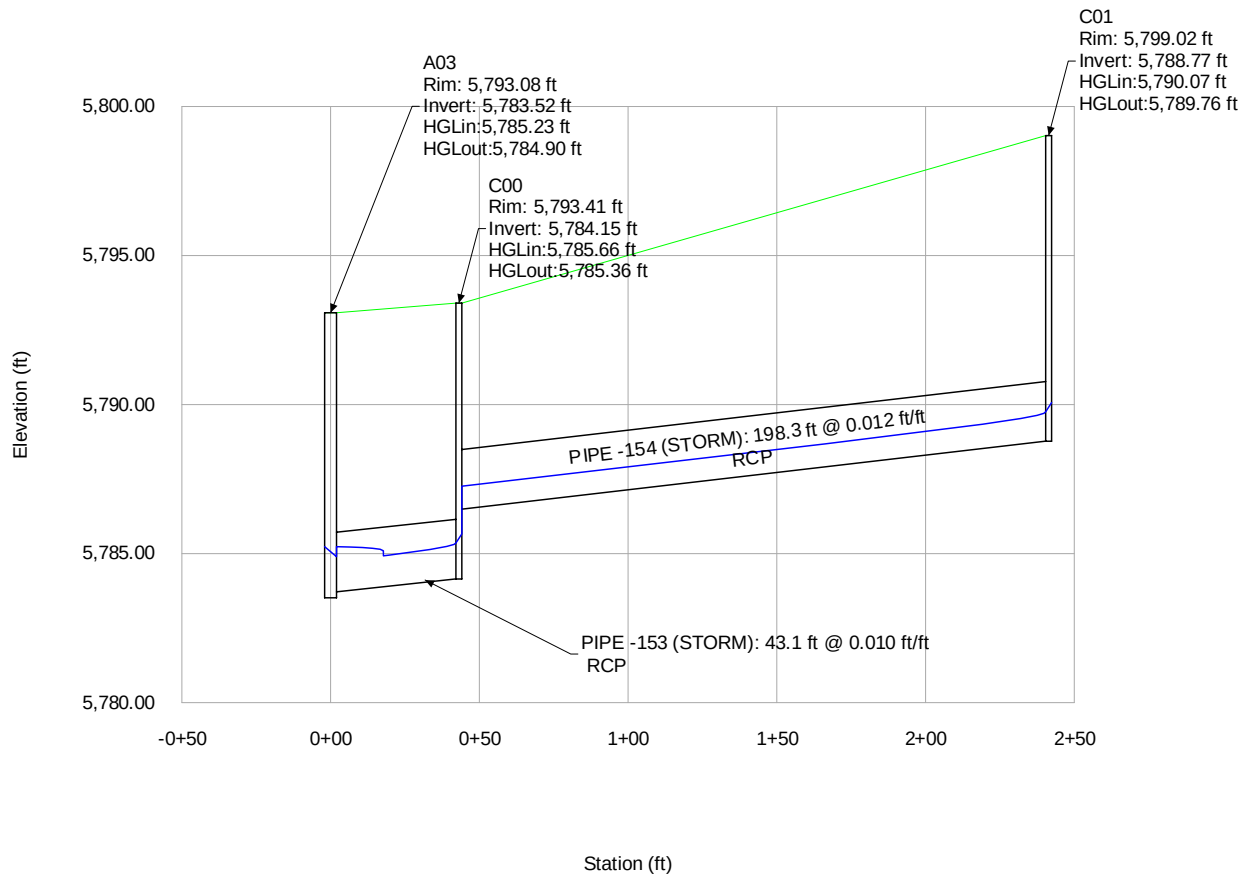
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Profile Report  
Profile Lateral B.4 (100-Year)

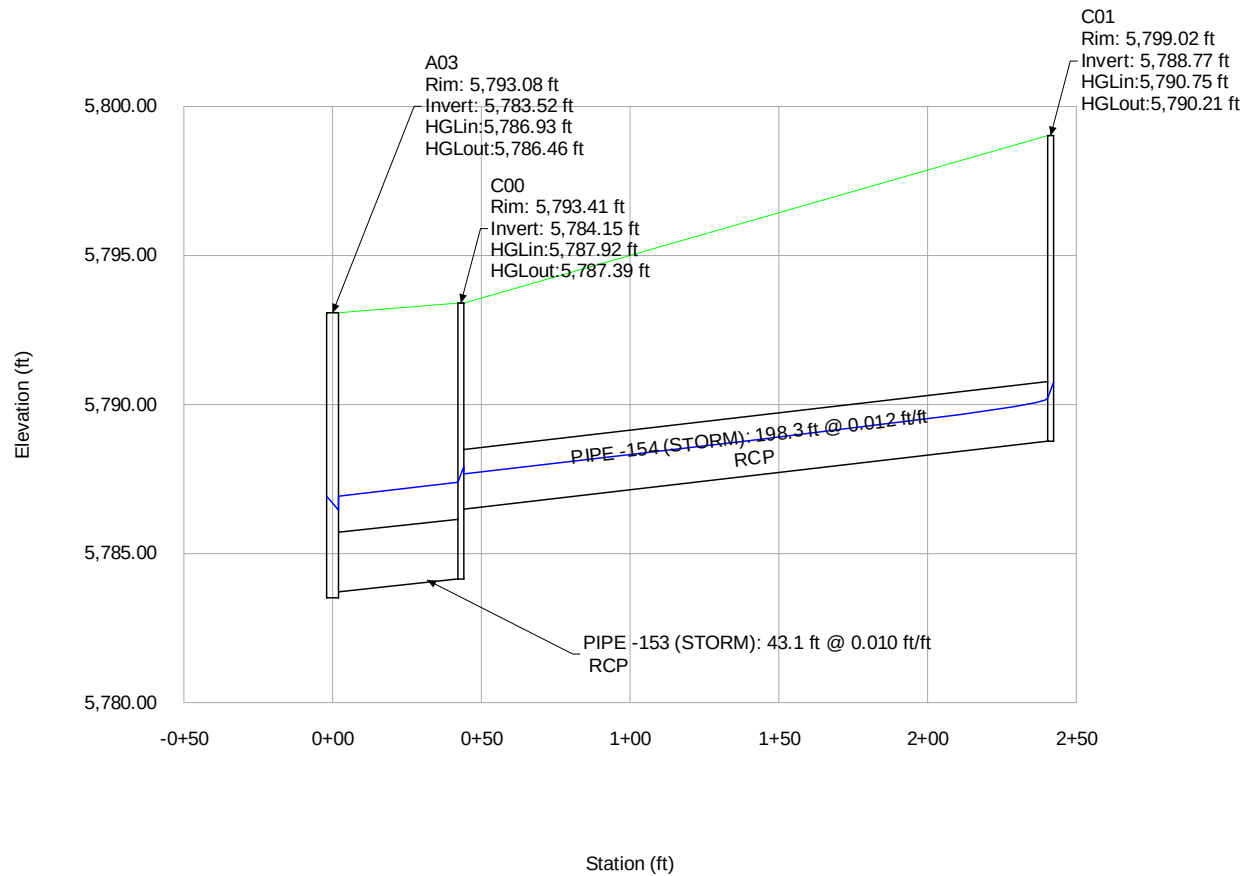


# Profile Report Profile Main C (5-Year)



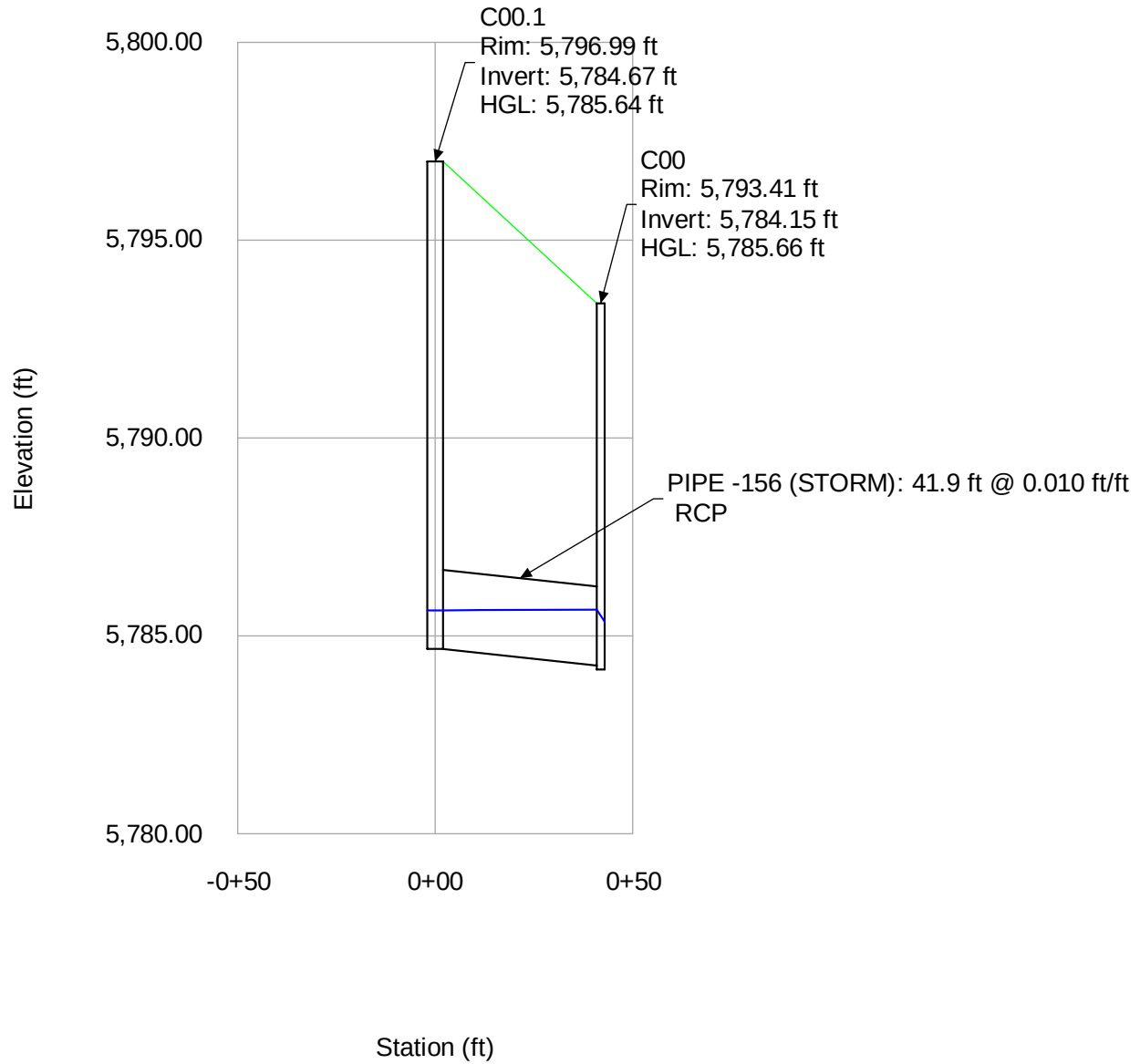
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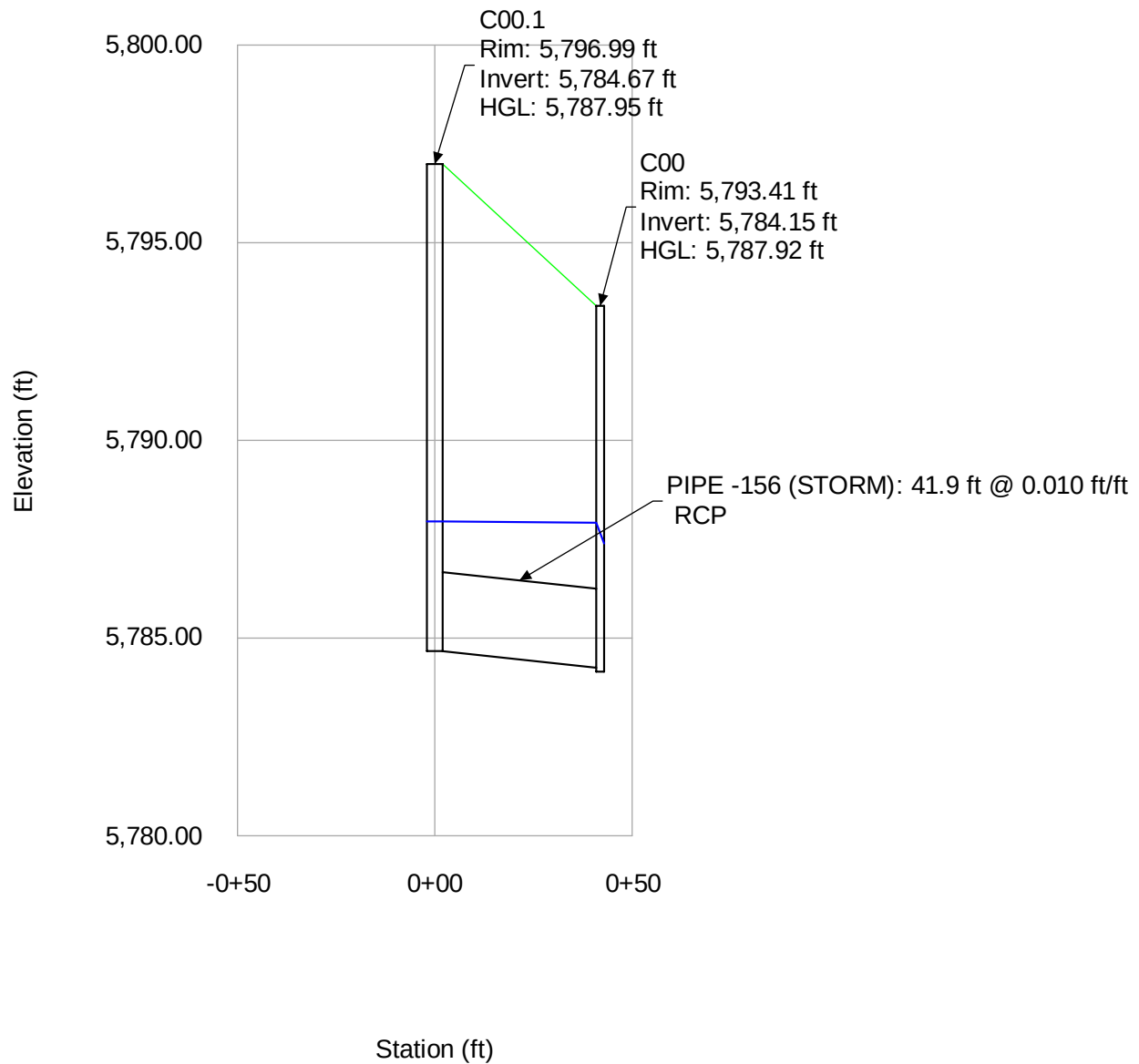
# Profile Report

## Profile Lateral C.1 (5-Year)



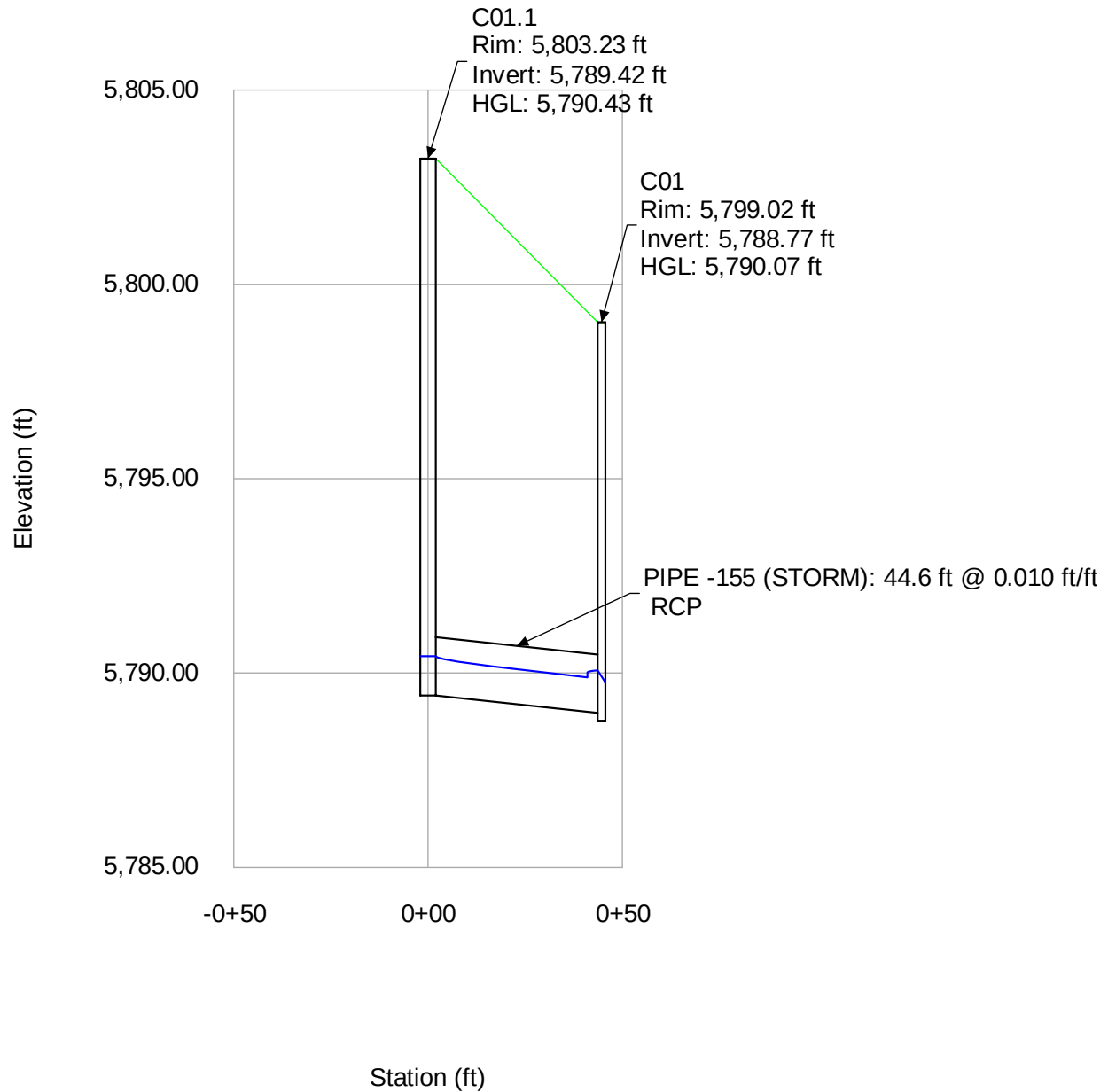
# Profile Report

## Profile Lateral C.1 (100-Year)



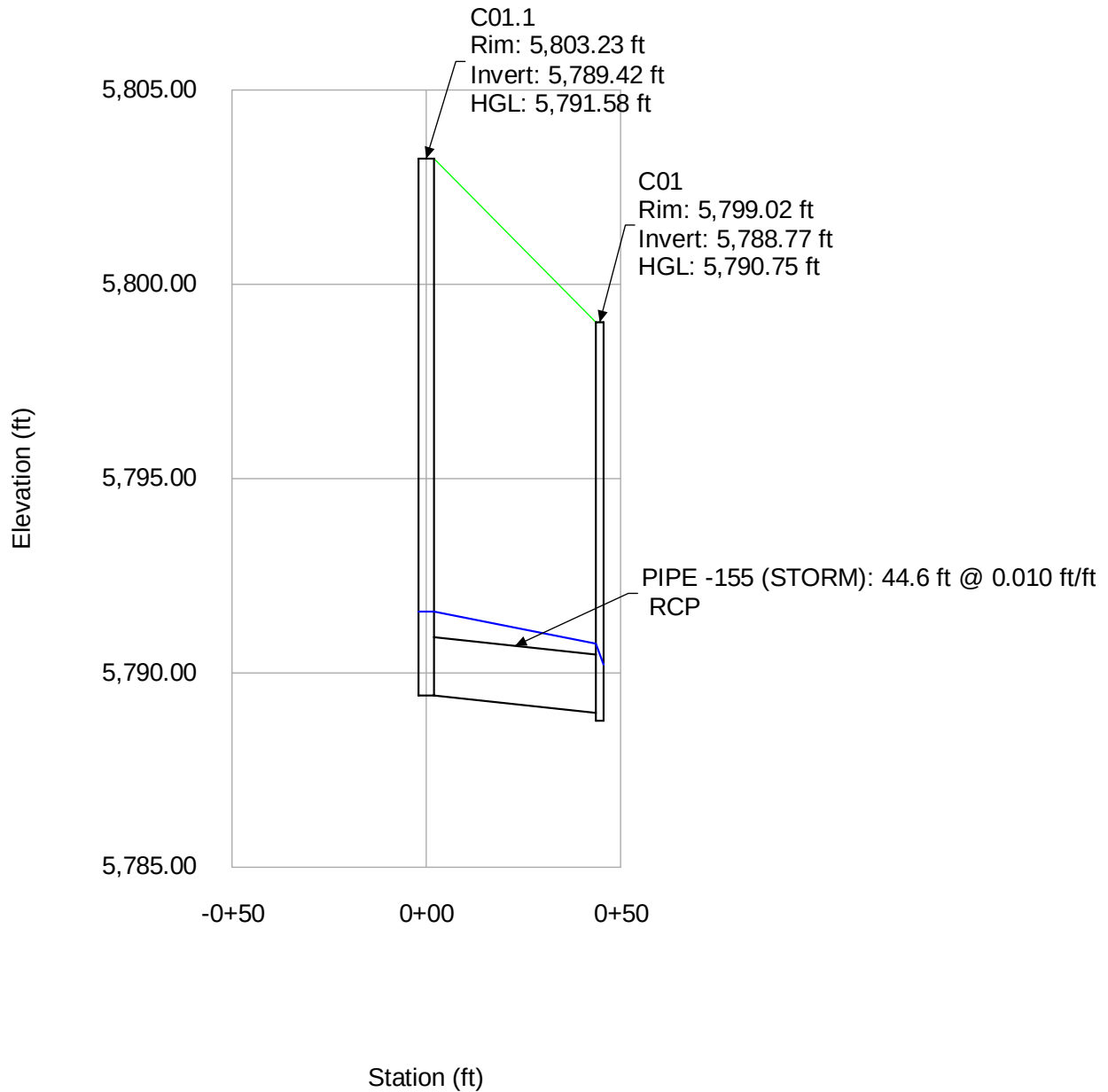
# Profile Report

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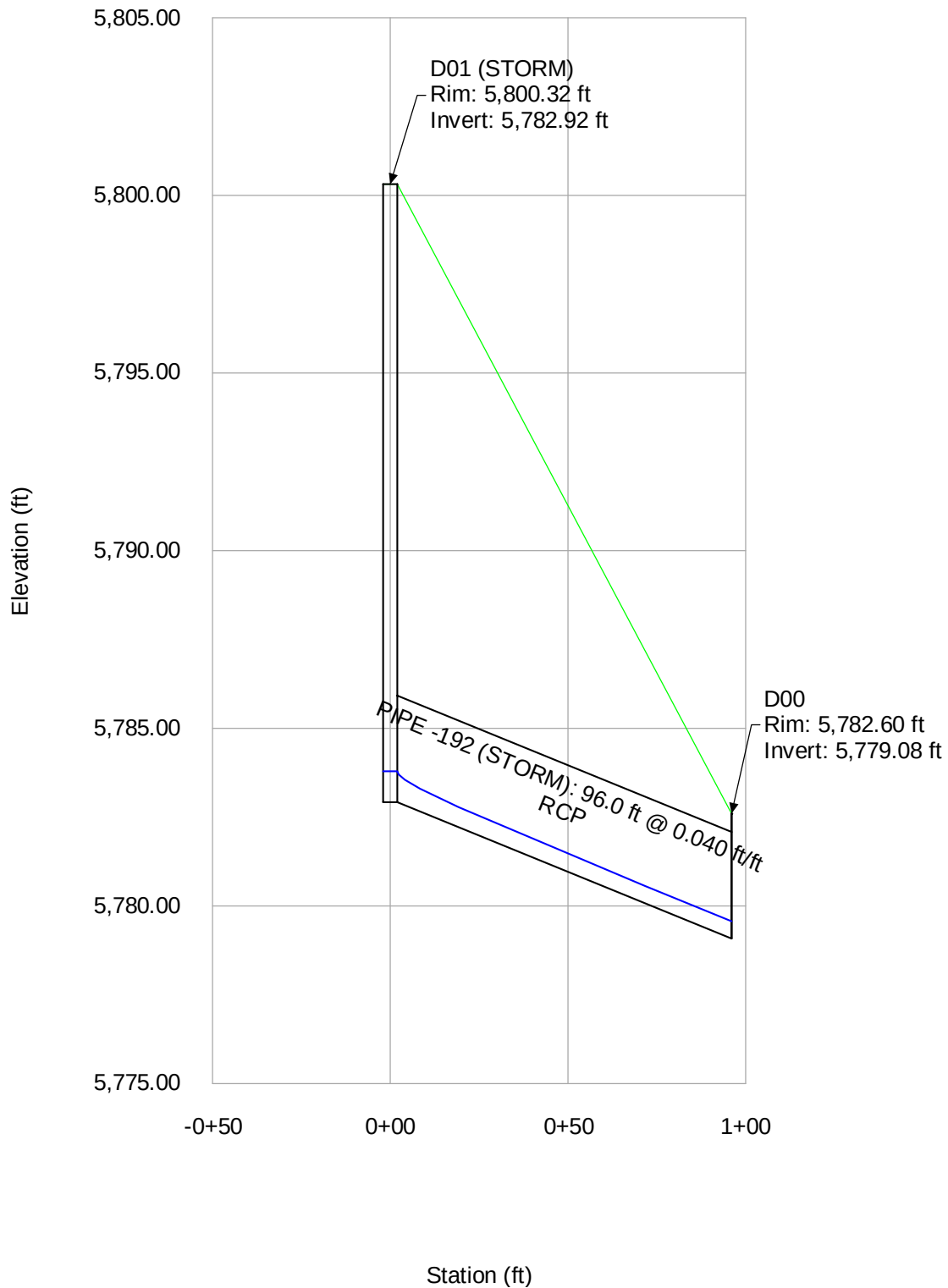




# Profile Report Profile Lateral C.2 (100-Year)

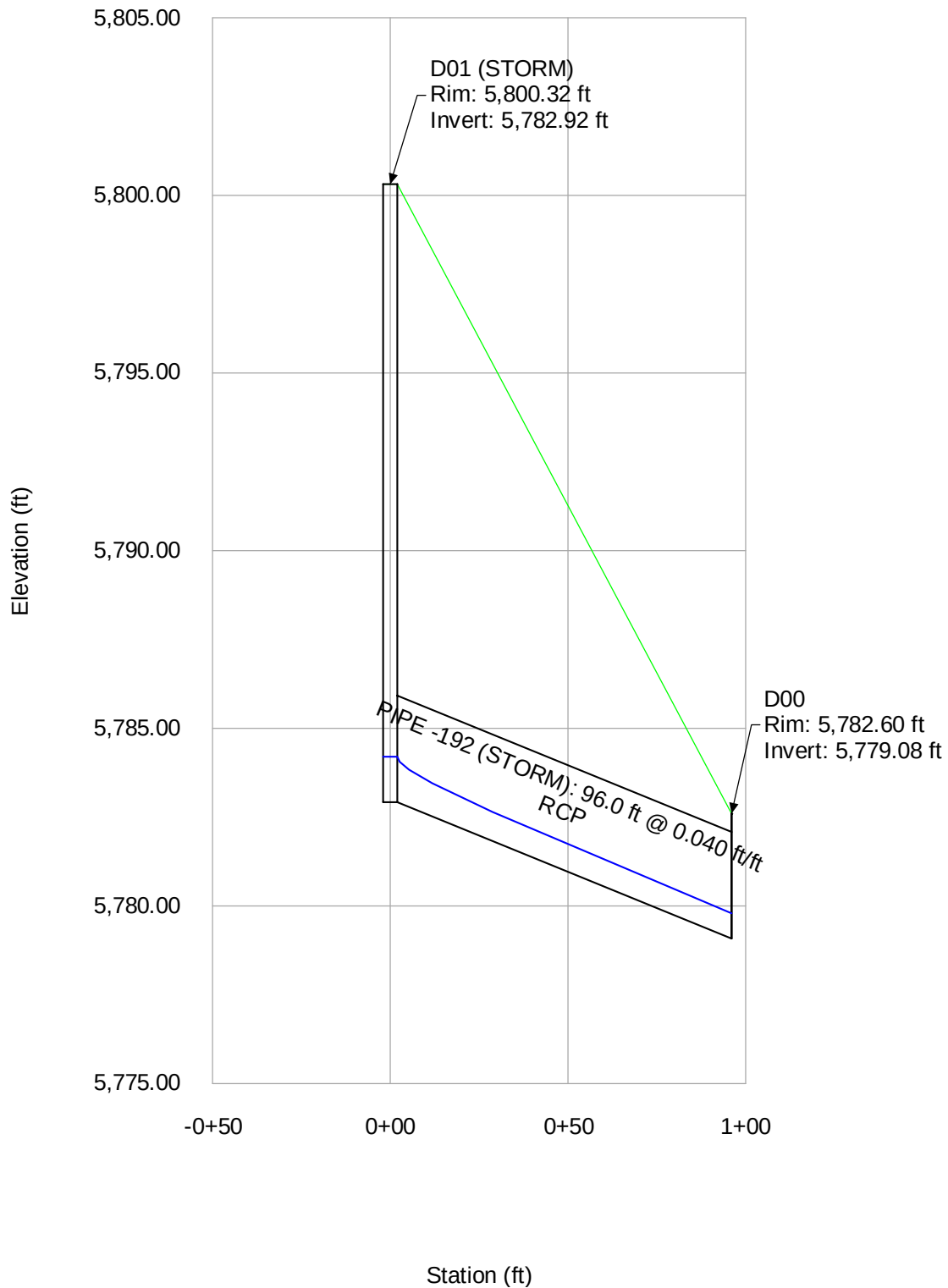


# Profile Report Profile Lateral D.1 (5-Year)



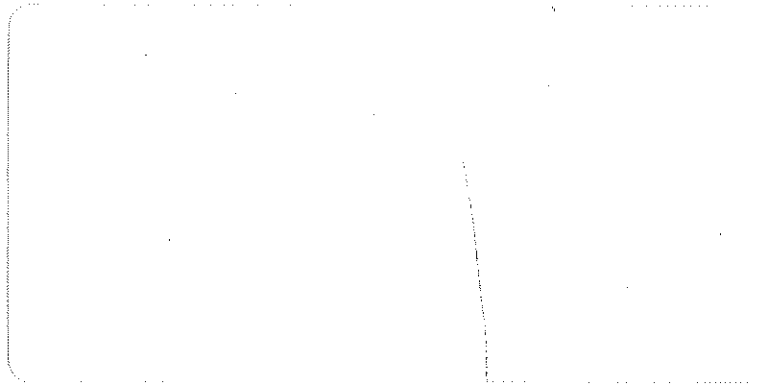
# Profile Report

## Profile Lateral D.1 (100-Year)



## ***APPENDIX E - REFERENCES***

TOWN OF PARKER  
AUG 13 2004  
PLANNING DEPT.



**Final Drainage Report  
Parker Auto Plaza  
Town of Parker  
Douglas County, Colorado**

Prepared for:

Parker Auto Plaza, LLLP  
% Concepts West Architecture  
202 East Cheyenne Mountain Blvd.  
Suite Q  
Colorado Springs, Colorado 80906

Prepared by:

Kiowa Engineering Corporation  
1604 South 21<sup>st</sup> Street  
Colorado Springs, Colorado 80904

Kiowa Project No. 00056

July 12, 2004

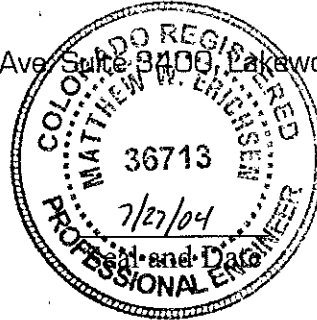
**ENGINEER'S STATEMENT:**

This report for the final design of the Parker Auto Plaza development was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

Kiowa Engineering Corporation, 7175 W. Jefferson Ave Suite 8400, Lakewood, CO 80235

*Matthew W. Ericksen*

Registered Professional Engineer  
State of Colorado # 36713  
(For and on behalf of Kiowa Engineering Corp.)



## Table of Contents

|                                                                                     |          |
|-------------------------------------------------------------------------------------|----------|
| <b>Engineer's Statement</b> .....                                                   | i        |
| <b>Table of Contents</b> .....                                                      | ii       |
| <b>General Location and Description</b> .....                                       | 1        |
| <b>Drainage Basins and Sub-Basins</b> .....                                         |          |
| Major Basin Description .....                                                       | 1        |
| Site Sub-Basin Description .....                                                    | 3        |
| Floodplains.....                                                                    | 3        |
| <b>Drainage Design Criteria</b> .....                                               |          |
| Regulations.....                                                                    | 4        |
| Development Criteria Reference and Constraints .....                                | 5        |
| Hydrologic Criteria .....                                                           | 5        |
| Hydraulic Criteria.....                                                             | 5        |
| <b>Drainage Facility Details</b> .....                                              |          |
| General Concept.....                                                                | 6        |
| Drainage Basin and Storm Sewer System Description .....                             | 6        |
| Detention Basin Facility Description .....                                          | 7        |
| Baldwin Gulch Drainageway Facility Description .....                                | 8        |
| Sculpted Concrete Drop – Cutoff Wall Analysis .....                                 | 9        |
| <b>Environmental Protection Criteria</b> .....                                      | 9        |
| <b>Conclusions</b> .....                                                            | 10       |
| <b>References and Software</b> .....                                                | 11       |
| <b>Appendix</b> .....                                                               | 12       |
| See Appendix for Table of Contents                                                  |          |
| <b>List of Figures (Additional figures and tables are included in the Appendix)</b> |          |
| Figure 3      Vicinity Map.....                                                     | 2        |
| Figure 7      Future Major Watershed Boundaries and Reach Delineations .....        | Appendix |
| Figure 8      Flood Insurance Rate Map.....                                         | Appendix |
| Figure 9      Soil Survey Map .....                                                 | Appendix |



## **General Location and Description**

This report addresses the drainage impacts related to the Parker Auto Plaza development. The development will include construction of automobile sales facilities, an automobile body shop and future commercial site development. The property is located in the northwest quarter and southwest quarter of Section 10, Township 6 South, Range 66 West of the Sixth Principal Meridian. The property lies northwest of the intersection of Parker Road and Lincoln Avenue. It is bounded on the north by Pine Lane, on the east by Parker Road, Dransfeldt Road and MacLachlan Subdivision Nos. 1 & 2, on the south by Lincoln Avenue and on the west by the proposed extension alignment of Twenty Mile Road. The proposed Parker Auto Plaza site includes approximately 52.7 acres. A vicinity map of the area is included as Figure 3.

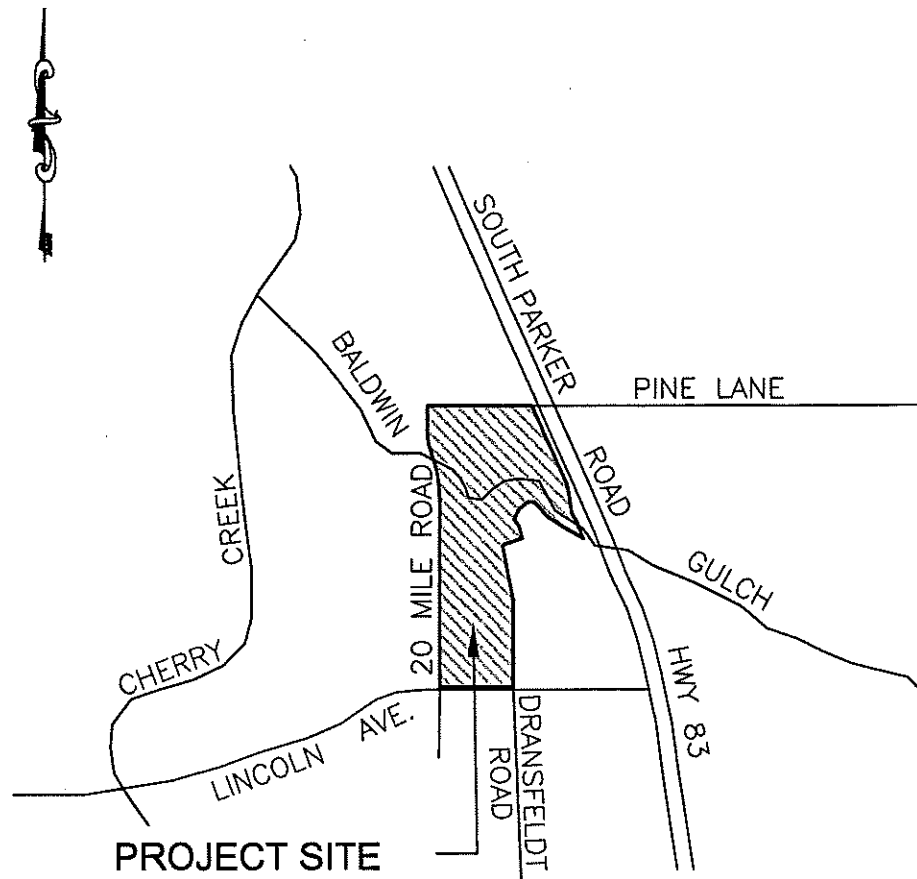
The site is covered by native vegetation, including weeds, sagebrush and a few large and smaller deciduous trees. Baldwin Gulch runs through the property from an existing box culvert under Parker Road to the proposed extension alignment of Twenty Mile Road.

Approximately 31.6 acres of the site will be utilized for the proposed commercial development sites described above. The 8.1 acres that surrounds Baldwin Gulch and the 100-year flood plain will be designated open space. This area will remain undeveloped except for a proposed trail and trailhead area and for channel improvements recommended in the *Baldwin Gulch Outfall Systems Planning Study* prepared by the Urban Drainage and Flood Control District.

## **Drainage Basins and Sub-Basins**

### **Major Basin Description**

The site was part of the MacLachlan Property (of which Filing Nos. 1 & 2 are currently developed). As a result of the review of the final drainage report for the MacLachlan Subdivision No. 1 (S.A. Miro, Inc., March 1994), and the *Newlin and Baldwin Gulches and Basin 4600-09 Outfall Systems Study Preliminary Design Report* (Kiowa Engineering Corporation, December 1994), it is apparent that the site lies within a portion of two major historic basins; Basin 4600-09 and Baldwin Gulch. Basin 4600-09 drains directly into Cherry Creek west of the site. A copy of the Future Major Watershed Boundaries and Reach Delineations, Baldwin Gulch basin 4600-09 is included in the Appendix of this report as Figure 7. The outfall for Baldwin Gulch into Cherry Creek is located approximately one-quarter mile west of the proposed extension of Twenty Mile Road. In the current condition it appears that a portion of the flows from the Basin 4600-09 section of the site are being diverted into Baldwin Gulch by the existing road in the Twenty Mile Road R.O.W. Existing drainage basins are shown on Figure 1 that is located in the map pocket at the end of this report.



**FIGURE 3**  
**VICINITY MAP**  
**PARKER AUTO PLAZA**

## Site Sub-Basin Description

Most of the flows from the developed lots within the MacLachlan subdivision drain to onsite detention basins. These detention basins in turn outfall directly into Baldwin Gulch and will remain in this condition. A small portion of Ponderosa Drive discharges onto the site in the current condition, and will be conveyed across the site by curb and gutter as Dransfeldt Road will be extended to Twenty Mile Road during the development of the site. Channel improvements will be made to Baldwin Gulch as part of the site development. The channel improvements noted in the *Newlin and Baldwin Gulches and Basin 4600-09 Outfall Systems Study (OSP) Preliminary Design Report* were reviewed during the Preliminary Drainage Report (PDR) for the site. The following modifications have been made to the channel improvements outlined in the *OSP* as part of the *PDR* review by UDFCD and the Town of Parker. Sculpted concrete drop structures have been substituted for the check structures shown in the *OSP*. The sculpted drop structures have replaced the checks so that the channel can be constructed to the ultimate longitudinal slope anticipated for sandy soils instead of allowing the channel to degrade over time with check structures as recommended in the *OSP*. This will minimize the amount of sediment that could be conveyed to Cherry Creek resulting from the degradation of the invert along this portion of Baldwin Gulch. The longitudinal slope of the channel was also modified from 0.94% to 0.6% to reduce the flow velocities in the channel. The proposed improvements to Baldwin Gulch are shown on the Drainage Plan, Figure 2. No further onsite drainage improvements are needed to convey flows from MacLachlan Subdivisions through the site.

The development of the site will not change the drainage patterns significantly onsite. However the increase in runoff that accompanies the development of the site will require the construction of two detention basins. The detention basins are located east of the future alignment of Twenty

Mile Road to regulate discharge from the site into Baldwin Gulch. A storm sewer system will be required on the parcels south of Baldwin Gulch in order to convey site runoff from drainage basins 1B-12B into Detention Basin B south of Baldwin Gulch. A storm sewer system will also be required to convey flows from drainage basins 1A-5A to Detention Basin A (see Figure 2).

The existing and proposed grading precludes any treatment or detention of the runoff from Twenty Mile Road basins 3C and 4C and Pine Lane basins 1D and 2D. The Twenty Mile Road basins will be released to their historic Baldwin Gulch outfall location. The drainage basins along Pine Lane will be released to their historic outfall location westerly along the south edge of Pine Lane, eventually reaching Baldwin Gulch. The drainage improvements associated with Pine Lane will be completed as part of the Pine Lane extension project by Douglas County.

## Floodplains

The Baldwin Gulch existing 100-year flood plain is shown on Figure 1 located in a map pocket at the end of this report. The 100-year flood plain boundary is based in part on the *1977 Flood Hazard Delineation (FHAD) Report* for Baldwin Gulch. The flood plain boundary was confirmed using Panel Number 080310 0070 D of the FEMA Flood Insurance Rate Map for

Douglas County, shown in Figure 8 which is located in the Appendix of this report. The development of this site will include channel improvements to Baldwin Gulch. These improvements, along with Detention Basin A south of Baldwin Gulch, east of the proposed Twenty Mile Road extension alignment will be the only grading that will occur within the 100-year floodplain. The construction of the channel improvements and attendant grading along the major drainageway will alter the 100-year floodway and floodplain through the site east of the proposed Twenty Mile Road extension. The proposed 100-year floodplain resulting from the proposed channel improvements is shown on Figure 2. A conditional Letter of Map Revision (CLOMR) will be required for this project. The submittal of a CLOMR to FEMA will commence once the design of the Baldwin Gulch improvements are generally approved and accepted by the Town of Parker and the Urban Drainage and Flood Control District.

### **Drainage Design Criteria**

#### **Regulations**

In accordance with the Town of Parker's Floodplain ordinance, no temporary or permanent structures designed for human habitation will be placed in the floodplain. There will be a multi-use trail proposed along the Baldwin Gulch drainageway. The area adjacent to the low flow channel and on overbanks will be revegetated with native grasses, trees, and shrubs.

The development of this site will include improvements to the Baldwin Gulch channel, as stated above. These improvements include four sculpted concrete drop structures as well as grading the channel to conform to the recommended channel section and reinforcing the channel as necessary to minimize the adverse affects of erosion along Baldwin Gulch and the lands adjacent to it. A riprap lined low flow channel of 5-year capacity with a benched channel section above the low flow area is proposed. The total 100-year flooding depth along the channel through the site ranges from four to six-feet. A multi-use trail will follow the channel along the north bench of the drainageway, generally located above the 100-year floodplain. This trail will cross beneath proposed Twenty Mile Road in a three-sided box culvert. The upstream portion of the multi-use trail will cross under Parker Road through the north bay of the existing twin box culvert. The trail will loop up to Parker Road on the north side. The trail will continue south along Parker Road to the existing multi-use trail located on the south side of Baldwin Gulch and east of Parker Road. The plan and profile design for Baldwin Gulch has been included in a map pocket at the end of this report.

The proposed channel improvements will alter the existing channel section for the entire length of Baldwin Gulch within the project site. As a result of field meetings with the U. S. Army Corps of Engineers it was determined that a 404 Permit will not be required for the proposed channel improvements. It was determined that the portion of Baldwin Gulch through the site is not considered as jurisdictional waters of the United States.

## Development Criteria Reference and Constraints

The Final Drainage Report for MacLachlan Subdivision No. 1 includes portions of this site in its analysis of historic drainage basins, however, drainage reports including developed conditions for this site could not be found. This drainage study generally agrees with the Final Drainage Report for MacLachlan Subdivision No. 1 concerning the historic drainage patterns for the site.

The Final Drainage Report for MacLachlan Subdivision No. 1 describes the developed flows of the neighboring subdivision. This study indicates that all flows aside from three small basins will be routed to a detention basin in MacLachlan Subdivision No. 1 and discharged directly into Baldwin Gulch. Two of the three small basins currently discharge onto the project site. When Dransfeldt Road is extended to Twenty Mile Road as a part of the development of this site, runoff from the offsite sub-basins currently discharging will be conveyed by curb and gutter to the storm sewer system in Dransfeldt Road and Twenty Mile Road and from there to Detention Basin B.

## Hydrologic Criteria

Basin runoff was calculated using the Rational Method. Hydrology for Baldwin Gulch was obtained from the Newlin and Baldwin Gulches Outfall Systems Planning Study. The 5-year and 100-year peak discharges for the segment of Baldwin Gulch adjacent to the site are 260 cubic feet per second and 2,100 cubic feet per second, respectively.

## Hydraulic Criteria

The drainage systems and street capacities for this site have been designed to accommodate the 5-year initial storm event and the 100-year major storm event as specified in the Town of Parker, Colorado, *Storm Drainage and Environmental Criteria Manual (SDECM)*. The hydraulic capacities of the curb inlets were determined using the UDINLET computer model developed by the University of Colorado at Denver. The initial storm event water spread was used to help determine the inlet locations in the site. Table 2.4 from the *SDECM* was used to determine the maximum allowable water spread for the initial storm runoff and has been included in the Appendix. An Inlet Capacity Summary spreadsheet is included in the Appendix, showing the inlet capacities and the minor storm water spread in tabular form. Colorado Department of Transportation (CDOT) Type R curb inlets will be used throughout the site. City of Denver Standard No. 16 Open Throat Inlets will be used in areas where there is insufficient area behind the curb for a curb-opening inlet.

Detention basins for this site have been designed to conform to the 10-year and 100-year regulated release rates per the aforementioned manual. Detention basins were sized and discharge rates determined using the UDFCD Detention Formulas. The supporting calculations associated with the sizing of hydraulic facilities for this development are included in the Appendix of this report.

## **Drainage Facility Details**

### **General Concept**

In the current condition, drainage from the proposed site flows into Baldwin Gulch. Calculations for the analysis of existing drainage basins are presented in the appendix at the end of this report. The existing Drainage Plan, including drainage basins are shown in Figure 1. The proposed development seeks to preserve the existing drainage patterns with the exception of routing flows through detention basins prior to discharging into Baldwin Gulch in order to limit flows from the developed site to acceptable levels. Calculations for the analysis of developed basins for this site, as well as calculations for the design of the detention basins and their tributary storm water conveyances are presented in the appendix of this report. The configuration of proposed basins and their related drainage facilities are presented in Figure 2. Offsite runoff impacting the site is minimal and will be conveyed across the site with the extension of Dransfeldt Road to be handled by the drainage facilities discharging to Detention Basin B.

### **Drainage Basin and Storm Sewer System Description**

Runoff from Basin 1A will sheet-flow westerly through a parking lot area to a 10-foot sump curb inlet (Inlet 1). The flows captured by the inlet will be routed to Inlet 2. Drainage from Basin 2A will sheet-flow westerly through a parking lot area to a 15-foot curb inlet in sump condition. The flows will combine with flows from Inlet 1 and be carried by a storm sewer to Detention Basin A. Flows generated from Basin 3A will sheet-flow westerly through a parking lot area to a 10-foot sump curb inlet. A storm sewer will route the flows to Detention Basin A. Runoff generated from Basin 4A will sheet-flow southwesterly through a parking lot area to a 10-foot sump curb inlet. The flows will be routed to Detention Basin A by a storm sewer.

Runoff from Basin 1B will be carried northerly by curb and gutter along the western side of Twenty Mile Road. The runoff will be collected by a 15-foot on grade curb inlet at Dransfeldt Road. Runoff generated within Basin 2B will be carried northerly by curb and gutter along on the eastern side of Twenty Mile Road. The runoff will be collected by a 10-foot on grade curb inlet at Inlet 11. Drainage developed from Basin 3B will sheet-flow westerly through a parking lot area to be collected by a 15-foot sump curb inlet near Twenty Mile Road. The flow will then be carried by a 24-inch RCP to join with flows at Inlet 20. Runoff generated within Basin 4B will sheet-flow west through a parking lot area and will be collected by a 10-foot sump curb inlet. The flow will then be carried to Inlet 20 by a storm sewer. Drainage from Basin 5B will sheet-flow northwest through a parking lot area and will be collected by a 10-foot sump curb inlet. The flow will be routed to Inlet 19 through a storm sewer. Drainage from Basin 6B will sheet-flow northwest through a parking lot area and will be collected by a 5-foot sump curb inlet. The flow will be routed to Detention Basin B through a storm sewer. Drainage from Basin 7B will be carried northwest by the Dransfeldt Road curb and gutter to 15-foot curb inlets on grade at the intersection of Twenty Mile Road. A storm sewer will route the flows into the storm

sewer system along Twenty Mile Road. Runoff generated from Basin 8B will sheet-flow directly to Detention Basin B. Runoff generated from Basin 9B will sheet-flow westerly to a 15-foot sump curb inlet. At this point the runoff will combine with the flows in the 36-inch RCP storm sewer located along the east side of Twenty Mile Road (Twenty Mile Storm Sewer). The storm sewer will continue north to a manhole to the north of Dransfeldt Road. The Twenty Mile Storm Sewer will bend at this manhole and be directed into Detention Basin B. The runoff generated by Basin 10B will be carried along the gutter of the private drive extending into the commercial development area. The flows will continue along the east curb and gutter of Twenty Mile Road to a 20-foot inlet (Inlet 18) on grade at the intersection with Dransfeldt Road. The runoff captured by Inlet 20 will be directed into the Twenty Mile Storm Sewer. Runoff generated within Basin 11B will sheet-flow westerly through a parking lot area and will be collected by a 10-foot sump curb inlet near Twenty Mile Road. The flows will be routed into the Twenty Mile Storm Sewer. Runoff generated within Basin 12B will sheet-flow westerly through a parking lot area and will be collected by a 10-foot sump curb inlet near Twenty Mile Road.

Flows developed within Basin 1C will be carried southeasterly by a grass-lined swale to enter Baldwin Gulch. Runoff from Basin 2C will sheet-flow directly to Baldwin Gulch. Drainage Basins 3C-5C are located along a superelevated portion of Twenty Mile Road. Inlets have been located along this section of Twenty Mile Road to minimize the amount of flows crossing the street at points of superelevation. Drainage generated from Basin 3C will sheet-flow onto the west median curb line of Twenty Mile Road. An inlet will be placed along the west curb of Twenty Mile Road to capture the flows. The flows will be conveyed to Baldwin Gulch through a storm sewer. Flows from Basin 4C will be carried along the west curb and gutter of Twenty Mile Road to Inlet 27A. The flows will be routed by a storm sewer into Inlet 27. Flows from Basin 5C will flow onto the east curb and gutter of Twenty Mile Road to Inlet 25 at the low point. Flows from Basin 6C will flow along the east median curb and gutter of Twenty Mile Road to Inlet 26 at the low point. A storm sewer will route the flows to Inlet 26 and Baldwin Gulch. Runoff generated from Basins 1D and 2D will be handled as part of the Pine Lane Improvements. Runoff generated from Basin 1D is carried northerly along the west curb and gutter onto Pine Lane. The flows from Basin 2D will be captured by an inlet and conveyed to the Pine Lane storm sewer system.

#### **Detention Basin Facility Description**

The required detention volumes for Detention Basin A are 2.06 acre-feet for the 10-year event and 2.97 acre-feet for the 100-year event, which includes the WQCV. Calculations for this detention basin are located in the Appendix of this report. To control the release of flows and allow for pollutant removal, the detention basin is designed as an Extended Detention Basin Sedimentation Facility, as shown in Figure EDB-1 in Volume 3 of the Urban Storm Drainage Criteria Manual, found in the Appendix of this report. The design will include a forebay, trickle channel and emergency spillway. Modifications to the Figure EDB-1 design were made per the request of the Town of Parker. The modifications include the elimination of the micropool and

**APPENDIX A**  
**Hydrologic Calculations**



**Parker Auto Plaza**  
**Time of Concentration (Existing)**

| Basin | Contributing Basins | Slope  |        | Length |         | C <sub>s</sub> | Velocity   |            | T <sub>c</sub> |           | T <sub>c</sub> |
|-------|---------------------|--------|--------|--------|---------|----------------|------------|------------|----------------|-----------|----------------|
|       |                     | O'land | Travel | O'land | Travel  |                | O'land     | Travel     | O'land         | Travel    |                |
| A     |                     | 6.1 %  | 0.9 %  | 150 lf | 1125 lf | 0.01           | 0.2 ft/sec | 0.5 ft/sec | 788 sec.       | 2272 sec. | 51.0 min.      |
| B     |                     | 2.4 %  | 2.5 %  | 150 lf | 1105 lf | 0.01           | 0.1 ft/sec | 1.0 ft/sec | 1077 sec.      | 1163 sec. | 37.3 min.      |
| C     |                     | 1.9 %  | 2.4 %  | 150 lf | 1659 lf | 0.01           | 0.1 ft/sec | 0.9 ft/sec | 1158 sec.      | 1880 sec. | 50.6 min.      |
| D     |                     | 2.5 %  | 3.4 %  | 150 lf | 900 lf  | 0.01           | 0.1 ft/sec | 1.1 ft/sec | 1067 sec.      | 842 sec.  | 31.8 min.      |
| E     |                     | 1.5 %  | 3.9 %  | 150 lf | 814 lf  | 0.01           | 0.1 ft/sec | 0.8 ft/sec | 1268 sec.      | 1072 sec. | 39.0 min.      |

Equations:

$$\text{Time of Concentration (Overland)} = 1.8(1.1 - C_s)L^{0.5} S^{-0.333}$$

C<sub>s</sub> = Runoff coefficient for five-year flow

L = Length of overland flow in feet (Length must be less than 1,000 feet for undeveloped area before entering a channel)

S = Slope of flow path in percent

**Parker Auto Plaza  
Basin Runoff Calculation (Existing)**

| Basin | Contributing Basins | Area       |          | $C_{10}$ | $C_{100}$ | Time of Concentration | Rainfall Intensity |           | Runoff   |           |
|-------|---------------------|------------|----------|----------|-----------|-----------------------|--------------------|-----------|----------|-----------|
|       |                     |            |          |          |           |                       | $i_{10}$           | $i_{100}$ | $Q_{10}$ | $Q_{100}$ |
| A     |                     | 519,090 sf | 11.92 ac | 0.05     | 0.20      | 51.0 min.             | 1.8 in/hr          | 2.9 in/hr | 1.1 cfs  | 7.0 cfs   |
| B     |                     | 657,300 sf | 15.09 ac | 0.05     | 0.20      | 37.3 min.             | 2.3 in/hr          | 3.6 in/hr | 1.7 cfs  | 10.8 cfs  |
| C     |                     | 512,500 sf | 11.77 ac | 0.05     | 0.20      | 50.6 min.             | 1.9 in/hr          | 2.9 in/hr | 1.1 cfs  | 6.9 cfs   |
| D     |                     | 256,610 sf | 5.89 ac  | 0.05     | 0.20      | 31.8 min.             | 2.5 in/hr          | 3.9 in/hr | 0.7 cfs  | 4.6 cfs   |
| E     |                     | 354,940 sf | 8.15 ac  | 0.05     | 0.20      | 39.0 min.             | 2.2 in/hr          | 3.5 in/hr | 0.9 cfs  | 5.7 cfs   |

Equations:

$$I = (28.5P) / (10 + t_c)^{0.786}$$

P=One-hour point rainfall depth (in.) P(5yr)=1.39in. P(10yr)=1.64in. P(100yr)=2.60in.

$i_5, i_{10}, i_{100}$ =Average 5, 10 and 100-year Rainfall Intensity in inches per hour (Fig 5.1, Town of Parker Storm Drainage and Environmental Criteria Manual)

$$Q = CiA$$

Q = Peak Runoff Rate, in cubic feet per second (cfs)

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

Parker Auto Plaza  
Runoff Coefficient Calculation (Developed)

| Design Point | Basin | Area     | % Area  | C <sub>s</sub> | C <sub>100</sub> | C <sub>s</sub> | C <sub>100</sub> |
|--------------|-------|----------|---------|----------------|------------------|----------------|------------------|
| DP 1         | 1A-4A | 13.96 ac | 90.31 % | 0.81           | 0.88             | 0.73           | 0.79             |
|              | 5A    | 1.50 ac  | 9.69 %  | 0.14           | 0.40             | 0.01           | 0.04             |
|              |       | 15.45 ac | 100.0 % |                |                  | 0.75           | 0.83             |

| Design Point | Basin           | Area     | % Area  | C <sub>s</sub> | C <sub>100</sub> | C <sub>s</sub> | C <sub>100</sub> |
|--------------|-----------------|----------|---------|----------------|------------------|----------------|------------------|
| DP 2         | 1B,3B-7B,9B-13B | 16.83 ac | 85.84 % | 0.81           | 0.88             | 0.70           | 0.76             |
|              | 2B              | 0.94 ac  | 4.78 %  | 0.54           | 0.66             | 0.03           | 0.03             |
|              | 8B              | 1.84 ac  | 9.38 %  | 0.14           | 0.40             | 0.01           | 0.04             |
|              |                 | 19.61 ac | 100.0 % |                |                  | 0.73           | 0.82             |

**Parker Auto Plaza**  
**Time of Concentration (Developed)**

| Basin | Contributing Basins | Slope  |        | Length |         | C <sub>s</sub> | Velocity   |                    | t <sub>c</sub>           |                          | Comp. t <sub>c</sub> | t <sub>c</sub> Check | Final t <sub>c</sub> |
|-------|---------------------|--------|--------|--------|---------|----------------|------------|--------------------|--------------------------|--------------------------|----------------------|----------------------|----------------------|
|       |                     | O'land | Travel | O'land | Travel  |                | O'land     | Travel (Fig. RO-1) | O'land (t <sub>i</sub> ) | Travel (t <sub>i</sub> ) |                      |                      |                      |
| 1A    |                     | 8.0 %  | 3.0 %  | 85 lf  | 430 lf  | 0.14           | 0.2 ft/sec | 3.4 ft/sec         | 8.0 min.                 | 2.1 min.                 | 10.1 min.            | 12.9 min.            | 10.1 min.            |
| 2A    |                     | 3.0 %  | 3.0 %  | 100 lf | 360 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 12.0 min.                | 1.8 min.                 | 13.8 min.            | 12.6 min.            | 12.6 min.            |
| 3A    |                     | 1.0 %  | 3.0 %  | 80 lf  | 410 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 15.5 min.                | 2.0 min.                 | 17.5 min.            | 12.7 min.            | 12.7 min.            |
| 4A    |                     | 3.0 %  | 1.3 %  | 70 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 2.2 ft/sec         | 10.0 min.                | 2.7 min.                 | 12.7 min.            | 12.3 min.            | 12.3 min.            |
| 5A    |                     | 4.0 %  | 1.0 %  | 110 lf | 50 lf   | 0.14           | 0.2 ft/sec | 1.6 ft/sec         | 11.4 min.                | 0.5 min.                 | 11.9 min.            | 10.9 min.            | 10.9 min.            |
| 1B    |                     | 3.0 %  | 1.5 %  | 20 lf  | 500 lf  | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 5.4 min.                 | 3.6 min.                 | 9.0 min.             | 12.9 min.            | 9.0 min.             |
| 2B    |                     | 1.0 %  | 1.5 %  | 200 lf | 550 lf  | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 24.4 min.                | 4.0 min.                 | 28.4 min.            | 14.2 min.            | 14.2 min.            |
| 3B    |                     | 3.0 %  | 1.0 %  | 60 lf  | 230 lf  | 0.14           | 0.1 ft/sec | 2.0 ft/sec         | 9.3 min.                 | 1.9 min.                 | 11.2 min.            | 11.6 min.            | 11.2 min.            |
| 4B    |                     | 8.0 %  | 2.5 %  | 30 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 4.7 min.                 | 1.9 min.                 | 6.6 min.             | 12.1 min.            | 6.6 min.             |
| 5B    |                     | 8.0 %  | 2.0 %  | 40 lf  | 300 lf  | 0.14           | 0.1 ft/sec | 2.8 ft/sec         | 5.5 min.                 | 1.8 min.                 | 7.3 min.             | 11.9 min.            | 7.3 min.             |
| 6B    |                     | 3.0 %  | 3.5 %  | 60 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.7 ft/sec         | 9.3 min.                 | 1.8 min.                 | 11.1 min.            | 12.6 min.            | 11.1 min.            |
| 7B    |                     | 4.0 %  | 4.5 %  | 15 lf  | 540 lf  | 0.14           | 0.1 ft/sec | 4.2 ft/sec         | 4.2 min.                 | 2.1 min.                 | 6.4 min.             | 13.1 min.            | 6.4 min.             |
| 8B    |                     | 3.0 %  | 1.0 %  | 80 lf  | 140 lf  | 0.14           | 0.1 ft/sec | 1.6 ft/sec         | 10.7 min.                | 1.5 min.                 | 12.2 min.            | 11.2 min.            | 11.2 min.            |
| 9B    |                     | 5.0 %  | 3.0 %  | 50 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 7.1 min.                 | 1.7 min.                 | 8.9 min.             | 12.2 min.            | 8.9 min.             |
| 10B   |                     | 3.0 %  | 2.5 %  | 20 lf  | 500 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 5.4 min.                 | 2.7 min.                 | 8.0 min.             | 12.9 min.            | 8.0 min.             |
| 11B   |                     | 3.0 %  | 2.5 %  | 25 lf  | 250 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 6.0 min.                 | 1.3 min.                 | 7.3 min.             | 11.5 min.            | 7.3 min.             |
| 12B   |                     | 3.0 %  | 2.5 %  | 50 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 8.5 min.                 | 2.2 min.                 | 10.6 min.            | 12.5 min.            | 10.6 min.            |
| 13B   |                     | 1.0 %  | 1.0 %  | 150 lf | 450 lf  | 0.14           | 0.1 ft/sec | 2.0 ft/sec         | 21.2 min.                | 3.8 min.                 | 24.9 min.            | 13.3 min.            | 13.3 min.            |
| 1C    |                     | 1.0 %  | 2.0 %  | 200 lf | 450 lf  | 0.14           | 0.1 ft/sec | 1.0 ft/sec         | 24.4 min.                | 7.5 min.                 | 31.9 min.            | 13.6 min.            | 13.6 min.            |
| 2C    |                     | 1.0 %  | 1.0 %  | 25 lf  | 1490 lf | 0.14           | 0.0 ft/sec | 1.5 ft/sec         | 8.6 min.                 | 16.6 min.                | 25.2 min.            | 18.4 min.            | 18.4 min.            |
| 3C    |                     | 2.0 %  | 1.0 %  | 150 lf | 700 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 16.8 min.                | 3.4 min.                 | 20.2 min.            | 14.7 min.            | 14.7 min.            |
| 4C    |                     | 1.0 %  | 1.1 %  | 10 lf  | 500 lf  | 0.14           | 0.0 ft/sec | 2.1 ft/sec         | 5.5 min.                 | 4.0 min.                 | 9.4 min.             | 12.8 min.            | 9.4 min.             |
| 5C    |                     | 2.0 %  | 1.0 %  | 60 lf  | 200 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 10.6 min.                | 1.0 min.                 | 11.6 min.            | 11.4 min.            | 11.4 min.            |
| 6C    |                     | 2.0 %  | 1.0 %  | 10 lf  | 340 lf  | 0.14           | 0.0 ft/sec | 1.6 ft/sec         | 4.3 min.                 | 3.5 min.                 | 7.9 min.             | 11.9 min.            | 7.9 min.             |
| 7C    |                     | 2.0 %  | 1.0 %  | 10 lf  | 220 lf  | 0.90           | 0.2 ft/sec | 3.4 ft/sec         | 0.9 min.                 | 1.1 min.                 | 5.0 min.             | 11.3 min.            | 5.0 min.             |
| 1D    |                     | 2.0 %  | 2.0 %  | 10 lf  | 350 lf  | 0.14           | 0.0 ft/sec | 2.8 ft/sec         | 4.3 min.                 | 2.1 min.                 | 6.4 min.             | 12.0 min.            | 6.4 min.             |
| 2D    |                     | 10.0 % | 3.0 %  | 30 lf  | 100 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 4.4 min.                 | 0.5 min.                 | 5.0 min.             | 10.7 min.            | 5.0 min.             |
| 3D    |                     | 10.0 % | 3.0 %  | 10 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 2.5 min.                 | 2.0 min.                 | 5.0 min.             | 12.3 min.            | 5.0 min.             |
| DP 1  | A Basins            | 1.0 %  | 3.0 %  | 80 lf  | 410 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 15.5 min.                | 2.0 min.                 | 17.5 min.            | 12.7 min.            | 12.7 min.            |
| DP 2  | B Basins            | 3.0 %  | 1.5 %  | 80 lf  | 1560 lf | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 10.7 min.                | 11.3 min.                | 22.0 min.            | 19.1 min.            | 19.1 min.            |

Equations:

$$t_i (\text{Overland}) = 1.8(1.1 - C_s)L^{0.5} S^{-0.333}$$

C<sub>s</sub> = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

$$t_c \text{ Check} = (L/180) + 10$$

L = Overall Length

Fig. RO-1: Average velocities for Estimating Travel Time

**Parker Auto Plaza**  
**Basin Runoff Calculation (Developed)**

| Basin | Contributing Basins | Area       |          | C <sub>s</sub> | C <sub>100</sub> | Time of Concentration | Rainfall Intensity |                  | Runoff         |                  | Basin |
|-------|---------------------|------------|----------|----------------|------------------|-----------------------|--------------------|------------------|----------------|------------------|-------|
|       |                     |            |          |                |                  |                       | i <sub>5</sub>     | i <sub>100</sub> | Q <sub>s</sub> | Q <sub>100</sub> |       |
| 1A    |                     | 124,700 sf | 2.86 ac  | 0.81           | 0.88             | 10.1 min.             | 3.7 in/hr          | 7.0 in/hr        | 8.7 cfs        | 17.7 cfs         | 1A    |
| 2A    |                     | 158,280 sf | 3.63 ac  | 0.81           | 0.88             | 12.6 min.             | 3.4 in/hr          | 6.4 in/hr        | 10.1 cfs       | 20.5 cfs         | 2A    |
| 3A    |                     | 149,800 sf | 3.44 ac  | 0.81           | 0.88             | 12.7 min.             | 3.4 in/hr          | 6.4 in/hr        | 9.5 cfs        | 19.3 cfs         | 3A    |
| 4A    |                     | 175,180 sf | 4.02 ac  | 0.81           | 0.88             | 12.3 min.             | 3.4 in/hr          | 6.4 in/hr        | 11.2 cfs       | 22.8 cfs         | 4A    |
| 5A    |                     | 65,250 sf  | 1.50 ac  | 0.14           | 0.40             | 10.9 min.             | 3.6 in/hr          | 6.8 in/hr        | 0.8 cfs        | 4.1 cfs          | 5A    |
| 1B    |                     | 26,630 sf  | 0.61 ac  | 0.81           | 0.88             | 9.0 min.              | 3.9 in/hr          | 7.3 in/hr        | 1.9 cfs        | 3.9 cfs          | 1B    |
| 2B    |                     | 40,850 sf  | 0.94 ac  | 0.54           | 0.66             | 14.2 min.             | 3.2 in/hr          | 6.1 in/hr        | 1.6 cfs        | 3.8 cfs          | 2B    |
| 3B    |                     | 114,100 sf | 2.62 ac  | 0.81           | 0.88             | 11.2 min.             | 3.6 in/hr          | 6.7 in/hr        | 7.6 cfs        | 15.5 cfs         | 3B    |
| 4B    |                     | 83,300 sf  | 1.91 ac  | 0.81           | 0.88             | 6.6 min.              | 4.4 in/hr          | 8.1 in/hr        | 6.7 cfs        | 13.7 cfs         | 4B    |
| 5B    |                     | 71,200 sf  | 1.63 ac  | 0.81           | 0.88             | 7.3 min.              | 4.2 in/hr          | 7.9 in/hr        | 5.6 cfs        | 11.4 cfs         | 5B    |
| 6B    |                     | 63,550 sf  | 1.46 ac  | 0.81           | 0.88             | 11.1 min.             | 3.6 in/hr          | 6.7 in/hr        | 4.3 cfs        | 8.7 cfs          | 6B    |
| 7B    |                     | 51,720 sf  | 1.19 ac  | 0.81           | 0.88             | 6.4 min.              | 4.4 in/hr          | 8.2 in/hr        | 4.2 cfs        | 8.6 cfs          | 7B    |
| 8B    |                     | 80,100 sf  | 1.84 ac  | 0.14           | 0.40             | 11.2 min.             | 3.6 in/hr          | 6.7 in/hr        | 0.9 cfs        | 4.9 cfs          | 8B    |
| 9B    |                     | 116,400 sf | 2.67 ac  | 0.81           | 0.88             | 8.9 min.              | 3.9 in/hr          | 7.4 in/hr        | 8.5 cfs        | 17.3 cfs         | 9B    |
| 10B   |                     | 46,600 sf  | 1.07 ac  | 0.81           | 0.88             | 8.0 min.              | 4.1 in/hr          | 7.6 in/hr        | 3.5 cfs        | 7.2 cfs          | 10B   |
| 11B   |                     | 59,600 sf  | 1.37 ac  | 0.81           | 0.88             | 7.3 min.              | 4.2 in/hr          | 7.9 in/hr        | 4.7 cfs        | 9.5 cfs          | 11B   |
| 12B   |                     | 100,200 sf | 2.30 ac  | 0.81           | 0.88             | 10.6 min.             | 3.7 in/hr          | 6.9 in/hr        | 6.8 cfs        | 13.9 cfs         | 12B   |
| 13B   |                     | 65,200 sf  | 1.50 ac  | 0.81           | 0.88             | 13.3 min.             | 3.3 in/hr          | 6.2 in/hr        | 4.0 cfs        | 8.2 cfs          | 13B   |
| 1C    |                     | 72,910 sf  | 1.67 ac  | 0.54           | 0.66             | 13.6 min.             | 3.3 in/hr          | 6.2 in/hr        | 3.0 cfs        | 6.8 cfs          | 1C    |
| 2C    |                     | 361,300 sf | 8.29 ac  | 0.14           | 0.40             | 18.4 min.             | 2.9 in/hr          | 5.3 in/hr        | 3.3 cfs        | 17.7 cfs         | 2C    |
| 3C    |                     | 43,100 sf  | 0.99 ac  | 0.81           | 0.88             | 14.7 min.             | 3.2 in/hr          | 6.0 in/hr        | 2.6 cfs        | 5.2 cfs          | 3C    |
| 4C    |                     | 32,500 sf  | 0.75 ac  | 0.81           | 0.88             | 9.4 min.              | 3.8 in/hr          | 7.2 in/hr        | 2.3 cfs        | 4.7 cfs          | 4C    |
| 5C    |                     | 42,640 sf  | 0.98 ac  | 0.81           | 0.88             | 11.4 min.             | 3.6 in/hr          | 6.7 in/hr        | 2.8 cfs        | 5.7 cfs          | 5C    |
| 6C    |                     | 22,020 sf  | 0.51 ac  | 0.81           | 0.88             | 7.9 min.              | 4.1 in/hr          | 7.7 in/hr        | 1.7 cfs        | 3.4 cfs          | 6C    |
| 7C    |                     | 37,700 sf  | 0.87 ac  | 0.90           | 0.96             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 3.7 cfs        | 7.3 cfs          | 7C    |
| 1D    |                     | 21,080 sf  | 0.48 ac  | 0.81           | 0.88             | 6.4 min.              | 4.4 in/hr          | 8.2 in/hr        | 1.7 cfs        | 3.5 cfs          | 1D    |
| 2D    |                     | 17,360 sf  | 0.40 ac  | 0.81           | 0.88             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 1.5 cfs        | 3.1 cfs          | 2D    |
| 3D    |                     | 25,680 sf  | 0.59 ac  | 0.81           | 0.88             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 2.3 cfs        | 4.6 cfs          | 3D    |
| DP 1  | A Basins            | 673,210 sf | 15.45 ac | 0.75           | 0.83             | 12.7 min.             | 3.4 in/hr          | 6.4 in/hr        | 39 cfs         | 82 cfs           | DP 1  |
| DP 2  | B Basins            | 919,450 sf | 21.11 ac | 0.74           | 0.83             | 19.1 min.             | 2.8 in/hr          | 5.2 in/hr        | 44 cfs         | 92 cfs           | DP 2  |

Equations:

$$I = (28.5P) / (10 + t_c)^{0.786}$$

P = One-hour point rainfall depth (in.) P(5yr)=1.39in. P(100yr)=2.60in.

i<sub>5</sub>, i<sub>10</sub>, i<sub>100</sub> = Average 5, 10 and 100-year Rainfall Intensity in inches per hour (Fig 5.1, Town of Parker Storm Drainage and Environmental Criteria Manual)

$$Q = CiA$$

Q = Peak Runoff Rate, in cubic feet per second (cfs) {Initial Storm=Q<sub>s</sub> Major Storm=Q<sub>100</sub>}

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

TABLE RO-3

Recommended Percentage Imperviousness Values

| Land Use or Surface Characteristics                   | Percentage Imperviousness |
|-------------------------------------------------------|---------------------------|
| Business:                                             |                           |
| Commercial areas                                      | 95                        |
| Neighborhood areas                                    | 85                        |
| Residential:                                          |                           |
| Single-family                                         | *                         |
| Multi-unit (detached)                                 | 60                        |
| Multi-unit (attached)                                 | 75                        |
| Half-acre lot or larger                               | *                         |
| Apartments                                            | 80                        |
| Industrial:                                           |                           |
| Light areas                                           | 80                        |
| Heavy areas                                           | 90                        |
| Parks, cemeteries                                     | 5                         |
| Playgrounds                                           | 10                        |
| Schools                                               | 50                        |
| Railroad yard areas                                   | 15                        |
| Undeveloped Areas:                                    |                           |
| Historic flow analysis                                | 2                         |
| Greenbelts, agricultural                              | 2                         |
| Off-site flow analysis<br>(when land use not defined) | 45                        |
| Streets:                                              |                           |
| Paved                                                 | 100                       |
| Gravel (packed)                                       | 40                        |
| Drive and walks                                       | 90                        |
| Roofs                                                 | 90                        |
| Lawns, sandy soil                                     | 0                         |
| Lawns, clayey soil                                    | 0                         |

\* See Figures RO-3 through RO-5 for percentage imperviousness.

Based in part on the data collected by the District since 1969, an empirical relationship between  $C$  and the percentage imperviousness for various storm return periods was developed. Thus, values for  $C$  can be determined using the following equations (Urbonas, Guo and Tucker 1990).

$$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \quad (\text{RO-6})$$

$$C_{CD} = K_{CD} + (0.858i^3 - 0.786i^2 + 0.774i + 0.04) \quad (\text{RO-7})$$

$$C_B = (C_A + C_{CD})/2$$

in which:

$i$  = % imperviousness/100 expressed as a decimal (see Table RO-3)

TABLE RO-5  
Runoff Coefficients, *C*

| Percentage<br>Imperviousness | Type C and D NRCS Hydrologic Soil Groups |      |       |       |       |        |
|------------------------------|------------------------------------------|------|-------|-------|-------|--------|
|                              | 2-yr                                     | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| 0%                           | 0.04                                     | 0.15 | 0.25  | 0.37  | 0.44  | 0.50   |
| 5%                           | 0.08                                     | 0.18 | 0.28  | 0.39  | 0.46  | 0.52   |
| 10%                          | 0.11                                     | 0.21 | 0.30  | 0.41  | 0.47  | 0.53   |
| 15%                          | 0.14                                     | 0.24 | 0.32  | 0.43  | 0.49  | 0.54   |
| 20%                          | 0.17                                     | 0.26 | 0.34  | 0.44  | 0.50  | 0.55   |
| 25%                          | 0.20                                     | 0.28 | 0.36  | 0.46  | 0.51  | 0.56   |
| 30%                          | 0.22                                     | 0.30 | 0.38  | 0.47  | 0.52  | 0.57   |
| 35%                          | 0.25                                     | 0.33 | 0.40  | 0.48  | 0.53  | 0.57   |
| 40%                          | 0.28                                     | 0.35 | 0.42  | 0.50  | 0.54  | 0.58   |
| 45%                          | 0.31                                     | 0.37 | 0.44  | 0.51  | 0.55  | 0.59   |
| 50%                          | 0.34                                     | 0.40 | 0.46  | 0.53  | 0.57  | 0.60   |
| 55%                          | 0.37                                     | 0.43 | 0.48  | 0.55  | 0.58  | 0.62   |
| 60%                          | 0.41                                     | 0.46 | 0.51  | 0.57  | 0.60  | 0.63   |
| 65%                          | 0.45                                     | 0.49 | 0.54  | 0.59  | 0.62  | 0.65   |
| 70%                          | 0.49                                     | 0.53 | 0.57  | 0.62  | 0.65  | 0.68   |
| 75%                          | 0.54                                     | 0.58 | 0.62  | 0.66  | 0.68  | 0.71   |
| 80%                          | 0.60                                     | 0.63 | 0.66  | 0.70  | 0.72  | 0.74   |
| 85%                          | 0.66                                     | 0.68 | 0.71  | 0.75  | 0.77  | 0.79   |
| 90%                          | 0.73                                     | 0.75 | 0.77  | 0.80  | 0.82  | 0.83   |
| 95%                          | 0.80                                     | 0.82 | 0.84  | 0.87  | 0.88  | 0.89   |
| 100%                         | 0.89                                     | 0.90 | 0.92  | 0.94  | 0.95  | 0.96   |

| Type B NRCS Hydrologic Soils Group |      |      |      |      |      |      |
|------------------------------------|------|------|------|------|------|------|
| 0%                                 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| 5%                                 | 0.04 | 0.10 | 0.19 | 0.28 | 0.33 | 0.38 |
| 10%                                | 0.06 | 0.14 | 0.22 | 0.31 | 0.36 | 0.40 |
| 15%                                | 0.08 | 0.17 | 0.25 | 0.33 | 0.38 | 0.42 |
| 20%                                | 0.12 | 0.20 | 0.27 | 0.35 | 0.40 | 0.44 |
| 25%                                | 0.15 | 0.22 | 0.30 | 0.37 | 0.41 | 0.46 |
| 30%                                | 0.18 | 0.25 | 0.32 | 0.39 | 0.43 | 0.47 |
| 35%                                | 0.20 | 0.27 | 0.34 | 0.41 | 0.44 | 0.48 |
| 40%                                | 0.23 | 0.30 | 0.36 | 0.42 | 0.46 | 0.50 |
| 45%                                | 0.26 | 0.32 | 0.38 | 0.44 | 0.48 | 0.51 |
| 50%                                | 0.29 | 0.35 | 0.40 | 0.46 | 0.49 | 0.52 |
| 55%                                | 0.33 | 0.38 | 0.43 | 0.48 | 0.51 | 0.54 |
| 60%                                | 0.37 | 0.41 | 0.46 | 0.51 | 0.54 | 0.56 |
| 65%                                | 0.41 | 0.45 | 0.49 | 0.54 | 0.57 | 0.59 |
| 70%                                | 0.45 | 0.49 | 0.53 | 0.58 | 0.60 | 0.62 |
| 75%                                | 0.51 | 0.54 | 0.58 | 0.62 | 0.64 | 0.66 |
| 80%                                | 0.57 | 0.59 | 0.63 | 0.66 | 0.68 | 0.70 |
| 85%                                | 0.63 | 0.66 | 0.69 | 0.72 | 0.73 | 0.75 |
| 90%                                | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 |
| 95%                                | 0.79 | 0.81 | 0.83 | 0.85 | 0.87 | 0.88 |
| 100%                               | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 |

TYPE B

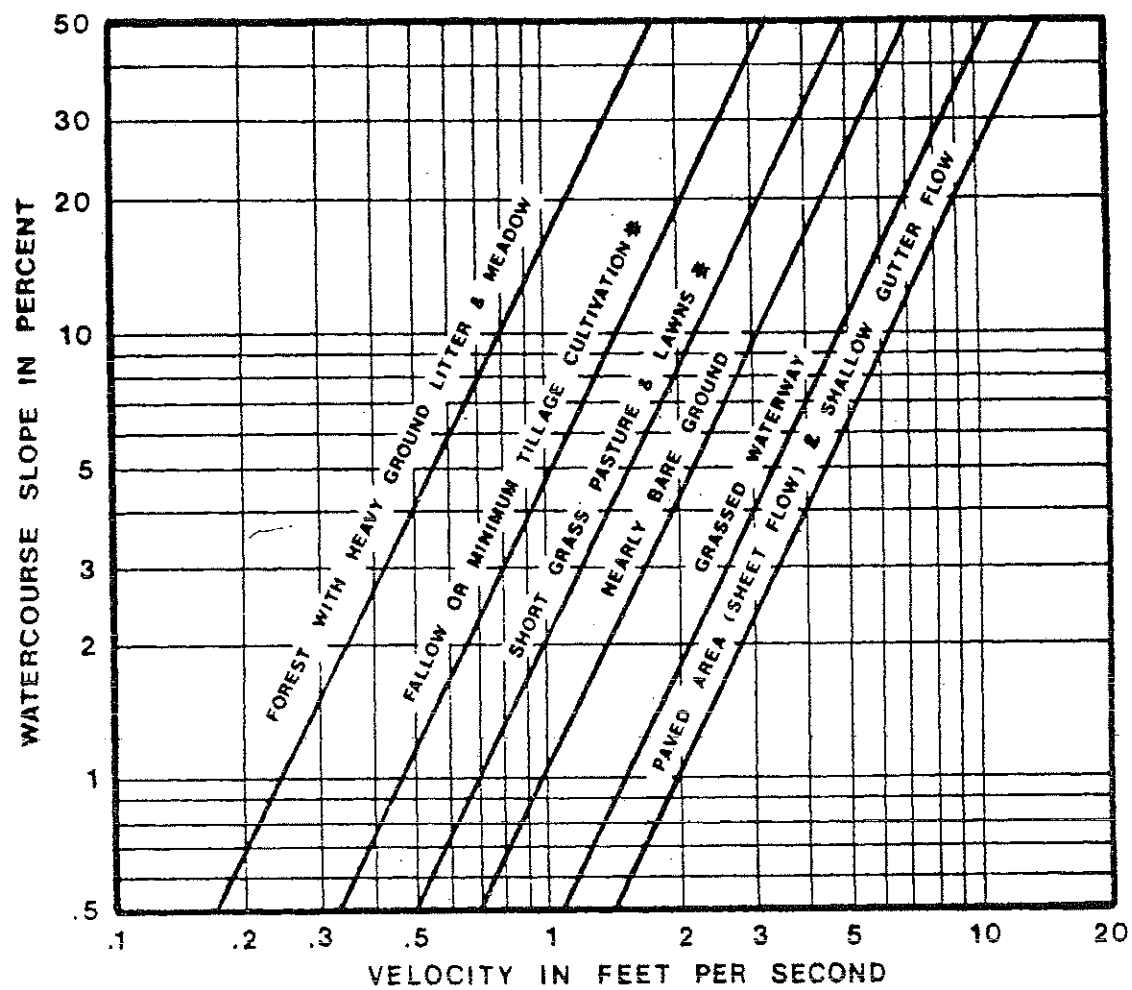


FIGURE RO-1

Estimate of Average Overland Flow Velocity for Use With the Rational Formula



## 5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions are required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (District) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this criteria MANUAL.

## 5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume III- Colorado. The design storm events developed and utilized are the same as those used by the District.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where,  $I$  = rainfall intensity (in/hr)  
 $P_1$  = one-hour point rainfall depth (in)  
 $t_c$  = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

Table 5.1  
ONE-HOUR POINT RAINFALL

| Frequency of Design Event<br>(yr) | One-hour Point Rainfall, $P_1$<br>(in) |
|-----------------------------------|----------------------------------------|
| 2                                 | 0.99                                   |
| 5                                 | 1.39                                   |
| 10                                | 1.64                                   |
| 25                                | 1.98                                   |
| 50                                | 2.31                                   |
| 100                               | 2.60                                   |

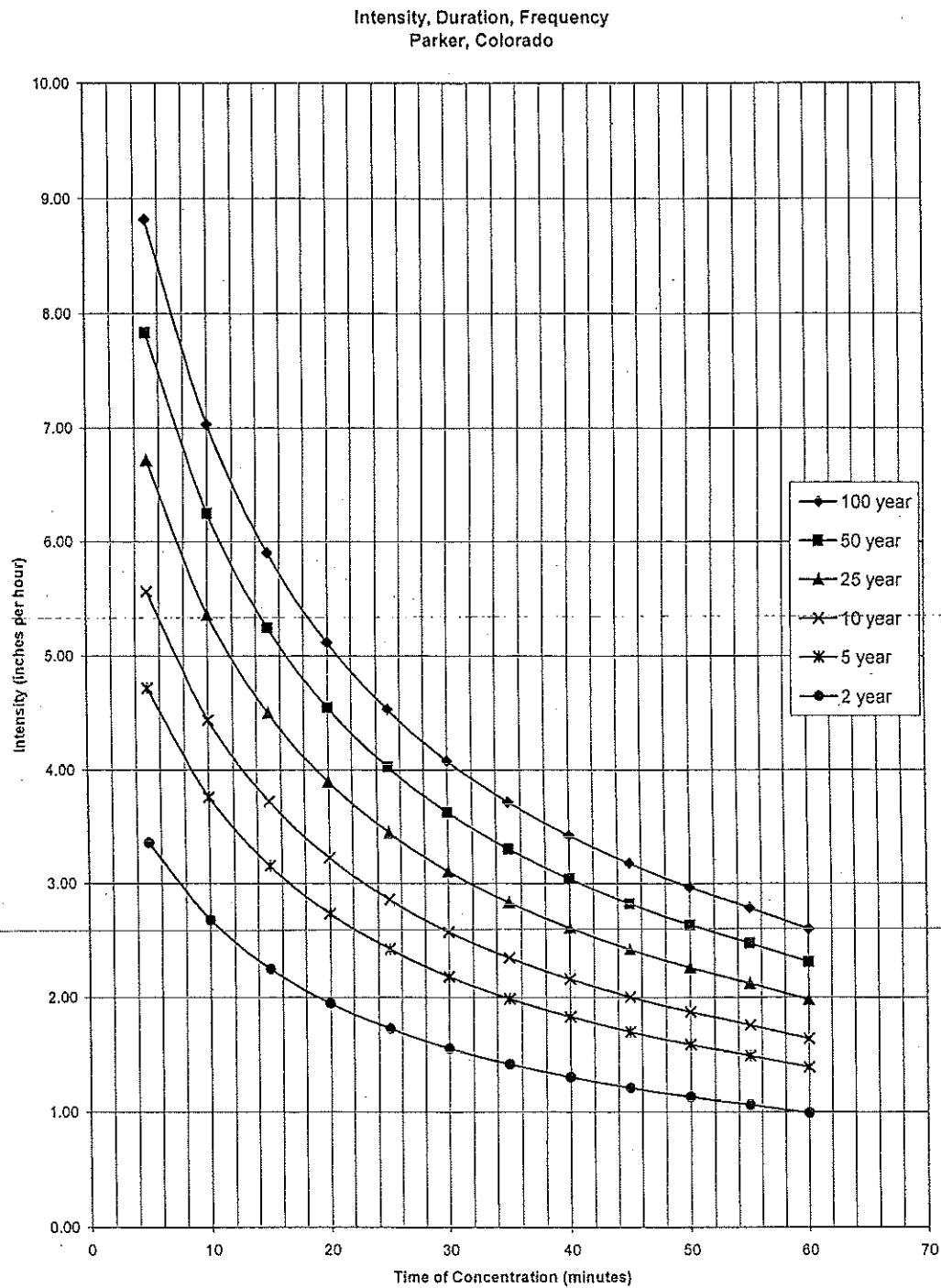


Figure 5.1 Rainfall Intensity Versus Duration Curves for Parker, Colorado

**APPENDIX B**  
**Hydraulic Calculations**

Table 2.3

**RECURRENCE INTERVALS (years) FOR  
INITIAL AND MAJOR STORM RUNOFF DESIGN**

| Land use                       | Initial Storm | Major Storm |
|--------------------------------|---------------|-------------|
| Residential                    | 2             | 100         |
| Open Space/Agricultural        | 2             | 100         |
| School                         | 2             | 100         |
| Commercial/Business/Industrial | 5             | 100         |

### 2.5.1 STREETS

Streets are an integral part of the urban drainage system and may be used for transporting storm runoff up to design limits. The design engineer should recognize that the primary purpose of streets is for traffic. Therefore, use of streets for storm runoff must be limited.

Although street criteria are formulated to allow certain drainage, streets should not routinely be considered as major drainageways. The Town of Parker, prohibits the practice of discharging offsite culverts and other non-local drainage outfalls onto streets. Storm drains should not outfall onto streets, but should be piped to suitable outfalls in a swale, channel, or detention basin. Street criteria should be applied to storm runoff flows emanating from building lots and other streets rather than discharges from major offsite drainageways flowing into streets.

Town of Parker criteria for allowable uses and depth of flow for initial and major storm runoff events is presented in Table 2.4, Table 2.5, and Table 2.6

Table 2.4

**ALLOWABLE USE OF STREETS FOR INITIAL STORM RUNOFF**

| Street Classification | Maximum Theoretical Encroachment                                                                               |
|-----------------------|----------------------------------------------------------------------------------------------------------------|
| Local                 | No curb overtopping. Flow may spread to crown of street.                                                       |
| Collector             | No curb overtopping. Flow spread must leave at least a 10 foot width free of water.                            |
| Arterial              | No curb overtopping. Flow spread must leave at least two lanes free of water, one 10 foot lane each direction. |

*Where no curbing exists, encroachment should not extend past the street right-of-way. The maximum allowable street flow shall be the product of the flow calculated at "maximum theoretical street encroachment" and required reduction factor. See Section 6.4*

Parker Auto Plaza  
Inlet Capacity Summary

| Inlet | Location   | Inlet Size | Inlet Condition | 5yr Flow | 5yr Flow Spread | 100yr Flow + Carry Over to Inlet | 100yr Inlet Capacity | 100yr Flow Past Inlet | Downstream Inlet if Carry Over | Contributing Flows           |
|-------|------------|------------|-----------------|----------|-----------------|----------------------------------|----------------------|-----------------------|--------------------------------|------------------------------|
| 1     | Interior   | 10 ft      | Sump            |          |                 | 17.9 cfs                         | 17.2 cfs             | 1 cfs                 |                                | Basin 1A                     |
| 2     | Interior   | 15 ft      | Sump            |          |                 | 20.7 cfs                         | 24.3 cfs             | (4 cfs)               |                                | Basin 2A                     |
| 3     | Interior   | 10 ft      | Sump            |          |                 | 19.5 cfs                         | 19.1 cfs             | 0 cfs                 |                                | Basin 3A                     |
| 4     | Interior   | 10 ft      | Sump            |          |                 | 23.1 cfs                         | 19.5 cfs             | 4 cfs                 |                                | Basin 4A                     |
| 10    | 20 Mile Rd | 15 ft      | Grade           | 1.9 cfs  | 7.3 ft          | 3.7 cfs                          | 3.6 cfs              | 0 cfs                 | Off Site                       | Basin 1B                     |
| 11    | 20 Mile Rd | 10 ft      | Grade           | 1.6 cfs  | 6.6 ft          | 3.8 cfs                          | 3.0 cfs              | 1 cfs                 | Inlet 18                       | Basin 2B                     |
| 12    | Interior   | 10 ft      | Sump            |          |                 | 8.2 cfs                          | 9.2 cfs              | (1 cfs)               |                                | Basin 13B                    |
| 13    | Interior   | 10 ft      | Sump            |          |                 | 13.7 cfs                         | 13.5 cfs             | 0 cfs                 |                                | Basin 4B                     |
| 14    | Interior   | 10 ft      | Sump            |          |                 | 11.4 cfs                         | 13.6 cfs             | (2 cfs)               |                                | Basin 5B                     |
| 15    | Interior   | 5 ft       | Sump            |          |                 | 8.8 cfs                          | 8.2 cfs              | 1 cfs                 | Detention Basin                | Basin 6B                     |
| 16    | Dransfeldt | 15 ft      | Grade           | 2.1 cfs  | 5.5 ft          | 4.3 cfs                          | 3.6 cfs              | 1 cfs                 | Inlet 27                       | 1/2 Basin 7B                 |
| 16a   | Dransfeldt | 15 ft      | Grade           | 2.1 cfs  | 5.5 ft          | 4.3 cfs                          | 3.6 cfs              | 1 cfs                 | Inlet 27                       | 1/2 Basin 7B                 |
| 17    | Interior   | 15 ft      | Sump            |          |                 | 17.3 cfs                         | 18.9 cfs             | (2 cfs)               |                                | Basin 9B                     |
| 18    | 20 Mile Rd | 15 ft      | Grade           | 3.5 cfs  | 12.3 ft         | 7.2 cfs                          | 6.4 cfs              | 1 cfs                 | Off Site to the west           | Basin 10B, Carry Inlet 11    |
| 19    | Interior   | 10 ft      | Sump            |          |                 | 9.5 cfs                          | 11.3 cfs             | (2 cfs)               |                                | Basin 11B                    |
| 20    | Interior   | 10 ft      | Sump            |          |                 | 13.9 cfs                         | 18.3 cfs             | (4 cfs)               |                                | Basin 12B                    |
| 21    | Interior   | 10 ft      | Sump            |          |                 | 15.5 cfs                         | 15.5 cfs             | 0 cfs                 |                                | Basin 3B                     |
| 25    | 20 Mile Rd | 10 ft      | Sump            | 2.8 cfs  | 9.1 ft          | 7.0 cfs                          | 11.6 cfs             | (5 cfs)               |                                | Basin 5C, Carry Inlet 27     |
| 26    | 20 Mile Rd | 3.25 ft    | Sump            | 1.7 cfs  | 6.9 ft          | 4.3 cfs                          | 5.8 cfs              | (2 cfs)               |                                | Basin 6C, Carry Inlet 27a    |
| 27    | 20 Mile Rd | 10 ft      | Grade           | 2.6 cfs  | 13.7 ft         | 5.9 cfs                          | 3.4 cfs              | 3 cfs                 | Inlet 25                       | Basin 3C, Carry Inlet 16,16a |
| 27a   | 20 Mile Rd | 10 ft      | Grade           | 2.3 cfs  | 10.9 ft         | 4.7 cfs                          | 2.9 cfs              | 2 cfs                 | Inlet 26                       | Basin 4C                     |
| 28    | 20 Mile Rd | 5 ft       | Grade           | 1.5 cfs  | 10.1 ft         | 3.1 cfs                          | 1.6 cfs              | 2 cfs                 |                                | Basin 2D                     |
| 40    | Parker Rd  | 5 ft       | Sump            | 3.7 cfs  | 8.6 ft          | 7.3 cfs                          | 6.2 cfs              | 1 cfs                 | Baldwin Gulch                  | Basin 7C                     |

Town of Parker Criteria (Pg 6-15, Section 6.3.5): A 50% reduction factor should be used on carry over flows when determining the amount of flow entering a downstream inlet, due to Carry Over.

**Table 2.4: Allowable Use of Streets for Initial Storm Runoff (5-year Runoff)**

Collector: No curb overtopping. Flow spread must leave at least a 10-ft width free of water.

**Dransfeldt Rd Maximum Flow Spread = 16.0 ft**

Arterial: No curb overtopping. Flow spread must leave at least two lanes free of water, one 10-ft lane each direction.

**Twenty Mile Rd Maximum Flow Spread = 17.0 ft**

**APPENDIX C**  
**Detention Basin Calculations**

**Parker Auto Plaza  
Detention Basin Calculations**

WQCV = 0.45 inches  
 % Impervious(I) = 95 %

WQCV (Water Quality Capture Volume) taken from Fig. EDB-2, Volume 3 of the Urban Storm Drainage Criteria Manual for the basin imperviousness shown.  
 Percent Impervious taken from Table RO-3, Volume 1 of the Urban Storm Drainage Criteria Manual

**WQCV = 0.045 \* A**  
**WQCV = WQCV/12 \* A \* 1.2**  
 A = Area

Required Detention Storage Volume =  $K_i A$

**$K_{10} = 0.08835$**   
 **$K_{100} = 0.14749$**

$K_{10} = (0.95I - 1.9)/1000$   
 $K_{100} = (1.78I - 0.002I^2 - 3.56)/1000$

**Unit Flow Release Rate (cfs/acre)**

Hydrologic Soil Group **B**  
 $U_{10} = 0.23$   
 $U_{100} = 0.85$

| Basin             | Total Acres | $V_{10}$   |           | $V_{100}$  |            | WQCV       |           | 10-yr Required Capacity |            | 100-yr Required Capacity |            | Release Rate |           |
|-------------------|-------------|------------|-----------|------------|------------|------------|-----------|-------------------------|------------|--------------------------|------------|--------------|-----------|
|                   |             | ac-ft      | cf        | ac-ft      | cf         | ac-ft      | cf        | ac-ft                   | cf         | ac-ft                    | cf         | $Q_{10}$     | $Q_{100}$ |
| Detention Basin A | 15.45 ac    | 1.37 ac-ft | 59,460 cf | 2.28 ac-ft | 99,261 cf  | 0.70 ac-ft | 30,285 cf | 2.06 ac-ft              | 89,745 cf  | 2.97 ac-ft               | 129,546 cf | 3.6 cfs      | 13.1 cfs  |
| Detention Basin B | 21.20 ac    | 1.87 ac-ft | 81,589 cf | 3.13 ac-ft | 136,203 cf | 0.95 ac-ft | 41,556 cf | 2.83 ac-ft              | 123,145 cf | 4.08 ac-ft               | 177,759 cf | 4.9 cfs      | 18.0 cfs  |

$V_x = K_x A$

Release Rate = Area \*  $U_x$

$U_x$  = Recommended Maximum Allowable Unit Flow Release Rates (cfs/acre) of Tributary Catchment (Table SO-1, Urban Drainage and Flood Control District - Volume 2)

**Parker Auto Plaza  
Detention Basin Calculations**

**Presedimentation / Forebay Sizing**

**Detention Basin A**

|                       |           |
|-----------------------|-----------|
| WQCV                  | 30,285 cf |
| 10% WQCV              | 3,029 cf  |
| Orifice Eqn Coef. (C) | 0.50      |

| Forebay Pipe Number | Flow     | % Total Flow | Weighted Forebay Area | Forebay Size |              |                 | 5 Minute Drain Flow | Pipes Out of Forebay - Orifice Calculation |             |                 |             |                 |             | Total Flow |
|---------------------|----------|--------------|-----------------------|--------------|--------------|-----------------|---------------------|--------------------------------------------|-------------|-----------------|-------------|-----------------|-------------|------------|
|                     |          |              |                       | Depth        | Surface Area | Semicirc. Radii |                     | Pipe 1 Diameter                            | Pipe 1 Flow | Pipe 2 Diameter | Pipe 2 Flow | Pipe 3 Diameter | Pipe 3 Flow |            |
| S2                  | 37 cfs   | 46.84 %      | 1,418 cf              | 2.0 ft       | 709 sf       | 21 ft           | 4.7 cfs             | 8 inches                                   | 1.8 cfs     | 10 inches       | 2.8 cfs     | 0 inches        | 0.0 cfs     | 4.6 cfs    |
| S3                  | 19 cfs   | 24.05 %      | 728 cf                | 2.0 ft       | 364 sf       | 15 ft           | 2.4 cfs             | 6 inches                                   | 1.0 cfs     | 6 inches        | 1.0 cfs     | 0 inches        | 0.0 cfs     | 2.1 cfs    |
| S4                  | 23 cfs   | 29.11 %      | 882 cf                | 2.0 ft       | 441 sf       | 17 ft           | 2.9 cfs             | 6 inches                                   | 1.0 cfs     | 8 inches        | 1.8 cfs     | 0 inches        | 0.0 cfs     | 2.9 cfs    |
|                     | 79.0 cfs | 100.00 %     | 3,029 cf              |              |              |                 |                     |                                            |             |                 |             |                 |             | 9.5 cfs    |

Orifice Equation:

$$Q = CA(2gH)^{0.5}$$

C = Orifice coefficient (dimensionless)

A = Cross-sectional area of opening, in sf

g = Gravitational acceleration constant, 32.2 ft/sec<sup>2</sup>

H = Head above the centerline of the pipe, in ft

**Detention Basin B**

|                       |           |
|-----------------------|-----------|
| WQCV                  | 41,556 cf |
| 10% WQCV              | 4,156 cf  |
| Orifice Eqn Coef. (C) | 0.50      |

| Forebay Pipe Number | Flow     | % Total Flow | Weighted Forebay Area | Forebay Size |              |                 | 5 Minute Drain Flow | Pipes Out of Forebay - Orifice Calculation |             |                 |             |                 |             | Total Flow |
|---------------------|----------|--------------|-----------------------|--------------|--------------|-----------------|---------------------|--------------------------------------------|-------------|-----------------|-------------|-----------------|-------------|------------|
|                     |          |              |                       | Depth        | Surface Area | Semicirc. Radii |                     | Pipe 1 Diameter                            | Pipe 1 Flow | Pipe 2 Diameter | Pipe 2 Flow | Pipe 3 Diameter | Pipe 3 Flow |            |
| S10                 | 92 cfs   | 100.00 %     | 4,156 cf              | 2.0 ft       | 2,078 sf     | 36 ft           | 13.9 cfs            | 12 inches                                  | 3.9 cfs     | 12 inches       | 3.9 cfs     | 12 inches       | 3.9 cfs     | 11.6 cfs   |
|                     | 92.0 cfs | 100.00 %     | 4,156 cf              |              |              |                 |                     |                                            |             |                 |             |                 |             | 11.6 cfs   |



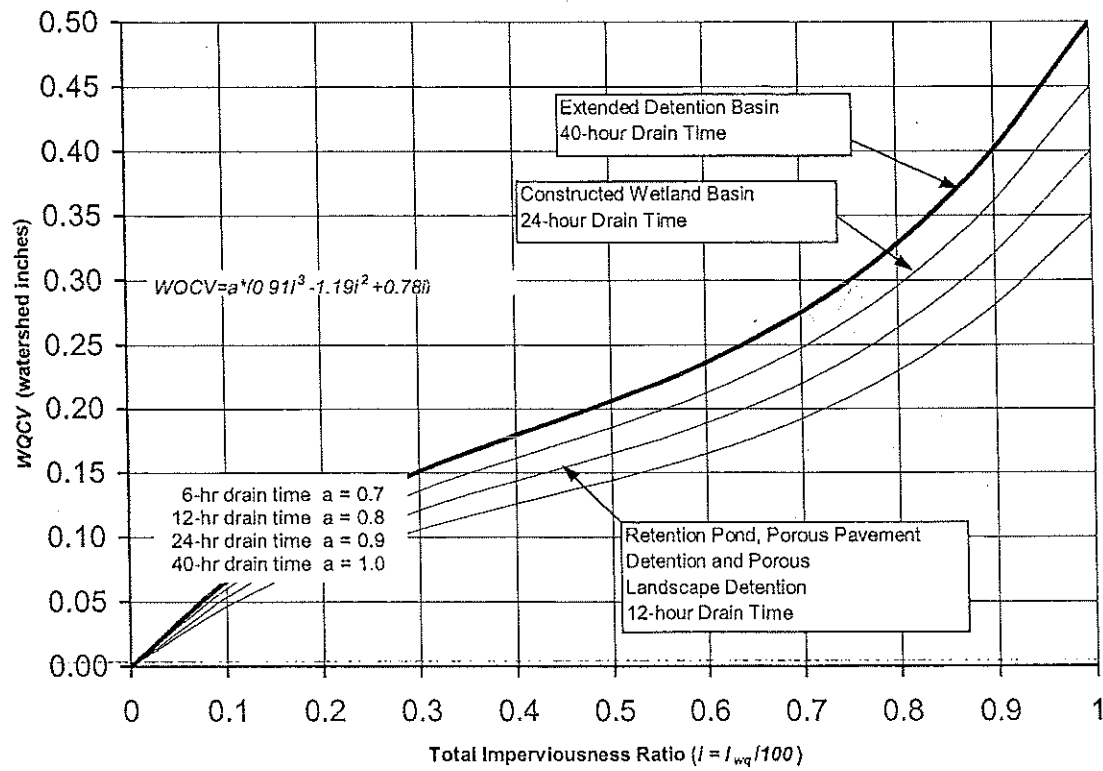


FIGURE EDB-2

Water Quality Capture Volume (WQCV), 80<sup>th</sup> Percentile Runoff Event

attempt to account for the effects of the WQCV on all control levels whenever it performs watershed-level drainage and flood control system master plans.

### **3.2 Sizing of On-Site Detention Facilities**

**3.2.1 Maximum Allowable Unit Release Rates for On-Site Facilities.** The maximum allowable unit release rates per acre for on-site detention facilities for a number of design return periods are listed in Table SO-1. These rates apply unless other rates are recommended in a District-approved master plan.

The predominant soil group for the total tributary catchment shall be used for determining the allowable release rates. Multiply the unit rates provided in Table SO-1 by the tributary catchment's area to obtain the actual design release rates in cubic feet per second (cfs). Whenever Natural Resources Conservation Service (NRCS) soil surveys are not available for the portion of a county being studied, extrapolate their types using soil investigations at the site.

**TABLE SO-1**

Recommended Maximum Allowable Unit Flow Release Rates (cfs/acre) of Tributary Catchment

| Design Return<br>Period<br>(Years) | NRCS Hydrologic Soil Group |      |       |
|------------------------------------|----------------------------|------|-------|
|                                    | A                          | B    | C & D |
| 2                                  | 0.02                       | 0.03 | 0.04  |
| 5                                  | 0.07                       | 0.13 | 0.17  |
| 10                                 | 0.13                       | 0.23 | 0.30  |
| 25                                 | 0.24                       | 0.41 | 0.52  |
| 50                                 | 0.33                       | 0.56 | 0.68  |
| 100                                | 0.50                       | 0.85 | 1.00  |

**3.2.2 Empirical Equations for the Sizing of On-Site Detention Storage Volumes.** Urbanas and Glidden (1983), as part of the District's ongoing hydrologic research, conducted studies that evaluated peak storm runoff flows along major drainageways. The following set of empirical equations provided preliminary estimates of on-site detention facility sizing for areas within the District. They are not intended for use when off-site inflows are present or when multi-stage controls are to be used (e.g., 10- and 100-year peak control) at the storage facility. In addition, these equations are not intended to replace detailed hydrologic and flood routing analysis, or even the analysis using the Rational Formula-based FAA method for the sizing of detention storage volumes. The District does not promote the use of these empirical equations. It does not object, however, to their use by local governments who have adopted them or want to adopt them as minimum requirements for the sizing of on-site detention for small catchments within their jurisdiction. If the District has a master plan that contains specific guidance for detention

**APPENDIX C.1**  
**Detention Basin A Calculations**

Parker Auto Plaza  
Detention Basin Earthwork Calculation

**Detention Basin A**

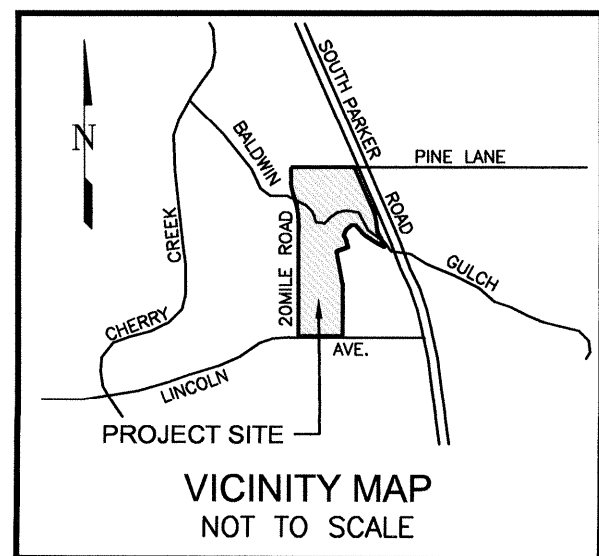
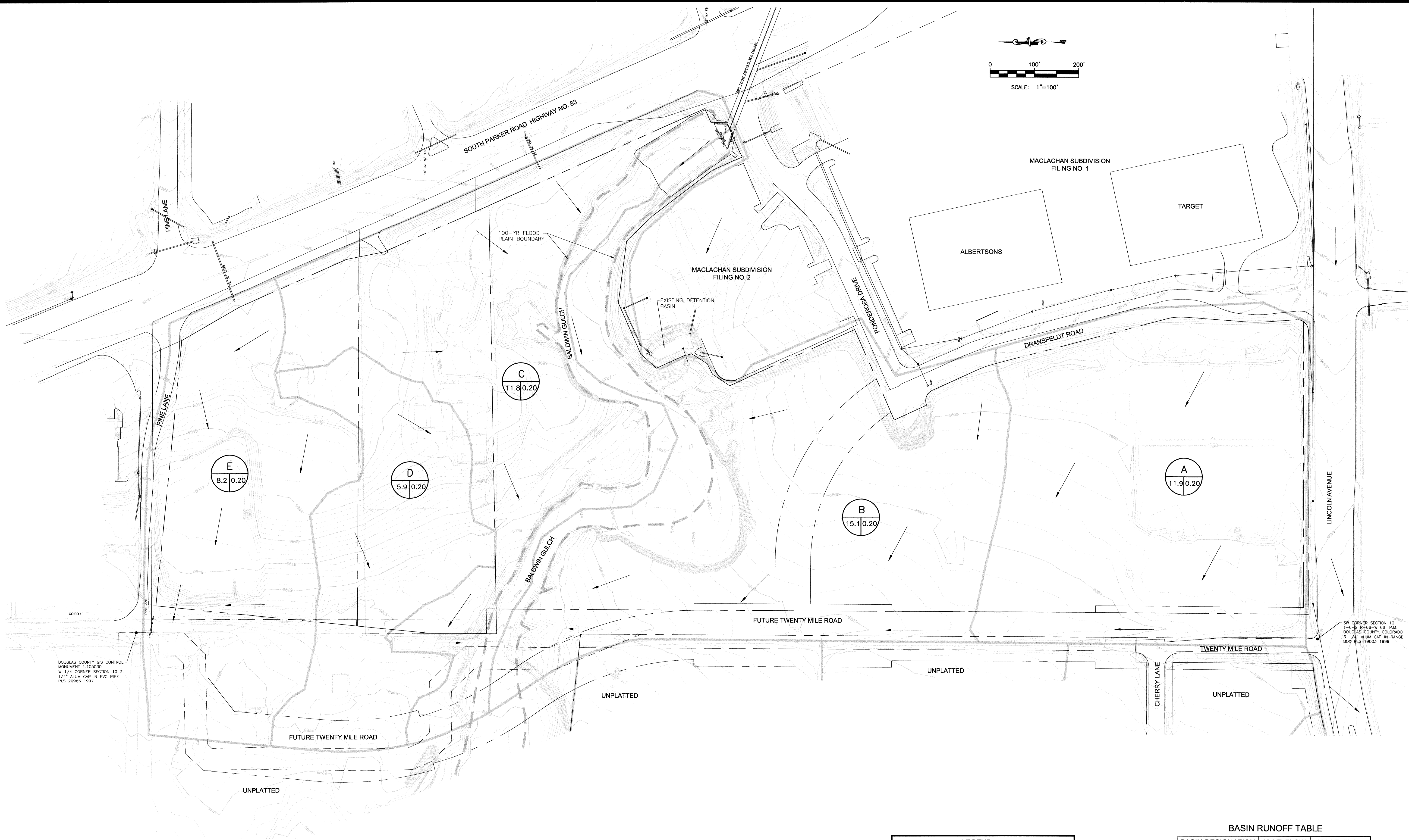
| Elevation | Area      | Avg. Area | Volume    | Basin Depth | Cumulative Basin Volume |             | Elevation |
|-----------|-----------|-----------|-----------|-------------|-------------------------|-------------|-----------|
| 77.7      | 315 sf    |           |           |             |                         |             |           |
|           |           | 448 sf    | 134 cf    | 0.3 ft      | 134 cf                  | 0.003 ac-ft | 78        |
| 78        | 580 sf    |           |           |             |                         |             |           |
|           |           | 3,743 sf  | 3,743 cf  | 1.3 ft      | 3,877 cf                | 0.09 ac-ft  | 79        |
| 79        | 6,905 sf  |           |           |             |                         |             |           |
|           |           | 13,299 sf | 13,299 cf | 2.3 ft      | 17,175 cf               | 0.39 ac-ft  | 80        |
| 80        | 19,692 sf |           |           |             |                         |             |           |
|           |           | 22,546 sf | 22,546 cf | 3.3 ft      | 39,721 cf               | 0.91 ac-ft  | 81        |
| 81        | 25,400 sf |           |           |             |                         |             |           |
|           |           | 27,000 sf | 27,000 cf | 4.3 ft      | 66,721 cf               | 1.53 ac-ft  | 82        |
| 82        | 28,600 sf |           |           |             |                         |             |           |
|           |           | 30,125 sf | 30,125 cf | 5.3 ft      | 96,846 cf               | 2.22 ac-ft  | 83        |
| 83        | 31,650 sf |           |           |             |                         |             |           |
|           |           | 33,225 sf | 33,225 cf | 6.3 ft      | 130,071 cf              | 2.99 ac-ft  | 84        |
| 84        | 34,800 sf |           |           |             |                         |             |           |
|           |           | 36,075 sf | 36,075 cf | 7.3 ft      | 166,146 cf              | 3.81 ac-ft  | 85        |
| 85        | 37,350 sf |           |           |             |                         |             |           |

Water Quality Capture Volume = 30,285 cf  
WQCV Elevation = 80.58 ft

10yr Water Volume = 89,745 cf  
10yr Water Surface Elevation = 82.76 ft

100yr Water Volume = 129,546 cf  
100yr Water Surface Elevation = 83.98 ft





PROJECT DATUM: ALL ELEVATIONS ARE REFERENCED TO NAVD 88 AS SHOWN ON THE 1998 DOUGLAS COUNTY TABULATION

| LEGEND |                                                     |
|--------|-----------------------------------------------------|
|        | BASIN DESIGNATION                                   |
|        | BASIN AREA (AC) 11.9   0.20 C100 RUNOFF COEFFICIENT |
|        | DIRECTIONAL FLOW ARROW                              |
|        | EXISTING DRAINAGE BASIN BOUNDARY                    |
|        | R.O.W. / PROPERTY LINE                              |

| BASIN RUNOFF TABLE |            |             |
|--------------------|------------|-------------|
| BASIN DESIGNATION  | 10-YR FLOW | 100-YR FLOW |
| A                  | 1.1 cfs    | 7.0 cfs     |
| B                  | 1.7 cfs    | 10.8 cfs    |
| C                  | 1.1 cfs    | 6.9 cfs     |
| D                  | 0.7 cfs    | 4.6 cfs     |
| E                  | 0.9 cfs    | 5.7 cfs     |

Kiowa Engineering Corporation

7175 West Jefferson Avenue, Suite 3400

Lakewood, Colorado 80235

(303) 692-0369

PARKER AUTO PLAZA

EXISTING DRAINAGE PATTERNS

FINAL DRAINAGE REPORT

PARKER, COLORADO

Project No.: 00056

Date: July 12, 2004

Design: MWE

Drawn: MWE

Check: RNW

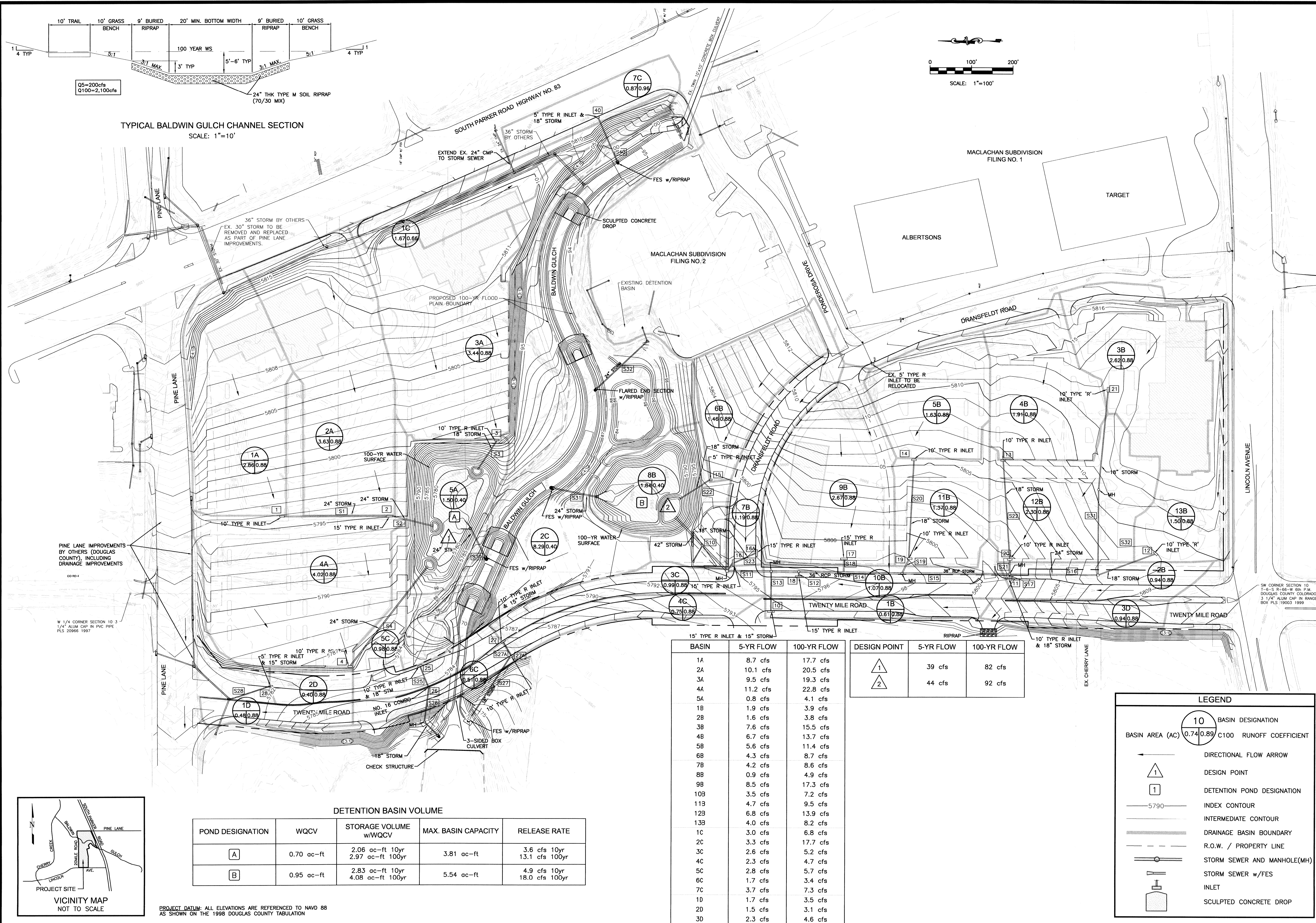
Revisions:

FIGURE

1

00056DRF-g1.dwg/Jul 12, 2004





TYPICAL BALDWIN GULCH CHANNEL SECTION  
SCALE: 1"=10'

DETENTION BASIN VOLUME

| POND DESIGNATION | WQCV       | STORAGE VOLUME<br>w/WQCV | MAX. BASIN CAPACITY | RELEASE RATE   |
|------------------|------------|--------------------------|---------------------|----------------|
| A                | 0.70 ac-ft | 2.08 ac-ft 10yr          | 3.81 ac-ft          | 3.6 cfs 10yr   |
|                  |            | 2.97 ac-ft 100yr         |                     | 13.1 cfs 100yr |
| B                | 0.95 ac-ft | 2.83 ac-ft 10yr          | 5.54 ac-ft          | 4.9 cfs 10yr   |
|                  |            | 4.08 ac-ft 100yr         |                     | 18.0 cfs 100yr |

| BASIN | 5-YR FLOW | 100-YR FLOW |
|-------|-----------|-------------|
| 1A    | 8.7 cfs   | 17.7 cfs    |
| 2A    | 10.1 cfs  | 20.5 cfs    |
| 3A    | 9.5 cfs   | 19.3 cfs    |
| 4A    | 11.2 cfs  | 22.8 cfs    |
| 5A    | 0.8 cfs   | 4.1 cfs     |
| 1B    | 1.9 cfs   | 3.9 cfs     |
| 2B    | 1.6 cfs   | 3.8 cfs     |
| 3B    | 7.6 cfs   | 15.5 cfs    |
| 4B    | 6.7 cfs   | 13.7 cfs    |
| 5B    | 5.6 cfs   | 11.4 cfs    |
| 6B    | 4.3 cfs   | 8.7 cfs     |
| 7B    | 4.2 cfs   | 8.6 cfs     |
| 8B    | 0.9 cfs   | 4.9 cfs     |
| 9B    | 8.5 cfs   | 17.3 cfs    |
| 10B   | 3.5 cfs   | 7.2 cfs     |
| 11B   | 4.7 cfs   | 9.5 cfs     |
| 12B   | 6.8 cfs   | 13.9 cfs    |
| 13B   | 4.0 cfs   | 8.2 cfs     |
| 1C    | 3.0 cfs   | 6.8 cfs     |
| 2C    | 3.3 cfs   | 17.7 cfs    |
| 3C    | 2.6 cfs   | 5.2 cfs     |
| 4C    | 2.3 cfs   | 4.7 cfs     |
| 5C    | 2.8 cfs   | 5.7 cfs     |
| 6C    | 1.7 cfs   | 3.4 cfs     |
| 7C    | 3.7 cfs   | 7.3 cfs     |
| 1D    | 1.7 cfs   | 3.5 cfs     |
| 2D    | 1.5 cfs   | 3.1 cfs     |
| 3D    | 2.3 cfs   | 4.6 cfs     |

| DESIGN POINT | 5-YR FLOW | 100-YR FLOW |
|--------------|-----------|-------------|
| 1            | 39 cfs    | 82 cfs      |
| 2            | 44 cfs    | 92 cfs      |

LEGEND

10 BASIN DESIGNATION  
BASIN AREA (AC) 0.74 0.89 C100 RUNOFF COEFFICIENT

DIRECTIONAL FLOW ARROW

DESIGN POINT

DETENTION POND DESIGNATION

INDEX CONTOUR

INTERMEDIATE CONTOUR

DRAINAGE BASIN BOUNDARY

R.O.W. / PROPERTY LINE

STORM SEWER AND MANHOLE(MH)

STORM SEWER w/FES

INLET

SCULPTED CONCRETE DROP

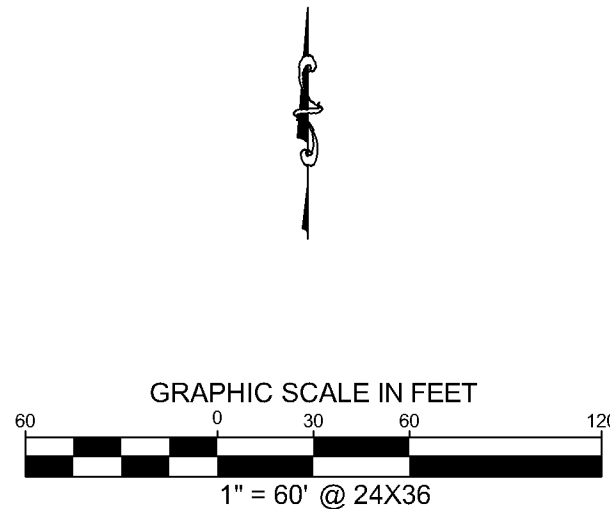
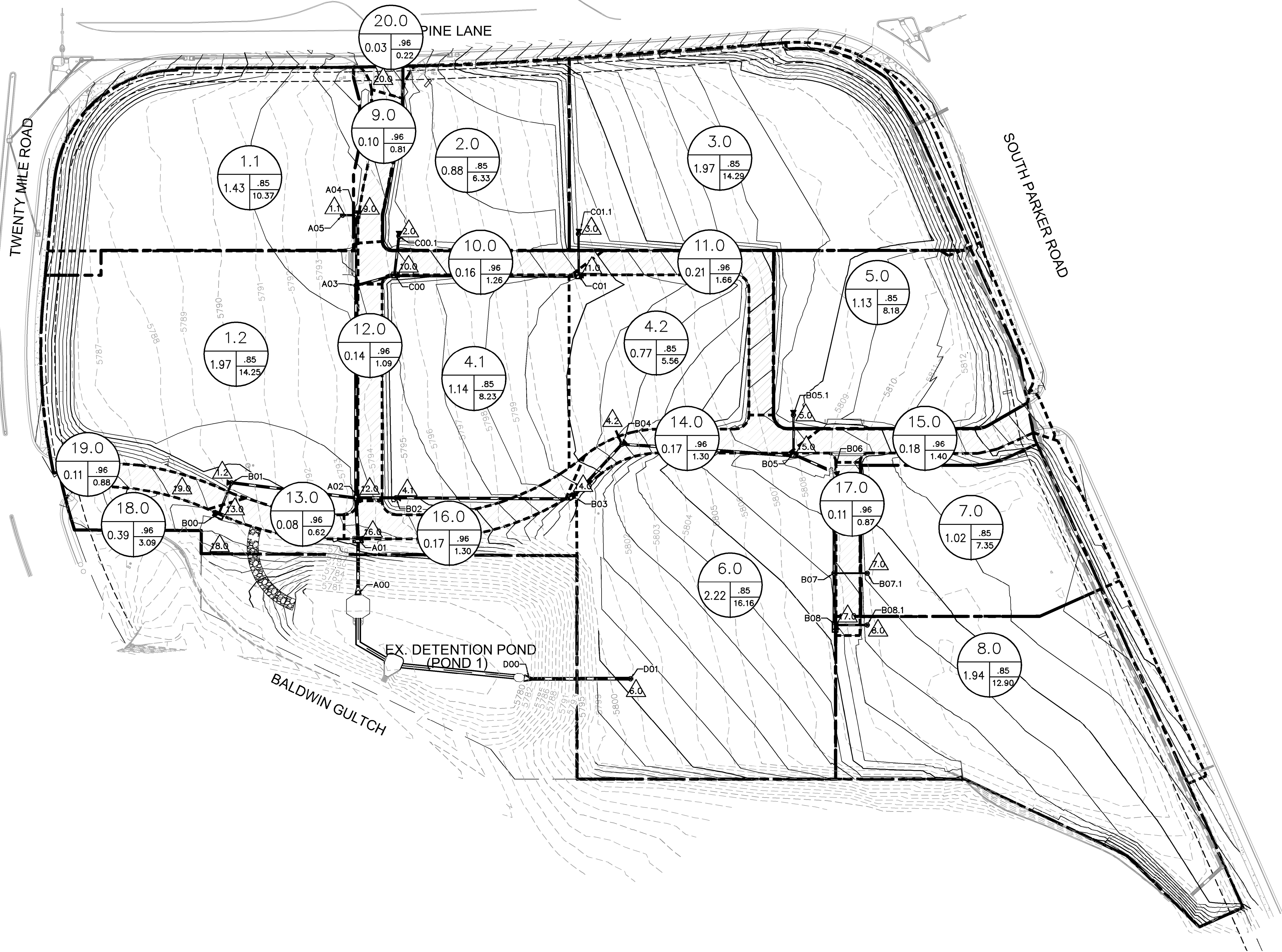
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7175 West Jefferson Avenue, Suite 3400  
Lakewood, Colorado 80235  
(303) 692-0369

PARKER AUTO PLAZA  
DEVELOPED DRAINAGE PATTERNS  
FINAL DRAINAGE REPORT  
PARKER, COLORADO

Project No.: 00056  
Date: July 12, 2004  
Design: MWE  
Drawn: MWE  
Check: RNW  
Revisions:



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### LEGEND

- |  |                                                                                                              |
|--|--------------------------------------------------------------------------------------------------------------|
|  | A = BASIN DESIGNATION<br>B = AREA (ACRES)<br>C = BASIN IMPERVIOUSNESS<br>D = 100YR DESIGN STORM RUNOFF (CFS) |
|  | FLOW DIRECTION                                                                                               |
|  | DRAINAGE BASIN BOUNDARY                                                                                      |
|  | EXISTING PROPERTY LINE                                                                                       |
|  | EXISTING CONTOUR                                                                                             |
|  | PROPOSED CONTOUR                                                                                             |
|  | EXISTING STORM SEWER                                                                                         |
|  | PROPOSED STORM SEWER                                                                                         |
|  | PROPOSED STORM INLET                                                                                         |

**Kimley»Horn**

2019 KIMLEY-HORN AND ASSOCIATES, INC.  
4552 South Ulster Street, Suite 1500  
Denver, Colorado 80237 (303) 228-2300

DESIGNED BY: DLS  
DRAWN BY: ECZ  
CHECKED BY: DLS  
DATE: 11/11/19

PARKER & PINE  
PARKER, CO  
CONSTRUCTION DOCUMENTS  
PRELIMINARY DRAINAGE AREA MAP

PRELIMINARY  
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PROJECT NO.  
096502001

DRAWING NAME  
096502001DRM

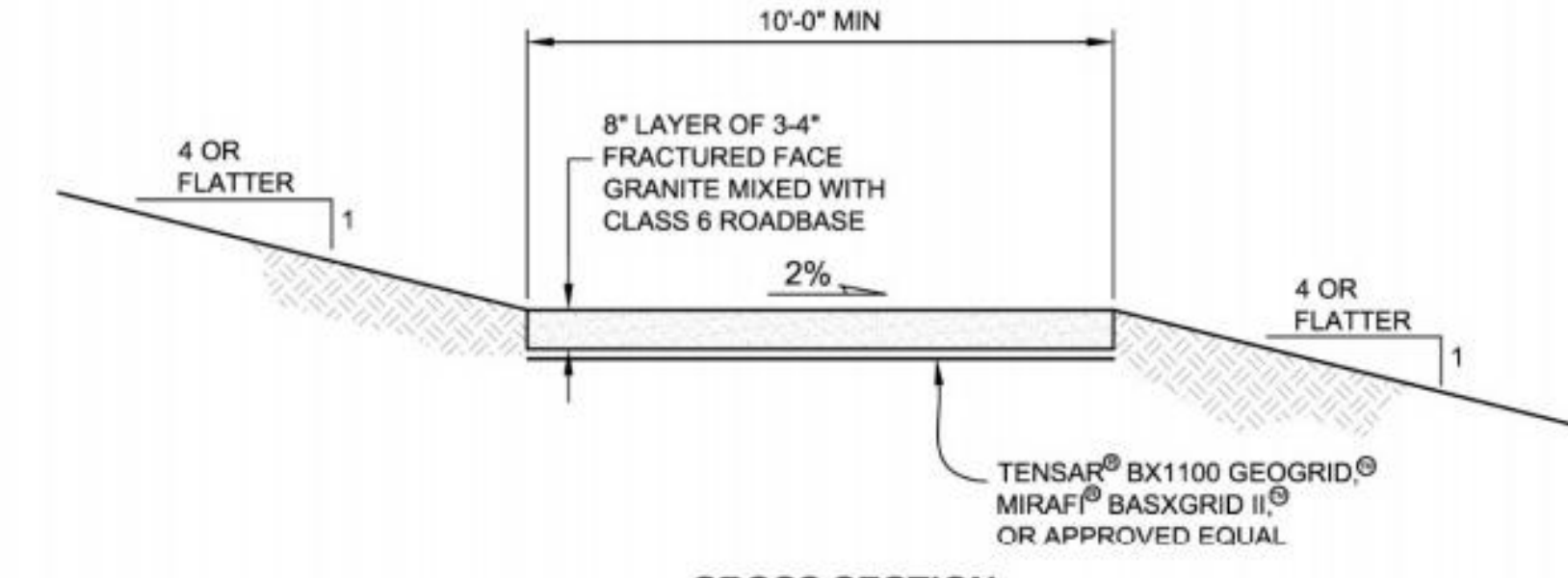
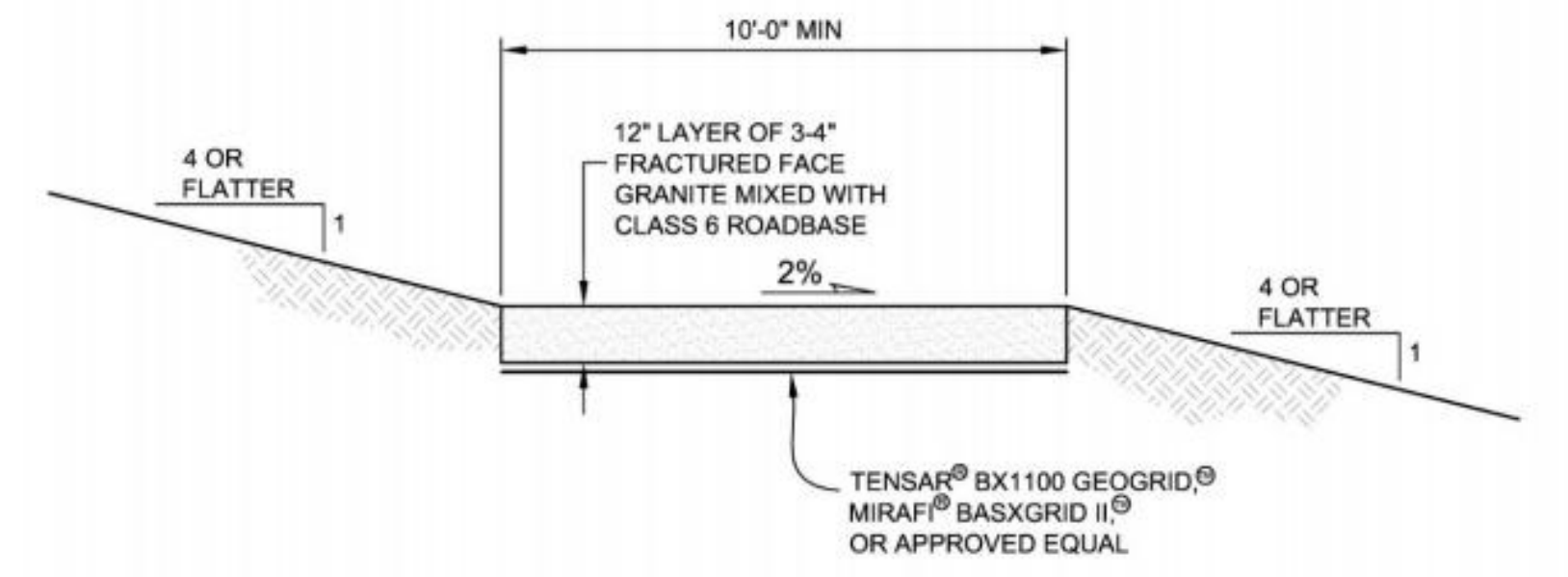
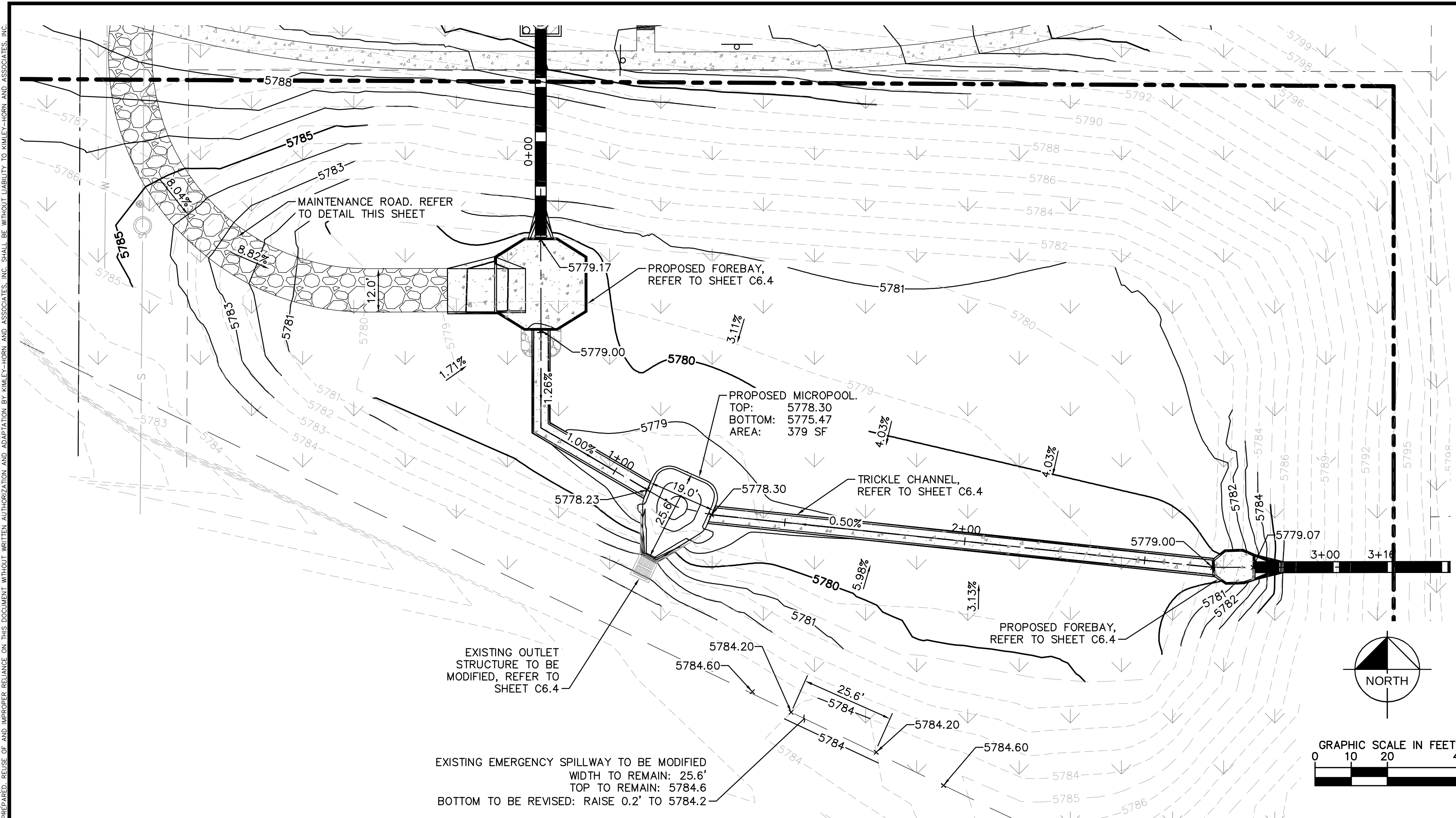
DRAINAGE



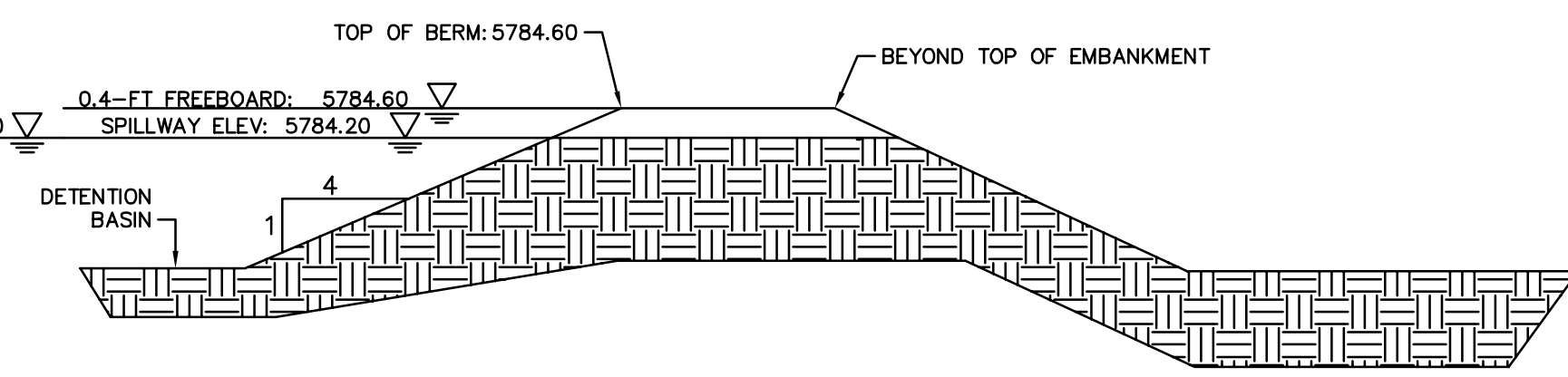
Know what's below.  
Call before you dig.



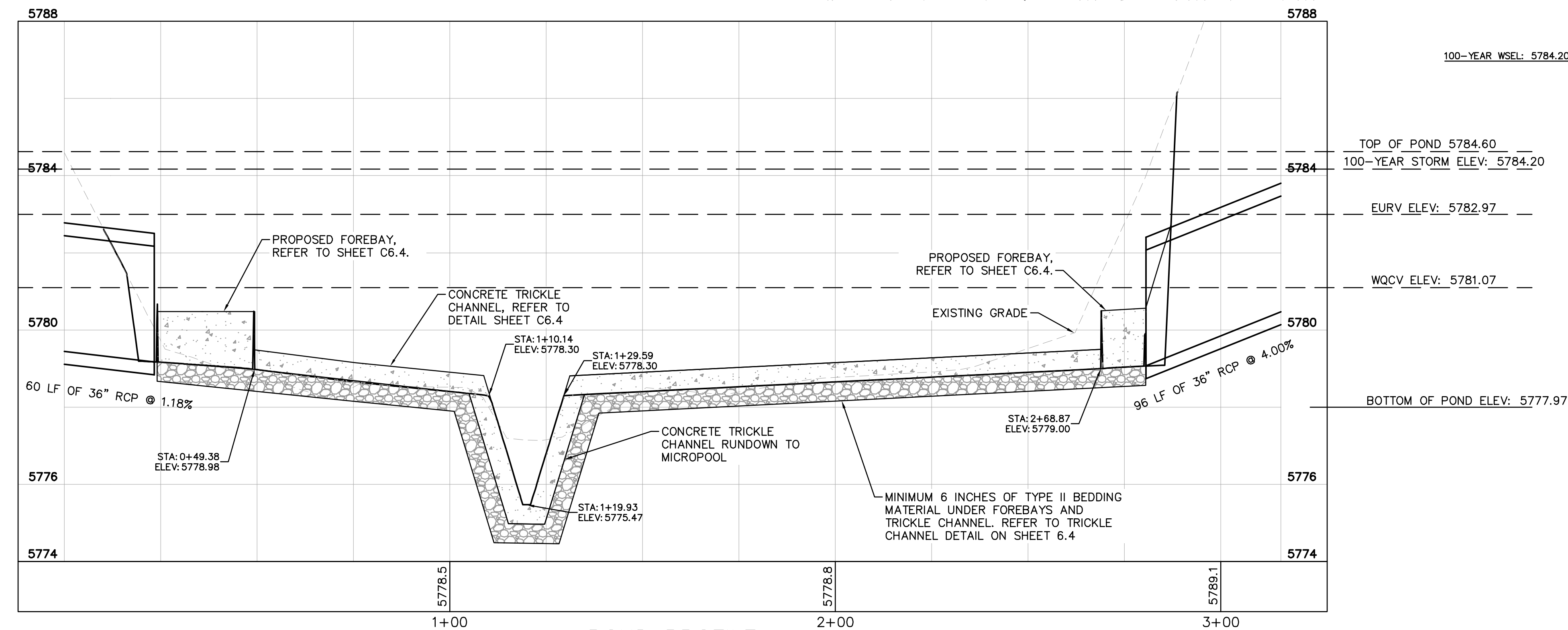
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MAINTENANCE ROAD DETAILS  
N.T.S.



MODIFIED EXISTING EMERGENCY SPILLWAY DETAIL  
N.T.S.



POND PROFILE  
HORIZONTAL SCALE: 1" = 20'  
VERTICAL SCALE: 1" = 2'

| NO. | REVISION | BY | DATE | APPR. |
|-----|----------|----|------|-------|
|     |          |    |      |       |
|     |          |    |      |       |
|     |          |    |      |       |
|     |          |    |      |       |

**Kimley»Horn**  
2020 KIMLEY-HORN AND ASSOCIATES, INC.  
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Denver, Colorado 80237 (303) 228-2300

DESIGNED BY: DLS  
DRAWN BY: JRK  
CHECKED BY: DLS  
DATE: 04/24/20

PARKER AND PINE FILING 1  
PARKER, CO  
CONSTRUCTION DOCUMENTS  
POND PLANS AND PROFILE

PRELIMINARY  
FOR REVIEW ONLY  
NOT FOR CONSTRUCTION  
**Kimley»Horn**  
Kimley-Horn and Associates, Inc.

PROJECT NO.  
096502001

DRAWING NAME  
096502001ST\_DET

C6.3







## APPENDIX E

---

Town of Parker

Parker and Pine

Filing 1

Parker and Pine  
Final Drainage Report

APRIL 2020 | VERSION 1

Prepared By:

**Kimley»Horn**

4582 South Ulster Street, Suite 1500

Denver, CO 80237

## CERTIFICATION

### ENGINEERS STATEMENT

*This report for the final design of Parker and Pine Development was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.*



---

Signature

*Daniel L. Skeehan, P.E.*

---

Colorado P.E. License No. 46391



04/24/2020

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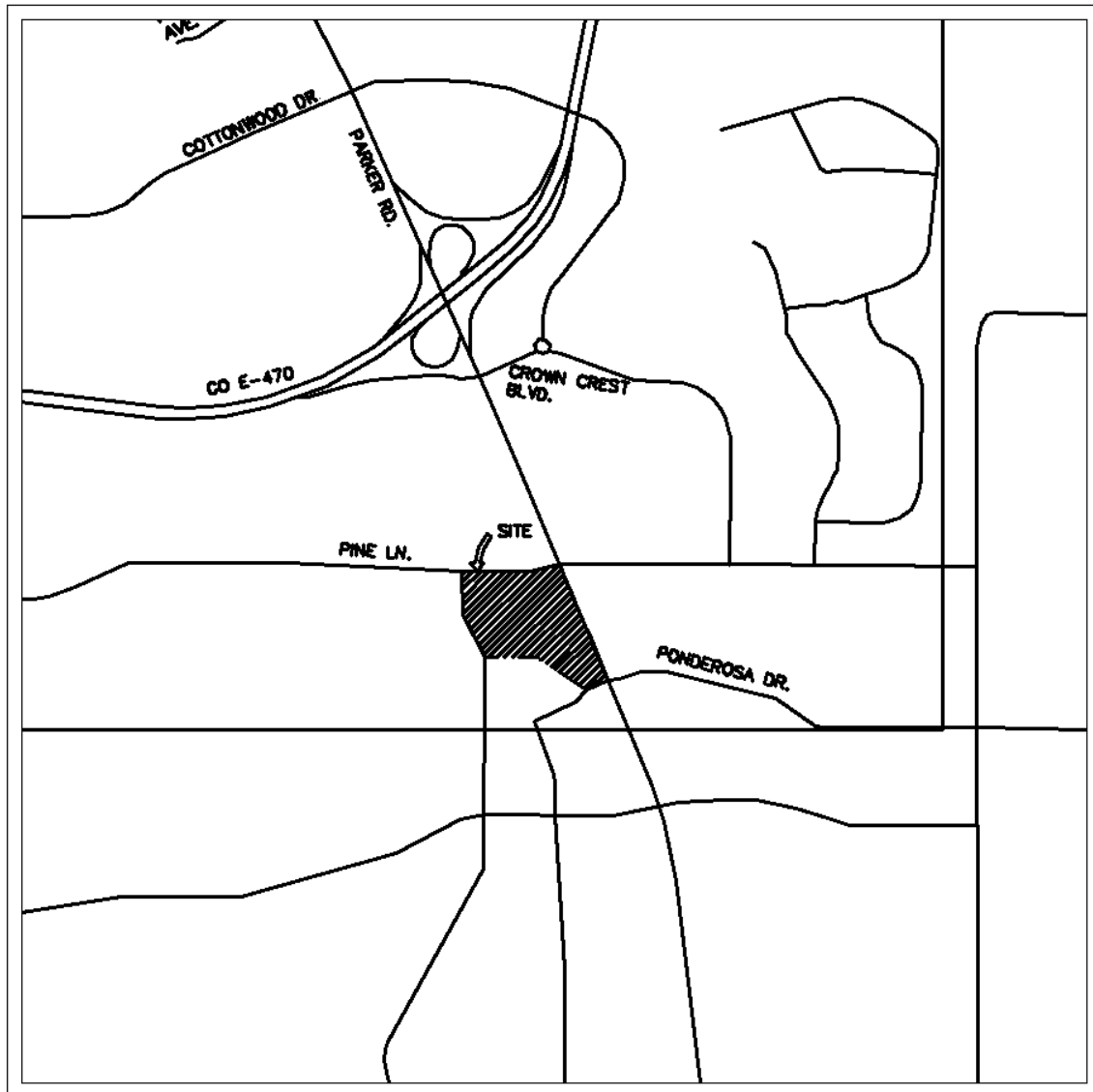
Seal and Date



## TABLE OF CONTENTS

|                                                            |           |
|------------------------------------------------------------|-----------|
| <b>CERTIFICATION .....</b>                                 | <b>1</b>  |
| ENGINEERS STATEMENT .....                                  | 1         |
| <b>VICINITY MAP.....</b>                                   | <b>3</b>  |
| <b>GENERAL LOCATION AND DESCRIPTION.....</b>               | <b>3</b>  |
| LOCATION.....                                              | 4         |
| DESCRIPTION OF PROPERTY .....                              | 4         |
| DESCRIPTION OF PROJECT.....                                | 4         |
| <b>DRAINAGE BASINS AND SUB-BASINS.....</b>                 | <b>4</b>  |
| MAJOR DRAINAGE BASIN DESCRIPTION .....                     | 5         |
| <b>DRAINAGE DESIGN CRITERIA .....</b>                      | <b>5</b>  |
| REGULATIONS.....                                           | 5         |
| DEVELOPMENT DESIGN CRITERIA REFERENCE AND CONSTRAINTS..... | 5         |
| HYDROLOGIC CRITERIA.....                                   | 6         |
| HYDRAULIC CRITERIA.....                                    | 6         |
| <b>DRAINAGE FACILITY DESIGN.....</b>                       | <b>6</b>  |
| GENERAL CONCEPT.....                                       | 6         |
| SUB-BASIN DESCRIPTION .....                                | 7         |
| DETAINED SUB-BASINS .....                                  | 9         |
| <i>Sub-Basins 1.1 – 18</i> .....                           | 9         |
| UNDETAINED SUB-BASINS.....                                 | 10        |
| <i>Sub-Basins 19, 20</i> .....                             | 10        |
| PARKER AUTO PLAZA FINAL DRAINAGE REPORT COMPLIANCE .....   | 11        |
| FLOODPLAIN DEVELOPMENT PERMIT .....                        | 11        |
| <b>ENVIRONMENTAL PROTECTION CRITERIA .....</b>             | <b>11</b> |
| GENERAL.....                                               | 11        |
| CONSTRUCTION BMP PLAN.....                                 | 11        |
| PERMANENT BMP PLAN .....                                   | 11        |
| <b>CONCLUSIONS .....</b>                                   | <b>12</b> |
| COMPLIANCE WITH STANDARDS .....                            | 12        |
| DRAINAGE CONCEPT .....                                     | 12        |
| SEDIMENT AND EROSION CONTROL CONCEPT .....                 | 12        |
| <b>REFERENCES.....</b>                                     | <b>13</b> |
| <b>APPENDIX.....</b>                                       | <b>14</b> |

## VICINITY MAP



## VICINITY MAP

1"=2,000'

## GENERAL LOCATION AND DESCRIPTION

The purpose of this report is to outline the drainage plan for the Parker and Pine Development located between Twenty Mile Road and Parker Road, south of Pine Lane in the Town of Parker, County of Douglas, State of Colorado (herein the "Project").



## **LOCATION**

The proposed Parker and Pine Development lies within 1 parcel of land, located in the southeast quarter of Section 9 and a part of the northeast quarter of section 16 within Township 6 South, Range 66 West of the Sixth Principal Meridian, Town of Parker, County of Douglas, State of Colorado (see Vicinity Map). South Parker Road (State Highway No. 83) borders the project to the east, Pine Lane borders the project to the north, and Twenty Mile Road to the west. An existing detention pond and Baldwin Gulch abut the project to the south. The Site is currently vacant.

## **DESCRIPTION OF PROPERTY**

The Project Site is 15.952 acres in size, a majority of which is currently native grass and overgrown vegetation. The project slopes from east to west from an elevation of  $\pm 5820$  feet on the east side to an elevation of  $\pm 5783$  feet on the west side at a slope of about 3.5%. There is a flat area in the southeast corner of the property at an elevation of  $\pm 5811$  feet that prevents a portion of the site from flowing west. This southeast corner of the site flows south, directly into Baldwin Gulch.

Soils onsite are generally USCS Type BrD, Lo, and Sa as verified by the soil survey included in Appendix A. There are 4 existing storm sewer inlets adjacent to the property. The proposed site conditions will convey stormwater to the existing detention pond via overland sheet flows and a proposed underground storm drain system. Currently, there are no storm inlets or detention facility improvements located on the site. The existing site conditions sheet flow to an existing off-site detention basin and ultimately discharge into Baldwin Gulch.

Water quality treatment is provided by means of an extended detention basin with a water quality outlet structure. The existing detention basin is located adjacent to Baldwin Gulch on the southwest side of the Site. The controlled WQCV, EURV, and 100-year release will outfall to Baldwin Gulch.

## **DESCRIPTION OF PROJECT**

The Project involves the construction of interior streets, vacant lots with native seeding, and utility mains including storm sewer infrastructure intended to convey flows for the phased site development. Modifications to an existing stormwater pond south of the site to current code is also in the scope of the project.

## **DRAINAGE BASINS AND SUB-BASINS**

The Project falls within the limits of the “Parker Auto Plaza Final Drainage Report” (FDR), prepared by Kiowa Engineering Corporation dated July 12, 2004 and included in Appendix F, as part of the Parker Auto Plaza development. The Project will ensure that the requirements of the FDR are met. For a detailed look at the requirements and how they are met, refer to the “Existing Parker Auto Plaza Storm Sewer Requirements” of this report.

The FDR provides design for the overall development of approximately 52.7 acres. The Project includes sub-basins 1A, 2A, 3A and 4A from the FDR which total to 13.95 acres. The drainage map from the Parker Auto Plaza FDR is included in Appendix F. Portions of sub-basins 1C and 5C from the FDR are also included in the Project site as part of detained sub-basins. The Project also captures offsite runoff from approximately 0.33 acres between the property line on the east

side of the Project and the existing sidewalk in the right of way along South Parker Road. Runoff from basins 1A-4A were planned to be conveyed to the detention basin (noted as sub-basin 5A in the FDR) via an underground storm sewer system that has not been implemented. Sub-basins 1C and 5C were planned to flow directly into Baldwin Gulch via grassed swales and a separate storm sewer system. The Project detains runoff from a total of 15.81 acres, which includes the entirety of FDR sub-basins 1A, 2A, 3A and 5A, a majority of FDR sub-basins 4A and 1C, and approximately a third of FDR sub-basin 5C.

### **MAJOR DRAINAGE BASIN DESCRIPTION**

Baldwin Gulch is mapped as a Zone AE, which is defined by FEMA as 'Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods' The existing FEMA Flood Insurance Rate Map (FIRM) is number 08035C0067G, effective date March 16, 2016.

The current FIRM Panel shows no portion of the subject property to be located within the 100-year floodplain; however, Baldwin Gulch is designated as a major drainageway by UDFCD. There are no planned improvements to the existing Baldwin Gulch.

The FIRM panel referenced above is included in Appendix B1. The overall drainage basin is mostly developed. The proposed development is ultimately tributary to Cherry Creek. Drainage facilities are provided to allow drainage into the detention pond on the southwest corner of the Site and ultimately discharging into Baldwin Gulch. The proposed Site consists of twenty-two (22) on-site drainage basins. Twenty (20) drainage basins are conveyed to the detention pond via overland flow or by storm sewer. There are 0.34 acres of off-site runoff included within the twenty (20) on-site basins that drain onsite and are conveyed to the existing detention pond via storm sewer. More specifically, sub-basins 3.0, 5.0, 7.0, 8.0, and 15.0 all account for portions of the off-site runoff totaling to 0.34 acres. Two (2) of the twenty-two (22) onsite drainage basins (sub-basins 19.0 and 20.0) drain overland into Pine Lane and Twenty Mile Road, mimicking conditions which currently exist onsite. One (1) of the twenty-two (22) drainage basins (sub-basin 18.0) drains directly into Baldwin Gulch, mimicking conditions which currently exist onsite. The existing detention pond discharges into Baldwin Gulch.

## **DRAINAGE DESIGN CRITERIA**

### **REGULATIONS**

There are no deviations from the Town of Parker and UDFCD floodplain regulations.

### **COMPLIANCE WITH TOWN'S STREAM PRESERVATION STANDARDS**

There are no existing stream buffers within the Project area. Baldwin Gulch is preserved with no drainage upgrades required to maintain compliance with Town of Parker and UDFCD regulations.

### **DEVELOPMENT DESIGN CRITERIA REFERENCE AND CONSTRAINTS**

The FIRM panel cited in the Major Drainage Basin Description Section shows no portion of the



Site to be located within the 100-year floodplain. The proposed storm facilities are in compliance with the Town of Parker Storm Drainage and Environmental Criteria Manual (the "CRITERIA") and the Urban Storm Drainage Criteria Manual (the "MANUAL"). Site drainage is not significantly impacted by such constraints as utilities or existing development.

The proposed approach includes pipe flow into an existing detention pond. Additional detail regarding onsite drainage patterns is provided in the Drainage Facility Design Section.

## **HYDROLOGIC CRITERIA**

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per Table 2.3 of the CRITERIA. Table 5.1 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table RO-5 of the MANUAL by calculating weighted impervious values for each specific site basin. The detention storage requirement was calculated using the same method and formulae used by Kiowa Engineering Corporation in the Parker Auto Plaza FDR.

An existing orifice plate placed in the first bay of a drop box outlet (Figure 2 of the Parker Auto Plaza FDR, UDFCD, Typical WQCV Outlet Structure Profiles) controls the release rate for the 10-year event. An orifice plate mounted to the second bay wall of the detention basin outlet structure controls the 100-year release rate. The release of flow is limited to 3.6 cubic feet per second (cfs) in the 10-year event and 13.1 cfs in the 100-year event. Flows from this existing detention basin discharge directly into Baldwin Gulch, and limited modifications (replacing existing orifice plate) to the existing outlet structure are being proposed.

## **HYDRAULIC CRITERIA**

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA.

Hydrologic and hydraulic calculations are summarized in Appendix D.

## **DRAINAGE FACILITY DESIGN**

### **GENERAL CONCEPT**

The Project consists of interior streets, vacant lots with native seeding, and utility mains including storm sewer infrastructure intended to convey flows for the phased site development.

The Project provides water quality treatment by means of an existing water quality outlet structure and detention through an existing surface detention pond for the entirety of the site. The detention pond outfalls to Baldwin Gulch. Improvements to the pond will consist of a proposed forebay, trickle channel, and access road.

The Site has been divided into twenty-two (22) sub-basins, sub-basins 1.1 through 20.0, which represent small sub-basins that are tributary to the adjacent right-of-way and Baldwin Gulch which mimics current site conditions. Ultimately the developed runoff is conveyed downstream to the existing detention pond. Further information regarding the basins and drainage patterns

can be found in Appendix C.

### ***SUB-BASIN DESCRIPTION***

Sub-basin 1.1 is 1.43 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter Storm Stub 1.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 4.93 and 10.37 for the 5-year and 100-year storm, respectively. If Storm Stub 1.1 were to plug, the runoff for the basin would flow east onto sub-basin 9.0 and drain into inlet A04.

Sub-basin 1.2 is 1.97 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B01 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 6.77 and 14.25 for the 5-year and 100-year storm, respectively. If inlet B01 were to plug, the runoff for the basin would flow south onto sub-basin 13.0 and drain into inlet B00.

Sub-basin 2.0 is 0.88 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet C00.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.00 and 6.33 for the 5-year and 100-year storm, respectively. If inlet C00.1 were to plug, the runoff for the basin would flow south onto sub-basin 10.0 and drain into inlet C00.

Sub-basin 3.0 is 1.97 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet C01.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 6.80 and 14.29 for the 5-year and 100-year storm, respectively. If inlet C01.1 were to plug, the runoff for the basin would flow south and drain onto sub-basin 11.0 and drain into inlet C01.

Sub-basin 4.1 is 1.14 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B02 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.91 and 8.23 for the 5-year and 100-year storm, respectively. If inlet B02 were to plug, the runoff for the basin would flow south onto sub-basin 16.0 and drain into inlet A01.

Sub-basin 4.2 is 0.77 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter Storm Stub 4.2 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 2.65 and 5.56 for the 5-year and 100-year storm, respectively. If inlet Storm Stub 4.2 were to plug, the runoff for the basin would flow south onto sub-basin 14.0 and drain into inlet B03.

Sub-basin 5.0 is 1.13 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B05.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.89 and 8.18 for the 5-year and 100-year storm, respectively. If inlet B05.1 were to plug, the runoff for the basin would flow south onto sub-basin 15 and drain into inlet B05.

Sub-basin 6.0 is 2.22 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter via a connection to manhole D01 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 7.62 and 16.06 for the 5-year and 100-year storm, respectively. If the connection to manhole D01 were to clog, the runoff for the basin would flow south directly into Baldwin Gulch.

Sub-basin 7.0 is 1.02 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B07.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 3.48 and 7.35 for the 5-year and 100-year storm, respectively. If inlet B07.1 were to plug, the runoff for the basin would flow south onto sub-basin 17 and drain into inlet B08.

Sub-basin 8.0 is 1.94 acres consisting of open lot with assumed imperviousness of 85%. Runoff will enter inlet B08.1 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 6.13 and 12.90 for the 5-year and 100-year storm, respectively. If inlet B08.1 were to plug, the runoff for the basin would flow west onto sub-basin 17 and drain into inlet B08.

Sub-basin 9.0 is 0.10 acres consisting of streets, curb, and gutter. Runoff will enter inlet A04 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.42 and 0.81 for the 5-year and 100-year storm, respectively. If the inlet were to plug, the runoff for the basin would flow south onto sub-basin 12 and drain into inlet A02.

Sub-basin 10.0 is 0.16 acres consisting of streets, curb, and gutter. Runoff will enter inlet C00 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.65 and 1.26 for the 5-year and 100-year storm, respectively. If inlet C00 were to plug, the runoff for the basin would flow west onto sub-basin 12 and drain into inlet A02.

Sub-basin 11.0 is 0.21 acres consisting of streets, curb, and gutter. Runoff will enter inlet C01 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.86 and 1.66 for the 5-year and 100-year storm, respectively. If inlet C01 were to plug, the runoff for the basin would flow west onto sub-basin 10 and drain into inlet C00.

Sub-basin 12.0 is 0.14 acres consisting of streets, curb, and gutter. Runoff will enter inlet A02 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.57 and 1.09 for the 5-year and 100-year storm, respectively. If inlet A02 were to plug, the runoff for the basin would flow south into sub-basin 16.0 and drain into inlet A01.

Sub-basin 13.0 is 0.08 acres consisting of streets, curb, and gutter. Runoff will enter inlet B00 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.32 and 0.62 for the 5-year and 100-year storm, respectively. If inlet B00 were to plug, the runoff for the basin would flow south and west onto sub-basin 19, flowing offsite following its historic path.

Sub-basin 14.0 is 0.17 acres consisting of streets, curb, and gutter. Runoff will enter inlet B03 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.67 and 1.30 for the 5-year and 100-year storm, respectively. If inlet B03 were to plug, the runoff for the basin would flow west onto sub-basin 16.0 and drain into inlet A01.

Sub-basin 15.0 is 0.18 acres consisting of streets, curb, and gutter. Runoff will enter inlet B05 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.72 and 1.40 for the 5-year and 100-year storm, respectively. If inlet B05 were to plug, the runoff for the basin would flow west onto sub-basin 17 and drain into inlet B08.

Sub-basin 16.0 is 0.17 acres consisting of streets, curb, and gutter. Runoff will be conveyed to

inlet A01 and outfall into Pond 1 through future private underground storm sewer. The runoff coefficients for this sub-basin are 0.67 and 1.30 for the 5-year and 100-year storm, respectively. This sub-basin will sheet flow directly into Pond 1.

Sub-basin 17.0 is 0.11 acres consisting of streets, curb, and gutter. Runoff will enter inlet B08 and be conveyed to Pond 1 through a private underground storm sewer. The runoff coefficients for this sub-basin are 0.45 and 0.87 for the 5-year and 100-year storm, respectively.

Sub-basin 18.0 is 0.39 acres consisting of landscaping. Runoff will sheet flow to Baldwin Gulch, following its historic path. The runoff coefficients for this sub-basin are 1.59 and 3.09 for the 5-year and 100-year storm, respectively.

Sub-basin 19.0 is 0.11 acres consisting of streets, curb, and gutter. Runoff will flow onto Twenty Mile Road, following its historic path. The runoff coefficients for this sub-basin are 0.45 and 0.88 for the 5-year and 100-year storm, respectively.

Sub-basin 20.0 is 0.03 acres consisting of streets, curb, and gutter. Runoff will flow onto Pine Lane, following its historic path. The runoff coefficients for this sub-basin are 0.11 and 0.22 for the 5-year and 100-year storm, respectively.

Runoff from the proposed development will generally be collected by means of curb and gutter in the paved driveways and access roads within each delineated basin area. The runoff collected from each basin will be conveyed to the existing detention pond at the southwest corner of the Site. The controlled stormwater release from the detention and water quality structures will be conveyed through the existing outlet structure into Baldwin Gulch.

There are two (2) drainage basins (0.14 acres) of the Project Site that drain off-site, following their historic paths. Sub-basins 19.0 & 20.0 drain into the adjacent right-of way to the North and West. These drainage basins represent the landscape area between the perimeter buildings and the adjacent roadways (Twenty Mile Road to the west and Pine Lane to the north).

## ***DETAINED SUB-BASINS***

### **Sub-Basins 1.1 – 18.0**

Sub-basins 1.1-18.0 are bound between Twenty Mile Road, Pine Lane and Baldwin Gulch. Some sub-basins being detained on-site include a total of 0.34 acres of off-site runoff. Sub-basins 3.0, 5.0, 7.0, 8.0, and 15.0 all account for portions of the off-site runoff being detained on-site. Each sub-basin contains a combination of paved areas, landscaping and streets. Overland flows will be directed to catch basins throughout the site. Curb inlets and grate inlets have been designed to accommodate the 100-yr storm. The landscaping areas overland flow to grate inlets or curb and gutter within each respective sub-basin. Runoff from the sub-basins is conveyed through an underground storm sewer system to the existing detention pond on the southwest corner of the site.

Refer to Table 1 for a summary of areas and post-development flows for the detained sub-basins.

**Table 1. Runoff Summary for All Detained Sub-Basins**

| <b>Runoff Summary</b> |      |                |                  |
|-----------------------|------|----------------|------------------|
| BASIN ID              | AREA | Q <sub>5</sub> | Q <sub>100</sub> |
|                       | Ac   | CFS            | CFS              |
| 1.1                   | 1.43 | 4.93           | 10.37            |
| 1.2                   | 1.97 | 6.77           | 14.25            |
| 2.0                   | 0.88 | 3.00           | 6.33             |
| 3.0                   | 1.97 | 6.80           | 14.29            |
| 4.1                   | 1.14 | 3.91           | 8.23             |
| 4.2                   | 0.77 | 2.65           | 5.56             |
| 5.0                   | 1.13 | 3.89           | 8.18             |
| 6.0                   | 2.22 | 7.62           | 16.06            |
| 7.0                   | 1.02 | 3.48           | 7.35             |
| 8.0                   | 1.94 | 6.13           | 12.90            |
| 9.0                   | 0.10 | 0.42           | 0.81             |
| 10.0                  | 0.16 | 0.65           | 1.26             |
| 11.0                  | 0.21 | 0.86           | 1.66             |
| 12.0                  | 0.14 | 0.57           | 1.09             |
| 13.0                  | 0.08 | 0.32           | 0.62             |
| 14.0                  | 0.17 | 0.67           | 1.30             |
| 15.0                  | 0.18 | 0.72           | 1.40             |
| 16.0                  | 0.17 | 0.67           | 1.30             |
| 17.0                  | 0.11 | 0.45           | 0.87             |
| 18.0                  | 0.39 | 1.59           | 3.09             |

## **UNDETAINED SUB-BASINS**

### **Sub-Basins 19.0, and 20.0**

Sub-basins 19.0, and 20.0 are a total of 0.14 acres in size and are not detained. These sub-basins follow their historic flows onto the public right of way and into Baldwin Gulch.

**Table 2. Runoff Summary for Undetained Sub-Basins**

| <b>Runoff Summary</b> |      |                |                  |
|-----------------------|------|----------------|------------------|
| BASIN ID              | AREA | Q <sub>5</sub> | Q <sub>100</sub> |
|                       | Ac   | CFS            | CFS              |
| 19.0                  | 0.11 | 0.45           | 0.88             |
| 20.0                  | 0.03 | 0.11           | 0.22             |

## ***PARKER AUTO PLAZA FINAL DRAINAGE REPORT COMPLIANCE***

The Parker Auto Plaza Final Drainage Report, dated July 12, 2004 was prepared as part of the Parker Auto Plaza Development by Kiowa Engineering Corporation.

The FDR extended detention basin is sized to store 15.45 acres of a proposed 95% impervious site. The Project extended detention basin will actually detain 15.81 acres of the proposed 85% impervious site.

The existing detention basin was sized based on a required 10-year and 100-year capacity of 2.06 ac-ft and 2.97 ac-ft, respectively. The Project site only requires 1.26 ac-ft and 2.13 ac-ft for the 10-year and 100-year capacities, respectively. The Project's required volumes were calculated to include WQCV capture volume. Based on this approach, the drainage design provided for the Project is in keeping with the Parker Auto Plaza FDR. Appendix D5 shows the calculations for the required 10-year and 100-year storage capacities for proposed development configuration.

## ***FLOODPLAIN DEVELOPMENT PERMIT***

A floodplain development permit from the Town of Parker is not required.

## **ENVIRONMENTAL PROTECTION CRITERIA**

### ***GENERAL***

The Site is influenced by Baldwin Gulch. Baldwin Gulch is in the Town of Parker and Urban Drainage and Flood Control District jurisdictions. No impacts to threatened or endangered species are anticipated as a result of the Project, and the Project is understood to comply with the State and Federal environmental permitting regulations.

### ***CONSTRUCTION BMP PLAN***

Construction BMPs will be used throughout the redevelopment of the Site in order to comply with section 8.2 of the CRITERIA. Construction BMPs implemented onsite include temporary sediment basins, diversion ditches, silt fence and construction fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area. The full list of construction BMPs to be implemented is shown on sheets C3.0- C3.11 of the Project's Civil Construction Documents.

### ***PERMANENT BMP PLAN***

The permanent plan to implement BMPs was designed in accordance with section 8.3 of the CRITERIA. For this Tier 3 redevelopment according to the CRITERIA, the primary permanent BMP that will be implemented is the existing detention pond for the Site drainage. The pond will satisfy the requirements for the permanent BMPs onsite.

## **CONCLUSIONS**

### ***COMPLIANCE WITH STANDARDS***

The drainage design presented within this report conforms to the Town of Parker Storm Drainage and Environmental Criteria Manual. The major drainageway in the area, Baldwin Gulch, will not be adversely affected by the Project, and the Project meets Urban Drainage and Flood Control District requirements.

### ***DRAINAGE CONCEPT***

The drainage design discussed herein effectively controls the storm runoff from the Project by conveying developed runoff to the detention pond at the southwest portion of the Site. The proposed 10-year and 100-year volume requirements fall below the Parker Auto Plaza FDR's 10-year and 100-year volume requirements, to which the existing detention pond was designed. The existing outlet structure and release rates will not be modified as part of the proposed development. The released drainage from the pond is carried through a storm sewer and outfalls into Baldwin Gulch.

### ***SEDIMENT AND EROSION CONTROL CONCEPT***

The Construction BMP plans are designed to prevent erosion within the Site during and after construction. BMPs are in place to prevent erosion during construction including a temporary sediment basin, diversion ditch, silt fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area. The forebay structure will prevent erosion at the bottom of the pond. Furthermore, the proposed concrete trickle channels within the pond will prevent erosion in the permanent condition.

## REFERENCES

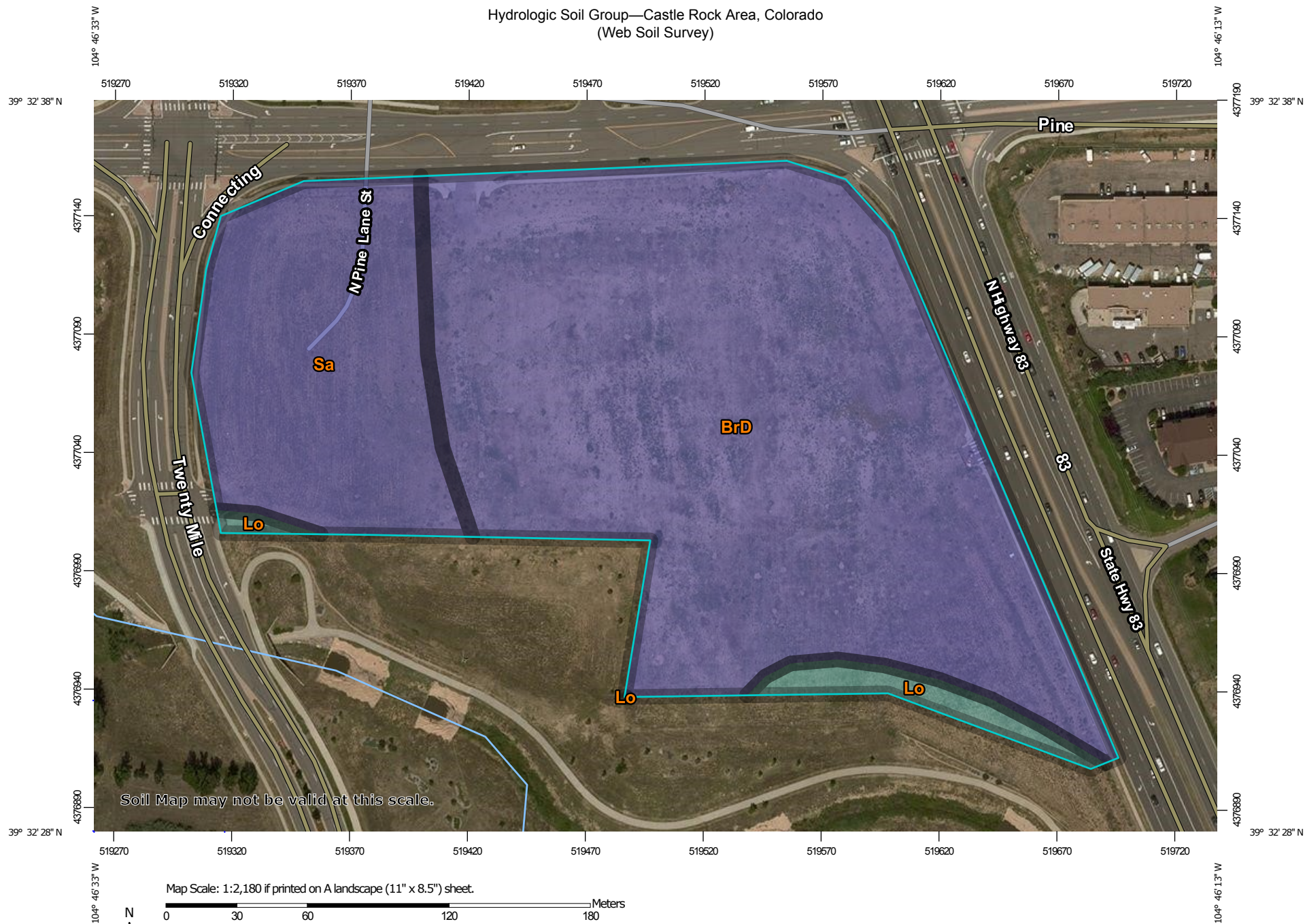
1. Town of Parker Storm Drainage and Environmental Criteria Manual, February 1996, Revised and Adopted February 2014.
2. Urban Drainage and Flood Control District Drainage Criteria Manual (UDFCDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.
3. Flood Insurance Rate Map, Douglas County, Colorado and Incorporated Areas, Map Number 08035C0067G, Revised March 16, 2016, prepared by the Federal Emergency Management Agency (FEMA).
4. Parker Auto Plaza Final Drainage Report, July 12, 2004, prepared by Kiowa Engineering Corporation.



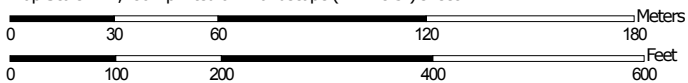
## APPENDIX

***APPENDIX A - HYDROLOGIC SOIL GROUP MAP***

# Hydrologic Soil Group—Castle Rock Area, Colorado (Web Soil Survey)



Map Scale: 1:2,180 if printed on A landscape (11" x 8.5") sheet.



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



**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

7/5/2017  
Page 1 of 4

# Hydrologic Soil Group—Castle Rock Area, Colorado (Web Soil Survey)

## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

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

#### Soil Rating Lines

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

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado  
 Survey Area Data: Version 9, Sep 22, 2016

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

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

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

| Hydrologic Soil Group— Summary by Map Unit — Castle Rock Area, Colorado (CO622) |                                                 |        |              |                |
|---------------------------------------------------------------------------------|-------------------------------------------------|--------|--------------|----------------|
| Map unit symbol                                                                 | Map unit name                                   | Rating | Acres in AOI | Percent of AOI |
| BrD                                                                             | Bresser sandy loam, cool, 5 to 9 percent slopes | B      | 11.2         | 73.8%          |
| Lo                                                                              | Loamy alluvial land                             | C      | 0.5          | 3.3%           |
| Sa                                                                              | Sampson loam                                    | B      | 3.5          | 22.9%          |
| <b>Totals for Area of Interest</b>                                              |                                                 |        | <b>15.2</b>  | <b>100.0%</b>  |

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

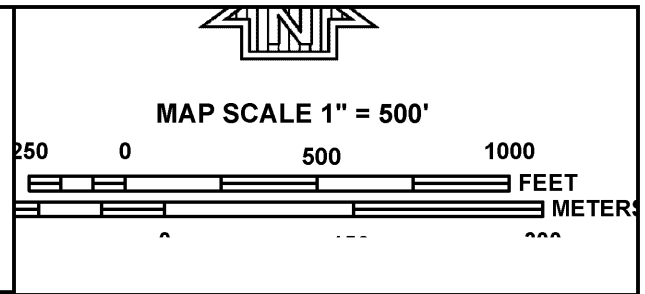
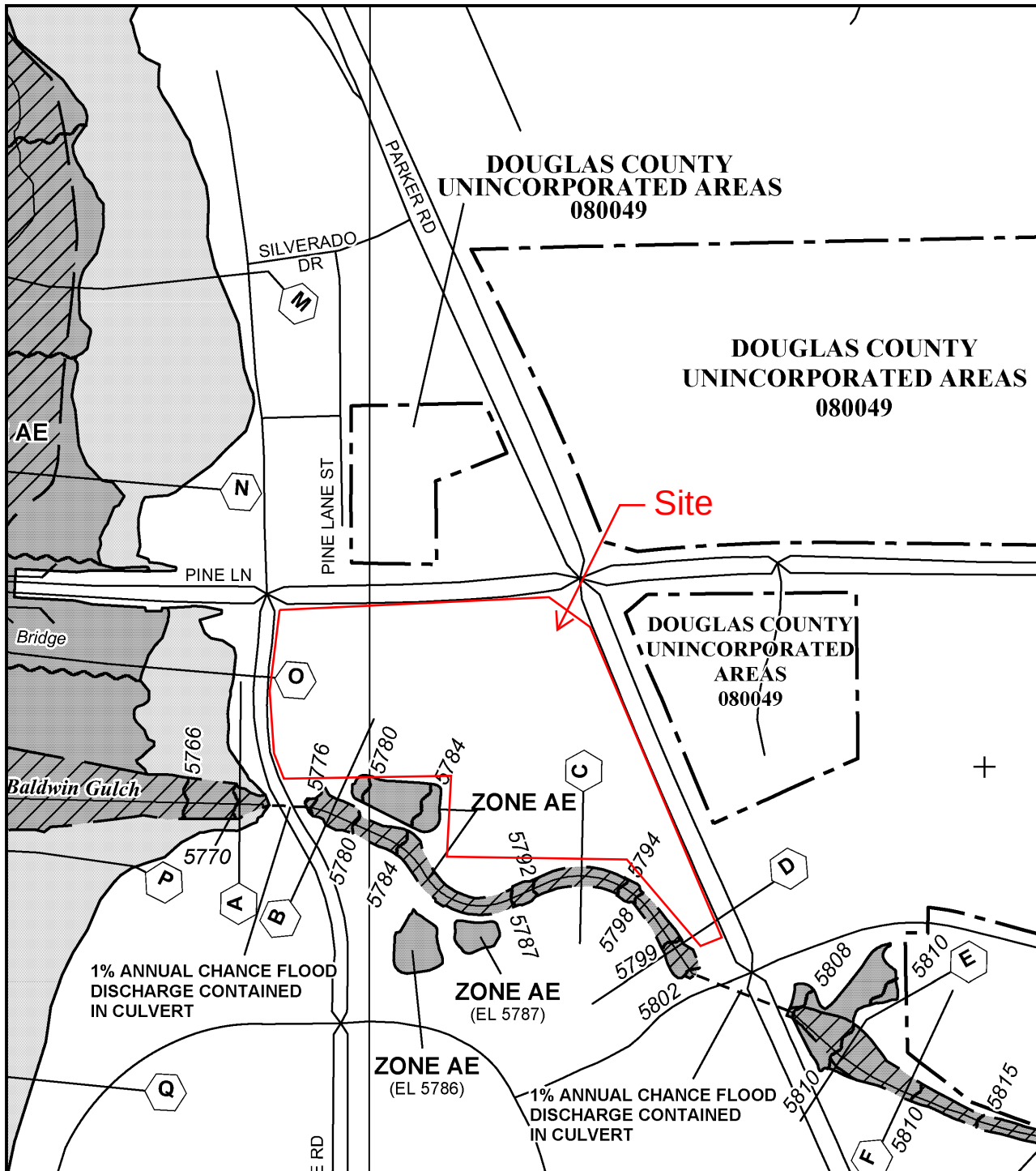
*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

***APPENDIX B1 - FEMA FIRM PANEL***





NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0067G

# FIRM

## FLOOD INSURANCE RATE MAP

### DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

**PANEL 67 OF 495**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY       | NUMBER | PANEL | SUFFIX |
|-----------------|--------|-------|--------|
| DOUGLAS COUNTY  | 080049 | 0067  | G      |
| PARKER, TOWN OF | 080310 | 0067  | G      |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



**MAP NUMBER**  
**08035C0067G**  
**MAP REVISED**  
**MARCH 16, 2016**

Federal Emergency Management Agency

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



***APPENDIX B2 – RAINFALL DATA***

## 5. HYDROLOGIC CRITERIA

### 5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general, hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions is required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (UDFCD) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this manual.

### 5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation—Frequency Atlas of the Western United States, Volume III—Colorado. The design storm events developed and utilized are the same as those used by UDFCD.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where,  $I$  = rainfall intensity (in/hr)  
 $P_1$  = one-hour point rainfall depth (in)  
 $t_c$  = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1 herein. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

**TABLE 5.1**  
**ONE-HOUR POINT RAINFALL**

| <b>Frequency of Design<br/>Event<br/>(yr)</b> | <b>One-hour Point<br/>Rainfall, <math>P_1</math><br/>(in)</b> |
|-----------------------------------------------|---------------------------------------------------------------|
| 2                                             | 0.99                                                          |
| 5                                             | 1.39                                                          |
| 10                                            | 1.64                                                          |
| 25                                            | 1.98                                                          |
| 50                                            | 2.31                                                          |
| 100                                           | 2.60                                                          |

## 5.3 FLOOD HYDROLOGY OVERVIEW

Various methods exist to determine appropriate flood peaks or hydrographs for storm drainage planning and design. Methods for determining flood peaks or hydrographs are the Rational Method, the Colorado Urban Hydrograph Procedure (CUHP), and Urban Drainage Stormwater Management (UDSWM) model. The Town of Parker discourages the use of computer models other than CUHP and UDSWM since these programs are preferred, if not required, by UDFCD for studies involving major drainageways where UDFCD approval is sought or where maintenance eligibility is requested.

The three methods are briefly described in this section, and a discussion of their applicability to the Town of Parker is discussed. UDSWM is mostly used to combine and route the hydrographs generated using CUHP.

In general, the Rational Method is the most widely used and accepted technique for determining peak flows in urban areas for small basins. Within the constraints outlined in the MANUAL, use of the Rational Method provides a relatively simple but effective way to analyze storm runoff.

CUHP is somewhat more complicated than the Rational Method. It allows a manual computation of a runoff hydrograph which may be used for further hydraulic routing through channels and/or detention ponds. Historically, CUHP is best used in urban areas for which runoff coefficients have been derived. However, recent improvements by UDFCD include consideration for different soil types, thus CUHP is now more applicable to rural areas. The reader is referred to UDFCD for the latest version of CUHP.

UDSWM is a computer model that generates runoff hydrographs and routes and combines these hydrographs. UDSWM is a modified version of the Runoff Block of the Environmental Protection Agency's Storm Water Management Model (SWMM). It has been modified to be used in conjunction with CUHP. Table 5.2 herein provides guidance on selecting the appropriate method for a given project.

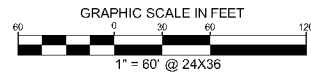
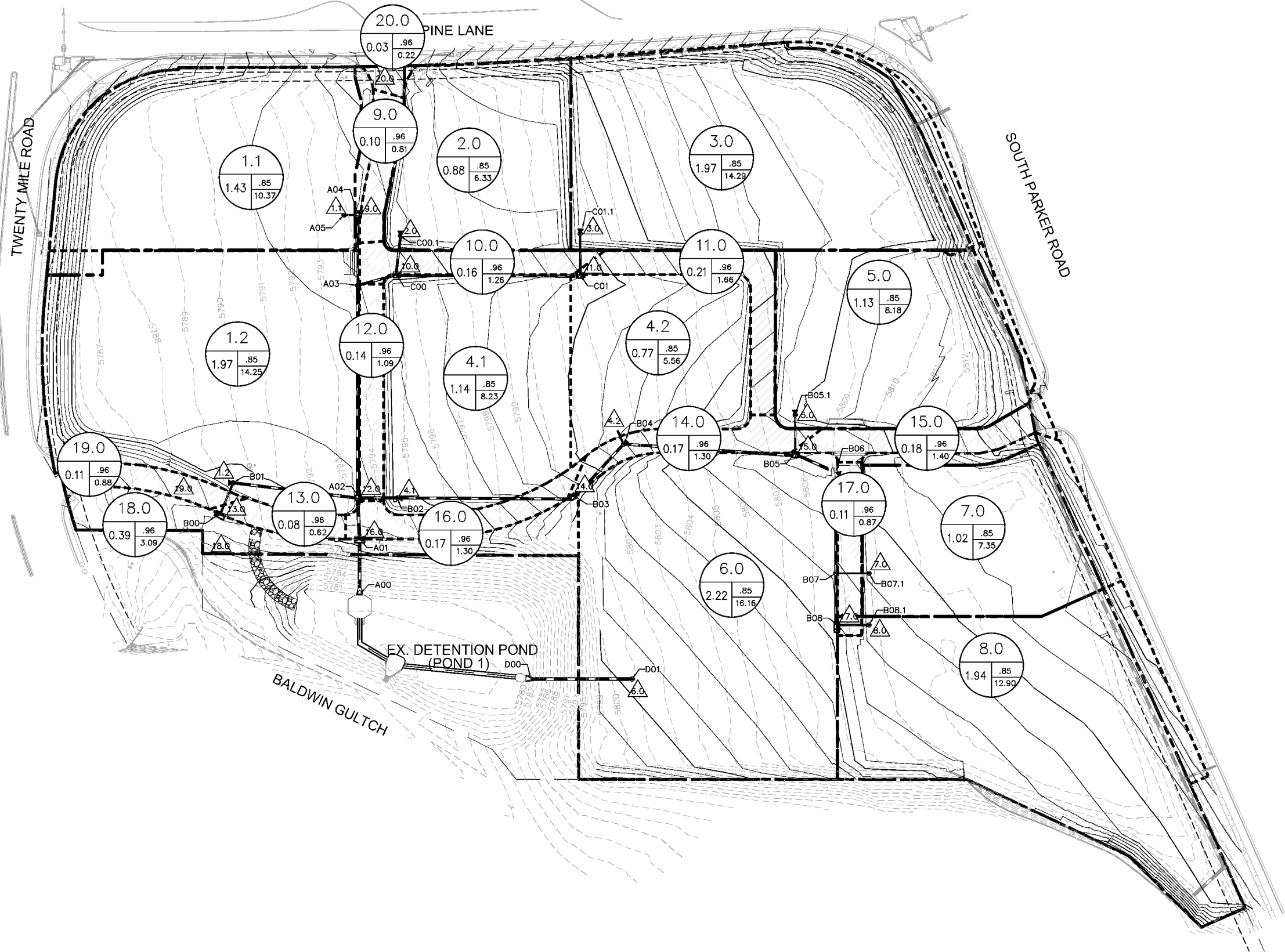
***APPENDIX B3 - C-VALUES***

Table 6-5. Runoff coefficients, *c*

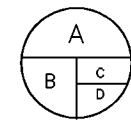
| Total or Effective<br>% Impervious | NRCS Hydrologic Soil Group A |        |         |         |         |          |          |
|------------------------------------|------------------------------|--------|---------|---------|---------|----------|----------|
|                                    | 2-Year                       | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year | 500-Year |
| 2%                                 | 0.01                         | 0.01   | 0.01    | 0.01    | 0.04    | 0.13     | 0.27     |
| 5%                                 | 0.02                         | 0.02   | 0.02    | 0.03    | 0.07    | 0.15     | 0.29     |
| 10%                                | 0.04                         | 0.05   | 0.05    | 0.07    | 0.11    | 0.19     | 0.32     |
| 15%                                | 0.07                         | 0.08   | 0.08    | 0.1     | 0.15    | 0.23     | 0.35     |
| 20%                                | 0.1                          | 0.11   | 0.12    | 0.14    | 0.2     | 0.27     | 0.38     |
| 25%                                | 0.14                         | 0.15   | 0.16    | 0.19    | 0.24    | 0.3      | 0.42     |
| 30%                                | 0.18                         | 0.19   | 0.2     | 0.23    | 0.28    | 0.34     | 0.45     |
| 35%                                | 0.21                         | 0.23   | 0.24    | 0.27    | 0.32    | 0.38     | 0.48     |
| 40%                                | 0.25                         | 0.27   | 0.28    | 0.32    | 0.37    | 0.42     | 0.51     |
| 45%                                | 0.3                          | 0.31   | 0.33    | 0.36    | 0.41    | 0.46     | 0.54     |
| 50%                                | 0.34                         | 0.36   | 0.37    | 0.41    | 0.45    | 0.5      | 0.58     |
| 55%                                | 0.39                         | 0.4    | 0.42    | 0.45    | 0.49    | 0.54     | 0.61     |
| 60%                                | 0.43                         | 0.45   | 0.47    | 0.5     | 0.54    | 0.58     | 0.64     |
| 65%                                | 0.48                         | 0.5    | 0.51    | 0.54    | 0.58    | 0.62     | 0.67     |
| 70%                                | 0.53                         | 0.55   | 0.56    | 0.59    | 0.62    | 0.65     | 0.71     |
| 75%                                | 0.58                         | 0.6    | 0.61    | 0.64    | 0.66    | 0.69     | 0.74     |
| 80%                                | 0.63                         | 0.65   | 0.66    | 0.69    | 0.71    | 0.73     | 0.77     |
| 85%                                | 0.68                         | 0.7    | 0.71    | 0.74    | 0.75    | 0.77     | 0.8      |
| 90%                                | 0.73                         | 0.75   | 0.77    | 0.79    | 0.79    | 0.81     | 0.84     |
| 95%                                | 0.79                         | 0.81   | 0.82    | 0.83    | 0.84    | 0.85     | 0.87     |
| 100%                               | 0.84                         | 0.86   | 0.87    | 0.88    | 0.88    | 0.89     | 0.9      |
| Total or Effective<br>% Impervious | NRCS Hydrologic Soil Group B |        |         |         |         |          |          |
|                                    | 2-Year                       | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year | 500-Year |
| 2%                                 | 0.01                         | 0.01   | 0.07    | 0.26    | 0.34    | 0.44     | 0.54     |
| 5%                                 | 0.03                         | 0.03   | 0.1     | 0.28    | 0.36    | 0.45     | 0.55     |
| 10%                                | 0.06                         | 0.07   | 0.14    | 0.31    | 0.38    | 0.47     | 0.57     |
| 15%                                | 0.09                         | 0.11   | 0.18    | 0.34    | 0.41    | 0.5      | 0.59     |
| 20%                                | 0.13                         | 0.15   | 0.22    | 0.38    | 0.44    | 0.52     | 0.61     |
| 25%                                | 0.17                         | 0.19   | 0.26    | 0.41    | 0.47    | 0.54     | 0.63     |
| 30%                                | 0.2                          | 0.23   | 0.3     | 0.44    | 0.49    | 0.57     | 0.65     |
| 35%                                | 0.24                         | 0.27   | 0.34    | 0.47    | 0.52    | 0.59     | 0.66     |
| 40%                                | 0.29                         | 0.32   | 0.38    | 0.5     | 0.55    | 0.61     | 0.68     |
| 45%                                | 0.33                         | 0.36   | 0.42    | 0.53    | 0.58    | 0.64     | 0.7      |
| 50%                                | 0.37                         | 0.4    | 0.46    | 0.56    | 0.61    | 0.66     | 0.72     |
| 55%                                | 0.42                         | 0.45   | 0.5     | 0.6     | 0.63    | 0.68     | 0.74     |
| 60%                                | 0.46                         | 0.49   | 0.54    | 0.63    | 0.66    | 0.71     | 0.76     |
| 65%                                | 0.5                          | 0.54   | 0.58    | 0.66    | 0.69    | 0.73     | 0.77     |
| 70%                                | 0.55                         | 0.58   | 0.62    | 0.69    | 0.72    | 0.75     | 0.79     |
| 75%                                | 0.6                          | 0.63   | 0.66    | 0.72    | 0.75    | 0.78     | 0.81     |
| 80%                                | 0.64                         | 0.67   | 0.7     | 0.75    | 0.77    | 0.8      | 0.83     |
| 85%                                | 0.69                         | 0.72   | 0.74    | 0.78    | 0.8     | 0.82     | 0.85     |
| 90%                                | 0.74                         | 0.76   | 0.78    | 0.81    | 0.83    | 0.84     | 0.87     |
| 95%                                | 0.79                         | 0.81   | 0.82    | 0.85    | 0.86    | 0.87     | 0.88     |
| 100%                               | 0.84                         | 0.86   | 0.86    | 0.88    | 0.89    | 0.89     | 0.9      |

***APPENDIX C - OVERALL DRAINAGE MAP***

K:\DEN\_Civil\096502001 - Mixed Use Parker Rd\CAAD\PlanSheets\096502001DRM.dwg Zentallis: Even 10/8/2019 10:57 AM  
THIS DOCUMENT, TOGETHER WITH THE COMMENTS AND REVISIONS, IS A PRELIMINARY DESIGN AND NOT FOR CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE USER TO VERIFY THE ACCURACY OF THE INFORMATION AND ASSOCIATES, INC. SHALL BE WITHOUT LIABILITY TO KIMLEY-HORN AND ASSOCIATES, INC.



### LEGEND



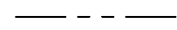
A = BASIN DESIGNATION  
B = AREA (ACRES)  
C = BASIN IMPERVIOUSNESS  
D = 100YR DESIGN STORM RUNOFF (CFS)



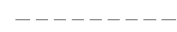
FLOW DIRECTION



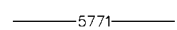
DRAINAGE BASIN BOUNDARY



EXISTING PROPERTY LINE



EXISTING CONTOUR



PROPOSED CONTOUR



EXISTING STORM SEWER



PROPOSED STORM SEWER



PROPOSED STORM INLET

**Kimley»Horn**

DESIGNED BY: DLS  
DRAWN BY: ECZ  
CHECKED BY: DLS  
DATE: 11/11/19

PARKER & PINE  
PARKER, CO  
CONSTRUCTION DOCUMENTS  
PRELIMINARY DRAINAGE AREA MAP

PRELIMINARY  
FOR REVIEW ONLY  
NOT FOR  
CONSTRUCTION  
**Kimley»Horn**  
Kimley-Horn and Associates, Inc.

PROJECT NO.  
096502001

DRAWING NAME  
096502001DRM

DRAINAGE



Know what's below.  
Call before you dig.

MAINTENANCE ROAD. REFER TO DETAIL THIS SHEET

PROPOSED FOREBAY, REFER TO SHEET C6.4

PROPOSED MICROPOOL.  
TOP: 5778.30  
BOTTOM: 5775.47  
AREA: 379 SF

TRICKLE CHANNEL, REFER TO SHEET C6.4

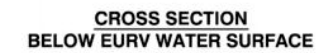
PROPOSED FOREBAY, REFER TO SHEET C6.4

EXISTING OUTLET STRUCTURE TO BE MODIFIED, REFER TO SHEET C6.4

EXISTING EMERGENCY SPILLWAY TO BE MODIFIED  
WIDTH TO REMAIN: 25.6'  
TOP TO REMAIN: 5784.6  
BOTTOM TO BE REVISED: RAISE 0.2' TO 5784.2

GRAPHIC SCALE IN FEET  
0 10 20

NORTH



MAINTENANCE ROAD DETAILS  
N.T.S.

[illegible]

# Kimley»»Horn

2020 KIMLEY-HORN AND ASSOCIATES, INC.  
4582 South Ulster Street, Suite 1500  
Denver, Colorado 80237 (303) 228-2300

DESIGNED BY: DLS  
DRAWN BY: JRK  
CHECKED BY: DLS  
DATE: 04/24/20

PARKER AND PINE FILING 1

PARKER, CO

## CONSTRUCTION DOCUMENTS

## **POND PLANS AND PROFILE**

**PRELIMINARY**  
**FOR REVIEW ONLY**  
**NOT FOR**  
**CONSTRUCTION**  
**Kimley**  **Horn**  
Kimley-Horn and Associates, Inc.

PROJECT NO.  
096502001

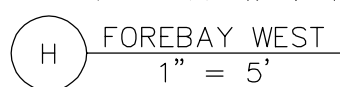
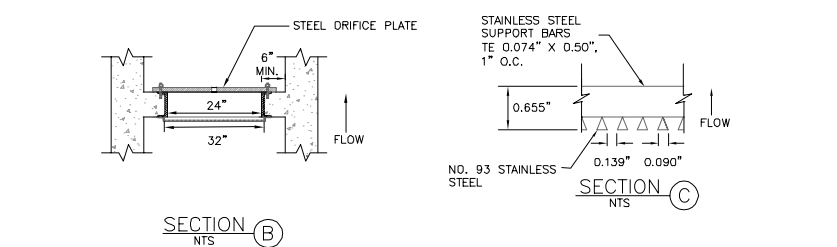
DRAWING NAME  
096502001ST\_DET

C6.3





ON BY KIMLEY-HORN AND ASSOCIATES, INC. SHALL BE WITHOUT LIABILITY TO KIMLEY-HORN AND ASSOCIATES, INC.



3" (TYP.)

8"

H

(4) #4 REBAR  
CONTINUOUS  
SPACED 9" O.C.

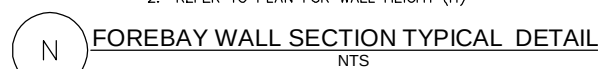
6"

18"

#4 REBAR  
SPACED 12" O.C.

NOTE:

1. REBAR REINFORCEMENT IS ONLY REQUIRED FOR FOREBAYS WITH WALL HEIGHTS GREATER THAN 8"
2. REFER TO PLAN FOR WALL HEIGHT (H)



ORIFICE PLATE NOTES:

1. PROVIDE CONTINUOUS NEOPRENE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND THE CONCRETE.
2. BOLT PLATE TO CONCRETE 12" MAX ON CENTER.

EURV AND WQCV TRASH RACKS

1. WELL--SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
2. BAR GATE TRASH RACKS SHALL BE ALUMINUM AND SHALL BE BOLTED USING STAINLESS STEEL HARDWARE.
3. TRASH RACKS OPEN AREA SHALL BE SPECIFIED FOR SPECIFIED TRASH RACK MATERIALS. TOTAL TRASH RACK SIZE MAY NEED TO BE ADJUSTED FOR MATERIALS HAVING DIFFERENT OPEN AREA/GROSS AREA RATIO.
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.



DESIGNED BY: DLS  
DRAWN BY: JRK  
CHECKED BY: DLS  
DATE: 04/24/20

PARKER AND PINE FILING 1  
PARKER, CO  
CONSTRUCTION DOCUMENTS  
POND DETAILS

**PRELIMINARY**  
**FOR REVIEW ONLY**  
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**CONSTRUCTION**  
**Kimley-Horn**  
Kimley-Horn and Associates, Inc.

PROJECT NO.

DRAWING NAME  
096502001ST\_DET

C6.4

***APPENDIX D - RATIONAL METHOD CALCULATIONS, INLET CALCULATIONS***

## Rainfall Intensity

### IDF - Intensity, Duration, Frequency Data

| Time Intensity Frequency Tabulation |      |      |       |        |
|-------------------------------------|------|------|-------|--------|
| TIME                                | 2 YR | 5 YR | 10 YR | 100 YR |
| 5                                   | 3.36 | 4.71 | 5.56  | 8.82   |
| 6                                   | 3.19 | 4.48 | 5.29  | 8.38   |
| 7                                   | 3.04 | 4.27 | 5.04  | 7.99   |
| 8                                   | 2.91 | 4.09 | 4.82  | 7.64   |
| 9                                   | 2.79 | 3.92 | 4.62  | 7.32   |
| 10                                  | 2.68 | 3.76 | 4.44  | 7.03   |
| 11                                  | 2.58 | 3.62 | 4.27  | 6.77   |
| 12                                  | 2.49 | 3.49 | 4.12  | 6.53   |
| 13                                  | 2.40 | 3.37 | 3.98  | 6.30   |
| 14                                  | 2.32 | 3.26 | 3.84  | 6.09   |
| 15                                  | 2.25 | 3.16 | 3.72  | 5.90   |
| 16                                  | 2.18 | 3.06 | 3.61  | 5.72   |
| 17                                  | 2.12 | 2.97 | 3.50  | 5.56   |
| 18                                  | 2.06 | 2.89 | 3.41  | 5.40   |
| 19                                  | 2.00 | 2.81 | 3.31  | 5.25   |
| 20                                  | 1.95 | 2.73 | 3.23  | 5.11   |
| 21                                  | 1.90 | 2.66 | 3.14  | 4.98   |
| 22                                  | 1.85 | 2.60 | 3.07  | 4.86   |
| 23                                  | 1.81 | 2.54 | 2.99  | 4.75   |
| 24                                  | 1.76 | 2.48 | 2.92  | 4.64   |
| 25                                  | 1.73 | 2.42 | 2.86  | 4.53   |
| 26                                  | 1.69 | 2.37 | 2.80  | 4.43   |
| 27                                  | 1.65 | 2.32 | 2.74  | 4.34   |
| 28                                  | 1.62 | 2.27 | 2.68  | 4.25   |
| 29                                  | 1.58 | 2.22 | 2.62  | 4.16   |
| 30                                  | 1.55 | 2.18 | 2.57  | 4.08   |
| 31                                  | 1.52 | 2.14 | 2.52  | 4.00   |
| 32                                  | 1.49 | 2.10 | 2.48  | 3.93   |
| 33                                  | 1.47 | 2.06 | 2.43  | 3.85   |
| 34                                  | 1.44 | 2.02 | 2.39  | 3.78   |
| 35                                  | 1.42 | 1.99 | 2.35  | 3.72   |
| 36                                  | 1.39 | 1.95 | 2.31  | 3.66   |
| 37                                  | 1.37 | 1.92 | 2.27  | 3.59   |
| 38                                  | 1.35 | 1.89 | 2.23  | 3.53   |
| 39                                  | 1.32 | 1.86 | 2.19  | 3.48   |
| 40                                  | 1.30 | 1.83 | 2.16  | 3.42   |
| 41                                  | 1.28 | 1.80 | 2.13  | 3.37   |
| 42                                  | 1.26 | 1.77 | 2.09  | 3.32   |
| 43                                  | 1.25 | 1.75 | 2.06  | 3.27   |
| 44                                  | 1.23 | 1.72 | 2.03  | 3.22   |
| 45                                  | 1.21 | 1.70 | 2.00  | 3.18   |
| 46                                  | 1.19 | 1.67 | 1.98  | 3.13   |
| 47                                  | 1.18 | 1.65 | 1.95  | 3.09   |
| 48                                  | 1.16 | 1.63 | 1.92  | 3.05   |
| 49                                  | 1.14 | 1.61 | 1.90  | 3.01   |
| 50                                  | 1.13 | 1.59 | 1.87  | 2.97   |
| 51                                  | 1.11 | 1.57 | 1.85  | 2.93   |
| 52                                  | 1.10 | 1.55 | 1.82  | 2.89   |
| 53                                  | 1.09 | 1.53 | 1.80  | 2.85   |
| 54                                  | 1.07 | 1.51 | 1.78  | 2.82   |
| 55                                  | 1.06 | 1.49 | 1.76  | 2.79   |
| 56                                  | 1.05 | 1.47 | 1.74  | 2.75   |
| 57                                  | 1.04 | 1.45 | 1.72  | 2.72   |
| 58                                  | 1.02 | 1.44 | 1.70  | 2.69   |
| 59                                  | 1.01 | 1.42 | 1.68  | 2.66   |
| 60                                  | 1.00 | 1.40 | 1.66  | 2.63   |

**Note:**

Intensity values utilized as published within the Town of Parker  
Storm Drainage Criteria Manual, Table 5.1

Time Intensity Frequency Tabulation

| TIME | 2 YR | 5 YR | 10 YR | 100 YR |
|------|------|------|-------|--------|
| 5    | 3.36 | 4.71 | 5.56  | 8.82   |
| 6    | 3.19 | 4.48 | 5.29  | 8.38   |
| 7    | 3.04 | 4.27 | 5.04  | 7.99   |
| 8    | 2.91 | 4.09 | 4.82  | 7.64   |
| 9    | 2.79 | 3.92 | 4.62  | 7.32   |
| 10   | 2.68 | 3.76 | 4.44  | 7.03   |
| 11   | 2.58 | 3.62 | 4.27  | 6.77   |
| 12   | 2.49 | 3.49 | 4.12  | 6.53   |
| 13   | 2.40 | 3.37 | 3.98  | 6.30   |
| 14   | 2.32 | 3.26 | 3.84  | 6.09   |
| 15   | 2.25 | 3.16 | 3.72  | 5.90   |
| 16   | 2.18 | 3.06 | 3.61  | 5.72   |
| 17   | 2.12 | 2.97 | 3.50  | 5.56   |
| 18   | 2.06 | 2.89 | 3.41  | 5.40   |
| 19   | 2.00 | 2.81 | 3.31  | 5.25   |
| 20   | 1.95 | 2.73 | 3.23  | 5.11   |
| 21   | 1.90 | 2.66 | 3.14  | 4.98   |
| 22   | 1.85 | 2.60 | 3.07  | 4.86   |
| 23   | 1.81 | 2.54 | 2.99  | 4.75   |
| 24   | 1.76 | 2.48 | 2.92  | 4.64   |
| 25   | 1.73 | 2.42 | 2.86  | 4.53   |
| 26   | 1.69 | 2.37 | 2.80  | 4.43   |
| 27   | 1.65 | 2.32 | 2.74  | 4.34   |
| 28   | 1.62 | 2.27 | 2.68  | 4.25   |
| 29   | 1.58 | 2.22 | 2.62  | 4.16   |
| 30   | 1.55 | 2.18 | 2.57  | 4.08   |
| 31   | 1.52 | 2.14 | 2.52  | 4.00   |
| 32   | 1.49 | 2.10 | 2.48  | 3.93   |
| 33   | 1.47 | 2.06 | 2.43  | 3.85   |
| 34   | 1.44 | 2.02 | 2.39  | 3.78   |
| 35   | 1.42 | 1.99 | 2.35  | 3.72   |
| 36   | 1.39 | 1.95 | 2.31  | 3.66   |
| 37   | 1.37 | 1.92 | 2.27  | 3.59   |
| 38   | 1.35 | 1.89 | 2.23  | 3.53   |
| 39   | 1.32 | 1.86 | 2.19  | 3.48   |
| 40   | 1.30 | 1.83 | 2.16  | 3.42   |
| 41   | 1.28 | 1.80 | 2.13  | 3.37   |
| 42   | 1.26 | 1.77 | 2.09  | 3.32   |
| 43   | 1.25 | 1.75 | 2.06  | 3.27   |
| 44   | 1.23 | 1.72 | 2.03  | 3.22   |
| 45   | 1.21 | 1.70 | 2.00  | 3.18   |
| 46   | 1.19 | 1.67 | 1.98  | 3.13   |
| 47   | 1.18 | 1.65 | 1.95  | 3.09   |
| 48   | 1.16 | 1.63 | 1.92  | 3.05   |
| 49   | 1.14 | 1.61 | 1.90  | 3.01   |
| 50   | 1.13 | 1.59 | 1.87  | 2.97   |
| 51   | 1.11 | 1.57 | 1.85  | 2.93   |
| 52   | 1.10 | 1.55 | 1.82  | 2.89   |
| 53   | 1.09 | 1.53 | 1.80  | 2.85   |
| 54   | 1.07 | 1.51 | 1.78  | 2.82   |
| 55   | 1.06 | 1.49 | 1.76  | 2.79   |
| 56   | 1.05 | 1.47 | 1.74  | 2.75   |
| 57   | 1.04 | 1.45 | 1.72  | 2.72   |
| 58   | 1.02 | 1.44 | 1.70  | 2.69   |
| 59   | 1.01 | 1.42 | 1.68  | 2.66   |
| 60   | 1.00 | 1.40 | 1.66  | 2.63   |

## BASIN IMPERVIOUSNESS AND RUNOFF COEFFICIENT

| Landuse                  | I    | C <sub>2</sub> | C <sub>5</sub> | C <sub>10</sub> | C <sub>100</sub> |
|--------------------------|------|----------------|----------------|-----------------|------------------|
| Landscape                | 2%   | 0.01           | 0.01           | 0.07            | 0.44             |
| Roof                     | 90%  | 0.74           | 0.76           | 0.78            | 0.84             |
| Streets/Drives and Walks | 100% | 0.84           | 0.86           | 0.86            | 0.89             |

## All Basins

| Basin Designation | A <sub>TOTAL</sub> (AC) | A <sub>TOTAL</sub> (SF) | A <sub>LANDSCAPE</sub> (SF) | A <sub>ROOF</sub> (SF) | A <sub>STREETS/DRIVES &amp; WALKS</sub> (SF) | I <sub>WEIGHTED</sub> | C <sub>2</sub> | C <sub>5</sub> | C <sub>100</sub> | SIGN POI | INLET |
|-------------------|-------------------------|-------------------------|-----------------------------|------------------------|----------------------------------------------|-----------------------|----------------|----------------|------------------|----------|-------|
| 1.1               | 1.43                    | 62,381                  | 9,500                       | 0                      | 52,881                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 1.2               | 1.97                    | 85,635                  | 13,000                      | 0                      | 72,635                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 2.0               | 0.88                    | 38,143                  | 6,000                       | 0                      | 32,143                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 3.0               | 1.97                    | 85,881                  | 13,000                      | 0                      | 72,881                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 4.1               | 1.14                    | 49,452                  | 7,500                       | 0                      | 41,952                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 4.2               | 0.77                    | 33,396                  | 5,000                       | 0                      | 28,396                                       | 85%                   | 0.72           | 0.73           | 0.82             |          |       |
| 5.0               | 1.13                    | 49,201                  | 7,500                       | 0                      | 41,701                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 6.0               | 2.22                    | 96,743                  | 15,000                      | 0                      | 81,743                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 7.0               | 1.02                    | 44,356                  | 7,000                       | 0                      | 37,356                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 8.0               | 1.94                    | 84,345                  | 13,000                      | 0                      | 71,345                                       | 85%                   | 0.71           | 0.73           | 0.82             |          |       |
| 9.0               | 0.10                    | 4,470                   | 0                           | 0                      | 4,470                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 10.0              | 0.16                    | 6,975                   | 0                           | 0                      | 6,975                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 11.0              | 0.21                    | 9,219                   | 0                           | 0                      | 9,219                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 12.0              | 0.14                    | 6,073                   | 0                           | 0                      | 6,073                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 13.0              | 0.08                    | 3,465                   | 0                           | 0                      | 3,465                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 14.0              | 0.17                    | 7,207                   | 0                           | 0                      | 7,207                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 15.0              | 0.18                    | 7,746                   | 0                           | 0                      | 7,746                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 16.0              | 0.17                    | 7,231                   | 0                           | 0                      | 7,231                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 17.0              | 0.11                    | 4,854                   | 0                           | 0                      | 4,854                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 18.0              | 0.39                    | 17,130                  | 0                           | 0                      | 17,130                                       | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 19.0              | 0.11                    | 4,871                   | 0                           | 0                      | 4,871                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
| 20.0              | 0.03                    | 1,228                   | 0                           | 0                      | 1,228                                        | 100%                  | 0.84           | 0.86           | 0.89             |          |       |
|                   | 16.30                   | 710,001                 | 96,500                      | -                      | 613,501                                      | 87%                   | 0.73           | 0.74           | 0.83             |          |       |

## Detained Basins

| Basin Designation | A <sub>TOTAL</sub> (AC) | A <sub>TOTAL</sub> (SF) | A <sub>LANDSCAPE</sub> (SF) | A <sub>ROOF</sub> (SF) | A <sub>DRIVES &amp; WALKS</sub> (SF) | I <sub>WEIGHTED</sub> | C <sub>2</sub> | C <sub>5</sub> | C <sub>100</sub> |
|-------------------|-------------------------|-------------------------|-----------------------------|------------------------|--------------------------------------|-----------------------|----------------|----------------|------------------|
| 1                 | 1.43                    | 62,381                  | 9,500                       | 0                      | 52,881                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 2                 | 1.97                    | 85,635                  | 13,000                      | 0                      | 72,635                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 3                 | 0.88                    | 38,143                  | 6,000                       | 0                      | 32,143                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 4                 | 1.97                    | 85,881                  | 13,000                      | 0                      | 72,881                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 5                 | 1.14                    | 49,452                  | 7,500                       | 0                      | 41,952                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 6                 | 0.77                    | 33,396                  | 5,000                       | 0                      | 28,396                               | 85%                   | 0.72           | 0.73           | 0.82             |
| 7                 | 1.13                    | 49,201                  | 7,500                       | 0                      | 41,701                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 8                 | 2.22                    | 96,743                  | 15,000                      | 0                      | 81,743                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 9                 | 1.02                    | 44,356                  | 7,000                       | 0                      | 37,356                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 10                | 1.94                    | 84,345                  | 13,000                      | 0                      | 71,345                               | 85%                   | 0.71           | 0.73           | 0.82             |
| 11                | 0.10                    | 4,470                   | 0                           | 0                      | 4,470                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 12                | 0.16                    | 6,975                   | 0                           | 0                      | 6,975                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 13                | 0.21                    | 9,219                   | 0                           | 0                      | 9,219                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 14                | 0.14                    | 6,073                   | 0                           | 0                      | 6,073                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 15                | 0.08                    | 3,465                   | 0                           | 0                      | 3,465                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 16                | 0.17                    | 7,207                   | 0                           | 0                      | 7,207                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 17                | 0.18                    | 7,746                   | 0                           | 0                      | 7,746                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 18                | 0.39                    | 17,130                  | 0                           | 0                      | 17,130                               | 100%                  | 0.84           | 0.86           | 0.89             |
|                   | 15.88                   | 691,818                 | 96,500                      | -                      | 595,318                              | 86%                   | 0.72           | 0.74           | 0.83             |

## Undetained Basins

| Basin Designation | A <sub>TOTAL</sub> (AC) | A <sub>TOTAL</sub> (SF) | A <sub>LANDSCAPE</sub> (SF) | A <sub>ROOF</sub> (SF) | A <sub>DRIVES &amp; WALKS</sub> (SF) | I <sub>WEIGHTED</sub> | C <sub>2</sub> | C <sub>5</sub> | C <sub>100</sub> |
|-------------------|-------------------------|-------------------------|-----------------------------|------------------------|--------------------------------------|-----------------------|----------------|----------------|------------------|
| 19                | 0.11                    | 4,871                   | 0                           | 0                      | 4,871                                | 100%                  | 0.84           | 0.86           | 0.89             |
| 20                | 0.03                    | 1,228                   | 0                           | 0                      | 1,228                                | 100%                  | 0.84           | 0.86           | 0.89             |
|                   | 0.14                    | 6,099                   | -                           | -                      | 6,099                                | 100%                  | 0.84           | 0.86           | 0.89             |

## Time of Concentration

| DESIGN POINT | SUB-BASIN DATA |         |         |                |      |      | INITIAL / OVERLAND TIME T(i) |         |          | TRAVEL TIME T(t) |         |             |              |          | T(c) CHECK (URBANIZED BASINS) |              |          | FINAL T(c) (MIN) |
|--------------|----------------|---------|---------|----------------|------|------|------------------------------|---------|----------|------------------|---------|-------------|--------------|----------|-------------------------------|--------------|----------|------------------|
|              | DRAIN BASIN    | AREA SF | AREA AC | NRCS Soil Type | I %  | C(5) | Length FT                    | Slope % | T(i) MIN | Length FT        | Slope % | Coefficient | Velocity FPS | T(t) MIN | T(c) (MIN)                    | TOTAL LENGTH | L/180+10 |                  |
| 1.1          | 1.1            | 62,381  | 1.43    | B              | 85%  | 0.73 | 45                           | 2.0%    | 3.6      | -                | -       | 20          | 0.0          | 0.0      | 5.0                           | 45           | 10.3     | 5.0              |
| 1.2          | 1.2            | 85,635  | 1.97    | B              | 85%  | 0.73 | 41                           | 21.0%   | 1.6      | 450              | 3.1%    | 15          | 2.6          | 2.8      | 5.0                           | 491          | 12.7     | 5.0              |
| 2.0          | 2.0            | 38,143  | 0.88    | B              | 85%  | 0.73 | 40                           | 5.6%    | 2.4      | 60               | 3.3%    | 20          | 3.6          | 0.3      | 5.0                           | 100          | 10.6     | 5.0              |
| 3.0          | 3.0            | 85,881  | 1.97    | B              | 85%  | 0.73 | 69                           | 4.3%    | 3.5      | 97               | 1.3%    | 20          | 2.2          | 0.7      | 5.0                           | 166          | 10.9     | 5.0              |
| 4.1          | 4.1            | 49,452  | 1.14    | B              | 85%  | 0.73 | 170                          | 7.0%    | 4.6      | 50               | 2.7%    | 20          | 3.3          | 0.3      | 5.0                           | 220          | 11.2     | 5.0              |
| 4.2          | 4.2            | 33,396  | 0.77    | B              | 85%  | 0.73 | 93                           | 9.2%    | 3.1      | 163              | 3.7%    | 20          | 3.8          | 0.7      | 5.0                           | 256          | 11.4     | 5.0              |
| 5.0          | 5.0            | 49,201  | 1.13    | B              | 85%  | 0.73 | 0                            | 0.0%    |          | 230              | 1.0%    | 21          | 2.1          | 1.8      | 5.0                           | 230          | 11.3     | 5.0              |
| 6.0          | 6.0            | 96,743  | 2.22    | B              | 85%  | 0.73 | 50                           | 2.0%    | 3.8      | 150              | 3.0%    | 20          | 3.5          | 0.7      | 5.0                           | 200          | 11.1     | 5.0              |
| 7.0          | 7.0            | 44,356  | 1.02    | B              | 85%  | 0.73 | 35                           | 1.5%    | 3.5      | 105              | 2.0%    | 20          | 2.8          | 0.6      | 5.0                           | 140          | 10.8     | 5.0              |
| 8.0          | 8.0            | 84,345  | 1.94    | B              | 85%  | 0.73 | 100                          | 1.0%    | 6.8      | 10               | 15.0%   | 20          | 7.7          | 0.0      | 6.8                           | 110          | 10.6     | 6.8              |
| 9.0          | 9.0            | 4,470   | 0.10    | B              | 100% | 0.86 | 101                          | 101.0%  | 0.9      | 11               | 115.0%  | 21          | 22.5         | 0.0      | 5.0                           | 112          | 10.6     | 5.0              |
| 10.0         | 10.0           | 6,975   | 0.16    | B              | 100% | 0.86 | 75                           | 5.0%    | 2.2      | 130              | 2.5%    | 20          | 3.2          | 0.7      | 5.0                           | 205          | 11.1     | 5.0              |
| 11.0         | 11.0           | 9,219   | 0.21    | B              | 100% | 0.86 | 45                           | 4.3%    | 1.8      | 500              | 3.6%    | 20          | 3.8          | 2.2      | 5.0                           | 545          | 13.0     | 5.0              |
| 12.0         | 12.0           | 6,073   | 0.14    | B              | 100% | 0.86 | 100                          | 1.0%    | 4.4      | 10               | 15.0%   | 20          | 7.7          | 0.0      | 5.0                           | 110          | 10.6     | 5.0              |
| 13.0         | 13.0           | 3,465   | 0.08    | B              | 100% | 0.86 | 101                          | 101.0%  | 0.9      | 11               | 115.0%  | 21          | 22.5         | 0.0      | 5.0                           | 112          | 10.6     | 5.0              |
| 14.0         | 14.0           | 7,207   | 0.17    | B              | 100% | 0.86 | 63                           | 2.0%    | 2.8      | 98               | 0.7%    | 20          | 1.7          | 1.0      | 5.0                           | 161          | 10.9     | 5.0              |
| 15.0         | 15.0           | 7,746   | 0.18    | B              | 100% | 0.86 | 35                           | 17.0%   | 1.0      | 72               | 1.2%    | 20          | 2.2          | 0.5      | 5.0                           | 107          | 10.6     | 5.0              |
| 16.0         | 16.0           | 7,231   | 0.17    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 50               | 3.0%    | 20          | 3.5          | 0.2      | 5.0                           | 140          | 10.8     | 5.0              |
| 17.0         | 17.0           | 4,854   | 0.11    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 51               | 3.0%    | 20          | 3.5          | 0.2      | 5.0                           | 141          | 10.8     | 5.0              |
| 18.0         | 18.0           | 17,130  | 0.39    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 52               | 3.0%    | 20          | 3.5          | 0.3      | 5.0                           | 142          | 10.8     | 5.0              |
| 19.0         | 19.0           | 4,871   | 0.11    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 53               | 3.0%    | 20          | 3.5          | 0.3      | 5.0                           | 143          | 10.8     | 5.0              |
| 20.0         | 20.0           | 1,228   | 0.03    | B              | 100% | 0.86 | 90                           | 15.0%   | 1.7      | 54               | 3.0%    | 20          | 3.5          | 0.3      | 5.0                           | 144          | 10.8     | 5.0              |

## Watercourse Coefficient

|                               |      |
|-------------------------------|------|
| Forest & Meadow               | 2.5  |
| Fallow or Cultivation         | 5.0  |
| Short Grass Pasture & Lawns   | 7.0  |
| Nearly Bare Ground            | 10.0 |
| Grassed Waterway              | 15.0 |
| Paved Area and Shallow Gutter | 20.0 |

## CIA Runoff Calculations

## 2-Year Design Storm Runoff Calculations

(Rational Method Procedure)

| BASIN INFORMATION |             |         |              | DIRECT RUNOFF |       |         |       | TOTAL RUNOFF |           |         |       | REMARKS |
|-------------------|-------------|---------|--------------|---------------|-------|---------|-------|--------------|-----------|---------|-------|---------|
| DESIGN POINT      | DRAIN BASIN | AREA Ac | RUNOFF COEFF | T(c) Min      | C x A | I In/Hr | Q CFS | T(c) Min     | SUM C x A | I In/Hr | Q CFS |         |
| 1                 | 1.1         | 1.43    | 0.71         | 5.0           | 1.02  | 3.36    | 3.43  | 5.0          | 1.02      | 3.4     | 3.43  |         |
| 1                 | 1.2         | 1.97    | 0.71         | 5.0           | 1.40  | 3.36    | 4.71  | 5.0          | 2.4       | 3.4     | 8.14  |         |
| 1                 | 2.0         | 0.88    | 0.71         | 5.0           | 0.62  | 3.36    | 2.09  | 5.0          | 3.0       | 3.4     | 10.23 |         |
| 1                 | 3.0         | 1.97    | 0.71         | 5.0           | 1.41  | 3.36    | 4.73  | 5.0          | 4.5       | 3.4     | 14.96 |         |
| 1                 | 4.1         | 1.14    | 0.71         | 5.0           | 0.81  | 3.36    | 2.72  | 5.0          | 5.3       | 3.4     | 17.68 |         |
| 1                 | 4.2         | 0.77    | 0.72         | 5.0           | 0.549 | 3.36    | 1.84  | 5.0          | 5.8       | 3.4     | 19.53 |         |
| 1                 | 5.0         | 1.13    | 0.71         | 5.0           | 0.806 | 3.36    | 2.71  | 5.0          | 6.6       | 3.4     | 22.23 |         |
| 1                 | 6.0         | 2.22    | 0.71         | 5.0           | 1.580 | 3.36    | 5.30  | 5.0          | 8.2       | 3.4     | 27.54 |         |
| 1                 | 7.0         | 1.02    | 0.71         | 5.0           | 0.722 | 3.36    | 2.42  | 5.0          | 8.9       | 3.4     | 29.96 |         |
| 1                 | 8.0         | 1.94    | 0.71         | 6.8           | 1.379 | 3.09    | 4.26  | 5.0          | 10.3      | 3.4     | 34.59 |         |
| 1                 | 9.0         | 0.10    | 0.84         | 5.0           | 0.086 | 3.36    | 0.29  | 5.0          | 10.4      | 3.4     | 34.88 |         |
| 1                 | 10.0        | 0.16    | 0.84         | 5.0           | 0.135 | 3.36    | 0.45  | 5.0          | 10.5      | 3.4     | 35.33 |         |
| 1                 | 11.0        | 0.21    | 0.84         | 5.0           | 0.178 | 3.36    | 0.60  | 5.0          | 10.7      | 3.4     | 35.93 |         |
| 1                 | 12.0        | 0.14    | 0.84         | 5.0           | 0.117 | 3.36    | 0.39  | 5.0          | 10.8      | 3.4     | 36.32 |         |
| 1                 | 13.0        | 0.08    | 0.84         | 5.0           | 0.067 | 3.36    | 0.22  | 5.0          | 10.9      | 3.4     | 36.55 |         |
| 1                 | 14.0        | 0.17    | 0.84         | 5.0           | 0.139 | 3.36    | 0.47  | 5.0          | 11.0      | 3.4     | 37.01 |         |
| 1                 | 15.0        | 0.18    | 0.84         | 5.0           | 0.149 | 3.36    | 0.50  | 5.0          | 11.2      | 3.4     | 37.51 |         |
| 1                 | 16.0        | 0.17    | 0.84         | 5.0           | 0.139 | 3.36    | 0.47  | 5.0          | 11.3      | 3.4     | 37.98 |         |
| 1                 | 17.0        | 0.11    | 0.84         | 5.0           | 0.094 | 3.36    | 0.31  | 5.0          | 11.4      | 3.4     | 38.30 |         |
| 1                 | 18.0        | 0.39    | 0.84         | 5.0           | 0.330 | 3.36    | 1.11  | 5.0          | 11.7      | 3.4     | 39.41 |         |
| 1                 | 19.0        | 0.11    | 0.84         | 5.0           | 0.094 | 3.36    | 0.32  | 5.0          | 11.8      | 3.4     | 39.72 |         |
| 1                 | 20.0        | 0.03    | 0.84         | 5.0           | 0.024 | 3.36    | 0.08  | 5.0          | 11.9      | 3.4     | 39.80 |         |

**5-Year Design Storm Runoff Calculations**

(Rational Method Procedure)

| BASIN INFORMATION |             |         |              | DIRECT RUNOFF |       |         |       | TOTAL RUNOFF |           |         |       | REMARKS |
|-------------------|-------------|---------|--------------|---------------|-------|---------|-------|--------------|-----------|---------|-------|---------|
| DESIGN POINT      | DRAIN BASIN | AREA Ac | RUNOFF COEFF | T(c) Min      | C x A | I In/Hr | Q CFS | T(c) Min     | SUM C x A | I In/Hr | Q CFS |         |
| 1                 | 1.1         | 1.43    | 0.73         | 5.0           | 1.05  | 4.71    | 4.93  | 5.0          | 1.05      | 4.7     | 4.93  |         |
| 1                 | 1.2         | 1.97    | 0.73         | 5.0           | 1.44  | 4.71    | 6.77  | 5.0          | 2.5       | 4.7     | 11.71 |         |
| 1                 | 2.0         | 0.88    | 0.73         | 5.0           | 0.64  | 4.71    | 3.00  | 5.0          | 3.1       | 4.7     | 14.71 |         |
| 1                 | 3.0         | 1.97    | 0.73         | 5.0           | 1.44  | 4.71    | 6.80  | 5.0          | 4.6       | 4.7     | 21.50 |         |
| 1                 | 4.1         | 1.14    | 0.73         | 5.0           | 0.83  | 4.71    | 3.91  | 5.0          | 5.4       | 4.7     | 25.42 |         |
| 1                 | 4.2         | 0.77    | 0.73         | 5.0           | 0.56  | 4.71    | 2.65  | 5.0          | 6.0       | 4.7     | 28.07 |         |
| 1                 | 5.0         | 1.13    | 0.73         | 5.0           | 0.83  | 4.71    | 3.89  | 5.0          | 6.8       | 4.7     | 31.96 |         |
| 1                 | 6.0         | 2.22    | 0.73         | 5.0           | 1.62  | 4.71    | 7.62  | 5.0          | 8.4       | 4.7     | 39.58 |         |
| 1                 | 7.0         | 1.02    | 0.73         | 5.0           | 0.74  | 4.71    | 3.48  | 5.0          | 9.1       | 4.7     | 43.06 |         |
| 1                 | 8.0         | 1.94    | 0.73         | 6.8           | 1.41  | 4.34    | 6.13  | 5.0          | 10.5      | 4.7     | 49.72 |         |
| 1                 | 9.0         | 0.10    | 0.86         | 5.0           | 0.09  | 4.71    | 0.42  | 5.0          | 10.6      | 4.7     | 50.14 |         |
| 1                 | 10.0        | 0.16    | 0.86         | 5.0           | 0.14  | 4.71    | 0.65  | 5.0          | 10.8      | 4.7     | 50.79 |         |
| 1                 | 11.0        | 0.21    | 0.86         | 5.0           | 0.18  | 4.71    | 0.86  | 5.0          | 11.0      | 4.7     | 51.64 |         |
| 1                 | 12.0        | 0.14    | 0.86         | 5.0           | 0.12  | 4.71    | 0.57  | 5.0          | 11.1      | 4.7     | 52.21 |         |
| 1                 | 13.0        | 0.08    | 0.86         | 5.0           | 0.07  | 4.71    | 0.32  | 5.0          | 11.1      | 4.7     | 52.53 |         |
| 1                 | 14.0        | 0.17    | 0.86         | 5.0           | 0.14  | 4.71    | 0.67  | 5.0          | 11.3      | 4.7     | 53.20 |         |
| 1                 | 15.0        | 0.18    | 0.86         | 5.0           | 0.15  | 4.71    | 0.72  | 5.0          | 11.4      | 4.7     | 53.92 |         |
| 1                 | 16.0        | 0.17    | 0.86         | 5.0           | 0.14  | 4.71    | 0.67  | 5.0          | 11.6      | 4.7     | 54.60 |         |
| 1                 | 17.0        | 0.11    | 0.86         | 5.0           | 0.10  | 4.71    | 0.45  | 5.0          | 11.7      | 4.7     | 55.05 |         |
| 1                 | 18.0        | 0.39    | 0.86         | 5.0           | 0.34  | 4.71    | 1.59  | 5.0          | 12.0      | 4.7     | 56.64 |         |
| 1                 | 19.0        | 0.11    | 0.86         | 5.0           | 0.10  | 4.71    | 0.45  | 5.0          | 12.1      | 4.7     | 57.10 |         |
| 1                 | 20.0        | 0.03    | 0.86         | 5.0           | 0.02  | 4.71    | 0.11  | 5.0          | 12.1      | 4.7     | 57.21 |         |



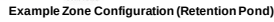
**100-Year Design Storm Runoff Calculations**

(Rational Method Procedure)

| BASIN INFORMATION |             |         |              | DIRECT RUNOFF |       |         |       | TOTAL RUNOFF |           |         |        | REMARKS |
|-------------------|-------------|---------|--------------|---------------|-------|---------|-------|--------------|-----------|---------|--------|---------|
| DESIGN POINT      | DRAIN BASIN | AREA Ac | RUNOFF COEFF | T(c) Min      | C x A | I In/Hr | Q CFS | T(c) Min     | SUM C x A | I In/Hr | Q CFS  |         |
| 1                 | 1.1         | 1.43    | 0.82         | 5.0           | 1.18  | 8.82    | 10.37 | 5.0          | 1.18      | 8.8     | 10.37  |         |
| 1                 | 1.2         | 1.97    | 0.82         | 5.0           | 1.62  | 8.82    | 14.25 | 5.0          | 2.8       | 8.8     | 24.62  |         |
| 1                 | 2.0         | 0.88    | 0.82         | 5.0           | 0.72  | 8.82    | 6.33  | 5.0          | 3.5       | 8.8     | 30.95  |         |
| 1                 | 3.0         | 1.97    | 0.82         | 5.0           | 1.62  | 8.82    | 14.29 | 5.0          | 5.1       | 8.8     | 45.24  |         |
| 1                 | 4.1         | 1.14    | 0.82         | 5.0           | 0.93  | 8.82    | 8.23  | 5.0          | 6.1       | 8.8     | 53.46  |         |
| 1                 | 4.2         | 0.77    | 0.82         | 5.0           | 0.631 | 8.82    | 5.56  | 5.0          | 6.7       | 8.8     | 59.03  |         |
| 1                 | 5.0         | 1.13    | 0.82         | 5.0           | 0.928 | 8.82    | 8.18  | 5.0          | 7.6       | 8.8     | 67.21  |         |
| 1                 | 6.0         | 2.22    | 0.82         | 5.0           | 1.822 | 8.82    | 16.06 | 5.0          | 9.4       | 8.8     | 83.27  |         |
| 1                 | 7.0         | 1.02    | 0.82         | 5.0           | 0.834 | 8.82    | 7.35  | 5.0          | 10.3      | 8.8     | 90.63  |         |
| 1                 | 8.0         | 1.94    | 0.82         | 6.8           | 1.589 | 8.12    | 12.90 | 5.0          | 11.9      | 8.8     | 104.64 |         |
| 1                 | 9.0         | 0.10    | 0.89         | 5.0           | 0.091 | 8.82    | 0.81  | 5.0          | 12.0      | 8.8     | 105.44 |         |
| 1                 | 10.0        | 0.16    | 0.89         | 5.0           | 0.143 | 8.82    | 1.26  | 5.0          | 12.1      | 8.8     | 106.70 |         |
| 1                 | 11.0        | 0.21    | 0.89         | 5.0           | 0.188 | 8.82    | 1.66  | 5.0          | 12.3      | 8.8     | 108.36 |         |
| 1                 | 12.0        | 0.14    | 0.89         | 5.0           | 0.124 | 8.82    | 1.09  | 5.0          | 12.4      | 8.8     | 109.46 |         |
| 1                 | 13.0        | 0.08    | 0.89         | 5.0           | 0.071 | 8.82    | 0.62  | 5.0          | 12.5      | 8.8     | 110.08 |         |
| 1                 | 14.0        | 0.17    | 0.89         | 5.0           | 0.147 | 8.82    | 1.30  | 5.0          | 12.6      | 8.8     | 111.38 |         |
| 1                 | 15.0        | 0.18    | 0.89         | 5.0           | 0.158 | 8.82    | 1.40  | 5.0          | 12.8      | 8.8     | 112.78 |         |
| 1                 | 16.0        | 0.17    | 0.89         | 5.0           | 0.148 | 8.82    | 1.30  | 5.0          | 12.9      | 8.8     | 114.08 |         |
| 1                 | 17.0        | 0.11    | 0.89         | 5.0           | 0.099 | 8.82    | 0.87  | 5.0          | 13.0      | 8.8     | 114.95 |         |
| 1                 | 18.0        | 0.39    | 0.89         | 5.0           | 0.350 | 8.82    | 3.09  | 5.0          | 13.4      | 8.8     | 118.04 |         |
| 1                 | 19.0        | 0.11    | 0.89         | 5.0           | 0.100 | 8.82    | 0.88  | 5.0          | 13.5      | 8.8     | 118.92 |         |
| 1                 | 20.0        | 0.03    | 0.89         | 5.0           | 0.025 | 8.82    | 0.22  | 5.0          | 13.5      | 8.8     | 119.14 |         |

MHFD-Detention, Version 4.02 (February 2020)

Basin ID:



Note:  $L_c/L$  Ratio  $> 0.9$   
 $L_c / L$  Ratio = 5

### Optional User Overrides

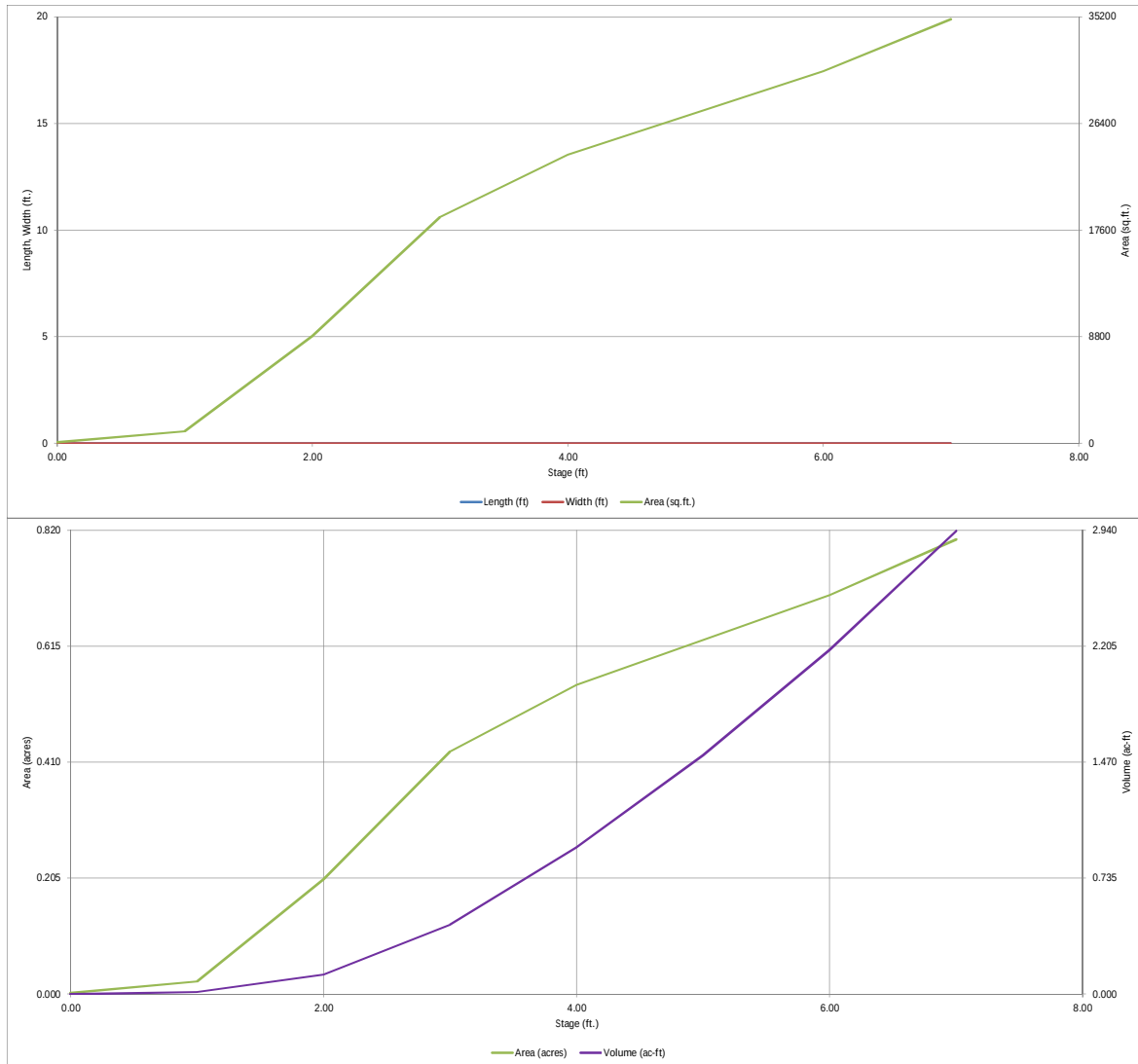
|      |           |
|------|-----------|
|      | acre-feet |
|      | acre-feet |
| 0.99 | inches    |
| 1.39 | inches    |
| 1.64 | inches    |
| 1.98 | inches    |
| 2.31 | inches    |
| 2.60 | inches    |
|      | inches    |

|                                                 |             |                 |
|-------------------------------------------------|-------------|-----------------|
| Zone 1 Volume ( $WQV_C$ ) =                     | 0.481       | acre-feet       |
| Zone 2 Volume ( $EURV - V$ ) =                  | 1.031       | acre-feet       |
| Zone 3 Volume (100-year - Zones 1 & 2) =        | 0.826       | acre-feet       |
| Total Detention Basin Volume =                  | 2.339       | acre-feet       |
| Initial Surcharge Volume ( $ISV$ ) =            | <u>user</u> | ft <sup>3</sup> |
| Initial Surcharge Depth ( $ISD$ ) =             | <u>user</u> | ft              |
| Total Available Detention Depth ( $H_{TAD}$ ) = | <u>user</u> | ft              |
| Depth of Trickle Channel ( $H_{TC}$ ) =         | <u>user</u> | ft              |
| Slope of Trickle Channel ( $Str$ ) =            | <u>user</u> | ft/ft           |
| Slopes of Main Basin Sides ( $S_{Main}$ ) =     | <u>user</u> | H:V             |
| Basin Length-to-Width Ratio ( $R_{L/W}$ ) =     | <u>user</u> |                 |
| Initial Surcharge Area ( $A_{ISV}$ ) =          | <u>user</u> | ft <sup>2</sup> |
| Surcharge Volume Length ( $LSV$ ) =             | <u>user</u> | ft              |
| Surcharge Volume Width ( $WSV$ ) =              | <u>user</u> | ft              |
| Depth of Basin Floor ( $H_{FL,DOQR}$ ) =        | <u>user</u> | ft              |
| Length of Basin Floor ( $L_{FL,DOQR}$ ) =       | <u>user</u> | ft              |
| Width of Basin Floor ( $W_{FL,DOQR}$ ) =        | <u>user</u> | ft              |
| Area of Basin Floor ( $A_{FL,DOQR}$ ) =         | <u>user</u> | ft <sup>2</sup> |
| Volume of Basin Floor ( $V_{FL,DOQR}$ ) =       | <u>user</u> | ft <sup>3</sup> |
| Depth of Main Basin ( $H_{MAIN}$ ) =            | <u>user</u> | ft              |
| Length of Main Basin ( $L_{MAIN}$ ) =           | <u>user</u> | ft              |
| Width of Main Basin ( $W_{MAIN}$ ) =            | <u>user</u> | ft              |
| Area of Main Basin ( $A_{MAIN}$ ) =             | <u>user</u> | ft <sup>2</sup> |
| Volume of Main Basin ( $V_{MAIN}$ ) =           | <u>user</u> | ft <sup>3</sup> |
| Calculated Total Basin Volume ( $V_{TAD}$ ) =   | <u>user</u> | acre-feet       |

4/24/2020, 9:41 AM

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

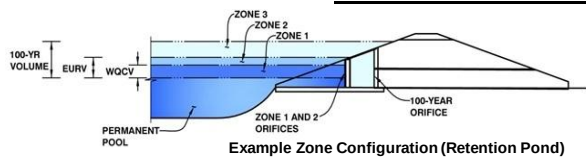


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-DETENTION, Version 4.02 (February 2020)

Project: Parker Mixed-Use - Parker and Pine

Basin ID: \_\_\_\_\_



Example Zone Configuration (Retention Pond)

|                   | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type       |
|-------------------|----------------------|--------------------------|-------------------|
| Zone 1 (WQCV)     | 3.10                 | 0.481                    | Orifice Plate     |
| Zone 2 (EURV)     | 5.00                 | 1.031                    | Circular Orifice  |
| Zone 3 (100-year) | 6.23                 | 0.826                    | Weir&Pipe (Rect.) |
| Total (all zones) |                      | 2.339                    |                   |

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

|                                   |     |                                                  |
|-----------------------------------|-----|--------------------------------------------------|
| Underdrain Orifice Invert Depth = | N/A | ft (distance below the filtration media surface) |
| Underdrain Orifice Diameter =     | N/A | inches                                           |

|                                      |                     |
|--------------------------------------|---------------------|
| Calculated Parameters for Underdrain |                     |
| Underdrain Orifice Area =            | N/A ft <sup>2</sup> |
| Underdrain Orifice Centroid =        | N/A feet            |

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

|                                            |       |                                               |
|--------------------------------------------|-------|-----------------------------------------------|
| Invert of Lowest Orifice =                 | 0.00  | ft (relative to basin bottom at Stage = 0 ft) |
| Depth at top of Zone using Orifice Plate = | 3.10  | ft (relative to basin bottom at Stage = 0 ft) |
| Orifice Plate: Orifice Vertical Spacing =  | 12.40 | inches                                        |
| Orifice Plate: Orifice Area per Row =      | 1.52  | sq. inches (diameter = 1-3/8 inches)          |

|                                 |                           |
|---------------------------------|---------------------------|
| Calculated Parameters for Plate |                           |
| WQ Orifice Area per Row =       | 1.056E-02 ft <sup>2</sup> |
| Elliptical Half-Width =         | N/A feet                  |
| Elliptical Slot Centroid =      | N/A feet                  |
| Elliptical Slot Area =          | N/A ft <sup>2</sup>       |

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

|                                | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Stage of Orifice Centroid (ft) | 0.00             | 1.03             | 2.07             |                  |                  |                  |                  |                  |
| Orifice Area (sq. inches)      | 1.52             | 1.52             | 1.52             |                  |                  |                  |                  |                  |

|                                | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
|--------------------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Stage of Orifice Centroid (ft) |                  |                   |                   |                   |                   |                   |                   |                   |
| Orifice Area (sq. inches)      |                  |                   |                   |                   |                   |                   |                   |                   |

User Input: Vertical Orifice (Circular or Rectangular)

|                                               | Zone 2 Circular | Not Selected |                                               |
|-----------------------------------------------|-----------------|--------------|-----------------------------------------------|
| Invert of Vertical Orifice =                  | 3.10            | N/A          | ft (relative to basin bottom at Stage = 0 ft) |
| Depth at top of Zone using Vertical Orifice = | 5.00            | N/A          | ft (relative to basin bottom at Stage = 0 ft) |
| Vertical Orifice Diameter =                   | 8.00            | N/A          | inches                                        |

|                                            | Zone 2 Circular | Not Selected |                 |
|--------------------------------------------|-----------------|--------------|-----------------|
| Calculated Parameters for Vertical Orifice |                 |              |                 |
| Vertical Orifice Area =                    | 0.35            | N/A          | ft <sup>2</sup> |
| Vertical Orifice Centroid =                | 0.33            | N/A          | feet            |

User Input: Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

|                                                   | Zone 3 Weir | Not Selected |                                               |
|---------------------------------------------------|-------------|--------------|-----------------------------------------------|
| Overflow Weir Front Edge Height, H <sub>o</sub> = | 4.79        | N/A          | ft (relative to basin bottom at Stage = 0 ft) |
| Overflow Weir Front Edge Length =                 | 1.00        | N/A          | feet                                          |
| Overflow Weir Gate Slope =                        | 4.00        | N/A          | H:V                                           |
| Horiz. Length of Weir Sides =                     | 5.00        | N/A          | feet                                          |
| Overflow Gate Open Area % =                       | 70%         | N/A          | %, gate open area/total area                  |
| Debris Clogging % =                               | 50%         | N/A          | %                                             |

|                                             | Zone 3 Weir | Not Selected |                 |
|---------------------------------------------|-------------|--------------|-----------------|
| Calculated Parameters for Overflow Weir     |             |              |                 |
| Height of Gate Upper Edge, H <sub>u</sub> = | 6.04        | N/A          | feet            |
| Overflow Weir Slope Length =                | 5.15        | N/A          | feet            |
| Gate Open Area / 100-yr Orifice Area =      | 4.68        | N/A          |                 |
| Overflow Gate Open Area w/o Debris =        | 3.61        | N/A          | ft <sup>2</sup> |
| Overflow Gate Open Area w/ Debris =         | 1.80        | N/A          | ft <sup>2</sup> |

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

|                                  | Zone 3 Rectangular | Not Selected |                                                  |
|----------------------------------|--------------------|--------------|--------------------------------------------------|
| Depth to Invert of Outlet Pipe = | 1.10               | N/A          | ft (distance below basin bottom at Stage = 0 ft) |
| Rectangular Orifice Width =      | 10.10              | N/A          | inches                                           |
| Rectangular Orifice Height =     | 11.00              | N/A          | inches                                           |

|                                                                 | Zone 3 Rectangular | Not Selected |                 |
|-----------------------------------------------------------------|--------------------|--------------|-----------------|
| Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate |                    |              |                 |
| Outlet Orifice Area =                                           | 0.77               | N/A          | ft <sup>2</sup> |
| Outlet Orifice Centroid =                                       | 0.46               | N/A          | feet            |
| Half-Central Angle of Restrictor Plate on Pipe =                | N/A                | N/A          | radians         |

User Input: Emergency Spillway (Rectangular or Trapezoidal)

|                                     |       |                                               |
|-------------------------------------|-------|-----------------------------------------------|
| Spillway Invert Stage =             | 6.20  | ft (relative to basin bottom at Stage = 0 ft) |
| Spillway Crest Length =             | 26.00 | feet                                          |
| Spillway End Slopes =               | 4.00  | H:V                                           |
| Freeboard above Max Water Surface = | 0.25  | feet                                          |

| Calculated Parameters for Spillway |      |         |
|------------------------------------|------|---------|
| Spillway Design Flow Depth=        | 0.55 | feet    |
| Stage at Top of Freeboard =        | 7.00 | feet    |
| Basin Area at Top of Freeboard =   | 0.80 | acres   |
| Basin Volume at Top of Freeboard = | 2.93 | acre-ft |

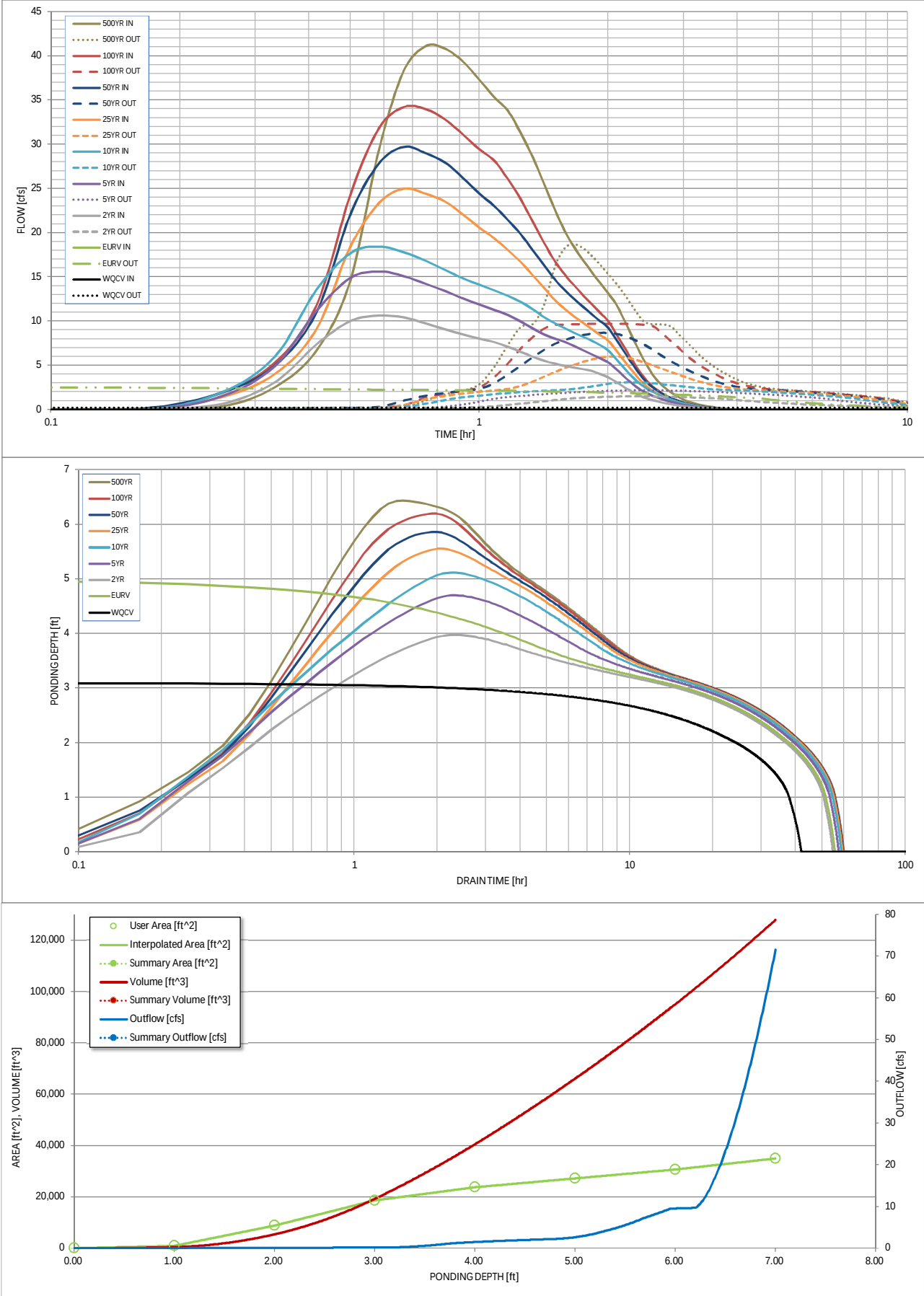
## Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

|                                               | WQCV  | EURV            | 2 Year             | 5 Year             | 10 Year         | 25 Year         | 50 Year         | 100 Year       | 500 Year |
|-----------------------------------------------|-------|-----------------|--------------------|--------------------|-----------------|-----------------|-----------------|----------------|----------|
| Design Storm Return Period                    |       |                 |                    |                    |                 |                 |                 |                |          |
| One-Hour Rainfall Depth (in)                  | N/A   | N/A             | 0.99               | 1.39               | 1.64            | 1.98            | 2.31            | 2.60           | 3.08     |
| CUHP Runoff Volume (acre-ft)                  | 0.481 | 1.512           | 1.094              | 1.632              | 1.976           | 2.479           | 2.950           | 3.380          | 4.070    |
| Inflow Hydrograph Volume (acre-ft)            | N/A   | N/A             | 1.094              | 1.632              | 1.976           | 2.479           | 2.950           | 3.380          | 4.070    |
| CUHP Predevelopment Peak Q (cfs)              | N/A   | N/A             | 0.1                | 1.5                | 2.6             | 5.9             | 8.0             | 10.7           | 14.0     |
| OPTIONAL Override Predevelopment Peak Q (cfs) | N/A   | N/A             |                    |                    |                 |                 |                 |                |          |
| Predevelopment Unit Peak Flow, q (cfs/acre)   | N/A   | N/A             | 0.01               | 0.09               | 0.16            | 0.37            | 0.50            | 0.67           | 0.87     |
| Peak Inflow Q (cfs)                           | N/A   | N/A             | 10.6               | 15.6               | 18.4            | 25.0            | 29.7            | 34.2           | 41.1     |
| Peak Outflow Q (cfs)                          | 0.2   | 2.6             | 1.5                | 2.2                | 3.1             | 6.0             | 8.7             | 9.7            | 18.7     |
| Ratio Peak Outflow to Predevelopment Q        | N/A   | N/A             | N/A                | 1.5                | 1.2             | 1.0             | 1.1             | 0.9            | 1.3      |
| Structure Controlling Flow                    | Plate | Overflow Weir 1 | Vertical Orifice 1 | Vertical Orifice 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Spillway |
| Max Velocity through Gate 1 (fps)             | N/A   | 0.07            | N/A                | N/A                | 0.2             | 0.9             | 1.6             | 1.8            | 1.8      |
| Max Velocity through Gate 2 (fps)             | N/A   | N/A             | N/A                | N/A                | N/A             | N/A             | N/A             | N/A            | N/A      |
| Time to Drain 97% of Inflow Volume (hours)    | 38    | 47              | 47                 | 48                 | 48              | 47              | 46              | 45             | 43       |
| Time to Drain 99% of Inflow Volume (hours)    | 40    | 51              | 51                 | 53                 | 53              | 53              | 53              | 52             | 52       |
| Maximum Ponding Depth (ft)                    | 3.10  | 5.00            | 3.97               | 4.70               | 5.11            | 5.55            | 5.86            | 6.19           | 6.43     |
| Area at Maximum Ponding Depth (acres)         | 0.44  | 0.63            | 0.54               | 0.60               | 0.63            | 0.67            | 0.69            | 0.72           | 0.75     |
| Maximum Volume Stored (acre-ft)               | 0.485 | 1.515           | 0.913              | 1.325              | 1.584           | 1.871           | 2.076           | 2.316          | 2.485    |

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|-----------------------------|--------|-------------|--------------|
| minimum bound               |        |             |              |
| maximum bound               |        |             |              |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

### Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

|               | SOURCE  | CUHP       | CUHP       | CUHP         | CUHP         | CUHP          | CUHP          | CUHP          | CUHP           | CUHP           |
|---------------|---------|------------|------------|--------------|--------------|---------------|---------------|---------------|----------------|----------------|
| Time Interval | TIME    | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min      | 0:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 0:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 0:10:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.16          | 0.06           | 0.35           |
|               | 0:15:00 | 0.00       | 0.00       | 0.63         | 1.49         | 1.91          | 1.40          | 1.92          | 1.86           | 2.53           |
|               | 0:20:00 | 0.00       | 0.00       | 3.10         | 4.93         | 6.00          | 4.02          | 4.98          | 5.28           | 6.67           |
|               | 0:25:00 | 0.00       | 0.00       | 7.35         | 11.15        | 13.54         | 9.09          | 10.98         | 11.78          | 14.56          |
|               | 0:30:00 | 0.00       | 0.00       | 10.01        | 14.88        | 17.68         | 18.42         | 22.05         | 24.26          | 29.39          |
|               | 0:35:00 | 0.00       | 0.00       | 10.64        | 15.62        | 18.44         | 23.34         | 27.83         | 31.82          | 38.32          |
|               | 0:40:00 | 0.00       | 0.00       | 10.42        | 15.10        | 17.79         | 24.98         | 29.71         | 34.21          | 41.10          |
|               | 0:45:00 | 0.00       | 0.00       | 9.75         | 14.21        | 16.82         | 24.40         | 28.99         | 33.98          | 40.80          |
|               | 0:50:00 | 0.00       | 0.00       | 9.07         | 13.40        | 15.79         | 23.51         | 27.92         | 32.79          | 39.35          |
|               | 0:55:00 | 0.00       | 0.00       | 8.48         | 12.56        | 14.84         | 22.04         | 26.18         | 31.10          | 37.32          |
|               | 1:00:00 | 0.00       | 0.00       | 8.02         | 11.88        | 14.12         | 20.58         | 24.44         | 29.45          | 35.34          |
|               | 1:05:00 | 0.00       | 0.00       | 7.64         | 11.28        | 13.49         | 19.39         | 23.03         | 28.16          | 33.79          |
|               | 1:10:00 | 0.00       | 0.00       | 7.10         | 10.68        | 12.85         | 18.05         | 21.43         | 26.06          | 31.27          |
|               | 1:15:00 | 0.00       | 0.00       | 6.53         | 9.95         | 12.18         | 16.68         | 19.82         | 23.78          | 28.56          |
|               | 1:20:00 | 0.00       | 0.00       | 5.97         | 9.17         | 11.36         | 15.18         | 18.03         | 21.25          | 25.53          |
|               | 1:25:00 | 0.00       | 0.00       | 5.51         | 8.49         | 10.46         | 13.76         | 16.33         | 18.87          | 22.67          |
|               | 1:30:00 | 0.00       | 0.00       | 5.20         | 8.02         | 9.77          | 12.41         | 14.74         | 16.82          | 20.21          |
|               | 1:35:00 | 0.00       | 0.00       | 4.96         | 7.66         | 9.20          | 11.38         | 13.52         | 15.27          | 18.36          |
|               | 1:40:00 | 0.00       | 0.00       | 4.75         | 7.19         | 8.69          | 10.52         | 12.49         | 14.02          | 16.85          |
|               | 1:45:00 | 0.00       | 0.00       | 4.56         | 6.70         | 8.21          | 9.77          | 11.59         | 12.90          | 15.50          |
|               | 1:50:00 | 0.00       | 0.00       | 4.36         | 6.23         | 7.77          | 9.08          | 10.77         | 11.88          | 14.28          |
|               | 1:55:00 | 0.00       | 0.00       | 4.01         | 5.80         | 7.28          | 8.43          | 9.99          | 10.92          | 13.12          |
|               | 2:00:00 | 0.00       | 0.00       | 3.64         | 5.33         | 6.70          | 7.80          | 9.25          | 10.01          | 12.02          |
|               | 2:05:00 | 0.00       | 0.00       | 3.14         | 4.61         | 5.78          | 6.78          | 8.03          | 8.67           | 10.41          |
|               | 2:10:00 | 0.00       | 0.00       | 2.63         | 3.85         | 4.83          | 5.70          | 6.75          | 7.28           | 8.74           |
|               | 2:15:00 | 0.00       | 0.00       | 2.15         | 3.14         | 3.95          | 4.67          | 5.53          | 5.96           | 7.15           |
|               | 2:20:00 | 0.00       | 0.00       | 1.73         | 2.53         | 3.21          | 3.76          | 4.44          | 4.77           | 5.72           |
|               | 2:25:00 | 0.00       | 0.00       | 1.40         | 2.05         | 2.62          | 2.96          | 3.50          | 3.72           | 4.47           |
|               | 2:30:00 | 0.00       | 0.00       | 1.15         | 1.70         | 2.19          | 2.35          | 2.78          | 2.91           | 3.50           |
|               | 2:35:00 | 0.00       | 0.00       | 0.96         | 1.42         | 1.83          | 1.91          | 2.26          | 2.32           | 2.79           |
|               | 2:40:00 | 0.00       | 0.00       | 0.80         | 1.19         | 1.53          | 1.55          | 1.84          | 1.86           | 2.23           |
|               | 2:45:00 | 0.00       | 0.00       | 0.66         | 0.98         | 1.26          | 1.26          | 1.49          | 1.48           | 1.78           |
|               | 2:50:00 | 0.00       | 0.00       | 0.55         | 0.81         | 1.04          | 1.02          | 1.20          | 1.17           | 1.41           |
|               | 2:55:00 | 0.00       | 0.00       | 0.45         | 0.66         | 0.85          | 0.82          | 0.97          | 0.92           | 1.11           |
|               | 3:00:00 | 0.00       | 0.00       | 0.37         | 0.54         | 0.69          | 0.66          | 0.78          | 0.73           | 0.88           |
|               | 3:05:00 | 0.00       | 0.00       | 0.31         | 0.44         | 0.56          | 0.54          | 0.64          | 0.59           | 0.72           |
|               | 3:10:00 | 0.00       | 0.00       | 0.25         | 0.35         | 0.45          | 0.44          | 0.52          | 0.48           | 0.58           |
|               | 3:15:00 | 0.00       | 0.00       | 0.20         | 0.28         | 0.36          | 0.35          | 0.41          | 0.39           | 0.47           |
|               | 3:20:00 | 0.00       | 0.00       | 0.15         | 0.21         | 0.28          | 0.27          | 0.32          | 0.31           | 0.37           |
|               | 3:25:00 | 0.00       | 0.00       | 0.11         | 0.16         | 0.21          | 0.21          | 0.24          | 0.23           | 0.28           |
|               | 3:30:00 | 0.00       | 0.00       | 0.08         | 0.11         | 0.15          | 0.15          | 0.18          | 0.17           | 0.21           |
|               | 3:35:00 | 0.00       | 0.00       | 0.05         | 0.08         | 0.10          | 0.11          | 0.12          | 0.12           | 0.14           |
|               | 3:40:00 | 0.00       | 0.00       | 0.03         | 0.05         | 0.06          | 0.07          | 0.08          | 0.08           | 0.09           |
|               | 3:45:00 | 0.00       | 0.00       | 0.02         | 0.03         | 0.03          | 0.04          | 0.04          | 0.04           | 0.05           |
|               | 3:50:00 | 0.00       | 0.00       | 0.01         | 0.01         | 0.01          | 0.02          | 0.02          | 0.02           | 0.02           |
|               | 3:55:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.01           |
|               | 4:00:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
|               | 4:05:00 | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           | 0.00           |
| 4:10:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:15:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:20:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:25:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:30:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:35:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:40:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:45:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:50:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 4:55:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:00:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:05:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:10:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:15:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:20:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:25:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:30:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:35:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:40:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:45:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:50:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 5:55:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |
| 6:00:00       | 0.00    | 0.00       | 0.00       | 0.00         | 0.00         | 0.00          | 0.00          | 0.00          | 0.00           |                |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.02 (February 2020)*

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

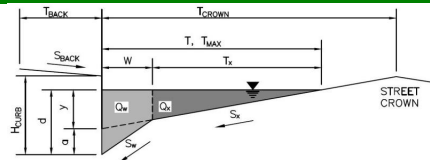
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet A04

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  0.000 ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.000 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm | Major Storm |
|-------------|-------------|-------------|
| $T_{MAX} =$ | 13.0        | 13.0        |
| $d_{MAX} =$ | 6.0         | 6.0         |

☐ ☐

$Q_{allow} =$ 

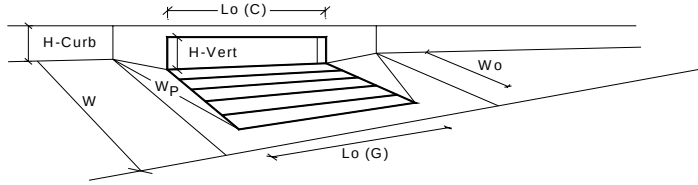
| Minor Storm | Major Storm |
|-------------|-------------|
| SUMP        | SUMP        |

 cfs



## INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   | MINOR                    | MAJOR        |                                          |
|------------------------------------------------------------------------------|--------------------------|--------------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening |              |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) | 3.00                     | 3.00         | inches                                   |
| Number of Unit Inlets (Grate or Curb Opening)                                | 1                        | 1            |                                          |
| Water Depth at Flowline (outside of local depression)                        | 3.9                      | 3.9          | inches                                   |
| <b>Grate Information</b>                                                     | <b>MINOR</b>             | <b>MAJOR</b> | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       | N/A                      | N/A          | feet                                     |
| Width of a Unit Grate                                                        | N/A                      | N/A          | feet                                     |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    | N/A                      | N/A          |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               | N/A                      | N/A          |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           | N/A                      | N/A          |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        | N/A                      | N/A          |                                          |
| <b>Curb Opening Information</b>                                              | <b>MINOR</b>             | <b>MAJOR</b> |                                          |
| Length of a Unit Curb Opening                                                | 5.00                     | 5.00         | feet                                     |
| Height of Vertical Curb Opening in Inches                                    | 6.00                     | 6.00         | inches                                   |
| Height of Curb Orifice Throat in Inches                                      | 6.00                     | 6.00         | inches                                   |
| Angle of Throat (see USDCM Figure ST-5)                                      | 63.40                    | 63.40        | degrees                                  |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         | 1.00                     | 1.00         | feet                                     |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               | 0.10                     | 0.10         |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        | 3.60                     | 3.60         |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 | 0.67                     | 0.67         |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           | <b>MINOR</b>             | <b>MAJOR</b> |                                          |
| Depth for Grate Midwidth                                                     | N/A                      | N/A          | ft                                       |
| Depth for Curb Opening Weir Equation                                         | 0.24                     | 0.24         | ft                                       |
| Combination Inlet Performance Reduction Factor for Long Inlets               | 0.50                     | 0.50         |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    | 1.00                     | 1.00         |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    | N/A                      | N/A          |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         | <b>MINOR</b>             | <b>MAJOR</b> |                                          |
| <b>Q<sub>a</sub></b>                                                         | <b>2.6</b>               | <b>2.6</b>   | <b>cfs</b>                               |
| <b>Q<sub>PEAK REQUIRED</sub></b>                                             | <b>0.4</b>               | <b>0.8</b>   | <b>cfs</b>                               |

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

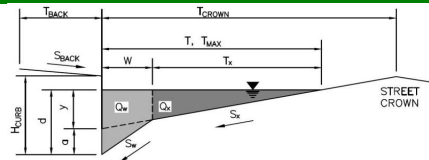
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet A02

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  0.000 ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.015 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.006 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

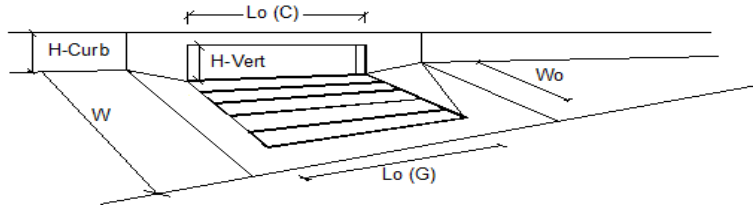
|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 3.2         | 3.2         | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          |                          | MINOR         |                          | MAJOR |        |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|-------|--------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |       |        |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL}$ = | 3.0                      | 3.0   | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | No =          | 1                        | 1     |        |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_o$ =       | 5.00                     | 5.00  | ft     |
| Width of a Unit Grate (cannot be greater than W, Gutter Width)                      |                          | $W_o$ =       | N/A                      | N/A   | ft     |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G$ =     | N/A                      | N/A   |        |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C$ =     | 0.10                     | 0.10  |        |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          |               | MINOR                    | MAJOR |        |
| Total Inlet Interception Capacity                                                   |                          | $Q$ =         | 0.6                      | 1.4   | cfs    |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b$ =       | 0.0                      | 0.3   | cfs    |
| Capture Percentage = $Q_i/Q_o$ =                                                    |                          | $C\%$ =       | 100                      | 80    | %      |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

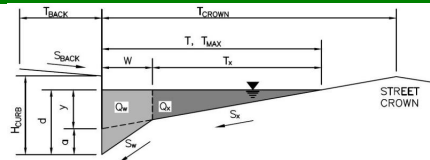
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet C00

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.000 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm | Major Storm |        |
|-------------|-------------|-------------|--------|
| $T_{MAX} =$ | 13.0        | 13.0        | ft     |
| $d_{MAX} =$ | 6.0         | 6.0         | inches |

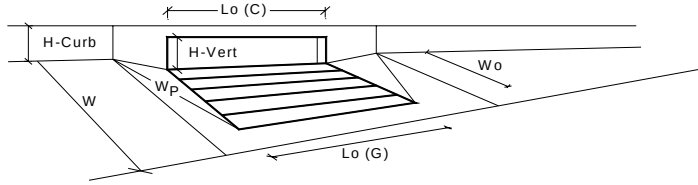
☐ ☐

$Q_{allow} =$ 

| Minor Storm | Major Storm |     |
|-------------|-------------|-----|
| SUMP        | SUMP        | cfs |

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   |                          | MINOR                        |                          | MAJOR |                                          |
|------------------------------------------------------------------------------|--------------------------|------------------------------|--------------------------|-------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening | Type =                       | CDOT Type R Curb Opening |       |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) |                          | a <sub>local</sub> =         | 3.00                     | 3.00  | inches                                   |
| Number of Unit Inlets (Grate or Curb Opening)                                |                          | No =                         | 1                        | 1     |                                          |
| Water Depth at Flowline (outside of local depression)                        |                          | Ponding Depth =              | 3.9                      | 3.9   | inches                                   |
| <b>Grate Information</b>                                                     |                          |                              | MINOR                    | MAJOR | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       |                          | L <sub>o</sub> (G) =         | N/A                      | N/A   | feet                                     |
| Width of a Unit Grate                                                        |                          | W <sub>o</sub> =             | N/A                      | N/A   | feet                                     |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    |                          | A <sub>ratio</sub> =         | N/A                      | N/A   |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               |                          | C <sub>l</sub> (G) =         | N/A                      | N/A   |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           |                          | C <sub>w</sub> (G) =         | N/A                      | N/A   |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        |                          | C <sub>o</sub> (G) =         | N/A                      | N/A   |                                          |
| <b>Curb Opening Information</b>                                              |                          |                              | MINOR                    | MAJOR |                                          |
| Length of a Unit Curb Opening                                                |                          | L <sub>o</sub> (C) =         | 5.00                     | 5.00  | feet                                     |
| Height of Vertical Curb Opening in Inches                                    |                          | H <sub>vert</sub> =          | 6.00                     | 6.00  | inches                                   |
| Height of Curb Orifice Throat in Inches                                      |                          | H <sub>throat</sub> =        | 6.00                     | 6.00  | inches                                   |
| Angle of Throat (see USDCM Figure ST-5)                                      |                          | Theta =                      | 63.40                    | 63.40 | degrees                                  |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         |                          | W <sub>p</sub> =             | 1.00                     | 1.00  | feet                                     |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               |                          | C <sub>l</sub> (C) =         | 0.10                     | 0.10  |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        |                          | C <sub>w</sub> (C) =         | 3.60                     | 3.60  |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 |                          | C <sub>o</sub> (C) =         | 0.67                     | 0.67  |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           |                          |                              | MINOR                    | MAJOR |                                          |
| Depth for Grate Midwidth                                                     |                          | d <sub>Grate</sub> =         | N/A                      | N/A   | ft                                       |
| Depth for Curb Opening Weir Equation                                         |                          | d <sub>Curb</sub> =          | 0.24                     | 0.24  | ft                                       |
| Combination Inlet Performance Reduction Factor for Long Inlets               |                          | RF <sub>Combination</sub> =  | 0.50                     | 0.50  |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Curb</sub> =         | 1.00                     | 1.00  |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Grate</sub> =        | N/A                      | N/A   |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         |                          |                              | MINOR                    | MAJOR |                                          |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)                   |                          | Q <sub>a</sub> =             | 2.6                      | 2.6   | cfs                                      |
|                                                                              |                          | Q <sub>PEAK REQUIRED</sub> = | 0.7                      | 1.3   | cfs                                      |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

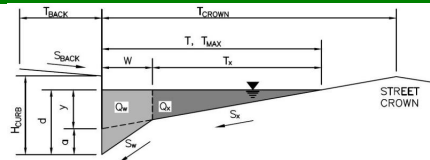
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet A01

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.028 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.000 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm | Major Storm |
|-------------|-------------|-------------|
| $T_{MAX} =$ | 13.0        | 13.0        |
| $d_{MAX} =$ | 6.0         | 6.0         |

☐ ☐

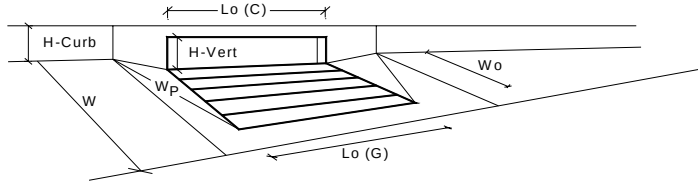
$Q_{allow} =$ 

| Minor Storm | Major Storm |
|-------------|-------------|
| SUMP        | SUMP        |

 cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   |                          | MINOR                        |                          | MAJOR |         |                                          |
|------------------------------------------------------------------------------|--------------------------|------------------------------|--------------------------|-------|---------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening | Type =                       | CDOT Type R Curb Opening |       |         |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) |                          | a <sub>local</sub> =         | 3.00                     | 3.00  | inches  |                                          |
| Number of Unit Inlets (Grate or Curb Opening)                                |                          | No =                         | 1                        | 1     |         |                                          |
| Water Depth at Flowline (outside of local depression)                        |                          | Ponding Depth =              | 5.1                      | 5.1   | inches  |                                          |
| <b>Grate Information</b>                                                     |                          |                              | MINOR                    | MAJOR |         | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       |                          | L <sub>o</sub> (G) =         | N/A                      | N/A   | feet    |                                          |
| Width of a Unit Grate                                                        |                          | W <sub>o</sub> =             | N/A                      | N/A   | feet    |                                          |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    |                          | A <sub>ratio</sub> =         | N/A                      | N/A   |         |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               |                          | C <sub>l</sub> (G) =         | N/A                      | N/A   |         |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           |                          | C <sub>w</sub> (G) =         | N/A                      | N/A   |         |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        |                          | C <sub>o</sub> (G) =         | N/A                      | N/A   |         |                                          |
| <b>Curb Opening Information</b>                                              |                          |                              | MINOR                    | MAJOR |         |                                          |
| Length of a Unit Curb Opening                                                |                          | L <sub>o</sub> (C) =         | 5.00                     | 5.00  | feet    |                                          |
| Height of Vertical Curb Opening in Inches                                    |                          | H <sub>vert</sub> =          | 6.00                     | 6.00  | inches  |                                          |
| Height of Curb Orifice Throat in Inches                                      |                          | H <sub>throat</sub> =        | 6.00                     | 6.00  | inches  |                                          |
| Angle of Throat (see USDCM Figure ST-5)                                      |                          | Theta =                      | 63.40                    | 63.40 | degrees |                                          |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         |                          | W <sub>p</sub> =             | 1.00                     | 1.00  | feet    |                                          |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               |                          | C <sub>l</sub> (C) =         | 0.10                     | 0.10  |         |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        |                          | C <sub>w</sub> (C) =         | 3.60                     | 3.60  |         |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 |                          | C <sub>o</sub> (C) =         | 0.67                     | 0.67  |         |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           |                          |                              | MINOR                    | MAJOR |         |                                          |
| Depth for Grate Midwidth                                                     |                          | d <sub>Grate</sub> =         | N/A                      | N/A   | ft      |                                          |
| Depth for Curb Opening Weir Equation                                         |                          | d <sub>Curb</sub> =          | 0.34                     | 0.34  | ft      |                                          |
| Combination Inlet Performance Reduction Factor for Long Inlets               |                          | RF <sub>Combination</sub> =  | 0.65                     | 0.65  |         |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Curb</sub> =         | 1.00                     | 1.00  |         |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Grate</sub> =        | N/A                      | N/A   |         |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         |                          |                              | MINOR                    | MAJOR |         |                                          |
|                                                                              |                          | Q <sub>a</sub> =             | 4.3                      | 4.3   | cfs     |                                          |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)                   |                          | Q <sub>PEAK REQUIRED</sub> = | 0.7                      | 2.2   | cfs     |                                          |

# ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

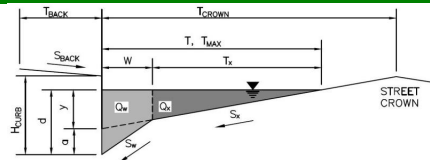
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B05



## Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

$T_{BACK} = 0.0$  ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} = 0.012$

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 13.0$  ft  
 $W = 1.00$  ft  
 $S_x = 0.020$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.017$  ft/ft  
 $n_{STREET} = 0.012$

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 8.7         | 8.7         | cfs |

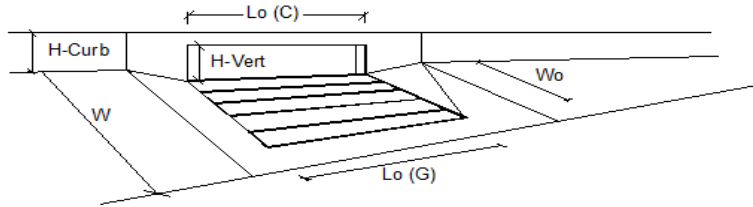
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'



# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          | CDOT Type R Curb Opening | MINOR         | MAJOR                    |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL}$ = | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | $N_0$ =       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_0$ =       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than W, Gutter Width)                      |                          | $W_0$ =       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G$ =     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C$ =     | 0.10 0.10                |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                                   |                          | $Q$ =         | 0.7 1.3 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b$ =       | 0.0 0.1 cfs              |
| Capture Percentage = $Q_i/Q_0$ =                                                    |                          | $C\%$ =       | 100 90 %                 |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

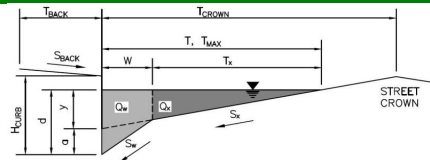
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B03

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.019 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.038 ft/ft  
 $n_{STREET} =$  0.012

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

**MINOR STORM** Allowable Capacity is based on Spread Criterion**MAJOR STORM** Allowable Capacity is based on Spread Criterion

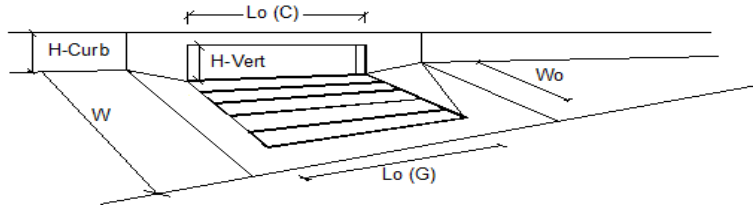
$Q_{allow} =$  Minor Storm Major Storm  
 12.0 12.0 cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          | CDOT Type R Curb Opening | MINOR         | MAJOR                    |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL} =$ | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | $N_0 =$       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_0 =$       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than W, Gutter Width)                      |                          | $W_0 =$       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G =$     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C =$     | 0.10 0.10                |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                                   |                          | $Q =$         | 0.7 1.2 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b =$       | 0.0 0.1 cfs              |
| Capture Percentage = $Q_i/Q_0 =$                                                    |                          | $C\% =$       | 100 93 %                 |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

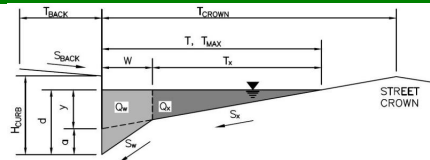
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B08

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.000 ft/ft  
 $n_{STREET} =$  0.012

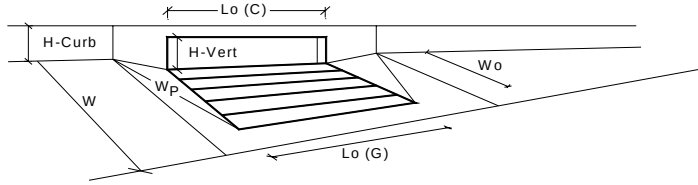
|             | Minor Storm | Major Storm |        |
|-------------|-------------|-------------|--------|
| $T_{MAX} =$ | 13.0        | 13.0        | ft     |
| $d_{MAX} =$ | 6.0         | 9.0         | inches |

☐ ☐

|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | SUMP        | SUMP        | cfs |

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input)                                                   |                          | MINOR                        |                          | MAJOR |         |                                          |
|------------------------------------------------------------------------------|--------------------------|------------------------------|--------------------------|-------|---------|------------------------------------------|
| Type of Inlet                                                                | CDOT Type R Curb Opening | Type =                       | CDOT Type R Curb Opening |       |         |                                          |
| Local Depression (additional to continuous gutter depression 'a' from above) |                          | a <sub>local</sub> =         | 3.00                     | 3.00  | inches  |                                          |
| Number of Unit Inlets (Grate or Curb Opening)                                |                          | No =                         | 1                        | 1     |         |                                          |
| Water Depth at Flowline (outside of local depression)                        |                          | Ponding Depth =              | 3.9                      | 3.9   | inches  |                                          |
| <b>Grate Information</b>                                                     |                          |                              | MINOR                    | MAJOR |         | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate                                                       |                          | L <sub>o</sub> (G) =         | N/A                      | N/A   | feet    |                                          |
| Width of a Unit Grate                                                        |                          | W <sub>o</sub> =             | N/A                      | N/A   | feet    |                                          |
| Area Opening Ratio for a Grate (typical values 0.15-0.90)                    |                          | A <sub>ratio</sub> =         | N/A                      | N/A   |         |                                          |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70)               |                          | C <sub>l</sub> (G) =         | N/A                      | N/A   |         |                                          |
| Grate Weir Coefficient (typical value 2.15 - 3.60)                           |                          | C <sub>w</sub> (G) =         | N/A                      | N/A   |         |                                          |
| Grate Orifice Coefficient (typical value 0.60 - 0.80)                        |                          | C <sub>o</sub> (G) =         | N/A                      | N/A   |         |                                          |
| <b>Curb Opening Information</b>                                              |                          |                              | MINOR                    | MAJOR |         |                                          |
| Length of a Unit Curb Opening                                                |                          | L <sub>o</sub> (C) =         | 5.00                     | 5.00  | feet    |                                          |
| Height of Vertical Curb Opening in Inches                                    |                          | H <sub>vert</sub> =          | 6.00                     | 6.00  | inches  |                                          |
| Height of Curb Orifice Throat in Inches                                      |                          | H <sub>throat</sub> =        | 6.00                     | 6.00  | inches  |                                          |
| Angle of Throat (see USDCM Figure ST-5)                                      |                          | Theta =                      | 63.40                    | 63.40 | degrees |                                          |
| Side Width for Depression Pan (typically the gutter width of 2 feet)         |                          | W <sub>p</sub> =             | 1.00                     | 1.00  | feet    |                                          |
| Clogging Factor for a Single Curb Opening (typical value 0.10)               |                          | C <sub>l</sub> (C) =         | 0.10                     | 0.10  |         |                                          |
| Curb Opening Weir Coefficient (typical value 2.3-3.7)                        |                          | C <sub>w</sub> (C) =         | 3.60                     | 3.60  |         |                                          |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)                 |                          | C <sub>o</sub> (C) =         | 0.67                     | 0.67  |         |                                          |
| <b>Low Head Performance Reduction (Calculated)</b>                           |                          |                              | MINOR                    | MAJOR |         |                                          |
| Depth for Grate Midwidth                                                     |                          | d <sub>Grate</sub> =         | N/A                      | N/A   | ft      |                                          |
| Depth for Curb Opening Weir Equation                                         |                          | d <sub>Curb</sub> =          | 0.24                     | 0.24  | ft      |                                          |
| Combination Inlet Performance Reduction Factor for Long Inlets               |                          | RF <sub>Combination</sub> =  | 0.50                     | 0.50  |         |                                          |
| Curb Opening Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Curb</sub> =         | 1.00                     | 1.00  |         |                                          |
| Grated Inlet Performance Reduction Factor for Long Inlets                    |                          | RF <sub>Grate</sub> =        | N/A                      | N/A   |         |                                          |
| <b>Total Inlet Interception Capacity (assumes clogged condition)</b>         |                          |                              | MINOR                    | MAJOR |         |                                          |
|                                                                              |                          | Q <sub>a</sub> =             | 2.6                      | 2.6   | cfs     |                                          |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)                   |                          | Q <sub>PEAK REQUIRED</sub> = | 0.5                      | 0.9   | cfs     |                                          |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

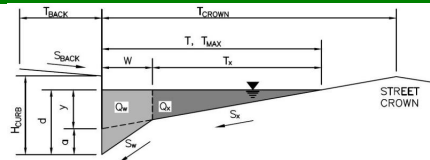
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet B00

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.014 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.024 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

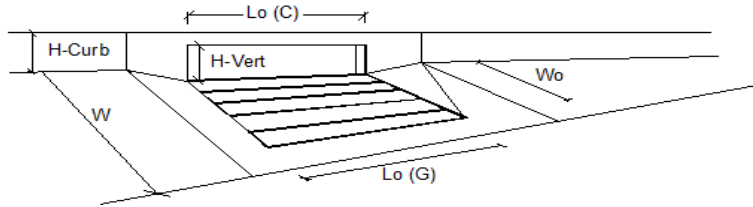
|               | Minor Storm | Major Storm |     |
|---------------|-------------|-------------|-----|
| $Q_{allow} =$ | 5.9         | 5.9         | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input)                                                          |                          | MINOR         | MAJOR                    |
|-------------------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                                       | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')                   |                          | $a_{LOCAL} =$ | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                          |                          | $N_0 =$       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                               |                          | $L_0 =$       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than W, Gutter Width)                      |                          | $W_0 =$       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)                  |                          | $C_F G =$     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)           |                          | $C_F C =$     | 0.10 0.10                |
| <b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b> |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                                   |                          | $Q =$         | 0.3 1.6 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                                  |                          | $Q_b =$       | 0.0 0.6 cfs              |
| Capture Percentage = $Q_i/Q_0 =$                                                    |                          | $C\% =$       | 100 72 %                 |

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

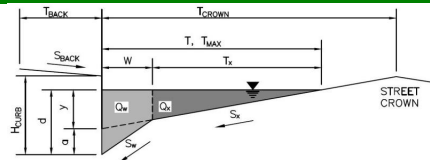
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker &amp; Pine Retail

Inlet ID:

Inlet C01

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

$T_{BACK} =$  0.0 ft  
 $S_{BACK} =$  ft/ft  
 $n_{BACK} =$  0.012

$H_{CURB} =$  6.00 inches  
 $T_{CROWN} =$  13.0 ft  
 $W =$  1.00 ft  
 $S_x =$  0.020 ft/ft  
 $S_w =$  0.083 ft/ft  
 $S_o =$  0.028 ft/ft  
 $n_{STREET} =$  0.012

|             | Minor Storm              | Major Storm              |             |
|-------------|--------------------------|--------------------------|-------------|
| $T_{MAX} =$ | 13.0                     | 13.0                     | ft          |
| $d_{MAX} =$ | 6.0                      | 6.0                      | inches      |
|             | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

**MINOR STORM** Allowable Capacity is based on Spread Criterion**MAJOR STORM** Allowable Capacity is based on Spread Criterion

$Q_{allow} =$ 

| Minor Storm | Major Storm |     |
|-------------|-------------|-----|
| 11.3        | 11.3        | cfs |

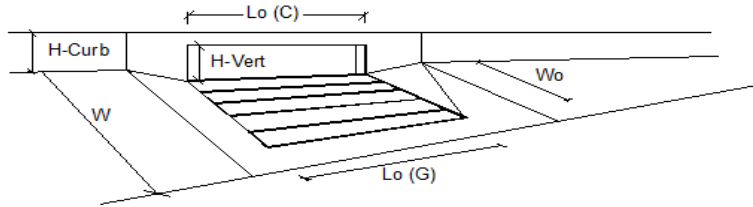
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'



# INLET ON A CONTINUOUS GRADE

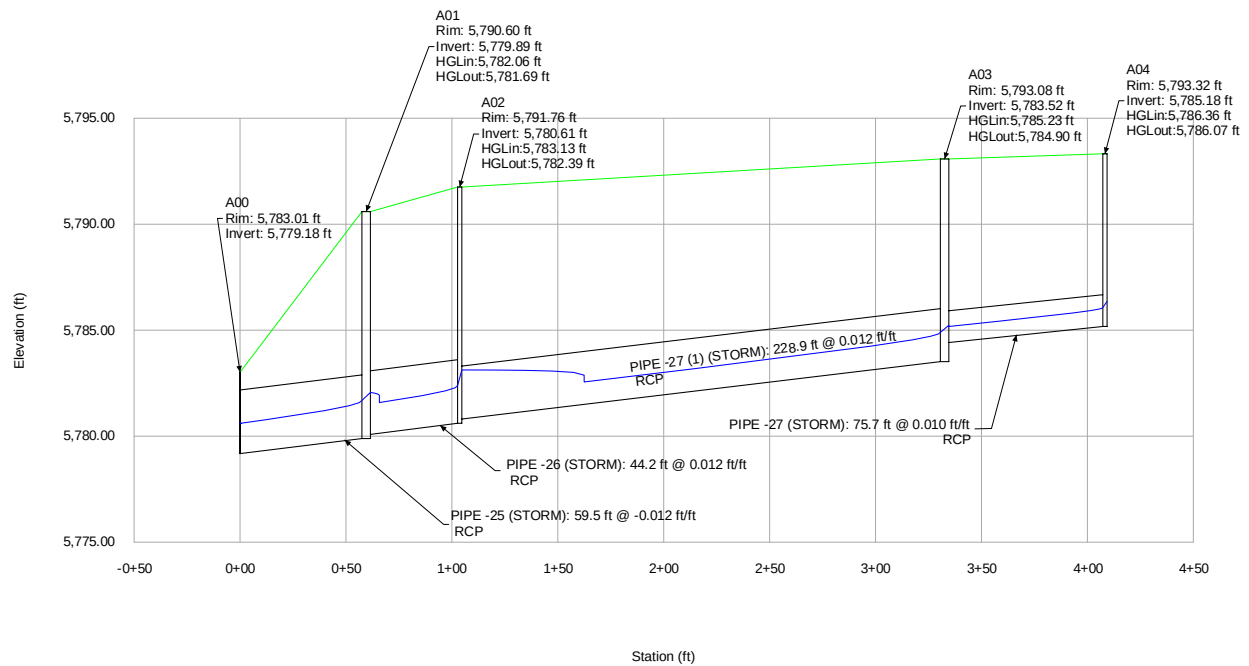
Version 4.05 Released March 2017



| Design Information (Input)                                                |                          | MINOR         | MAJOR                    |
|---------------------------------------------------------------------------|--------------------------|---------------|--------------------------|
| Type of Inlet                                                             | CDOT Type R Curb Opening | Type =        | CDOT Type R Curb Opening |
| Local Depression (additional to continuous gutter depression 'a')         |                          | $a_{LOCAL} =$ | 3.0 3.0 inches           |
| Total Number of Units in the Inlet (Grate or Curb Opening)                |                          | $N_0 =$       | 1 1                      |
| Length of a Single Unit Inlet (Grate or Curb Opening)                     |                          | $L_0 =$       | 5.00 5.00 ft             |
| Width of a Unit Grate (cannot be greater than $W$ , Gutter Width)         |                          | $W_0 =$       | N/A N/A ft               |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5)        |                          | $C_F G =$     | N/A N/A                  |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) |                          | $C_F C =$     | 0.10 0.10                |
| Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$            |                          | MINOR         | MAJOR                    |
| Total Inlet Interception Capacity                                         |                          | $Q =$         | 0.9 1.4 cfs              |
| Total Inlet Carry-Over Flow (flow bypassing inlet)                        |                          | $Q_b =$       | 0.0 0.2 cfs              |
| Capture Percentage = $Q_i/Q_0 =$                                          |                          | $C\% =$       | 100 85 %                 |

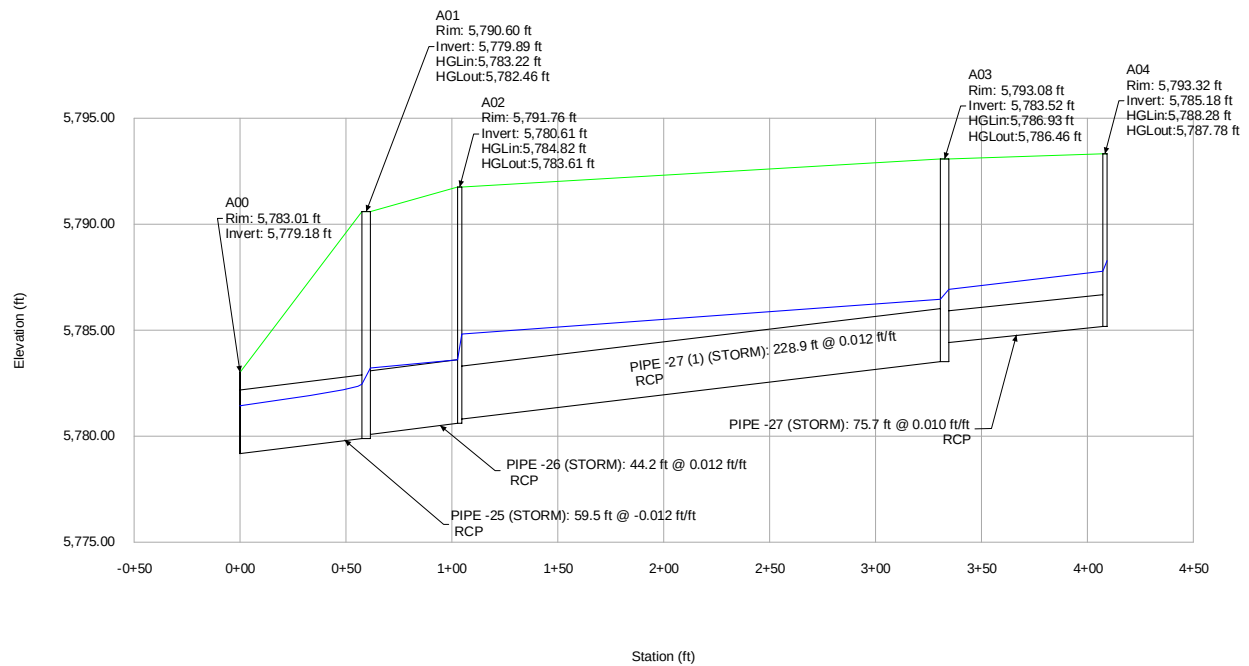
# Profile Report

## Profile Main A (5-Year)

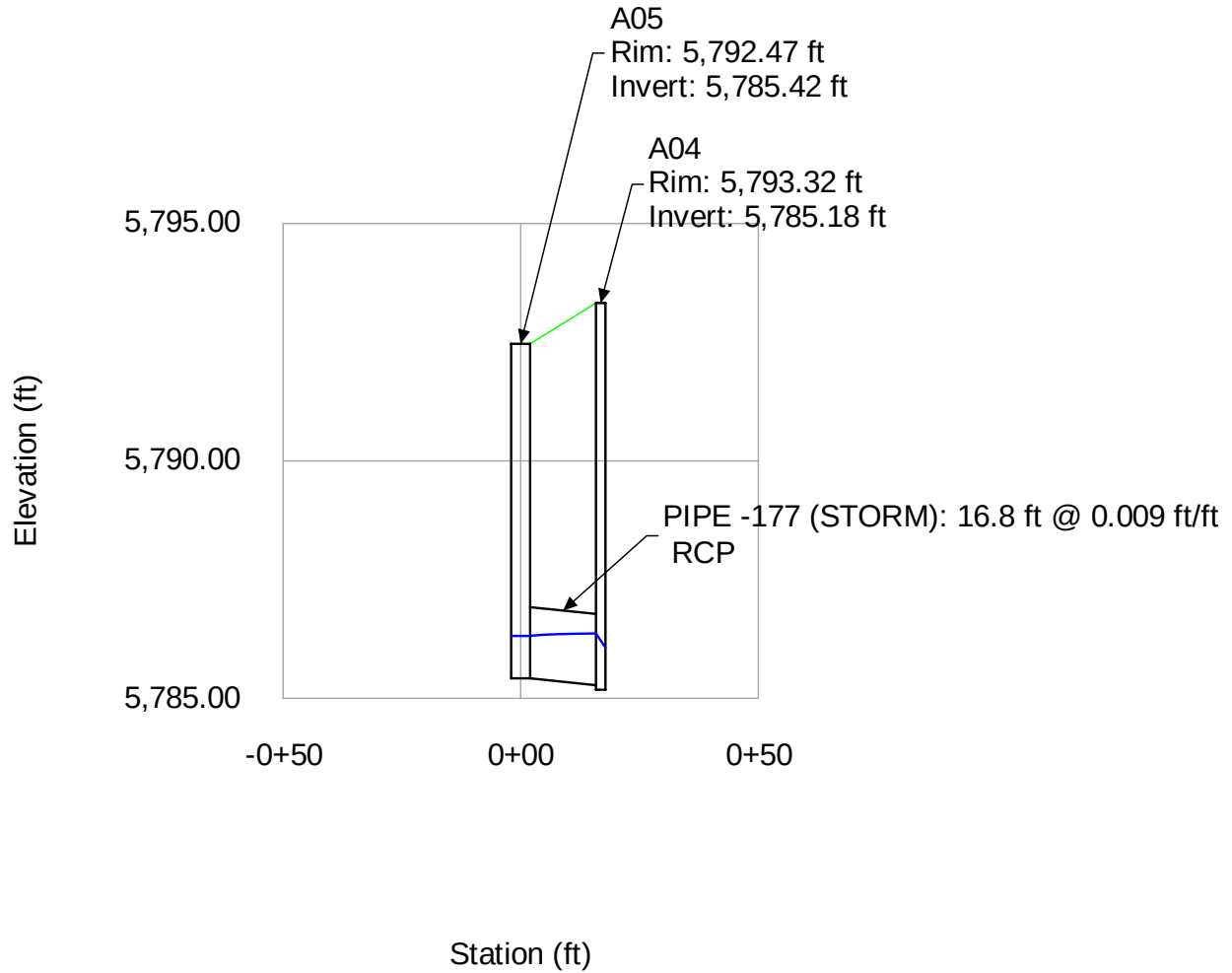


# Profile Report

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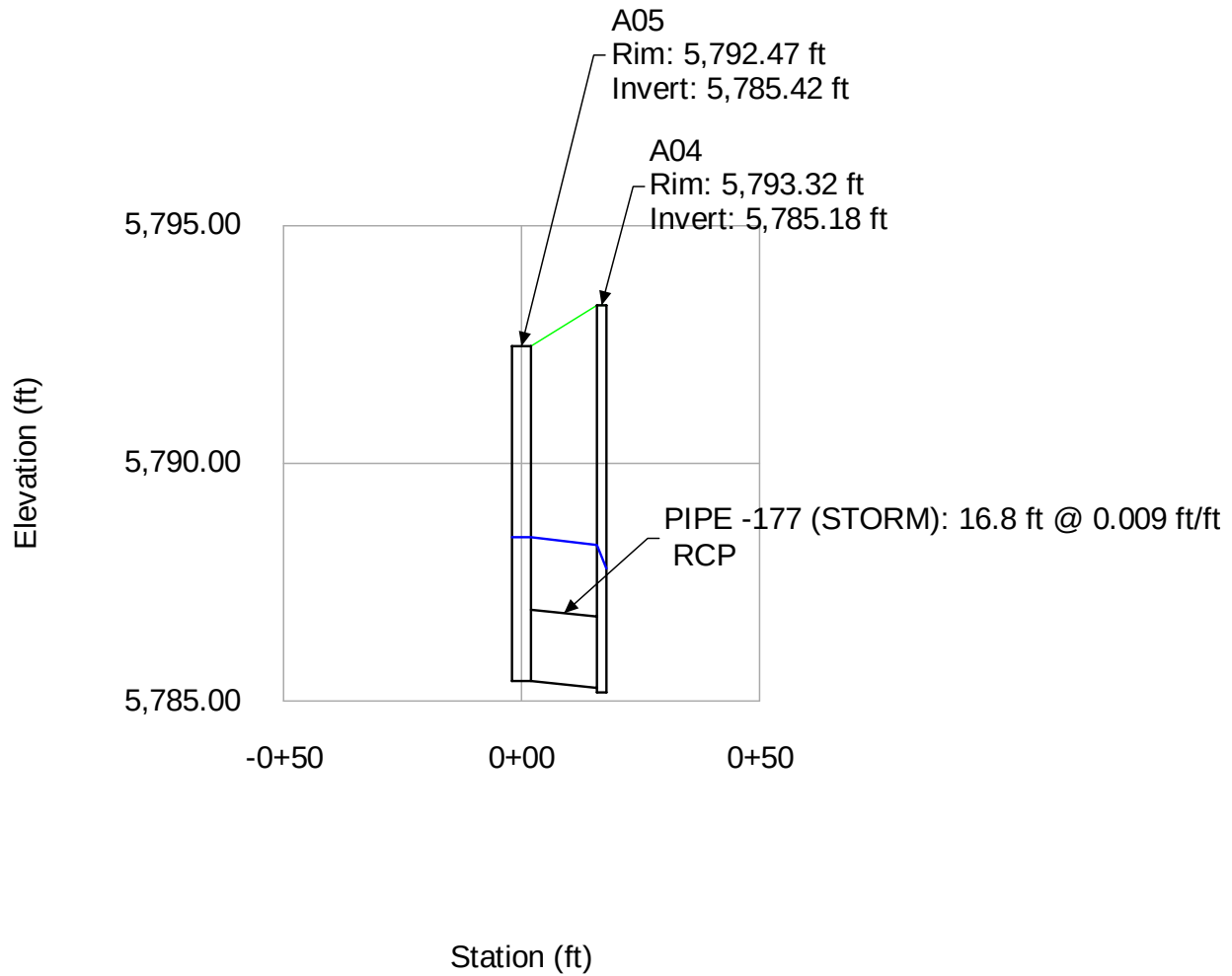


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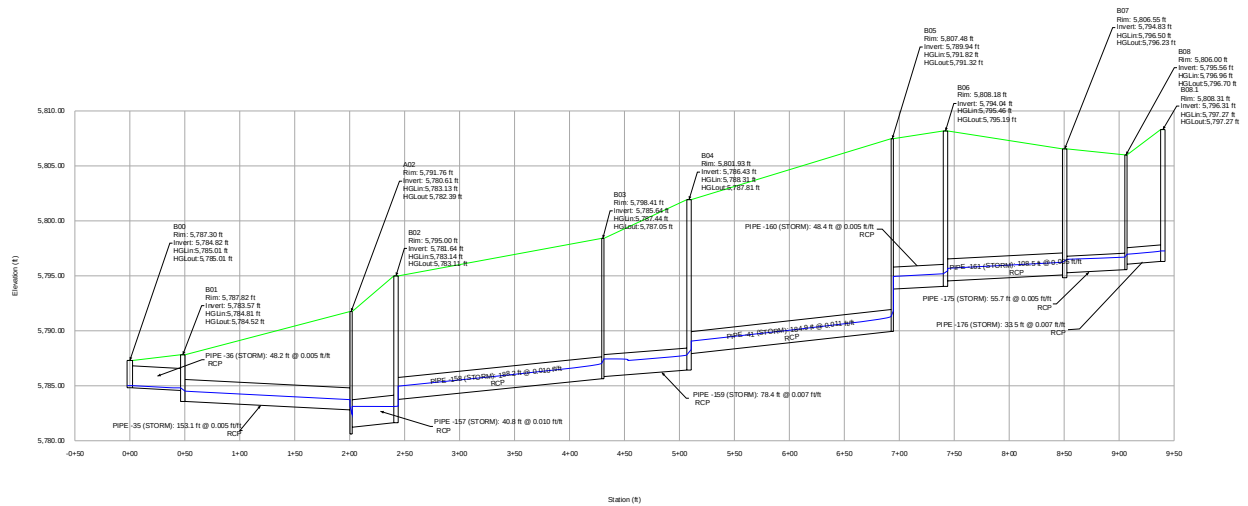


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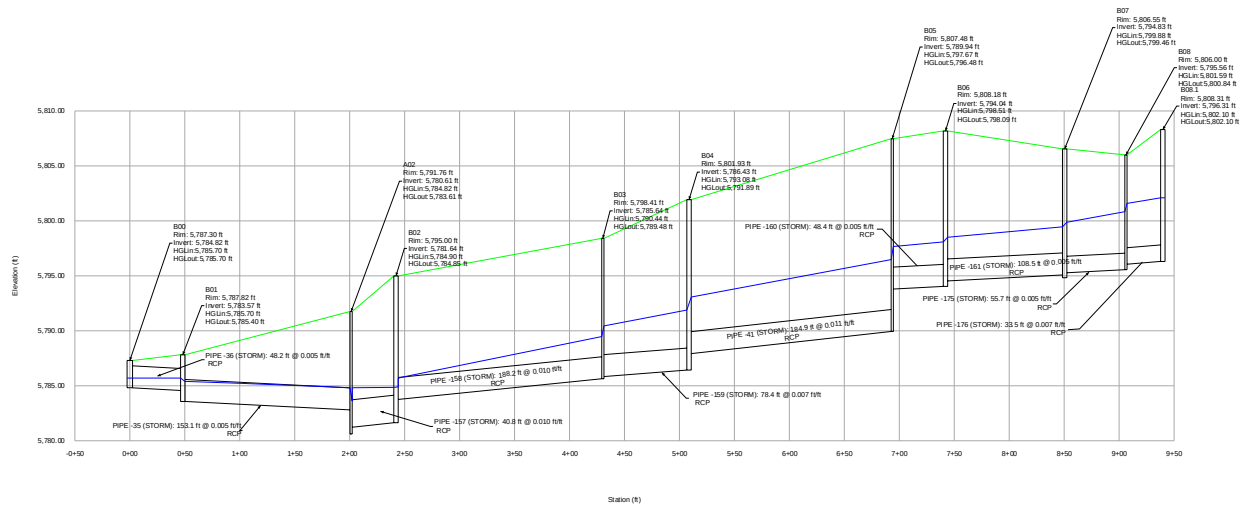


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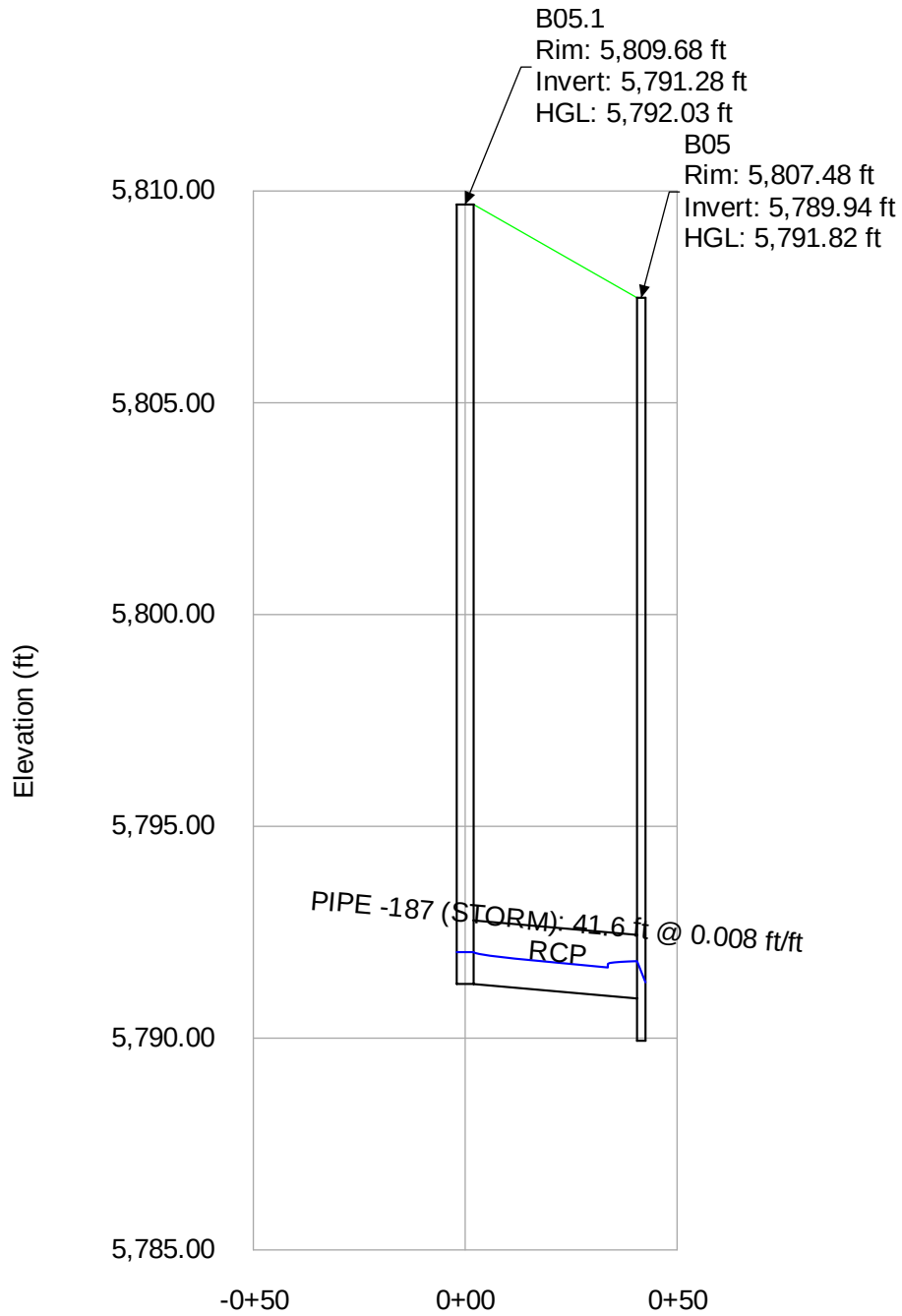


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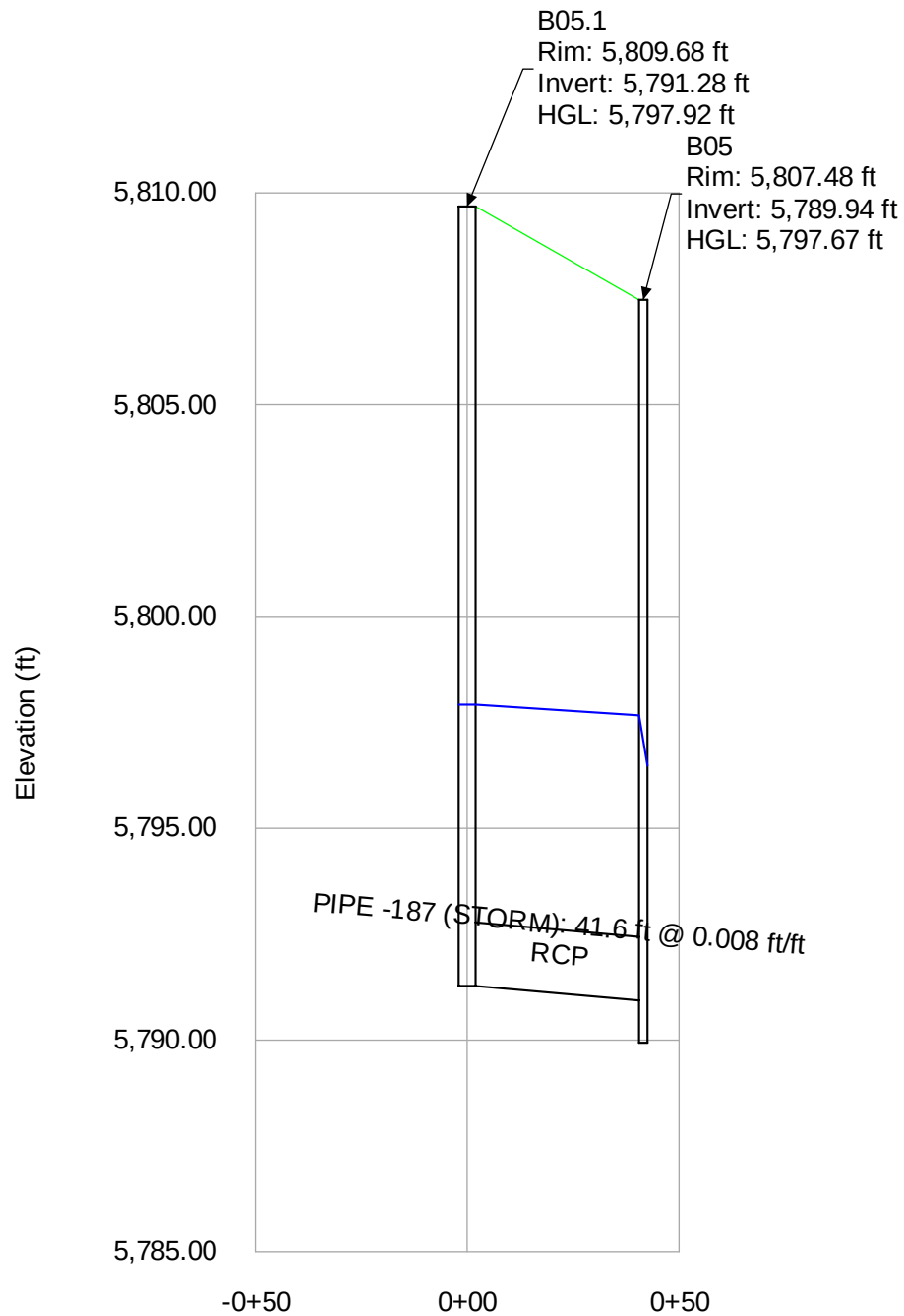


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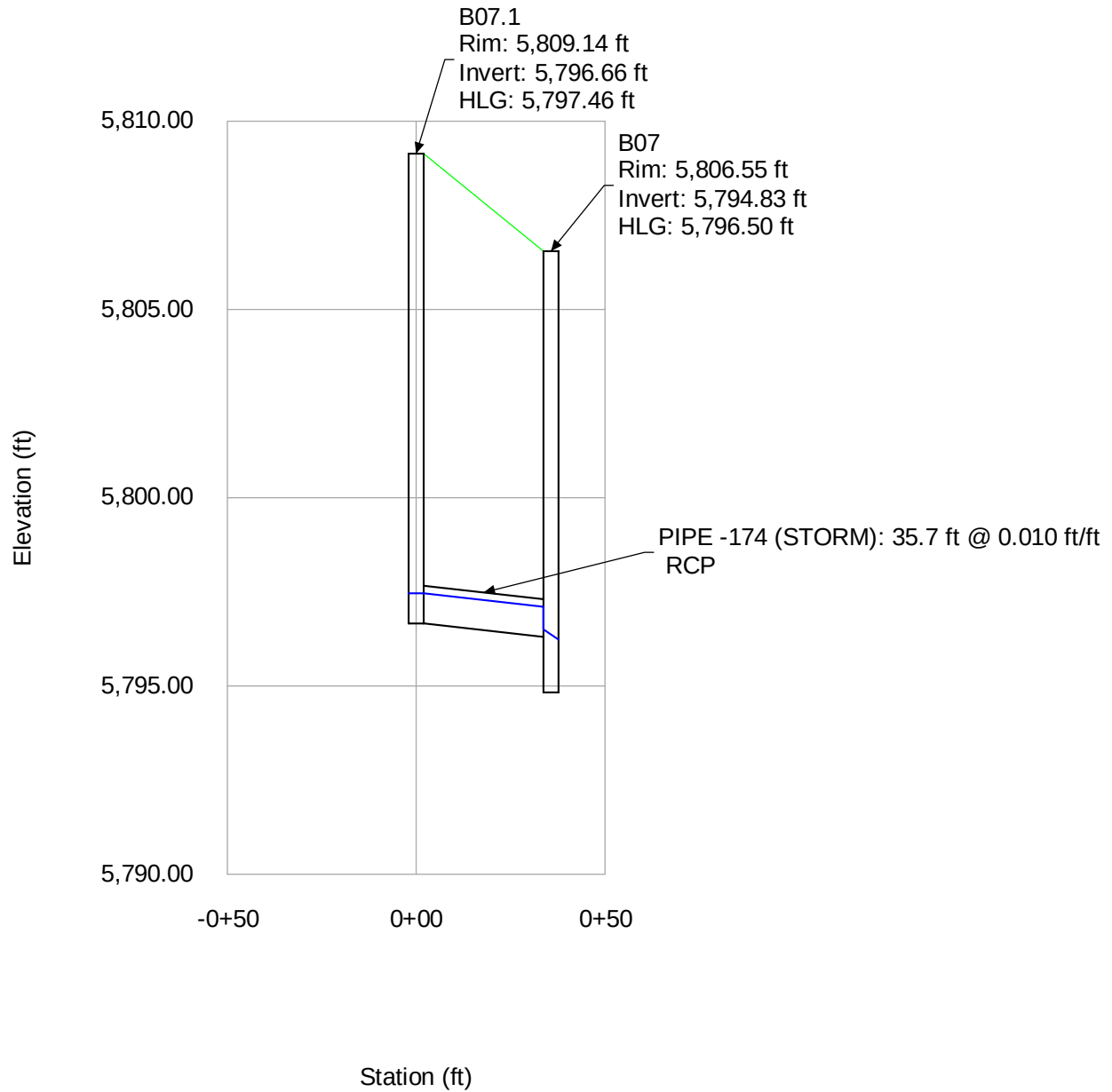




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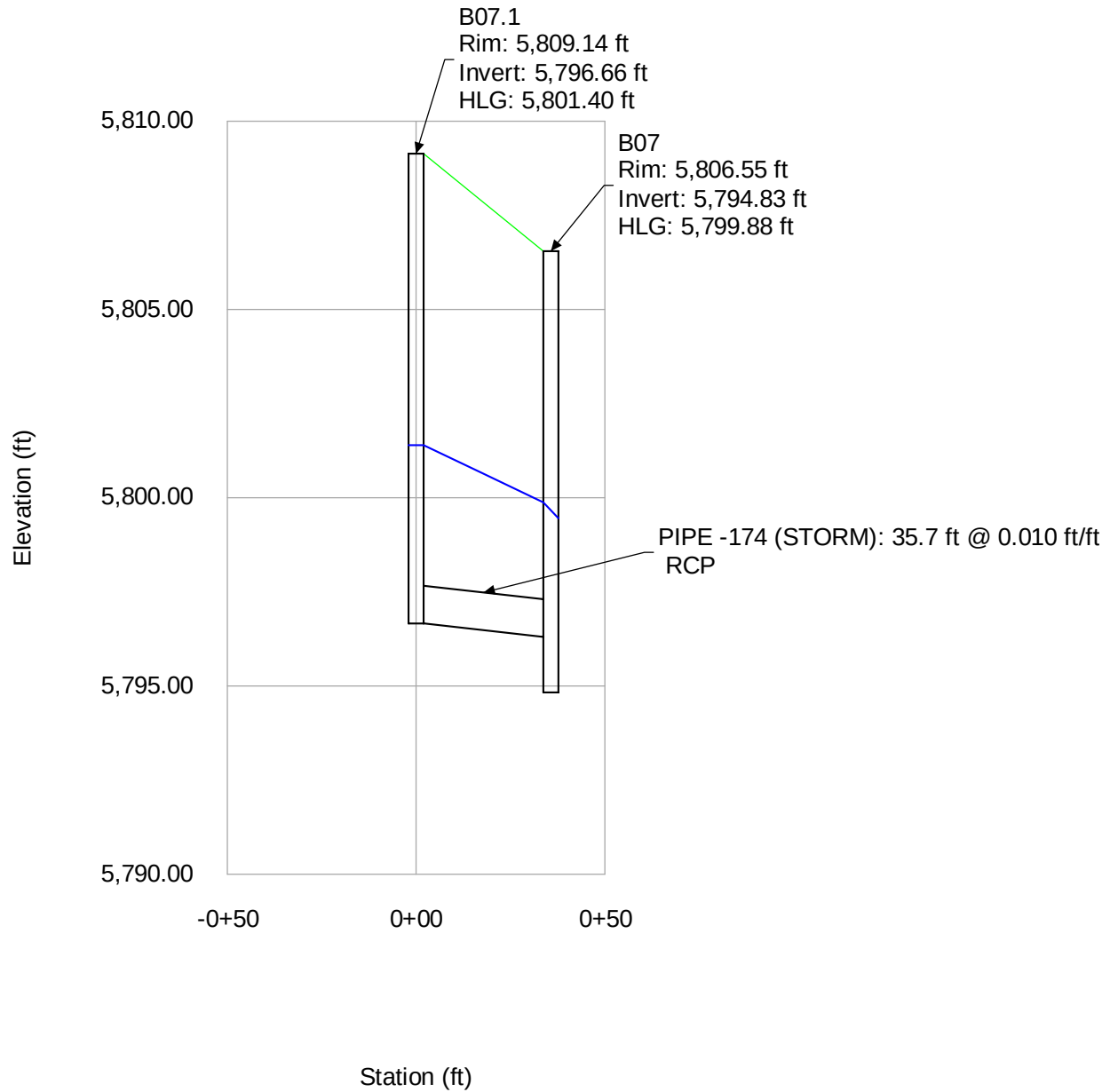


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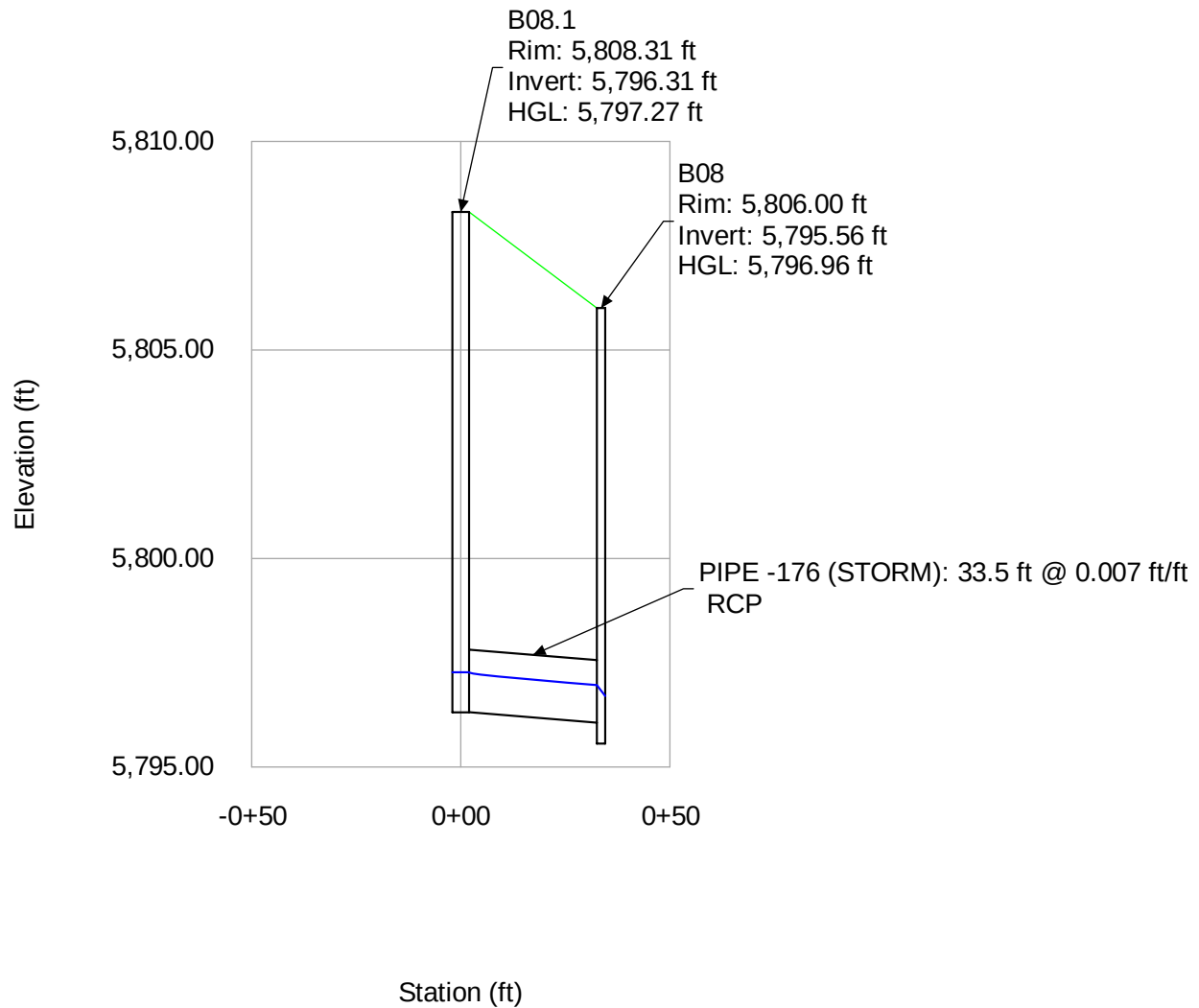
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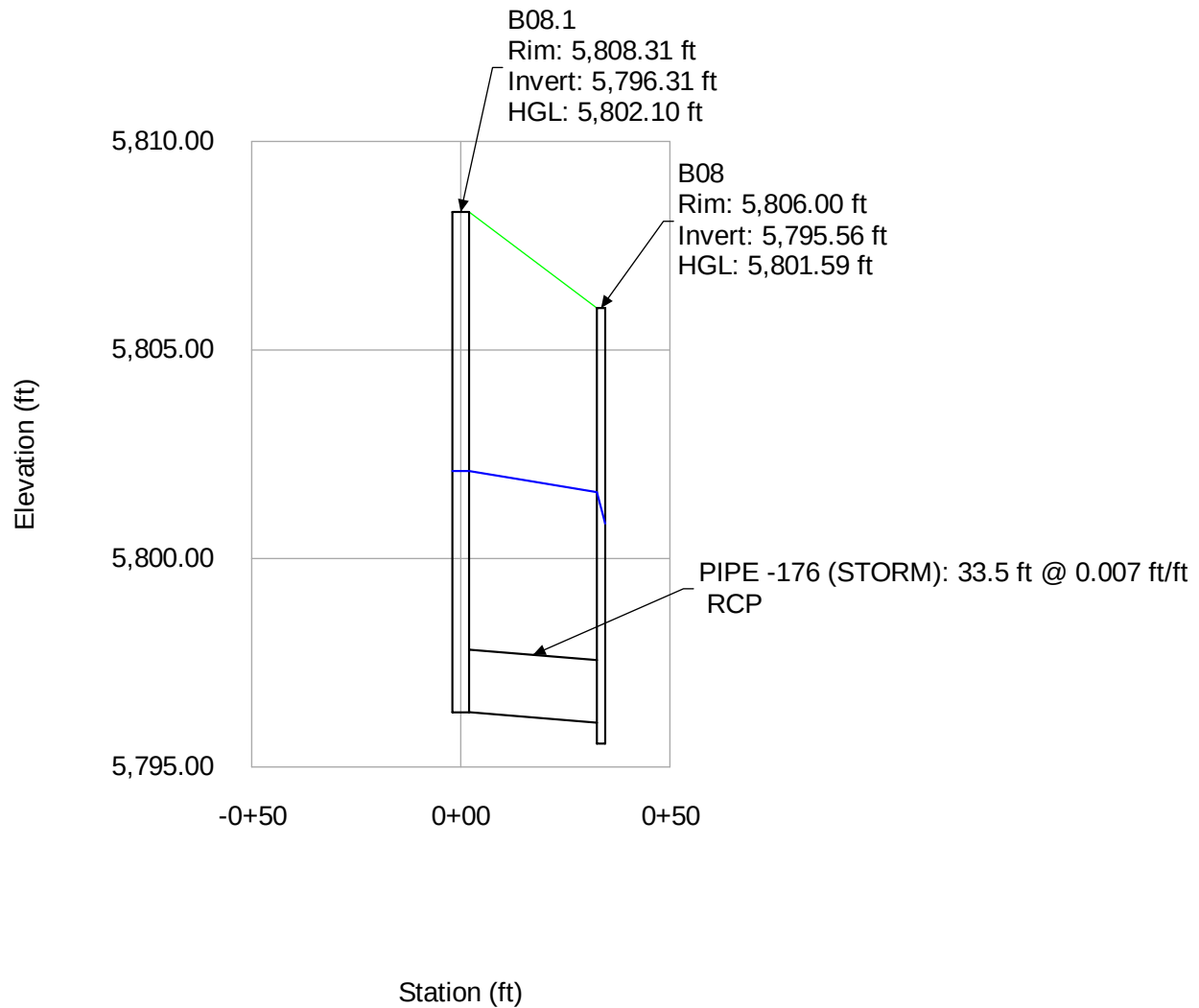
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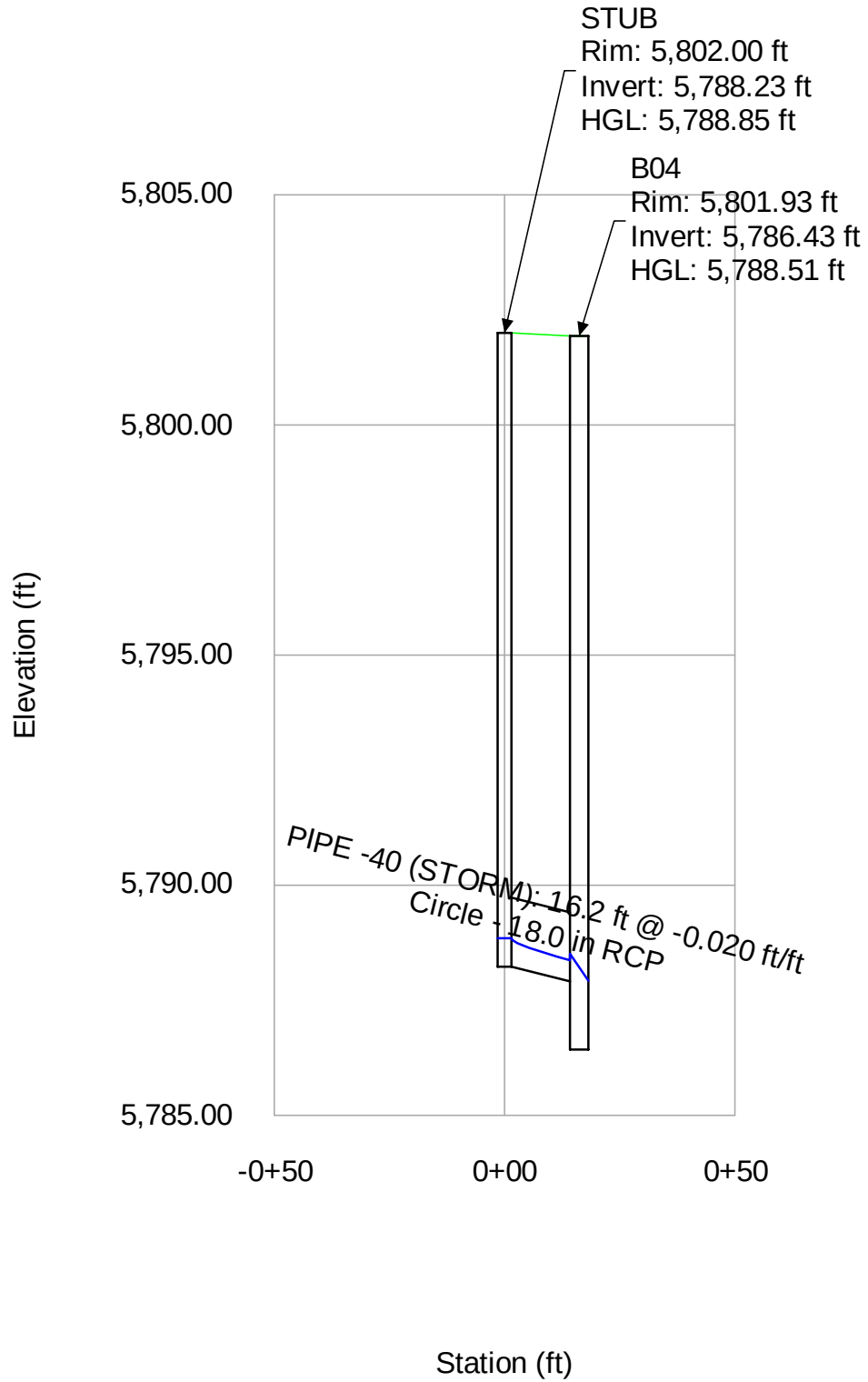


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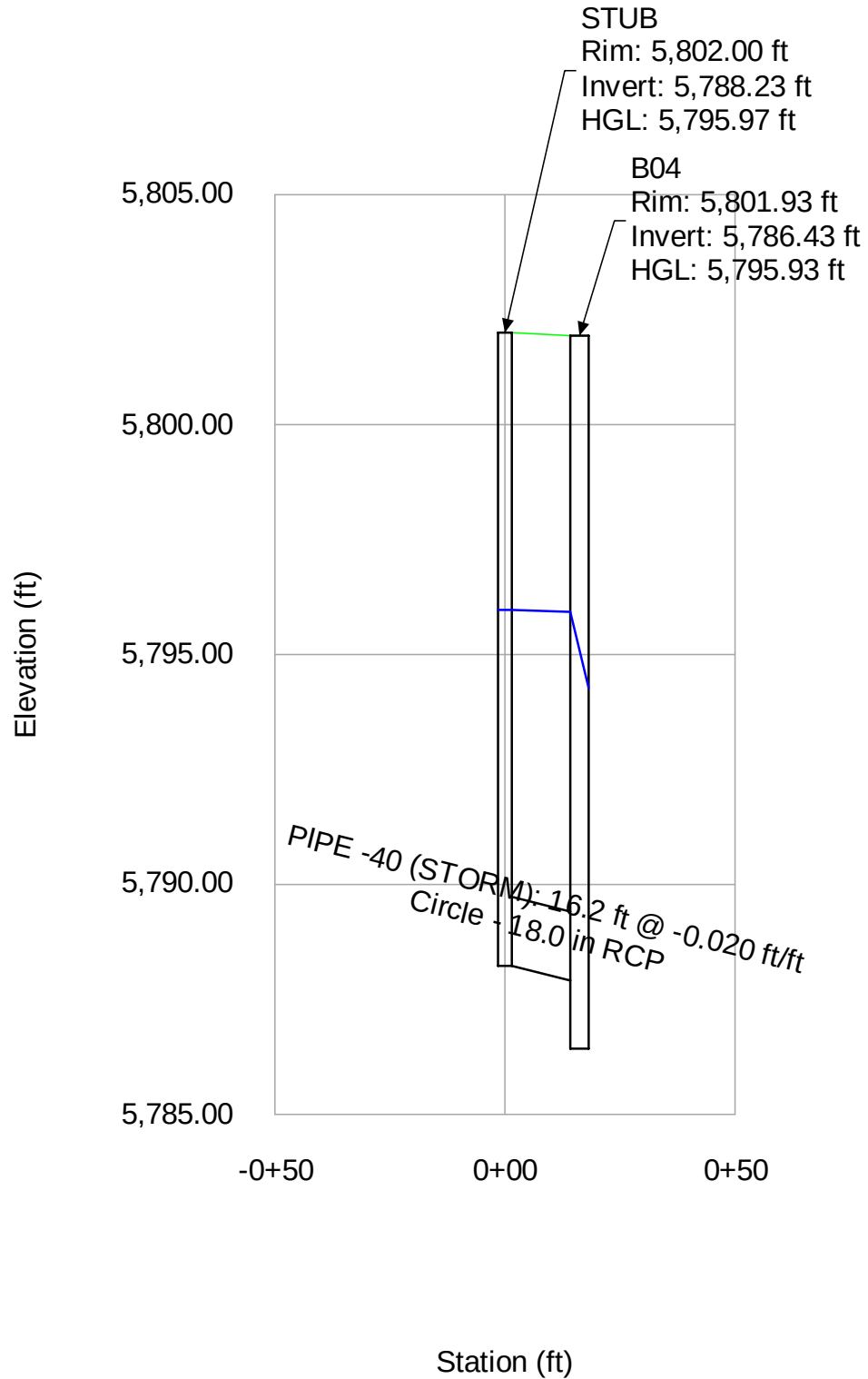
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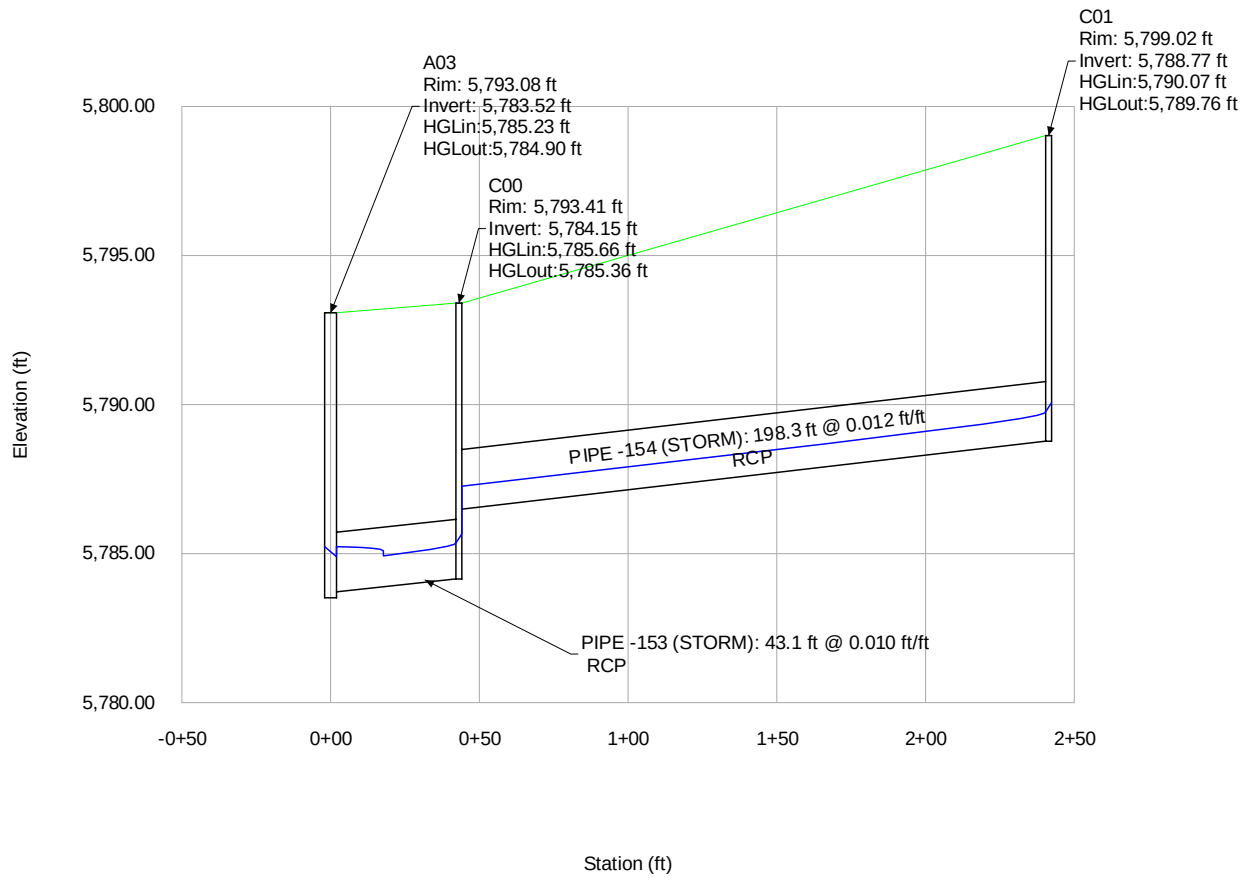
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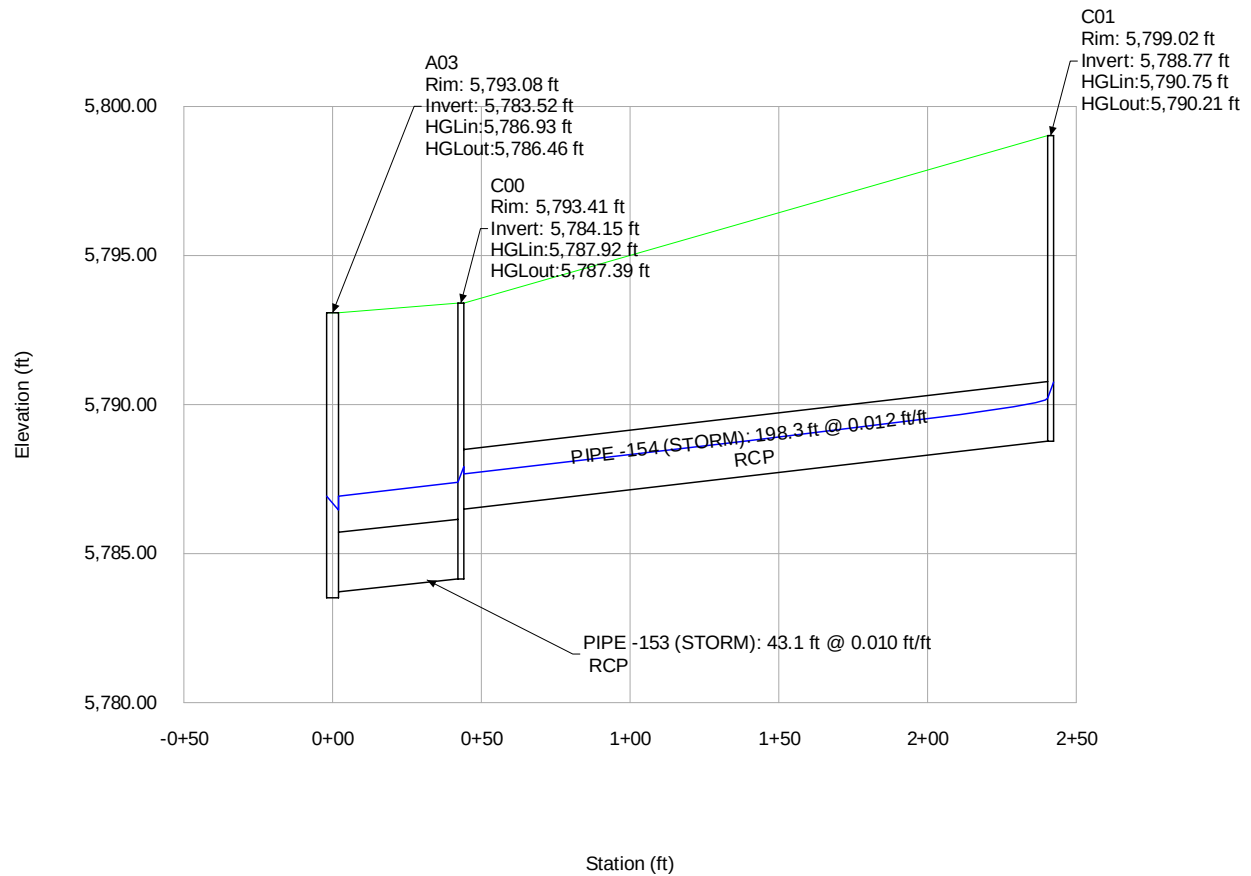
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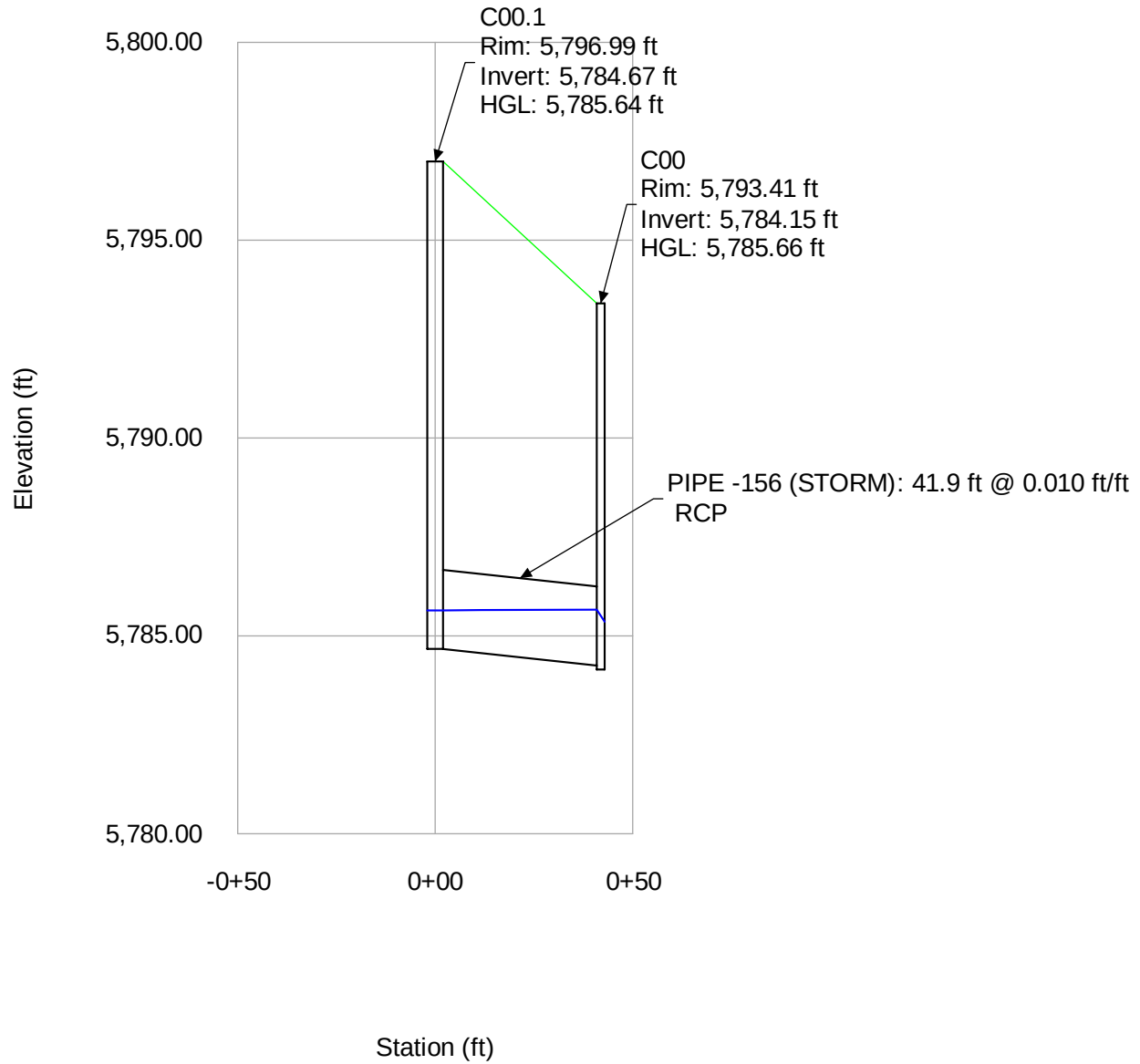
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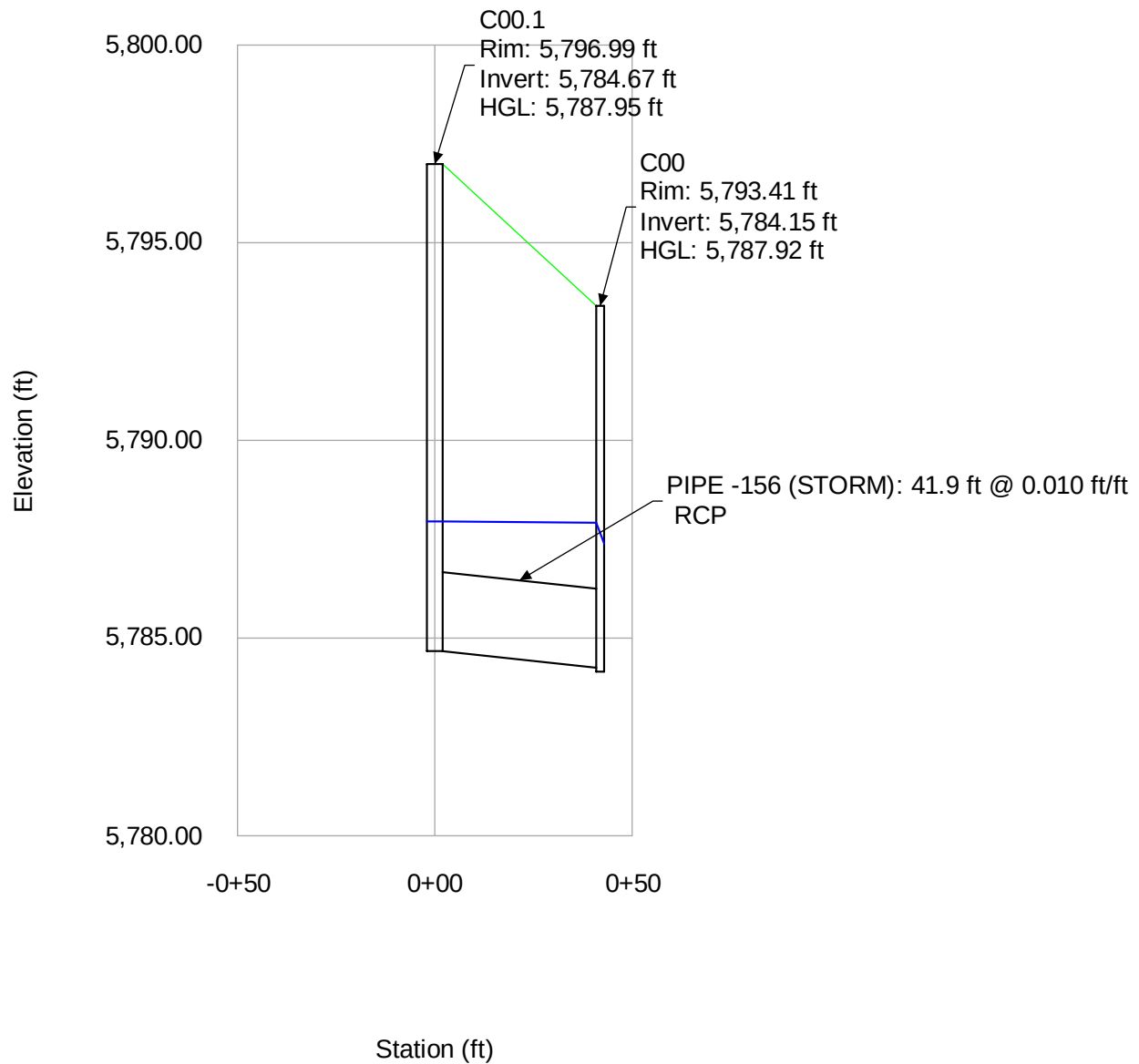
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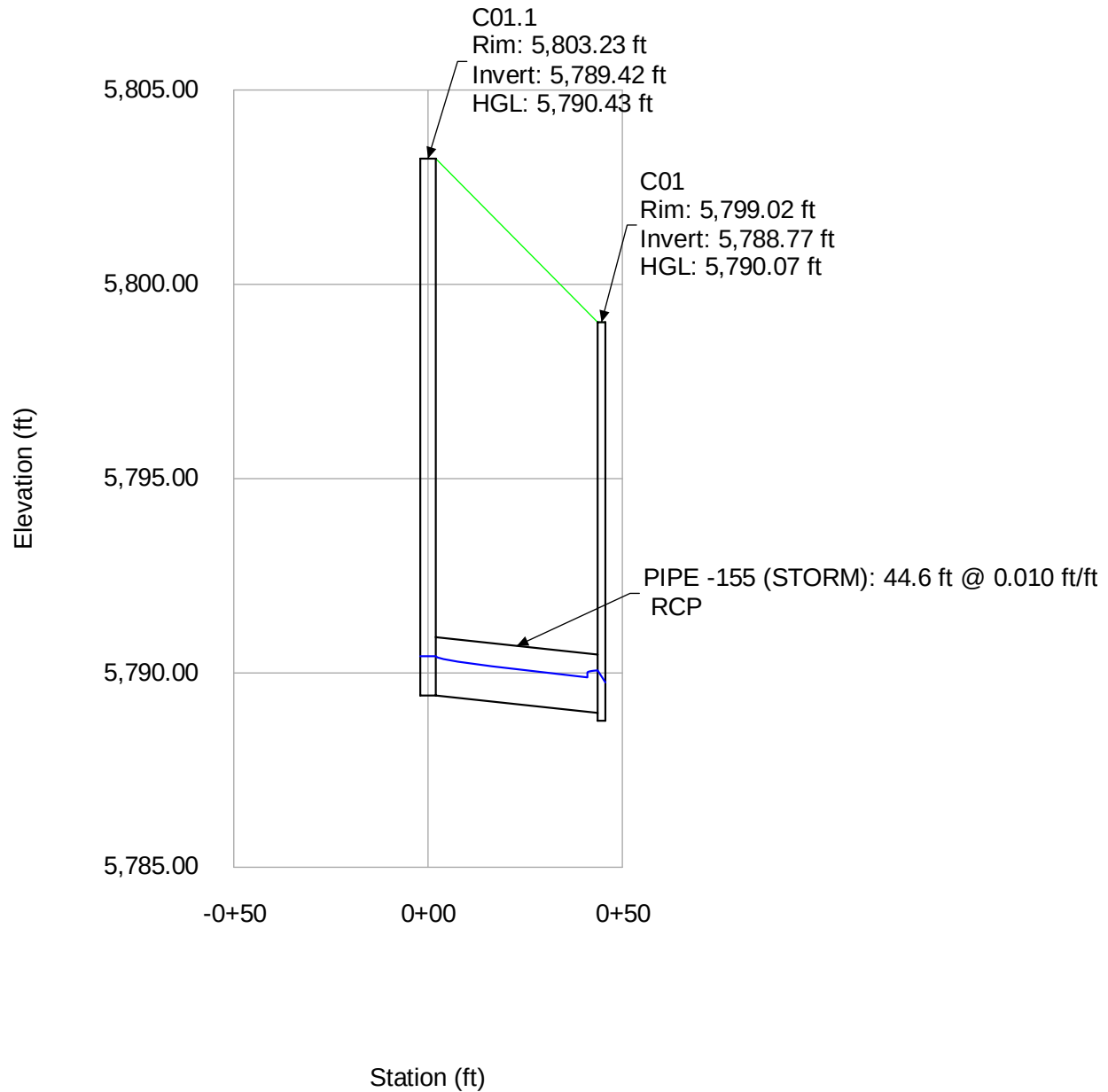
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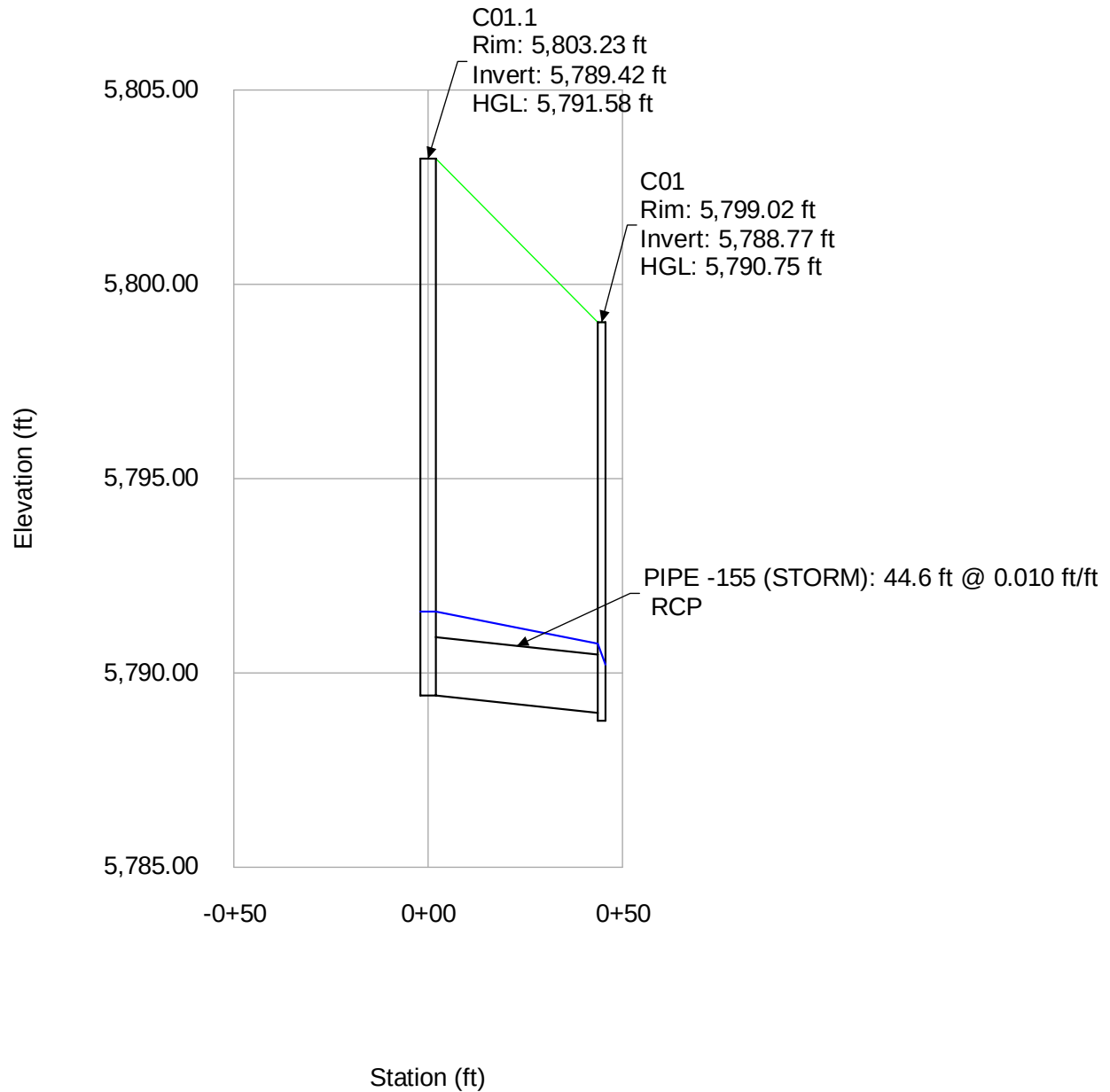
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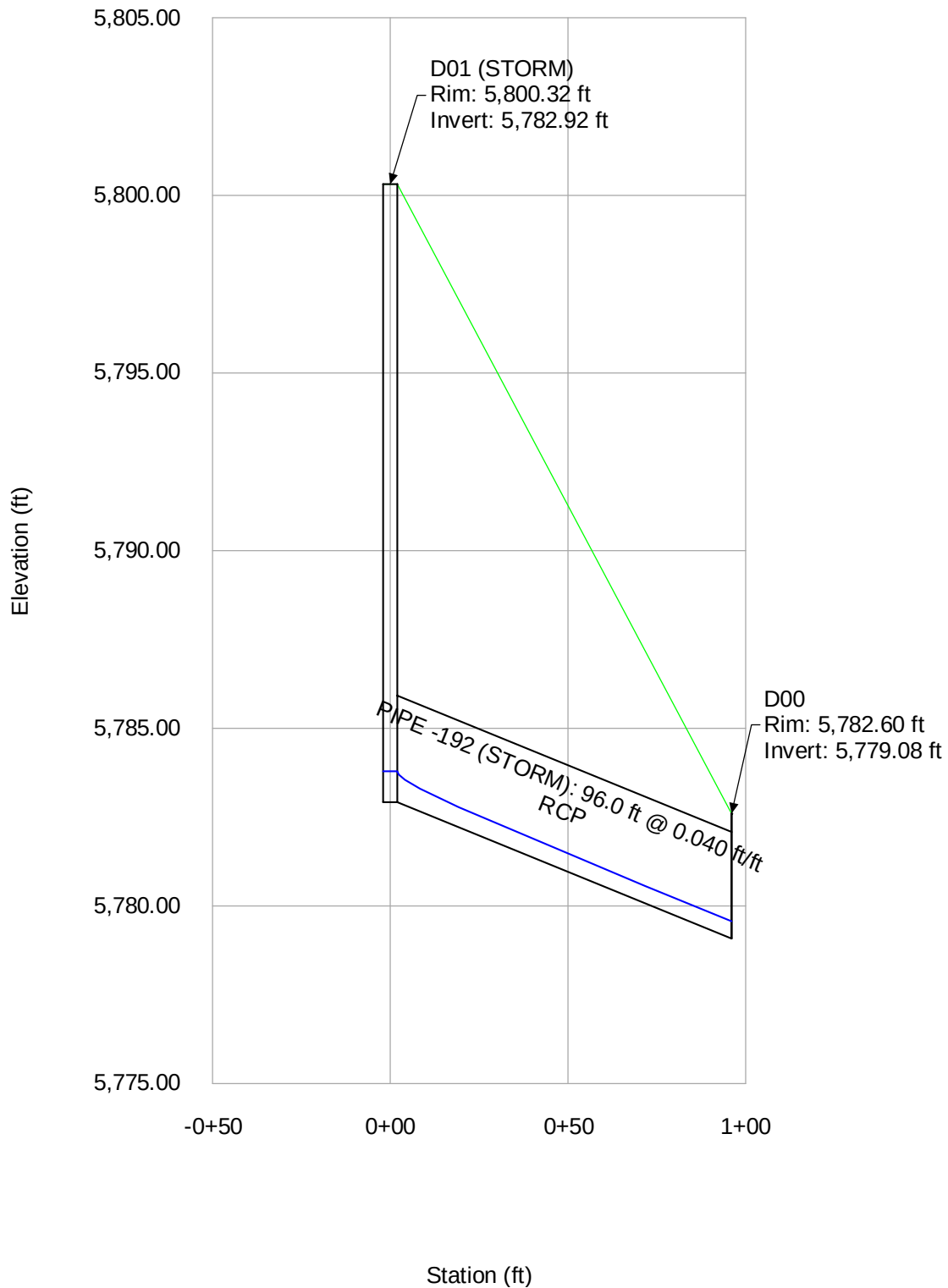


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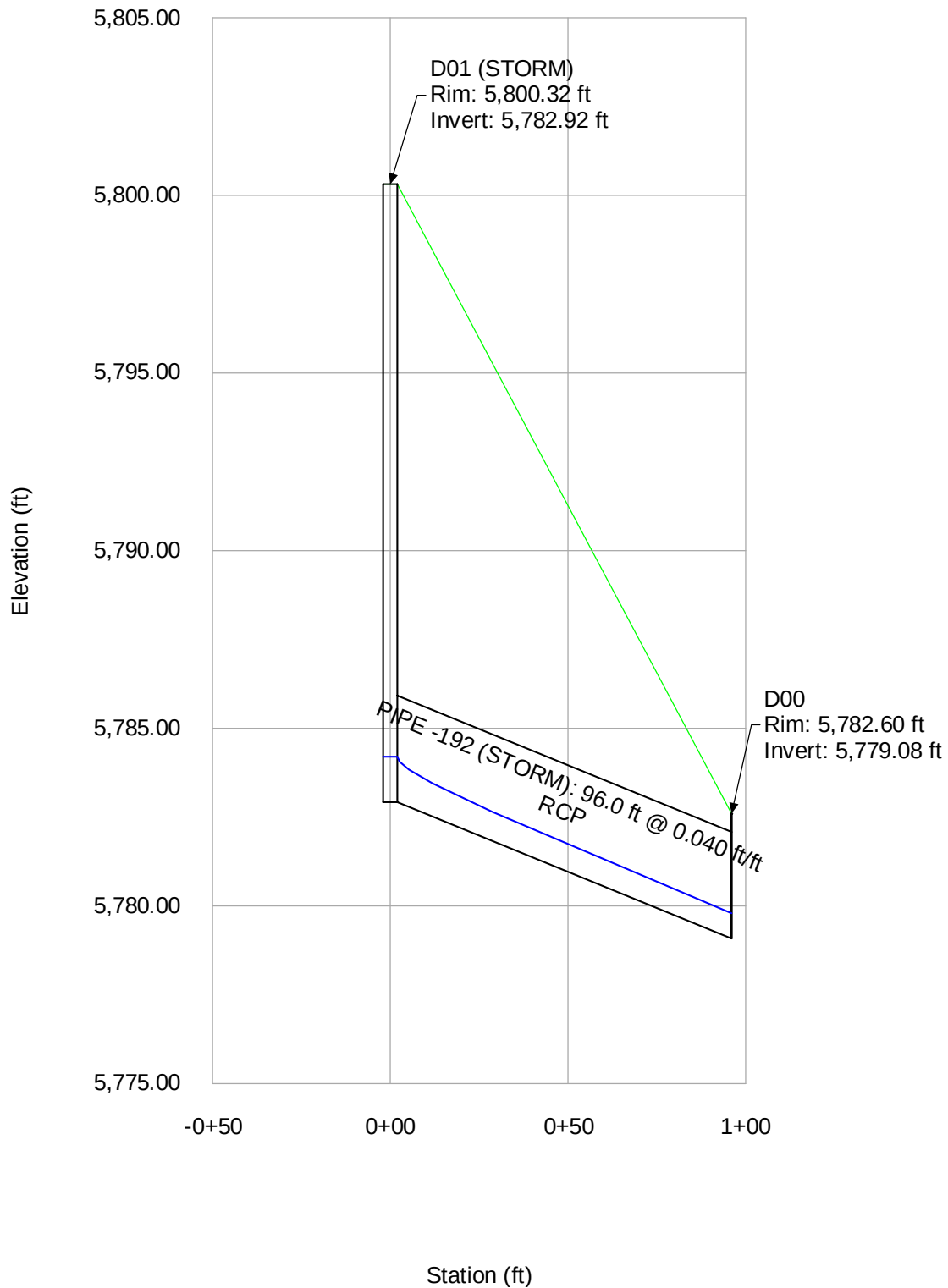
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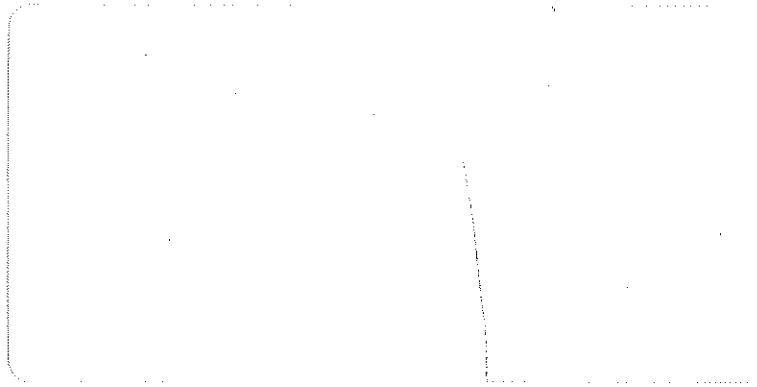
# Profile Report Profile Lateral D.1 (100-Year)



## ***APPENDIX E - REFERENCES***



TOWN OF PARKER  
AUG 13 2004  
PLANNING DEPT.



**Final Drainage Report  
Parker Auto Plaza  
Town of Parker  
Douglas County, Colorado**

Prepared for:

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% Concepts West Architecture  
202 East Cheyenne Mountain Blvd.  
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Prepared by:

Kiowa Engineering Corporation  
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Colorado Springs, Colorado 80904

Kiowa Project No. 00056

July 12, 2004

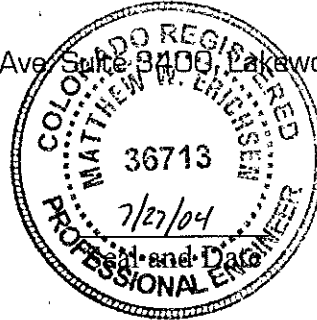
**ENGINEER'S STATEMENT:**

This report for the final design of the Parker Auto Plaza development was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

Kiowa Engineering Corporation, 7175 W. Jefferson Ave Suite 8400, Lakewood, CO 80235

*Matthew W. Ericksen*

Registered Professional Engineer  
State of Colorado # 36713  
(For and on behalf of Kiowa Engineering Corp.)



## Table of Contents

|                                                                                     |          |
|-------------------------------------------------------------------------------------|----------|
| <b>Engineer's Statement</b> .....                                                   | i        |
| <b>Table of Contents</b> .....                                                      | ii       |
| <b>General Location and Description</b> .....                                       | 1        |
| <b>Drainage Basins and Sub-Basins</b> .....                                         |          |
| Major Basin Description .....                                                       | 1        |
| Site Sub-Basin Description .....                                                    | 3        |
| Floodplains.....                                                                    | 3        |
| <b>Drainage Design Criteria</b> .....                                               |          |
| Regulations.....                                                                    | 4        |
| Development Criteria Reference and Constraints .....                                | 5        |
| Hydrologic Criteria .....                                                           | 5        |
| Hydraulic Criteria.....                                                             | 5        |
| <b>Drainage Facility Details</b> .....                                              |          |
| General Concept.....                                                                | 6        |
| Drainage Basin and Storm Sewer System Description .....                             | 6        |
| Detention Basin Facility Description .....                                          | 7        |
| Baldwin Gulch Drainageway Facility Description .....                                | 8        |
| Sculpted Concrete Drop – Cutoff Wall Analysis .....                                 | 9        |
| <b>Environmental Protection Criteria</b> .....                                      | 9        |
| <b>Conclusions</b> .....                                                            | 10       |
| <b>References and Software</b> .....                                                | 11       |
| <b>Appendix</b> .....                                                               | 12       |
| See Appendix for Table of Contents                                                  |          |
| <b>List of Figures (Additional figures and tables are included in the Appendix)</b> |          |
| Figure 3      Vicinity Map.....                                                     | 2        |
| Figure 7      Future Major Watershed Boundaries and Reach Delineations .....        | Appendix |
| Figure 8      Flood Insurance Rate Map.....                                         | Appendix |
| Figure 9      Soil Survey Map .....                                                 | Appendix |

## **General Location and Description**

This report addresses the drainage impacts related to the Parker Auto Plaza development. The development will include construction of automobile sales facilities, an automobile body shop and future commercial site development. The property is located in the northwest quarter and southwest quarter of Section 10, Township 6 South, Range 66 West of the Sixth Principal Meridian. The property lies northwest of the intersection of Parker Road and Lincoln Avenue. It is bounded on the north by Pine Lane, on the east by Parker Road, Dransfeldt Road and MacLachlan Subdivision Nos. 1 & 2, on the south by Lincoln Avenue and on the west by the proposed extension alignment of Twenty Mile Road. The proposed Parker Auto Plaza site includes approximately 52.7 acres. A vicinity map of the area is included as Figure 3.

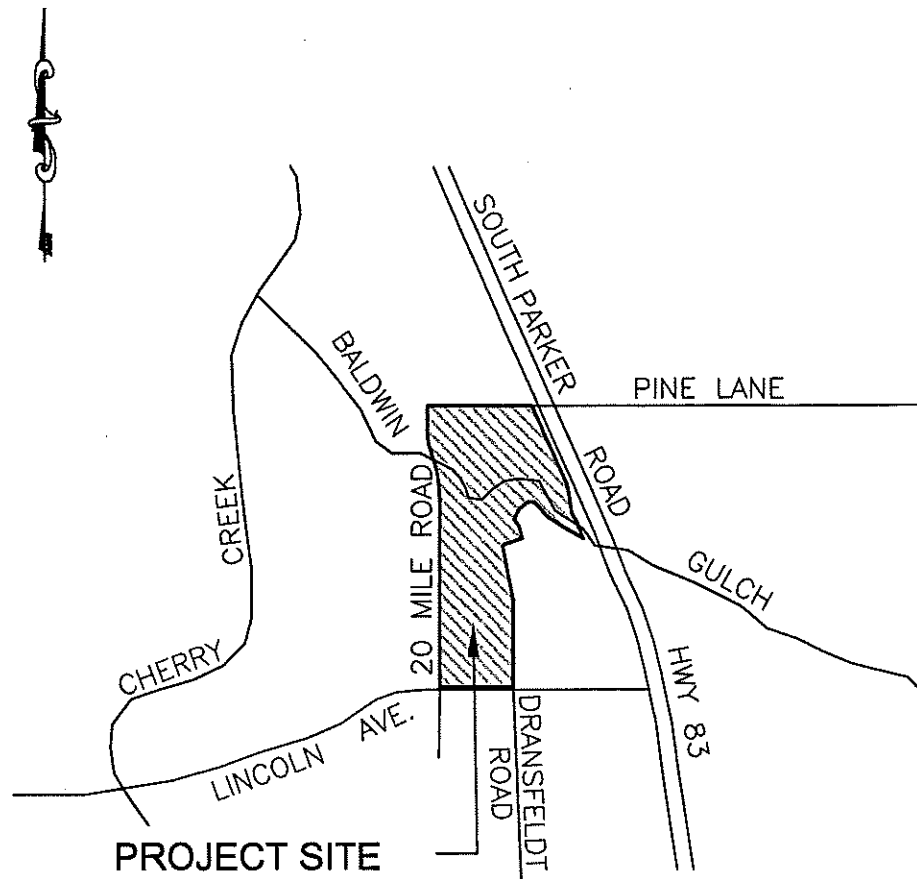
The site is covered by native vegetation, including weeds, sagebrush and a few large and smaller deciduous trees. Baldwin Gulch runs through the property from an existing box culvert under Parker Road to the proposed extension alignment of Twenty Mile Road.

Approximately 31.6 acres of the site will be utilized for the proposed commercial development sites described above. The 8.1 acres that surrounds Baldwin Gulch and the 100-year flood plain will be designated open space. This area will remain undeveloped except for a proposed trail and trailhead area and for channel improvements recommended in the *Baldwin Gulch Outfall Systems Planning Study* prepared by the Urban Drainage and Flood Control District.

## **Drainage Basins and Sub-Basins**

### **Major Basin Description**

The site was part of the MacLachlan Property (of which Filing Nos. 1 & 2 are currently developed). As a result of the review of the final drainage report for the MacLachlan Subdivision No. 1 (S.A. Miro, Inc., March 1994), and the *Newlin and Baldwin Gulches and Basin 4600-09 Outfall Systems Study Preliminary Design Report* (Kiowa Engineering Corporation, December 1994), it is apparent that the site lies within a portion of two major historic basins; Basin 4600-09 and Baldwin Gulch. Basin 4600-09 drains directly into Cherry Creek west of the site. A copy of the Future Major Watershed Boundaries and Reach Delineations, Baldwin Gulch basin 4600-09 is included in the Appendix of this report as Figure 7. The outfall for Baldwin Gulch into Cherry Creek is located approximately one-quarter mile west of the proposed extension of Twenty Mile Road. In the current condition it appears that a portion of the flows from the Basin 4600-09 section of the site are being diverted into Baldwin Gulch by the existing road in the Twenty Mile Road R.O.W. Existing drainage basins are shown on Figure 1 that is located in the map pocket at the end of this report.



**FIGURE 3**  
**VICINITY MAP**  
**PARKER AUTO PLAZA**

## Site Sub-Basin Description

Most of the flows from the developed lots within the MacLachlan subdivision drain to onsite detention basins. These detention basins in turn outfall directly into Baldwin Gulch and will remain in this condition. A small portion of Ponderosa Drive discharges onto the site in the current condition, and will be conveyed across the site by curb and gutter as Dransfeldt Road will be extended to Twenty Mile Road during the development of the site. Channel improvements will be made to Baldwin Gulch as part of the site development. The channel improvements noted in the *Newlin and Baldwin Gulches and Basin 4600-09 Outfall Systems Study (OSP) Preliminary Design Report* were reviewed during the Preliminary Drainage Report (PDR) for the site. The following modifications have been made to the channel improvements outlined in the *OSP* as part of the *PDR* review by UDFCD and the Town of Parker. Sculpted concrete drop structures have been substituted for the check structures shown in the *OSP*. The sculpted drop structures have replaced the checks so that the channel can be constructed to the ultimate longitudinal slope anticipated for sandy soils instead of allowing the channel to degrade over time with check structures as recommended in the *OSP*. This will minimize the amount of sediment that could be conveyed to Cherry Creek resulting from the degradation of the invert along this portion of Baldwin Gulch. The longitudinal slope of the channel was also modified from 0.94% to 0.6% to reduce the flow velocities in the channel. The proposed improvements to Baldwin Gulch are shown on the Drainage Plan, Figure 2. No further onsite drainage improvements are needed to convey flows from MacLachlan Subdivisions through the site.

The development of the site will not change the drainage patterns significantly onsite. However the increase in runoff that accompanies the development of the site will require the construction of two detention basins. The detention basins are located east of the future alignment of Twenty

Mile Road to regulate discharge from the site into Baldwin Gulch. A storm sewer system will be required on the parcels south of Baldwin Gulch in order to convey site runoff from drainage basins 1B-12B into Detention Basin B south of Baldwin Gulch. A storm sewer system will also be required to convey flows from drainage basins 1A-5A to Detention Basin A (see Figure 2).

The existing and proposed grading precludes any treatment or detention of the runoff from Twenty Mile Road basins 3C and 4C and Pine Lane basins 1D and 2D. The Twenty Mile Road basins will be released to their historic Baldwin Gulch outfall location. The drainage basins along Pine Lane will be released to their historic outfall location westerly along the south edge of Pine Lane, eventually reaching Baldwin Gulch. The drainage improvements associated with Pine Lane will be completed as part of the Pine Lane extension project by Douglas County.

## Floodplains

The Baldwin Gulch existing 100-year flood plain is shown on Figure 1 located in a map pocket at the end of this report. The 100-year flood plain boundary is based in part on the *1977 Flood Hazard Delineation (FHAD) Report* for Baldwin Gulch. The flood plain boundary was confirmed using Panel Number 080310 0070 D of the FEMA Flood Insurance Rate Map for

Douglas County, shown in Figure 8 which is located in the Appendix of this report. The development of this site will include channel improvements to Baldwin Gulch. These improvements, along with Detention Basin A south of Baldwin Gulch, east of the proposed Twenty Mile Road extension alignment will be the only grading that will occur within the 100-year floodplain. The construction of the channel improvements and attendant grading along the major drainageway will alter the 100-year floodway and floodplain through the site east of the proposed Twenty Mile Road extension. The proposed 100-year floodplain resulting from the proposed channel improvements is shown on Figure 2. A conditional Letter of Map Revision (CLOMR) will be required for this project. The submittal of a CLOMR to FEMA will commence once the design of the Baldwin Gulch improvements are generally approved and accepted by the Town of Parker and the Urban Drainage and Flood Control District.

### **Drainage Design Criteria**

#### **Regulations**

In accordance with the Town of Parker's Floodplain ordinance, no temporary or permanent structures designed for human habitation will be placed in the floodplain. There will be a multi-use trail proposed along the Baldwin Gulch drainageway. The area adjacent to the low flow channel and on overbanks will be revegetated with native grasses, trees, and shrubs.

The development of this site will include improvements to the Baldwin Gulch channel, as stated above. These improvements include four sculpted concrete drop structures as well as grading the channel to conform to the recommended channel section and reinforcing the channel as necessary to minimize the adverse affects of erosion along Baldwin Gulch and the lands adjacent to it. A riprap lined low flow channel of 5-year capacity with a benched channel section above the low flow area is proposed. The total 100-year flooding depth along the channel through the site ranges from four to six-feet. A multi-use trail will follow the channel along the north bench of the drainageway, generally located above the 100-year floodplain. This trail will cross beneath proposed Twenty Mile Road in a three-sided box culvert. The upstream portion of the multi-use trail will cross under Parker Road through the north bay of the existing twin box culvert. The trail will loop up to Parker Road on the north side. The trail will continue south along Parker Road to the existing multi-use trail located on the south side of Baldwin Gulch and east of Parker Road. The plan and profile design for Baldwin Gulch has been included in a map pocket at the end of this report.

The proposed channel improvements will alter the existing channel section for the entire length of Baldwin Gulch within the project site. As a result of field meetings with the U. S. Army Corps of Engineers it was determined that a 404 Permit will not be required for the proposed channel improvements. It was determined that the portion of Baldwin Gulch through the site is not considered as jurisdictional waters of the United States.



## Development Criteria Reference and Constraints

The Final Drainage Report for MacLachlan Subdivision No. 1 includes portions of this site in its analysis of historic drainage basins, however, drainage reports including developed conditions for this site could not be found. This drainage study generally agrees with the Final Drainage Report for MacLachlan Subdivision No. 1 concerning the historic drainage patterns for the site.

The Final Drainage Report for MacLachlan Subdivision No. 1 describes the developed flows of the neighboring subdivision. This study indicates that all flows aside from three small basins will be routed to a detention basin in MacLachlan Subdivision No. 1 and discharged directly into Baldwin Gulch. Two of the three small basins currently discharge onto the project site. When Dransfeldt Road is extended to Twenty Mile Road as a part of the development of this site, runoff from the offsite sub-basins currently discharging will be conveyed by curb and gutter to the storm sewer system in Dransfeldt Road and Twenty Mile Road and from there to Detention Basin B.

## Hydrologic Criteria

Basin runoff was calculated using the Rational Method. Hydrology for Baldwin Gulch was obtained from the Newlin and Baldwin Gulches Outfall Systems Planning Study. The 5-year and 100-year peak discharges for the segment of Baldwin Gulch adjacent to the site are 260 cubic feet per second and 2,100 cubic feet per second, respectively.

## Hydraulic Criteria

The drainage systems and street capacities for this site have been designed to accommodate the 5-year initial storm event and the 100-year major storm event as specified in the Town of Parker, Colorado, *Storm Drainage and Environmental Criteria Manual (SDECM)*. The hydraulic capacities of the curb inlets were determined using the UDINLET computer model developed by the University of Colorado at Denver. The initial storm event water spread was used to help determine the inlet locations in the site. Table 2.4 from the *SDECM* was used to determine the maximum allowable water spread for the initial storm runoff and has been included in the Appendix. An Inlet Capacity Summary spreadsheet is included in the Appendix, showing the inlet capacities and the minor storm water spread in tabular form. Colorado Department of Transportation (CDOT) Type R curb inlets will be used throughout the site. City of Denver Standard No. 16 Open Throat Inlets will be used in areas where there is insufficient area behind the curb for a curb-opening inlet.

Detention basins for this site have been designed to conform to the 10-year and 100-year regulated release rates per the aforementioned manual. Detention basins were sized and discharge rates determined using the UDFCD Detention Formulas. The supporting calculations associated with the sizing of hydraulic facilities for this development are included in the Appendix of this report.

## **Drainage Facility Details**

### **General Concept**

In the current condition, drainage from the proposed site flows into Baldwin Gulch. Calculations for the analysis of existing drainage basins are presented in the appendix at the end of this report. The existing Drainage Plan, including drainage basins are shown in Figure 1. The proposed development seeks to preserve the existing drainage patterns with the exception of routing flows through detention basins prior to discharging into Baldwin Gulch in order to limit flows from the developed site to acceptable levels. Calculations for the analysis of developed basins for this site, as well as calculations for the design of the detention basins and their tributary storm water conveyances are presented in the appendix of this report. The configuration of proposed basins and their related drainage facilities are presented in Figure 2. Offsite runoff impacting the site is minimal and will be conveyed across the site with the extension of Dransfeldt Road to be handled by the drainage facilities discharging to Detention Basin B.

### **Drainage Basin and Storm Sewer System Description**

Runoff from Basin 1A will sheet-flow westerly through a parking lot area to a 10-foot sump curb inlet (Inlet 1). The flows captured by the inlet will be routed to Inlet 2. Drainage from Basin 2A will sheet-flow westerly through a parking lot area to a 15-foot curb inlet in sump condition. The flows will combine with flows from Inlet 1 and be carried by a storm sewer to Detention Basin A. Flows generated from Basin 3A will sheet-flow westerly through a parking lot area to a 10-foot sump curb inlet. A storm sewer will route the flows to Detention Basin A. Runoff generated from Basin 4A will sheet-flow southwesterly through a parking lot area to a 10-foot sump curb inlet. The flows will be routed to Detention Basin A by a storm sewer.

Runoff from Basin 1B will be carried northerly by curb and gutter along the western side of Twenty Mile Road. The runoff will be collected by a 15-foot on grade curb inlet at Dransfeldt Road. Runoff generated within Basin 2B will be carried northerly by curb and gutter along on the eastern side of Twenty Mile Road. The runoff will be collected by a 10-foot on grade curb inlet at Inlet 11. Drainage developed from Basin 3B will sheet-flow westerly through a parking lot area to be collected by a 15-foot sump curb inlet near Twenty Mile Road. The flow will then be carried by a 24-inch RCP to join with flows at Inlet 20. Runoff generated within Basin 4B will sheet-flow west through a parking lot area and will be collected by a 10-foot sump curb inlet. The flow will then be carried to Inlet 20 by a storm sewer. Drainage from Basin 5B will sheet-flow northwest through a parking lot area and will be collected by a 10-foot sump curb inlet. The flow will be routed to Inlet 19 through a storm sewer. Drainage from Basin 6B will sheet-flow northwest through a parking lot area and will be collected by a 5-foot sump curb inlet. The flow will be routed to Detention Basin B through a storm sewer. Drainage from Basin 7B will be carried northwest by the Dransfeldt Road curb and gutter to 15-foot curb inlets on grade at the intersection of Twenty Mile Road. A storm sewer will route the flows into the storm

sewer system along Twenty Mile Road. Runoff generated from Basin 8B will sheet-flow directly to Detention Basin B. Runoff generated from Basin 9B will sheet-flow westerly to a 15-foot sump curb inlet. At this point the runoff will combine with the flows in the 36-inch RCP storm sewer located along the east side of Twenty Mile Road (Twenty Mile Storm Sewer). The storm sewer will continue north to a manhole to the north of Dransfeldt Road. The Twenty Mile Storm Sewer will bend at this manhole and be directed into Detention Basin B. The runoff generated by Basin 10B will be carried along the gutter of the private drive extending into the commercial development area. The flows will continue along the east curb and gutter of Twenty Mile Road to a 20-foot inlet (Inlet 18) on grade at the intersection with Dransfeldt Road. The runoff captured by Inlet 20 will be directed into the Twenty Mile Storm Sewer. Runoff generated within Basin 11B will sheet-flow westerly through a parking lot area and will be collected by a 10-foot sump curb inlet near Twenty Mile Road. The flows will be routed into the Twenty Mile Storm Sewer. Runoff generated within Basin 12B will sheet-flow westerly through a parking lot area and will be collected by a 10-foot sump curb inlet near Twenty Mile Road.

Flows developed within Basin 1C will be carried southeasterly by a grass-lined swale to enter Baldwin Gulch. Runoff from Basin 2C will sheet-flow directly to Baldwin Gulch. Drainage Basins 3C-5C are located along a superelevated portion of Twenty Mile Road. Inlets have been located along this section of Twenty Mile Road to minimize the amount of flows crossing the street at points of superelevation. Drainage generated from Basin 3C will sheet-flow onto the west median curb line of Twenty Mile Road. An inlet will be placed along the west curb of Twenty Mile Road to capture the flows. The flows will be conveyed to Baldwin Gulch through a storm sewer. Flows from Basin 4C will be carried along the west curb and gutter of Twenty Mile Road to Inlet 27A. The flows will be routed by a storm sewer into Inlet 27. Flows from Basin 5C will flow onto the east curb and gutter of Twenty Mile Road to Inlet 25 at the low point. Flows from Basin 6C will flow along the east median curb and gutter of Twenty Mile Road to Inlet 26 at the low point. A storm sewer will route the flows to Inlet 26 and Baldwin Gulch. Runoff generated from Basins 1D and 2D will be handled as part of the Pine Lane Improvements. Runoff generated from Basin 1D is carried northerly along the west curb and gutter onto Pine Lane. The flows from Basin 2D will be captured by an inlet and conveyed to the Pine Lane storm sewer system.

#### **Detention Basin Facility Description**

The required detention volumes for Detention Basin A are 2.06 acre-feet for the 10-year event and 2.97 acre-feet for the 100-year event, which includes the WQCV. Calculations for this detention basin are located in the Appendix of this report. To control the release of flows and allow for pollutant removal, the detention basin is designed as an Extended Detention Basin Sedimentation Facility, as shown in Figure EDB-1 in Volume 3 of the Urban Storm Drainage Criteria Manual, found in the Appendix of this report. The design will include a forebay, trickle channel and emergency spillway. Modifications to the Figure EDB-1 design were made per the request of the Town of Parker. The modifications include the elimination of the micropool and

**APPENDIX A**  
**Hydrologic Calculations**

**Parker Auto Plaza**  
**Time of Concentration (Existing)**

| Basin | Contributing Basins | Slope  |        | Length |         | C <sub>s</sub> | Velocity   |            | T <sub>c</sub> |           | T <sub>c</sub> |
|-------|---------------------|--------|--------|--------|---------|----------------|------------|------------|----------------|-----------|----------------|
|       |                     | O'land | Travel | O'land | Travel  |                | O'land     | Travel     | O'land         | Travel    |                |
| A     |                     | 6.1 %  | 0.9 %  | 150 lf | 1125 lf | 0.01           | 0.2 ft/sec | 0.5 ft/sec | 788 sec.       | 2272 sec. | 51.0 min.      |
| B     |                     | 2.4 %  | 2.5 %  | 150 lf | 1105 lf | 0.01           | 0.1 ft/sec | 1.0 ft/sec | 1077 sec.      | 1163 sec. | 37.3 min.      |
| C     |                     | 1.9 %  | 2.4 %  | 150 lf | 1659 lf | 0.01           | 0.1 ft/sec | 0.9 ft/sec | 1158 sec.      | 1880 sec. | 50.6 min.      |
| D     |                     | 2.5 %  | 3.4 %  | 150 lf | 900 lf  | 0.01           | 0.1 ft/sec | 1.1 ft/sec | 1067 sec.      | 842 sec.  | 31.8 min.      |
| E     |                     | 1.5 %  | 3.9 %  | 150 lf | 814 lf  | 0.01           | 0.1 ft/sec | 0.8 ft/sec | 1268 sec.      | 1072 sec. | 39.0 min.      |

Equations:

$$\text{Time of Concentration (Overland)} = 1.8(1.1 - C_s)L^{0.5} S^{-0.333}$$

C<sub>s</sub> = Runoff coefficient for five-year flow

L = Length of overland flow in feet (Length must be less than 1,000 feet for undeveloped area before entering a channel)

S = Slope of flow path in percent

**Parker Auto Plaza  
Basin Runoff Calculation (Existing)**

| Basin | Contributing Basins | Area       |          | $C_{10}$ | $C_{100}$ | Time of Concentration | Rainfall Intensity |           | Runoff   |           |
|-------|---------------------|------------|----------|----------|-----------|-----------------------|--------------------|-----------|----------|-----------|
|       |                     |            |          |          |           |                       | $i_{10}$           | $i_{100}$ | $Q_{10}$ | $Q_{100}$ |
| A     |                     | 519,090 sf | 11.92 ac | 0.05     | 0.20      | 51.0 min.             | 1.8 in/hr          | 2.9 in/hr | 1.1 cfs  | 7.0 cfs   |
| B     |                     | 657,300 sf | 15.09 ac | 0.05     | 0.20      | 37.3 min.             | 2.3 in/hr          | 3.6 in/hr | 1.7 cfs  | 10.8 cfs  |
| C     |                     | 512,500 sf | 11.77 ac | 0.05     | 0.20      | 50.6 min.             | 1.9 in/hr          | 2.9 in/hr | 1.1 cfs  | 6.9 cfs   |
| D     |                     | 256,610 sf | 5.89 ac  | 0.05     | 0.20      | 31.8 min.             | 2.5 in/hr          | 3.9 in/hr | 0.7 cfs  | 4.6 cfs   |
| E     |                     | 354,940 sf | 8.15 ac  | 0.05     | 0.20      | 39.0 min.             | 2.2 in/hr          | 3.5 in/hr | 0.9 cfs  | 5.7 cfs   |

Equations:

$$I = (28.5P) / (10 + t_c)^{0.786}$$

P=One-hour point rainfall depth (in.) P(5yr)=1.39in. P(10yr)=1.64in. P(100yr)=2.60in.

$i_5, i_{10}, i_{100}$ =Average 5, 10 and 100-year Rainfall Intensity in inches per hour (Fig 5.1, Town of Parker Storm Drainage and Environmental Criteria Manual)

$$Q = CiA$$

Q = Peak Runoff Rate, in cubic feet per second (cfs)

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

Parker Auto Plaza  
Runoff Coefficient Calculation (Developed)

| Design Point | Basin | Area     | % Area  | C <sub>s</sub> | C <sub>100</sub> | C <sub>s</sub> | C <sub>100</sub> |
|--------------|-------|----------|---------|----------------|------------------|----------------|------------------|
| DP 1         | 1A-4A | 13.96 ac | 90.31 % | 0.81           | 0.88             | 0.73           | 0.79             |
|              | 5A    | 1.50 ac  | 9.69 %  | 0.14           | 0.40             | 0.01           | 0.04             |
|              |       | 15.45 ac | 100.0 % |                |                  | 0.75           | 0.83             |

| Design Point | Basin           | Area     | % Area  | C <sub>s</sub> | C <sub>100</sub> | C <sub>s</sub> | C <sub>100</sub> |
|--------------|-----------------|----------|---------|----------------|------------------|----------------|------------------|
| DP 2         | 1B,3B-7B,9B-13B | 16.83 ac | 85.84 % | 0.81           | 0.88             | 0.70           | 0.76             |
|              | 2B              | 0.94 ac  | 4.78 %  | 0.54           | 0.66             | 0.03           | 0.03             |
|              | 8B              | 1.84 ac  | 9.38 %  | 0.14           | 0.40             | 0.01           | 0.04             |
|              |                 | 19.61 ac | 100.0 % |                |                  | 0.73           | 0.82             |

**Parker Auto Plaza**  
**Time of Concentration (Developed)**

| Basin | Contributing Basins | Slope  |        | Length |         | C <sub>s</sub> | Velocity   |                    | t <sub>c</sub>           |                          | Comp. t <sub>c</sub> | t <sub>c</sub> Check | Final t <sub>c</sub> |
|-------|---------------------|--------|--------|--------|---------|----------------|------------|--------------------|--------------------------|--------------------------|----------------------|----------------------|----------------------|
|       |                     | O'land | Travel | O'land | Travel  |                | O'land     | Travel (Fig. RO-1) | O'land (t <sub>i</sub> ) | Travel (t <sub>i</sub> ) |                      |                      |                      |
| 1A    |                     | 8.0 %  | 3.0 %  | 85 lf  | 430 lf  | 0.14           | 0.2 ft/sec | 3.4 ft/sec         | 8.0 min.                 | 2.1 min.                 | 10.1 min.            | 12.9 min.            | 10.1 min.            |
| 2A    |                     | 3.0 %  | 3.0 %  | 100 lf | 360 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 12.0 min.                | 1.8 min.                 | 13.8 min.            | 12.6 min.            | 12.6 min.            |
| 3A    |                     | 1.0 %  | 3.0 %  | 80 lf  | 410 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 15.5 min.                | 2.0 min.                 | 17.5 min.            | 12.7 min.            | 12.7 min.            |
| 4A    |                     | 3.0 %  | 1.3 %  | 70 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 2.2 ft/sec         | 10.0 min.                | 2.7 min.                 | 12.7 min.            | 12.3 min.            | 12.3 min.            |
| 5A    |                     | 4.0 %  | 1.0 %  | 110 lf | 50 lf   | 0.14           | 0.2 ft/sec | 1.6 ft/sec         | 11.4 min.                | 0.5 min.                 | 11.9 min.            | 10.9 min.            | 10.9 min.            |
| 1B    |                     | 3.0 %  | 1.5 %  | 20 lf  | 500 lf  | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 5.4 min.                 | 3.6 min.                 | 9.0 min.             | 12.9 min.            | 9.0 min.             |
| 2B    |                     | 1.0 %  | 1.5 %  | 200 lf | 550 lf  | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 24.4 min.                | 4.0 min.                 | 28.4 min.            | 14.2 min.            | 14.2 min.            |
| 3B    |                     | 3.0 %  | 1.0 %  | 60 lf  | 230 lf  | 0.14           | 0.1 ft/sec | 2.0 ft/sec         | 9.3 min.                 | 1.9 min.                 | 11.2 min.            | 11.6 min.            | 11.2 min.            |
| 4B    |                     | 8.0 %  | 2.5 %  | 30 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 4.7 min.                 | 1.9 min.                 | 6.6 min.             | 12.1 min.            | 6.6 min.             |
| 5B    |                     | 8.0 %  | 2.0 %  | 40 lf  | 300 lf  | 0.14           | 0.1 ft/sec | 2.8 ft/sec         | 5.5 min.                 | 1.8 min.                 | 7.3 min.             | 11.9 min.            | 7.3 min.             |
| 6B    |                     | 3.0 %  | 3.5 %  | 60 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.7 ft/sec         | 9.3 min.                 | 1.8 min.                 | 11.1 min.            | 12.6 min.            | 11.1 min.            |
| 7B    |                     | 4.0 %  | 4.5 %  | 15 lf  | 540 lf  | 0.14           | 0.1 ft/sec | 4.2 ft/sec         | 4.2 min.                 | 2.1 min.                 | 6.4 min.             | 13.1 min.            | 6.4 min.             |
| 8B    |                     | 3.0 %  | 1.0 %  | 80 lf  | 140 lf  | 0.14           | 0.1 ft/sec | 1.6 ft/sec         | 10.7 min.                | 1.5 min.                 | 12.2 min.            | 11.2 min.            | 11.2 min.            |
| 9B    |                     | 5.0 %  | 3.0 %  | 50 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 7.1 min.                 | 1.7 min.                 | 8.9 min.             | 12.2 min.            | 8.9 min.             |
| 10B   |                     | 3.0 %  | 2.5 %  | 20 lf  | 500 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 5.4 min.                 | 2.7 min.                 | 8.0 min.             | 12.9 min.            | 8.0 min.             |
| 11B   |                     | 3.0 %  | 2.5 %  | 25 lf  | 250 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 6.0 min.                 | 1.3 min.                 | 7.3 min.             | 11.5 min.            | 7.3 min.             |
| 12B   |                     | 3.0 %  | 2.5 %  | 50 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 8.5 min.                 | 2.2 min.                 | 10.6 min.            | 12.5 min.            | 10.6 min.            |
| 13B   |                     | 1.0 %  | 1.0 %  | 150 lf | 450 lf  | 0.14           | 0.1 ft/sec | 2.0 ft/sec         | 21.2 min.                | 3.8 min.                 | 24.9 min.            | 13.3 min.            | 13.3 min.            |
| 1C    |                     | 1.0 %  | 2.0 %  | 200 lf | 450 lf  | 0.14           | 0.1 ft/sec | 1.0 ft/sec         | 24.4 min.                | 7.5 min.                 | 31.9 min.            | 13.6 min.            | 13.6 min.            |
| 2C    |                     | 1.0 %  | 1.0 %  | 25 lf  | 1490 lf | 0.14           | 0.0 ft/sec | 1.5 ft/sec         | 8.6 min.                 | 16.6 min.                | 25.2 min.            | 18.4 min.            | 18.4 min.            |
| 3C    |                     | 2.0 %  | 1.0 %  | 150 lf | 700 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 16.8 min.                | 3.4 min.                 | 20.2 min.            | 14.7 min.            | 14.7 min.            |
| 4C    |                     | 1.0 %  | 1.1 %  | 10 lf  | 500 lf  | 0.14           | 0.0 ft/sec | 2.1 ft/sec         | 5.5 min.                 | 4.0 min.                 | 9.4 min.             | 12.8 min.            | 9.4 min.             |
| 5C    |                     | 2.0 %  | 1.0 %  | 60 lf  | 200 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 10.6 min.                | 1.0 min.                 | 11.6 min.            | 11.4 min.            | 11.4 min.            |
| 6C    |                     | 2.0 %  | 1.0 %  | 10 lf  | 340 lf  | 0.14           | 0.0 ft/sec | 1.6 ft/sec         | 4.3 min.                 | 3.5 min.                 | 7.9 min.             | 11.9 min.            | 7.9 min.             |
| 7C    |                     | 2.0 %  | 1.0 %  | 10 lf  | 220 lf  | 0.90           | 0.2 ft/sec | 3.4 ft/sec         | 0.9 min.                 | 1.1 min.                 | 5.0 min.             | 11.3 min.            | 5.0 min.             |
| 1D    |                     | 2.0 %  | 2.0 %  | 10 lf  | 350 lf  | 0.14           | 0.0 ft/sec | 2.8 ft/sec         | 4.3 min.                 | 2.1 min.                 | 6.4 min.             | 12.0 min.            | 6.4 min.             |
| 2D    |                     | 10.0 % | 3.0 %  | 30 lf  | 100 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 4.4 min.                 | 0.5 min.                 | 5.0 min.             | 10.7 min.            | 5.0 min.             |
| 3D    |                     | 10.0 % | 3.0 %  | 10 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 2.5 min.                 | 2.0 min.                 | 5.0 min.             | 12.3 min.            | 5.0 min.             |
| DP 1  | A Basins            | 1.0 %  | 3.0 %  | 80 lf  | 410 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 15.5 min.                | 2.0 min.                 | 17.5 min.            | 12.7 min.            | 12.7 min.            |
| DP 2  | B Basins            | 3.0 %  | 1.5 %  | 80 lf  | 1560 lf | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 10.7 min.                | 11.3 min.                | 22.0 min.            | 19.1 min.            | 19.1 min.            |

Equations:

$$t_i (\text{Overland}) = 1.8(1.1 - C_s)L^{0.5} S^{-0.333}$$

C<sub>s</sub> = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

$$t_c \text{ Check} = (L/180) + 10$$

L = Overall Length

Fig. RO-1: Average velocities for Estimating Travel Time



**Parker Auto Plaza**  
**Basin Runoff Calculation (Developed)**

| Basin | Contributing Basins | Area       |          | C <sub>s</sub> | C <sub>100</sub> | Time of Concentration | Rainfall Intensity |                  | Runoff         |                  | Basin |
|-------|---------------------|------------|----------|----------------|------------------|-----------------------|--------------------|------------------|----------------|------------------|-------|
|       |                     |            |          |                |                  |                       | i <sub>5</sub>     | i <sub>100</sub> | Q <sub>s</sub> | Q <sub>100</sub> |       |
| 1A    |                     | 124,700 sf | 2.86 ac  | 0.81           | 0.88             | 10.1 min.             | 3.7 in/hr          | 7.0 in/hr        | 8.7 cfs        | 17.7 cfs         | 1A    |
| 2A    |                     | 158,280 sf | 3.63 ac  | 0.81           | 0.88             | 12.6 min.             | 3.4 in/hr          | 6.4 in/hr        | 10.1 cfs       | 20.5 cfs         | 2A    |
| 3A    |                     | 149,800 sf | 3.44 ac  | 0.81           | 0.88             | 12.7 min.             | 3.4 in/hr          | 6.4 in/hr        | 9.5 cfs        | 19.3 cfs         | 3A    |
| 4A    |                     | 175,180 sf | 4.02 ac  | 0.81           | 0.88             | 12.3 min.             | 3.4 in/hr          | 6.4 in/hr        | 11.2 cfs       | 22.8 cfs         | 4A    |
| 5A    |                     | 65,250 sf  | 1.50 ac  | 0.14           | 0.40             | 10.9 min.             | 3.6 in/hr          | 6.8 in/hr        | 0.8 cfs        | 4.1 cfs          | 5A    |
| 1B    |                     | 26,630 sf  | 0.61 ac  | 0.81           | 0.88             | 9.0 min.              | 3.9 in/hr          | 7.3 in/hr        | 1.9 cfs        | 3.9 cfs          | 1B    |
| 2B    |                     | 40,850 sf  | 0.94 ac  | 0.54           | 0.66             | 14.2 min.             | 3.2 in/hr          | 6.1 in/hr        | 1.6 cfs        | 3.8 cfs          | 2B    |
| 3B    |                     | 114,100 sf | 2.62 ac  | 0.81           | 0.88             | 11.2 min.             | 3.6 in/hr          | 6.7 in/hr        | 7.6 cfs        | 15.5 cfs         | 3B    |
| 4B    |                     | 83,300 sf  | 1.91 ac  | 0.81           | 0.88             | 6.6 min.              | 4.4 in/hr          | 8.1 in/hr        | 6.7 cfs        | 13.7 cfs         | 4B    |
| 5B    |                     | 71,200 sf  | 1.63 ac  | 0.81           | 0.88             | 7.3 min.              | 4.2 in/hr          | 7.9 in/hr        | 5.6 cfs        | 11.4 cfs         | 5B    |
| 6B    |                     | 63,550 sf  | 1.46 ac  | 0.81           | 0.88             | 11.1 min.             | 3.6 in/hr          | 6.7 in/hr        | 4.3 cfs        | 8.7 cfs          | 6B    |
| 7B    |                     | 51,720 sf  | 1.19 ac  | 0.81           | 0.88             | 6.4 min.              | 4.4 in/hr          | 8.2 in/hr        | 4.2 cfs        | 8.6 cfs          | 7B    |
| 8B    |                     | 80,100 sf  | 1.84 ac  | 0.14           | 0.40             | 11.2 min.             | 3.6 in/hr          | 6.7 in/hr        | 0.9 cfs        | 4.9 cfs          | 8B    |
| 9B    |                     | 116,400 sf | 2.67 ac  | 0.81           | 0.88             | 8.9 min.              | 3.9 in/hr          | 7.4 in/hr        | 8.5 cfs        | 17.3 cfs         | 9B    |
| 10B   |                     | 46,600 sf  | 1.07 ac  | 0.81           | 0.88             | 8.0 min.              | 4.1 in/hr          | 7.6 in/hr        | 3.5 cfs        | 7.2 cfs          | 10B   |
| 11B   |                     | 59,600 sf  | 1.37 ac  | 0.81           | 0.88             | 7.3 min.              | 4.2 in/hr          | 7.9 in/hr        | 4.7 cfs        | 9.5 cfs          | 11B   |
| 12B   |                     | 100,200 sf | 2.30 ac  | 0.81           | 0.88             | 10.6 min.             | 3.7 in/hr          | 6.9 in/hr        | 6.8 cfs        | 13.9 cfs         | 12B   |
| 13B   |                     | 65,200 sf  | 1.50 ac  | 0.81           | 0.88             | 13.3 min.             | 3.3 in/hr          | 6.2 in/hr        | 4.0 cfs        | 8.2 cfs          | 13B   |
| 1C    |                     | 72,910 sf  | 1.67 ac  | 0.54           | 0.66             | 13.6 min.             | 3.3 in/hr          | 6.2 in/hr        | 3.0 cfs        | 6.8 cfs          | 1C    |
| 2C    |                     | 361,300 sf | 8.29 ac  | 0.14           | 0.40             | 18.4 min.             | 2.9 in/hr          | 5.3 in/hr        | 3.3 cfs        | 17.7 cfs         | 2C    |
| 3C    |                     | 43,100 sf  | 0.99 ac  | 0.81           | 0.88             | 14.7 min.             | 3.2 in/hr          | 6.0 in/hr        | 2.6 cfs        | 5.2 cfs          | 3C    |
| 4C    |                     | 32,500 sf  | 0.75 ac  | 0.81           | 0.88             | 9.4 min.              | 3.8 in/hr          | 7.2 in/hr        | 2.3 cfs        | 4.7 cfs          | 4C    |
| 5C    |                     | 42,640 sf  | 0.98 ac  | 0.81           | 0.88             | 11.4 min.             | 3.6 in/hr          | 6.7 in/hr        | 2.8 cfs        | 5.7 cfs          | 5C    |
| 6C    |                     | 22,020 sf  | 0.51 ac  | 0.81           | 0.88             | 7.9 min.              | 4.1 in/hr          | 7.7 in/hr        | 1.7 cfs        | 3.4 cfs          | 6C    |
| 7C    |                     | 37,700 sf  | 0.87 ac  | 0.90           | 0.96             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 3.7 cfs        | 7.3 cfs          | 7C    |
| 1D    |                     | 21,080 sf  | 0.48 ac  | 0.81           | 0.88             | 6.4 min.              | 4.4 in/hr          | 8.2 in/hr        | 1.7 cfs        | 3.5 cfs          | 1D    |
| 2D    |                     | 17,360 sf  | 0.40 ac  | 0.81           | 0.88             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 1.5 cfs        | 3.1 cfs          | 2D    |
| 3D    |                     | 25,680 sf  | 0.59 ac  | 0.81           | 0.88             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 2.3 cfs        | 4.6 cfs          | 3D    |
| DP 1  | A Basins            | 673,210 sf | 15.45 ac | 0.75           | 0.83             | 12.7 min.             | 3.4 in/hr          | 6.4 in/hr        | 39 cfs         | 82 cfs           | DP 1  |
| DP 2  | B Basins            | 919,450 sf | 21.11 ac | 0.74           | 0.83             | 19.1 min.             | 2.8 in/hr          | 5.2 in/hr        | 44 cfs         | 92 cfs           | DP 2  |

Equations:

$$I = (28.5P) / (10 + t_c)^{0.786}$$

P = One-hour point rainfall depth (in.) P(5yr)=1.39in. P(100yr)=2.60in.

i<sub>5</sub>, i<sub>10</sub>, i<sub>100</sub> = Average 5, 10 and 100-year Rainfall Intensity in inches per hour (Fig 5.1, Town of Parker Storm Drainage and Environmental Criteria Manual)

$$Q = CiA$$

Q = Peak Runoff Rate, in cubic feet per second (cfs) {Initial Storm=Q<sub>s</sub> Major Storm=Q<sub>100</sub>}

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

TABLE RO-3

Recommended Percentage Imperviousness Values

| Land Use or Surface Characteristics                   | Percentage Imperviousness |
|-------------------------------------------------------|---------------------------|
| Business:                                             |                           |
| Commercial areas                                      | 95                        |
| Neighborhood areas                                    | 85                        |
| Residential:                                          |                           |
| Single-family                                         | *                         |
| Multi-unit (detached)                                 | 60                        |
| Multi-unit (attached)                                 | 75                        |
| Half-acre lot or larger                               | *                         |
| Apartments                                            | 80                        |
| Industrial:                                           |                           |
| Light areas                                           | 80                        |
| Heavy areas                                           | 90                        |
| Parks, cemeteries                                     | 5                         |
| Playgrounds                                           | 10                        |
| Schools                                               | 50                        |
| Railroad yard areas                                   | 15                        |
| Undeveloped Areas:                                    |                           |
| Historic flow analysis                                | 2                         |
| Greenbelts, agricultural                              | 2                         |
| Off-site flow analysis<br>(when land use not defined) | 45                        |
| Streets:                                              |                           |
| Paved                                                 | 100                       |
| Gravel (packed)                                       | 40                        |
| Drive and walks                                       | 90                        |
| Roofs                                                 | 90                        |
| Lawns, sandy soil                                     | 0                         |
| Lawns, clayey soil                                    | 0                         |

\* See Figures RO-3 through RO-5 for percentage imperviousness.

Based in part on the data collected by the District since 1969, an empirical relationship between  $C$  and the percentage imperviousness for various storm return periods was developed. Thus, values for  $C$  can be determined using the following equations (Urbonas, Guo and Tucker 1990).

$$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \quad (\text{RO-6})$$

$$C_{CD} = K_{CD} + (0.858i^3 - 0.786i^2 + 0.774i + 0.04) \quad (\text{RO-7})$$

$$C_B = (C_A + C_{CD})/2$$

in which:

$i$  = % imperviousness/100 expressed as a decimal (see Table RO-3)

**TABLE RO-5**  
Runoff Coefficients, *C*

| Percentage<br>Imperviousness | Type C and D NRCS Hydrologic Soil Groups |      |       |       |       |        |
|------------------------------|------------------------------------------|------|-------|-------|-------|--------|
|                              | 2-yr                                     | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| 0%                           | 0.04                                     | 0.15 | 0.25  | 0.37  | 0.44  | 0.50   |
| 5%                           | 0.08                                     | 0.18 | 0.28  | 0.39  | 0.46  | 0.52   |
| 10%                          | 0.11                                     | 0.21 | 0.30  | 0.41  | 0.47  | 0.53   |
| 15%                          | 0.14                                     | 0.24 | 0.32  | 0.43  | 0.49  | 0.54   |
| 20%                          | 0.17                                     | 0.26 | 0.34  | 0.44  | 0.50  | 0.55   |
| 25%                          | 0.20                                     | 0.28 | 0.36  | 0.46  | 0.51  | 0.56   |
| 30%                          | 0.22                                     | 0.30 | 0.38  | 0.47  | 0.52  | 0.57   |
| 35%                          | 0.25                                     | 0.33 | 0.40  | 0.48  | 0.53  | 0.57   |
| 40%                          | 0.28                                     | 0.35 | 0.42  | 0.50  | 0.54  | 0.58   |
| 45%                          | 0.31                                     | 0.37 | 0.44  | 0.51  | 0.55  | 0.59   |
| 50%                          | 0.34                                     | 0.40 | 0.46  | 0.53  | 0.57  | 0.60   |
| 55%                          | 0.37                                     | 0.43 | 0.48  | 0.55  | 0.58  | 0.62   |
| 60%                          | 0.41                                     | 0.46 | 0.51  | 0.57  | 0.60  | 0.63   |
| 65%                          | 0.45                                     | 0.49 | 0.54  | 0.59  | 0.62  | 0.65   |
| 70%                          | 0.49                                     | 0.53 | 0.57  | 0.62  | 0.65  | 0.68   |
| 75%                          | 0.54                                     | 0.58 | 0.62  | 0.66  | 0.68  | 0.71   |
| 80%                          | 0.60                                     | 0.63 | 0.66  | 0.70  | 0.72  | 0.74   |
| 85%                          | 0.66                                     | 0.68 | 0.71  | 0.75  | 0.77  | 0.79   |
| 90%                          | 0.73                                     | 0.75 | 0.77  | 0.80  | 0.82  | 0.83   |
| 95%                          | 0.80                                     | 0.82 | 0.84  | 0.87  | 0.88  | 0.89   |
| 100%                         | 0.89                                     | 0.90 | 0.92  | 0.94  | 0.95  | 0.96   |

| Type B NRCS Hydrologic Soils Group |      |      |      |      |      |      |
|------------------------------------|------|------|------|------|------|------|
| 0%                                 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| 5%                                 | 0.04 | 0.10 | 0.19 | 0.28 | 0.33 | 0.38 |
| 10%                                | 0.06 | 0.14 | 0.22 | 0.31 | 0.36 | 0.40 |
| 15%                                | 0.08 | 0.17 | 0.25 | 0.33 | 0.38 | 0.42 |
| 20%                                | 0.12 | 0.20 | 0.27 | 0.35 | 0.40 | 0.44 |
| 25%                                | 0.15 | 0.22 | 0.30 | 0.37 | 0.41 | 0.46 |
| 30%                                | 0.18 | 0.25 | 0.32 | 0.39 | 0.43 | 0.47 |
| 35%                                | 0.20 | 0.27 | 0.34 | 0.41 | 0.44 | 0.48 |
| 40%                                | 0.23 | 0.30 | 0.36 | 0.42 | 0.46 | 0.50 |
| 45%                                | 0.26 | 0.32 | 0.38 | 0.44 | 0.48 | 0.51 |
| 50%                                | 0.29 | 0.35 | 0.40 | 0.46 | 0.49 | 0.52 |
| 55%                                | 0.33 | 0.38 | 0.43 | 0.48 | 0.51 | 0.54 |
| 60%                                | 0.37 | 0.41 | 0.46 | 0.51 | 0.54 | 0.56 |
| 65%                                | 0.41 | 0.45 | 0.49 | 0.54 | 0.57 | 0.59 |
| 70%                                | 0.45 | 0.49 | 0.53 | 0.58 | 0.60 | 0.62 |
| 75%                                | 0.51 | 0.54 | 0.58 | 0.62 | 0.64 | 0.66 |
| 80%                                | 0.57 | 0.59 | 0.63 | 0.66 | 0.68 | 0.70 |
| 85%                                | 0.63 | 0.66 | 0.69 | 0.72 | 0.73 | 0.75 |
| 90%                                | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 |
| 95%                                | 0.79 | 0.81 | 0.83 | 0.85 | 0.87 | 0.88 |
| 100%                               | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 |

TYPE B

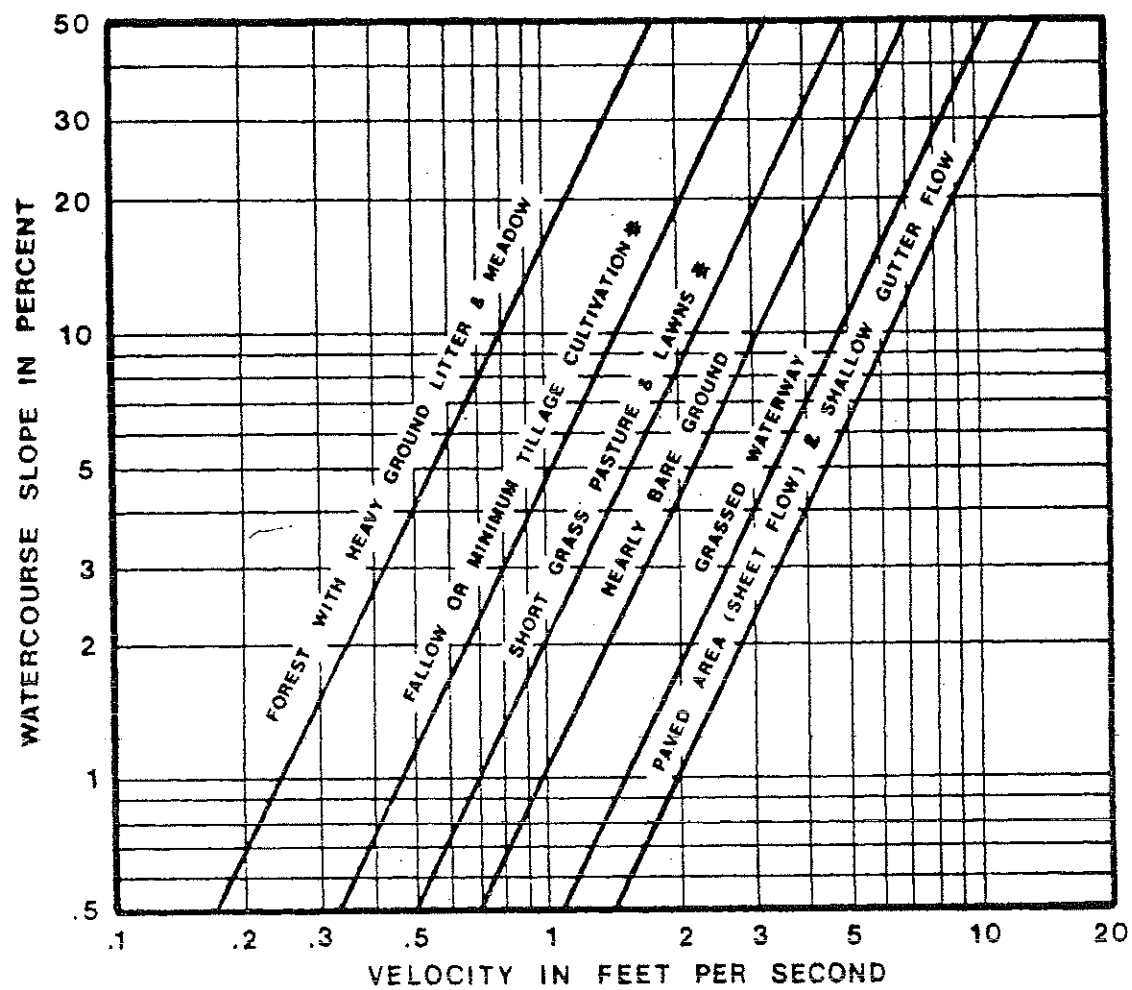


FIGURE RO-1

Estimate of Average Overland Flow Velocity for Use With the Rational Formula

## 5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions are required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (District) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this criteria MANUAL.

## 5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume III- Colorado. The design storm events developed and utilized are the same as those used by the District.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where,  $I$  = rainfall intensity (in/hr)  
 $P_1$  = one-hour point rainfall depth (in)  
 $t_c$  = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

Table 5.1  
ONE-HOUR POINT RAINFALL

| Frequency of Design Event<br>(yr) | One-hour Point Rainfall, $P_1$<br>(in) |
|-----------------------------------|----------------------------------------|
| 2                                 | 0.99                                   |
| 5                                 | 1.39                                   |
| 10                                | 1.64                                   |
| 25                                | 1.98                                   |
| 50                                | 2.31                                   |
| 100                               | 2.60                                   |

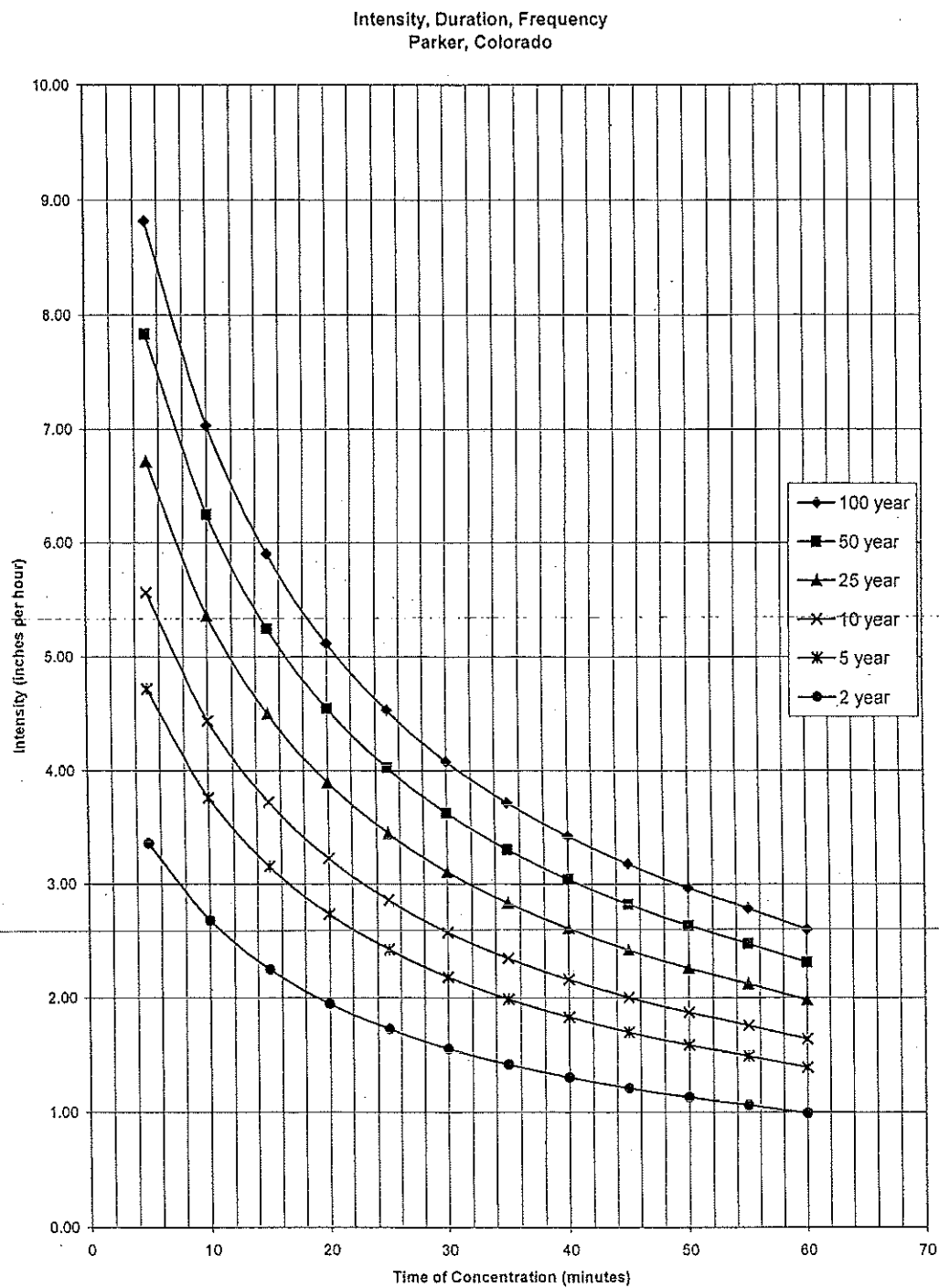


Figure 5.1 Rainfall Intensity Versus Duration Curves for Parker, Colorado

**APPENDIX B**  
**Hydraulic Calculations**

Table 2.3

**RECURRENCE INTERVALS (years) FOR  
INITIAL AND MAJOR STORM RUNOFF DESIGN**

| Land use                       | Initial Storm | Major Storm |
|--------------------------------|---------------|-------------|
| Residential                    | 2             | 100         |
| Open Space/Agricultural        | 2             | 100         |
| School                         | 2             | 100         |
| Commercial/Business/Industrial | 5             | 100         |

### 2.5.1 STREETS

Streets are an integral part of the urban drainage system and may be used for transporting storm runoff up to design limits. The design engineer should recognize that the primary purpose of streets is for traffic. Therefore, use of streets for storm runoff must be limited.

Although street criteria are formulated to allow certain drainage, streets should not routinely be considered as major drainageways. The Town of Parker, prohibits the practice of discharging offsite culverts and other non-local drainage outfalls onto streets. Storm drains should not outfall onto streets, but should be piped to suitable outfalls in a swale, channel, or detention basin. Street criteria should be applied to storm runoff flows emanating from building lots and other streets rather than discharges from major offsite drainageways flowing into streets.

Town of Parker criteria for allowable uses and depth of flow for initial and major storm runoff events is presented in Table 2.4, Table 2.5, and Table 2.6

Table 2.4

**ALLOWABLE USE OF STREETS FOR INITIAL STORM RUNOFF**

| Street Classification | Maximum Theoretical Encroachment                                                                               |
|-----------------------|----------------------------------------------------------------------------------------------------------------|
| Local                 | No curb overtopping. Flow may spread to crown of street.                                                       |
| Collector             | No curb overtopping. Flow spread must leave at least a 10 foot width free of water.                            |
| Arterial              | No curb overtopping. Flow spread must leave at least two lanes free of water, one 10 foot lane each direction. |

*Where no curbing exists, encroachment should not extend past the street right-of-way. The maximum allowable street flow shall be the product of the flow calculated at "maximum theoretical street encroachment" and required reduction factor. See Section 6.4*



Parker Auto Plaza  
Inlet Capacity Summary

| Inlet | Location   | Inlet Size | Inlet Condition | 5yr Flow | 5yr Flow Spread | 100yr Flow + Carry Over to Inlet | 100yr Inlet Capacity | 100yr Flow Past Inlet | Downstream Inlet if Carry Over | Contributing Flows           |
|-------|------------|------------|-----------------|----------|-----------------|----------------------------------|----------------------|-----------------------|--------------------------------|------------------------------|
| 1     | Interior   | 10 ft      | Sump            |          |                 | 17.9 cfs                         | 17.2 cfs             | 1 cfs                 |                                | Basin 1A                     |
| 2     | Interior   | 15 ft      | Sump            |          |                 | 20.7 cfs                         | 24.3 cfs             | (4 cfs)               |                                | Basin 2A                     |
| 3     | Interior   | 10 ft      | Sump            |          |                 | 19.5 cfs                         | 19.1 cfs             | 0 cfs                 |                                | Basin 3A                     |
| 4     | Interior   | 10 ft      | Sump            |          |                 | 23.1 cfs                         | 19.5 cfs             | 4 cfs                 |                                | Basin 4A                     |
| 10    | 20 Mile Rd | 15 ft      | Grade           | 1.9 cfs  | 7.3 ft          | 3.7 cfs                          | 3.6 cfs              | 0 cfs                 | Off Site                       | Basin 1B                     |
| 11    | 20 Mile Rd | 10 ft      | Grade           | 1.6 cfs  | 6.6 ft          | 3.8 cfs                          | 3.0 cfs              | 1 cfs                 | Inlet 18                       | Basin 2B                     |
| 12    | Interior   | 10 ft      | Sump            |          |                 | 8.2 cfs                          | 9.2 cfs              | (1 cfs)               |                                | Basin 13B                    |
| 13    | Interior   | 10 ft      | Sump            |          |                 | 13.7 cfs                         | 13.5 cfs             | 0 cfs                 |                                | Basin 4B                     |
| 14    | Interior   | 10 ft      | Sump            |          |                 | 11.4 cfs                         | 13.6 cfs             | (2 cfs)               |                                | Basin 5B                     |
| 15    | Interior   | 5 ft       | Sump            |          |                 | 8.8 cfs                          | 8.2 cfs              | 1 cfs                 | Detention Basin                | Basin 6B                     |
| 16    | Dransfeldt | 15 ft      | Grade           | 2.1 cfs  | 5.5 ft          | 4.3 cfs                          | 3.6 cfs              | 1 cfs                 | Inlet 27                       | 1/2 Basin 7B                 |
| 16a   | Dransfeldt | 15 ft      | Grade           | 2.1 cfs  | 5.5 ft          | 4.3 cfs                          | 3.6 cfs              | 1 cfs                 | Inlet 27                       | 1/2 Basin 7B                 |
| 17    | Interior   | 15 ft      | Sump            |          |                 | 17.3 cfs                         | 18.9 cfs             | (2 cfs)               |                                | Basin 9B                     |
| 18    | 20 Mile Rd | 15 ft      | Grade           | 3.5 cfs  | 12.3 ft         | 7.2 cfs                          | 6.4 cfs              | 1 cfs                 | Off Site to the west           | Basin 10B, Carry Inlet 11    |
| 19    | Interior   | 10 ft      | Sump            |          |                 | 9.5 cfs                          | 11.3 cfs             | (2 cfs)               |                                | Basin 11B                    |
| 20    | Interior   | 10 ft      | Sump            |          |                 | 13.9 cfs                         | 18.3 cfs             | (4 cfs)               |                                | Basin 12B                    |
| 21    | Interior   | 10 ft      | Sump            |          |                 | 15.5 cfs                         | 15.5 cfs             | 0 cfs                 |                                | Basin 3B                     |
| 25    | 20 Mile Rd | 10 ft      | Sump            | 2.8 cfs  | 9.1 ft          | 7.0 cfs                          | 11.6 cfs             | (5 cfs)               |                                | Basin 5C, Carry Inlet 27     |
| 26    | 20 Mile Rd | 3.25 ft    | Sump            | 1.7 cfs  | 6.9 ft          | 4.3 cfs                          | 5.8 cfs              | (2 cfs)               |                                | Basin 6C, Carry Inlet 27a    |
| 27    | 20 Mile Rd | 10 ft      | Grade           | 2.6 cfs  | 13.7 ft         | 5.9 cfs                          | 3.4 cfs              | 3 cfs                 | Inlet 25                       | Basin 3C, Carry Inlet 16,16a |
| 27a   | 20 Mile Rd | 10 ft      | Grade           | 2.3 cfs  | 10.9 ft         | 4.7 cfs                          | 2.9 cfs              | 2 cfs                 | Inlet 26                       | Basin 4C                     |
| 28    | 20 Mile Rd | 5 ft       | Grade           | 1.5 cfs  | 10.1 ft         | 3.1 cfs                          | 1.6 cfs              | 2 cfs                 |                                | Basin 2D                     |
| 40    | Parker Rd  | 5 ft       | Sump            | 3.7 cfs  | 8.6 ft          | 7.3 cfs                          | 6.2 cfs              | 1 cfs                 | Baldwin Gulch                  | Basin 7C                     |

Town of Parker Criteria (Pg 6-15, Section 6.3.5): A 50% reduction factor should be used on carry over flows when determining the amount of flow entering a downstream inlet, due to Carry Over.

**Table 2.4: Allowable Use of Streets for Initial Storm Runoff (5-year Runoff)**

Collector: No curb overtopping. Flow spread must leave at least a 10-ft width free of water.

**Dransfeldt Rd Maximum Flow Spread = 16.0 ft**

Arterial: No curb overtopping. Flow spread must leave at least two lanes free of water, one 10-ft lane each direction.

**Twenty Mile Rd Maximum Flow Spread = 17.0 ft**

**APPENDIX C**  
**Detention Basin Calculations**

**Parker Auto Plaza  
Detention Basin Calculations**

WQCV = 0.45 inches  
% Impervious(I) = 95 %

WQCV (Water Quality Capture Volume) taken from Fig. EDB-2, Volume 3 of the Urban Storm Drainage Criteria Manual for the basin imperviousness shown.  
Percent Impervious taken from Table RO-3, Volume 1 of the Urban Storm Drainage Criteria Manual

**WQCV = 0.045 \* A**  
WQCV = WQCV/12 \* A \* 1.2  
A = Area

Required Detention Storage Volume =  $K_i A$

**$K_{10} = 0.08835$**   
 **$K_{100} = 0.14749$**

$K_{10} = (0.95I - 1.9)/1000$   
 $K_{100} = (1.78I - 0.002I^2 - 3.56)/1000$

**Unit Flow Release Rate (cfs/acre)**

Hydrologic Soil Group **B**  
 $U_{10} = 0.23$   
 $U_{100} = 0.85$

| Basin             | Total Acres | $V_{10}$   |           | $V_{100}$  |            | WQCV       |           | 10-yr Required Capacity |            | 100-yr Required Capacity |            | Release Rate |           |
|-------------------|-------------|------------|-----------|------------|------------|------------|-----------|-------------------------|------------|--------------------------|------------|--------------|-----------|
|                   |             | ac-ft      | cf        | ac-ft      | cf         | ac-ft      | cf        | ac-ft                   | cf         | ac-ft                    | cf         | $Q_{10}$     | $Q_{100}$ |
| Detention Basin A | 15.45 ac    | 1.37 ac-ft | 59,460 cf | 2.28 ac-ft | 99,261 cf  | 0.70 ac-ft | 30,285 cf | 2.06 ac-ft              | 89,745 cf  | 2.97 ac-ft               | 129,546 cf | 3.6 cfs      | 13.1 cfs  |
| Detention Basin B | 21.20 ac    | 1.87 ac-ft | 81,589 cf | 3.13 ac-ft | 136,203 cf | 0.95 ac-ft | 41,556 cf | 2.83 ac-ft              | 123,145 cf | 4.08 ac-ft               | 177,759 cf | 4.9 cfs      | 18.0 cfs  |

$V_x = K_x A$

Release Rate = Area \*  $U_x$

$U_x$  = Recommended Maximum Allowable Unit Flow Release Rates (cfs/acre) of Tributary Catchment (Table SO-1, Urban Drainage and Flood Control District - Volume 2)

**Parker Auto Plaza  
Detention Basin Calculations**

**Presedimentation / Forebay Sizing**

**Detention Basin A**

|                       |           |
|-----------------------|-----------|
| WQCV                  | 30,285 cf |
| 10% WQCV              | 3,029 cf  |
| Orifice Eqn Coef. (C) | 0.50      |

| Forebay Pipe Number | Flow     | % Total Flow | Weighted Forebay Area | Forebay Size |              |                 | 5 Minute Drain Flow | Pipes Out of Forebay - Orifice Calculation |             |                 |             |                 |             | Total Flow |
|---------------------|----------|--------------|-----------------------|--------------|--------------|-----------------|---------------------|--------------------------------------------|-------------|-----------------|-------------|-----------------|-------------|------------|
|                     |          |              |                       | Depth        | Surface Area | Semicirc. Radii |                     | Pipe 1 Diameter                            | Pipe 1 Flow | Pipe 2 Diameter | Pipe 2 Flow | Pipe 3 Diameter | Pipe 3 Flow |            |
| S2                  | 37 cfs   | 46.84 %      | 1,418 cf              | 2.0 ft       | 709 sf       | 21 ft           | 4.7 cfs             | 8 inches                                   | 1.8 cfs     | 10 inches       | 2.8 cfs     | 0 inches        | 0.0 cfs     | 4.6 cfs    |
| S3                  | 19 cfs   | 24.05 %      | 728 cf                | 2.0 ft       | 364 sf       | 15 ft           | 2.4 cfs             | 6 inches                                   | 1.0 cfs     | 6 inches        | 1.0 cfs     | 0 inches        | 0.0 cfs     | 2.1 cfs    |
| S4                  | 23 cfs   | 29.11 %      | 882 cf                | 2.0 ft       | 441 sf       | 17 ft           | 2.9 cfs             | 6 inches                                   | 1.0 cfs     | 8 inches        | 1.8 cfs     | 0 inches        | 0.0 cfs     | 2.9 cfs    |
|                     | 79.0 cfs | 100.00 %     | 3,029 cf              |              |              |                 |                     |                                            |             |                 |             |                 |             | 9.5 cfs    |

Orifice Equation:

$$Q = CA(2gH)^{0.5}$$

C = Orifice coefficient (dimensionless)

A = Cross-sectional area of opening, in sf

g = Gravitational acceleration constant, 32.2 ft/sec<sup>2</sup>

H = Head above the centerline of the pipe, in ft

**Detention Basin B**

|                       |           |
|-----------------------|-----------|
| WQCV                  | 41,556 cf |
| 10% WQCV              | 4,156 cf  |
| Orifice Eqn Coef. (C) | 0.50      |

| Forebay Pipe Number | Flow     | % Total Flow | Weighted Forebay Area | Forebay Size |              |                 | 5 Minute Drain Flow | Pipes Out of Forebay - Orifice Calculation |             |                 |             |                 |             | Total Flow |
|---------------------|----------|--------------|-----------------------|--------------|--------------|-----------------|---------------------|--------------------------------------------|-------------|-----------------|-------------|-----------------|-------------|------------|
|                     |          |              |                       | Depth        | Surface Area | Semicirc. Radii |                     | Pipe 1 Diameter                            | Pipe 1 Flow | Pipe 2 Diameter | Pipe 2 Flow | Pipe 3 Diameter | Pipe 3 Flow |            |
| S10                 | 92 cfs   | 100.00 %     | 4,156 cf              | 2.0 ft       | 2,078 sf     | 36 ft           | 13.9 cfs            | 12 inches                                  | 3.9 cfs     | 12 inches       | 3.9 cfs     | 12 inches       | 3.9 cfs     | 11.6 cfs   |
|                     | 92.0 cfs | 100.00 %     | 4,156 cf              |              |              |                 |                     |                                            |             |                 |             |                 |             | 11.6 cfs   |

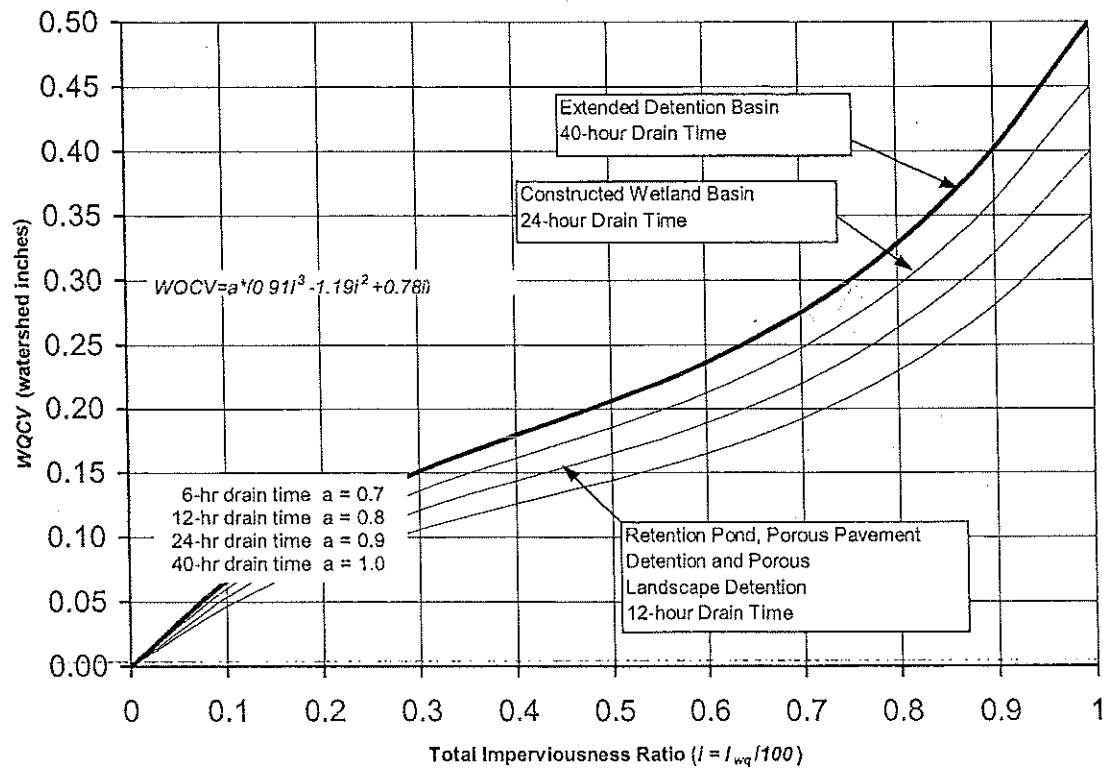


FIGURE EDB-2

Water Quality Capture Volume (WQCV), 80<sup>th</sup> Percentile Runoff Event

attempt to account for the effects of the WQCV on all control levels whenever it performs watershed-level drainage and flood control system master plans.

### **3.2 Sizing of On-Site Detention Facilities**

**3.2.1 Maximum Allowable Unit Release Rates for On-Site Facilities.** The maximum allowable unit release rates per acre for on-site detention facilities for a number of design return periods are listed in Table SO-1. These rates apply unless other rates are recommended in a District-approved master plan.

The predominant soil group for the total tributary catchment shall be used for determining the allowable release rates. Multiply the unit rates provided in Table SO-1 by the tributary catchment's area to obtain the actual design release rates in cubic feet per second (cfs). Whenever Natural Resources Conservation Service (NRCS) soil surveys are not available for the portion of a county being studied, extrapolate their types using soil investigations at the site.

**TABLE SO-1**

Recommended Maximum Allowable Unit Flow Release Rates (cfs/acre) of Tributary Catchment

| Design Return<br>Period<br>(Years) | NRCS Hydrologic Soil Group |      |       |
|------------------------------------|----------------------------|------|-------|
|                                    | A                          | B    | C & D |
| 2                                  | 0.02                       | 0.03 | 0.04  |
| 5                                  | 0.07                       | 0.13 | 0.17  |
| 10                                 | 0.13                       | 0.23 | 0.30  |
| 25                                 | 0.24                       | 0.41 | 0.52  |
| 50                                 | 0.33                       | 0.56 | 0.68  |
| 100                                | 0.50                       | 0.85 | 1.00  |

**3.2.2 Empirical Equations for the Sizing of On-Site Detention Storage Volumes.** Urbanas and Glidden (1983), as part of the District's ongoing hydrologic research, conducted studies that evaluated peak storm runoff flows along major drainageways. The following set of empirical equations provided preliminary estimates of on-site detention facility sizing for areas within the District. They are not intended for use when off-site inflows are present or when multi-stage controls are to be used (e.g., 10- and 100-year peak control) at the storage facility. In addition, these equations are not intended to replace detailed hydrologic and flood routing analysis, or even the analysis using the Rational Formula-based FAA method for the sizing of detention storage volumes. The District does not promote the use of these empirical equations. It does not object, however, to their use by local governments who have adopted them or want to adopt them as minimum requirements for the sizing of on-site detention for small catchments within their jurisdiction. If the District has a master plan that contains specific guidance for detention

**APPENDIX C.1**  
**Detention Basin A Calculations**

Parker Auto Plaza  
Detention Basin Earthwork Calculation

**Detention Basin A**

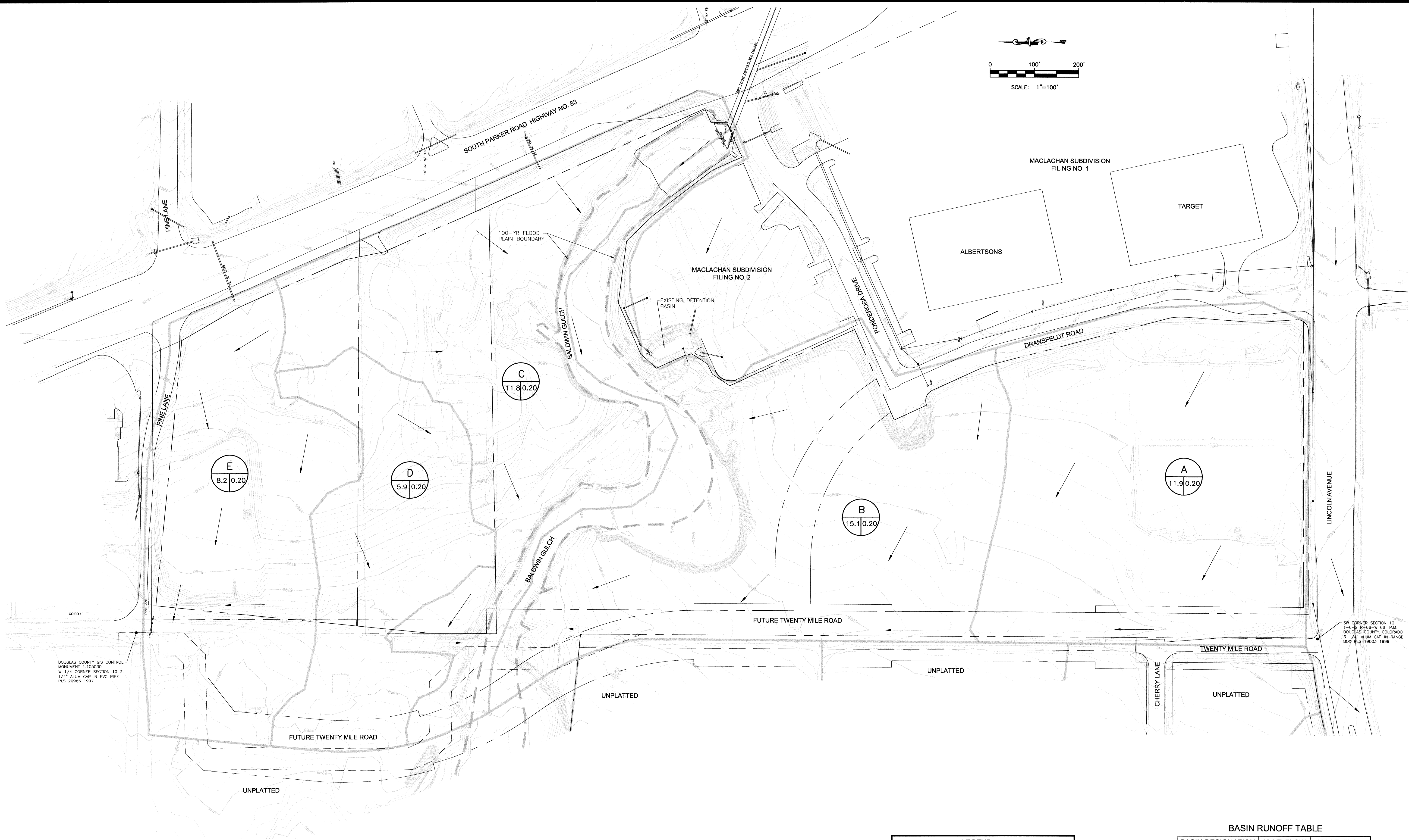
| Elevation | Area      | Avg. Area | Volume    | Basin Depth | Cumulative Basin Volume |             | Elevation |
|-----------|-----------|-----------|-----------|-------------|-------------------------|-------------|-----------|
| 77.7      | 315 sf    |           |           |             |                         |             |           |
|           |           | 448 sf    | 134 cf    | 0.3 ft      | 134 cf                  | 0.003 ac-ft | 78        |
| 78        | 580 sf    |           |           |             |                         |             |           |
|           |           | 3,743 sf  | 3,743 cf  | 1.3 ft      | 3,877 cf                | 0.09 ac-ft  | 79        |
| 79        | 6,905 sf  |           |           |             |                         |             |           |
|           |           | 13,299 sf | 13,299 cf | 2.3 ft      | 17,175 cf               | 0.39 ac-ft  | 80        |
| 80        | 19,692 sf |           |           |             |                         |             |           |
|           |           | 22,546 sf | 22,546 cf | 3.3 ft      | 39,721 cf               | 0.91 ac-ft  | 81        |
| 81        | 25,400 sf |           |           |             |                         |             |           |
|           |           | 27,000 sf | 27,000 cf | 4.3 ft      | 66,721 cf               | 1.53 ac-ft  | 82        |
| 82        | 28,600 sf |           |           |             |                         |             |           |
|           |           | 30,125 sf | 30,125 cf | 5.3 ft      | 96,846 cf               | 2.22 ac-ft  | 83        |
| 83        | 31,650 sf |           |           |             |                         |             |           |
|           |           | 33,225 sf | 33,225 cf | 6.3 ft      | 130,071 cf              | 2.99 ac-ft  | 84        |
| 84        | 34,800 sf |           |           |             |                         |             |           |
|           |           | 36,075 sf | 36,075 cf | 7.3 ft      | 166,146 cf              | 3.81 ac-ft  | 85        |
| 85        | 37,350 sf |           |           |             |                         |             |           |

Water Quality Capture Volume = 30,285 cf  
WQCV Elevation = 80.58 ft

10yr Water Volume = 89,745 cf  
10yr Water Surface Elevation = 82.76 ft

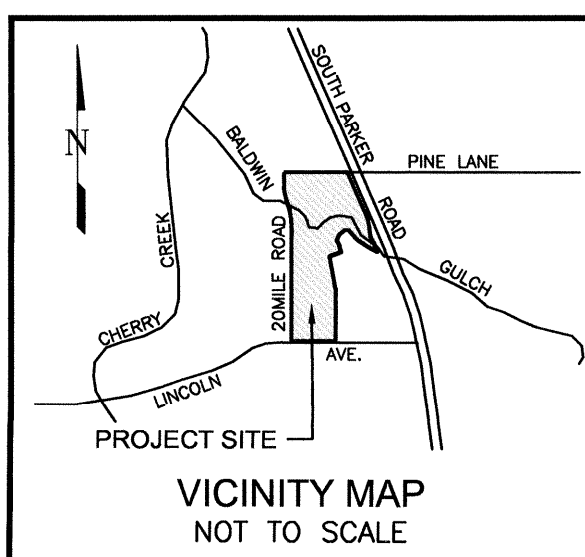
100yr Water Volume = 129,546 cf  
100yr Water Surface Elevation = 83.98 ft





DOUGLAS COUNTY GIS CONTROL MONUMENT 1.105030 W 1/4 CORNER SECTION 10 3 1/4" ALUM CAP IN PVC PIPE. PLS 20966 1997

SW CORNER SECTION 10 T-6-S R-66-W 6th P.M. DOUGLAS COUNTY COLORADO 3 1/4" ALUM CAP IN RANGE BOX PLS 19003 1999



PROJECT DATUM: ALL ELEVATIONS ARE REFERENCED TO NAVD 88 AS SHOWN ON THE 1998 DOUGLAS COUNTY TABULATION

**LEGEND**

**A** BASIN DESIGNATION

BASIN AREA (AC) 11.9 | 0.20 C100 RUNOFF COEFFICIENT

— DIRECTIONAL FLOW ARROW

— EXISTING DRAINAGE BASIN BOUNDARY

--- R.O.W. / PROPERTY LINE

**BASIN RUNOFF TABLE**

| BASIN DESIGNATION | 10-YR FLOW | 100-YR FLOW |
|-------------------|------------|-------------|
| A                 | 1.1 cfs    | 7.0 cfs     |
| B                 | 1.7 cfs    | 10.8 cfs    |
| C                 | 1.1 cfs    | 6.9 cfs     |
| D                 | 0.7 cfs    | 4.6 cfs     |
| E                 | 0.9 cfs    | 5.7 cfs     |

Kiowa Engineering Corporation

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Lakewood, Colorado 80235

(303) 692-0369

PARKER AUTO PLAZA

EXISTING DRAINAGE PATTERNS

FINAL DRAINAGE REPORT

PARKER, COLORADO

Project No.: 00056

Date: July 12, 2004

Design: MWE

Drawn: MWE

Check: RNW

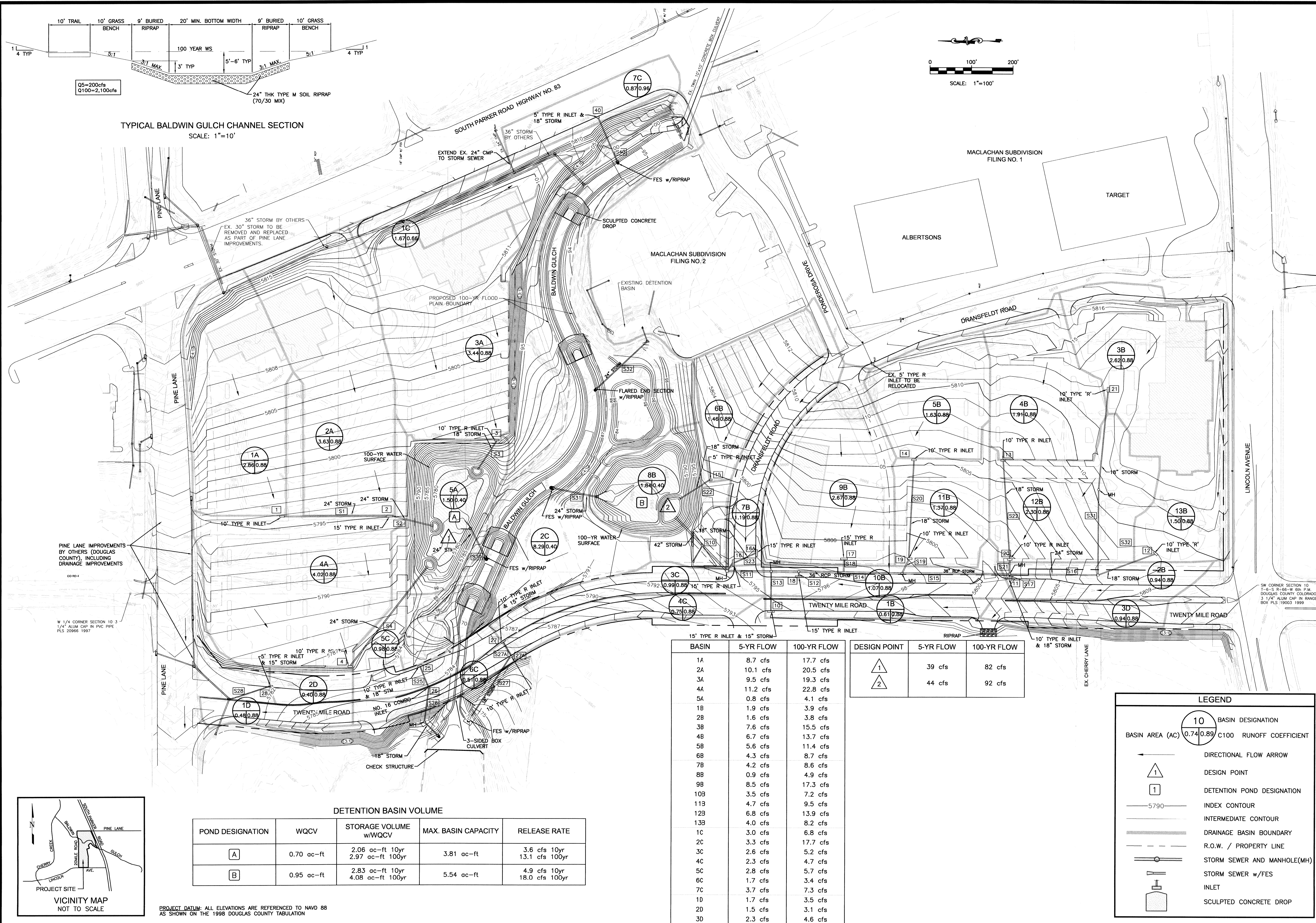
Revisions:

FIGURE

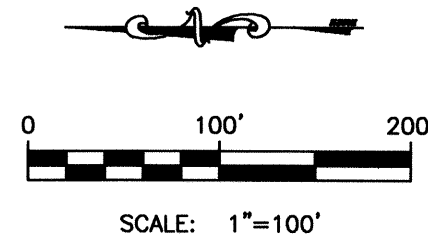
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TYPICAL BALDWIN GULCH CHANNEL SECTION  
SCALE: 1"=10'



| DETENTION BASIN VOLUME |            |                                     |                     |                                |
|------------------------|------------|-------------------------------------|---------------------|--------------------------------|
| POND DESIGNATION       | WQCV       | STORAGE VOLUME<br>w/WQCV            | MAX. BASIN CAPACITY | RELEASE RATE                   |
| A                      | 0.70 ac-ft | 2.06 ac-ft 10yr                     | 3.81 ac-ft          | 3.6 cfs 10yr                   |
|                        |            | 2.97 ac-ft 100yr                    |                     | 13.1 cfs 100yr                 |
| B                      | 0.95 ac-ft | 2.83 ac-ft 10yr<br>4.08 ac-ft 100yr | 5.54 ac-ft          | 4.9 cfs 10yr<br>18.0 cfs 100yr |

| BASIN | 5-YR FLOW | 100-YR FLOW |
|-------|-----------|-------------|
| 1A    | 8.7 cfs   | 17.7 cfs    |
| 2A    | 10.1 cfs  | 20.5 cfs    |
| 3A    | 9.5 cfs   | 19.3 cfs    |
| 4A    | 11.2 cfs  | 22.8 cfs    |
| 5A    | 0.8 cfs   | 4.1 cfs     |
| 1B    | 1.9 cfs   | 3.9 cfs     |
| 2B    | 1.6 cfs   | 3.8 cfs     |
| 3B    | 7.6 cfs   | 15.5 cfs    |
| 4B    | 6.7 cfs   | 13.7 cfs    |
| 5B    | 5.6 cfs   | 11.4 cfs    |
| 6B    | 4.3 cfs   | 8.7 cfs     |
| 7B    | 4.2 cfs   | 8.6 cfs     |
| 8B    | 0.9 cfs   | 4.9 cfs     |
| 9B    | 8.5 cfs   | 17.3 cfs    |
| 10B   | 3.5 cfs   | 7.2 cfs     |
| 11B   | 4.7 cfs   | 9.5 cfs     |
| 12B   | 6.8 cfs   | 13.9 cfs    |
| 13B   | 4.0 cfs   | 8.2 cfs     |
| 1C    | 3.0 cfs   | 6.8 cfs     |
| 2C    | 3.3 cfs   | 17.7 cfs    |
| 3C    | 2.6 cfs   | 5.2 cfs     |
| 4C    | 2.3 cfs   | 4.7 cfs     |
| 5C    | 2.8 cfs   | 5.7 cfs     |
| 6C    | 1.7 cfs   | 3.4 cfs     |
| 7C    | 3.7 cfs   | 7.3 cfs     |
| 1D    | 1.7 cfs   | 3.5 cfs     |
| 2D    | 1.5 cfs   | 3.1 cfs     |
| 3D    | 2.3 cfs   | 4.6 cfs     |

| DESIGN POINT | 5-YR FLOW | 100-YR FLOW |
|--------------|-----------|-------------|
| 1            | 39 cfs    | 82 cfs      |
| 2            | 44 cfs    | 92 cfs      |

LEGEND

10

BASIN DESIGNATION

BASIN AREA (AC) 0.74 0.89 C100 RUNOFF COEFFICIENT

→

DIRECTIONAL FLOW ARROW

1

DESIGN POINT

1

DETENTION POND DESIGNATION

—5790—

INDEX CONTOUR

---

INTERMEDIATE CONTOUR

---

DRAINAGE BASIN BOUNDARY

---

R.O.W. / PROPERTY LINE

—+—

STORM SEWER AND MANHOLE(MH)

+

STORM SEWER w/FES

+

INLET

+

SCULPTED CONCRETE DROP

Kiowa Engineering Corporation

7175 West Jefferson Avenue, Suite 3400  
Lakewood, Colorado 80235  
(303) 692-0369

PARKER AUTO PLAZA

DEVELOPED DRAINAGE PATTERNS

FINAL DRAINAGE REPORT

PARKER, COLORADO

Project No.: 00056

Date: July 12, 2004

Design: MWE

Drawn: MWE

Check: RNW

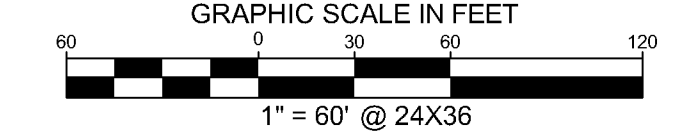
Revisions:

FIGURE

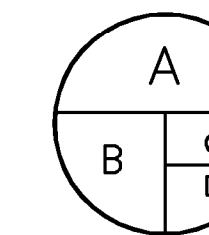
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### LEGEND



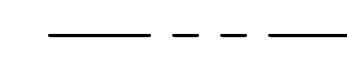
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B = AREA (ACRES)  
C = BASIN IMPERVIOUSNESS  
D = 100YR DESIGN STORM RUNOFF (CFS)



FLOW DIRECTION



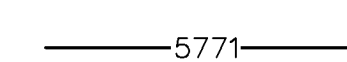
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— EXISTING PROPERTY LINE



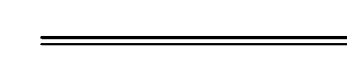
— EXISTING CONTOUR



— PROPOSED CONTOUR



— EXISTING STORM SEWER

 PROPOSED STORM SEWER

PROPOSED STORM INLET

**Kimley»»Horn**  
2019, KIMLEY-HORN AND ASSOCIATES, INC.

2019 KIMLEY-HORN AND ASSOCIATES, INC.  
4582 South Ulster Street, Suite 1500  
Denver, Colorado 80237 (303) 228-2300

DESIGNED BY: DLS  
DRAWN BY: ECZ  
CHECKED BY: DLS  
DATE: 11/11/19

**PARKER & PINE**  
PARKER, CO

CONSTRUCTION DOCUMENTS  
INAPV DRAINAGE AREA

# PRELIMINARY DRAINAGE AREA MAP

PRELIMINARY

FOR REVIEW ONLY  
NOT FOR  
CONSTRUCTION

**Kimley»Horn**  
Kimley-Horn and Associates, Inc.

PROJECT NO.  
096502001

DRAWING NAME  
096502001DRM

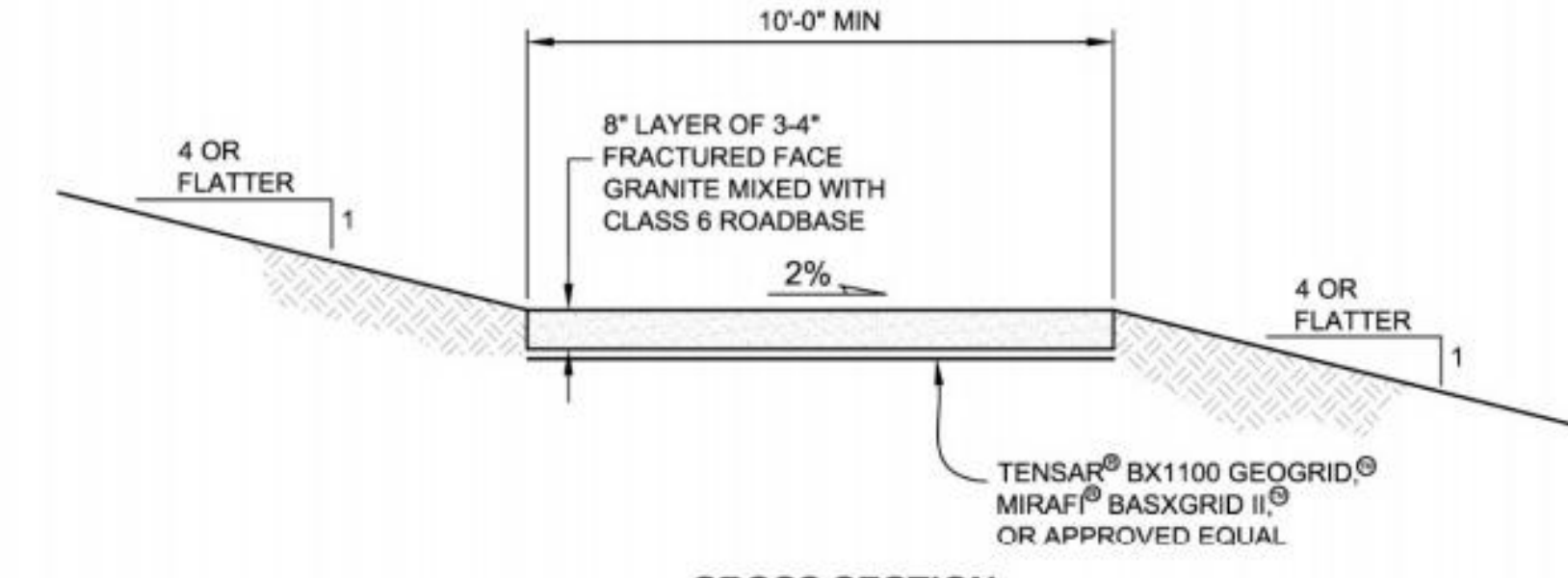
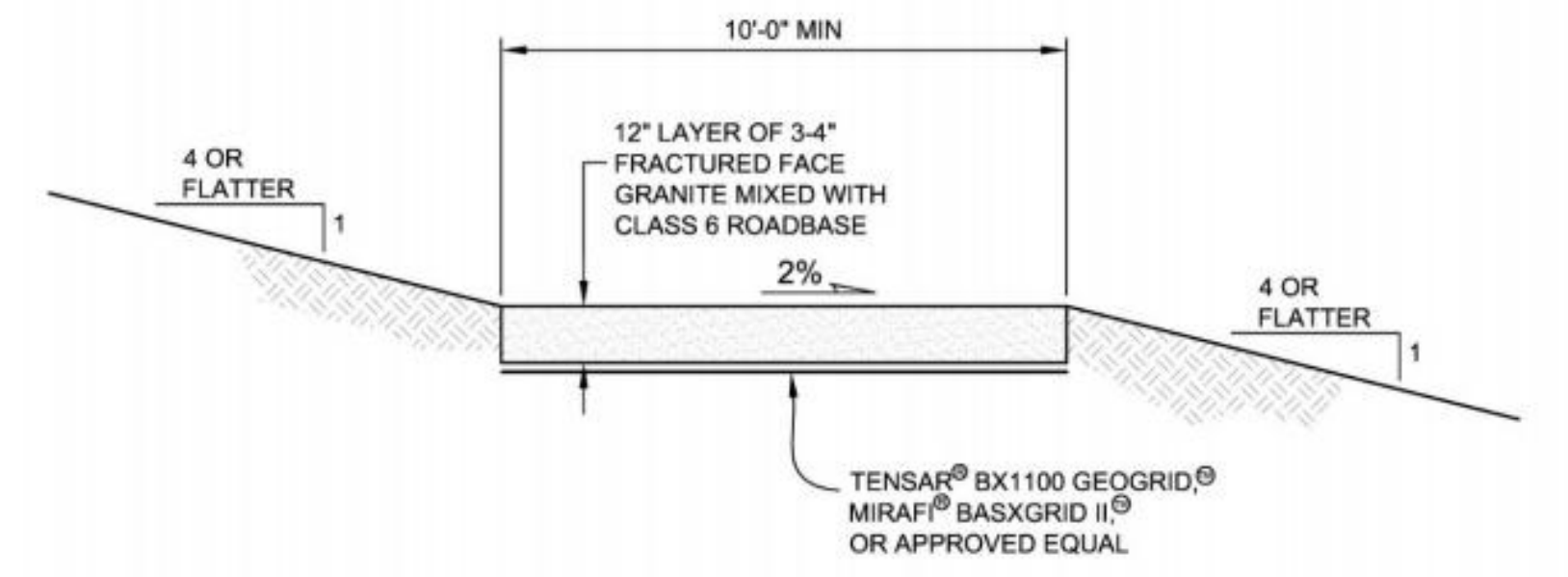
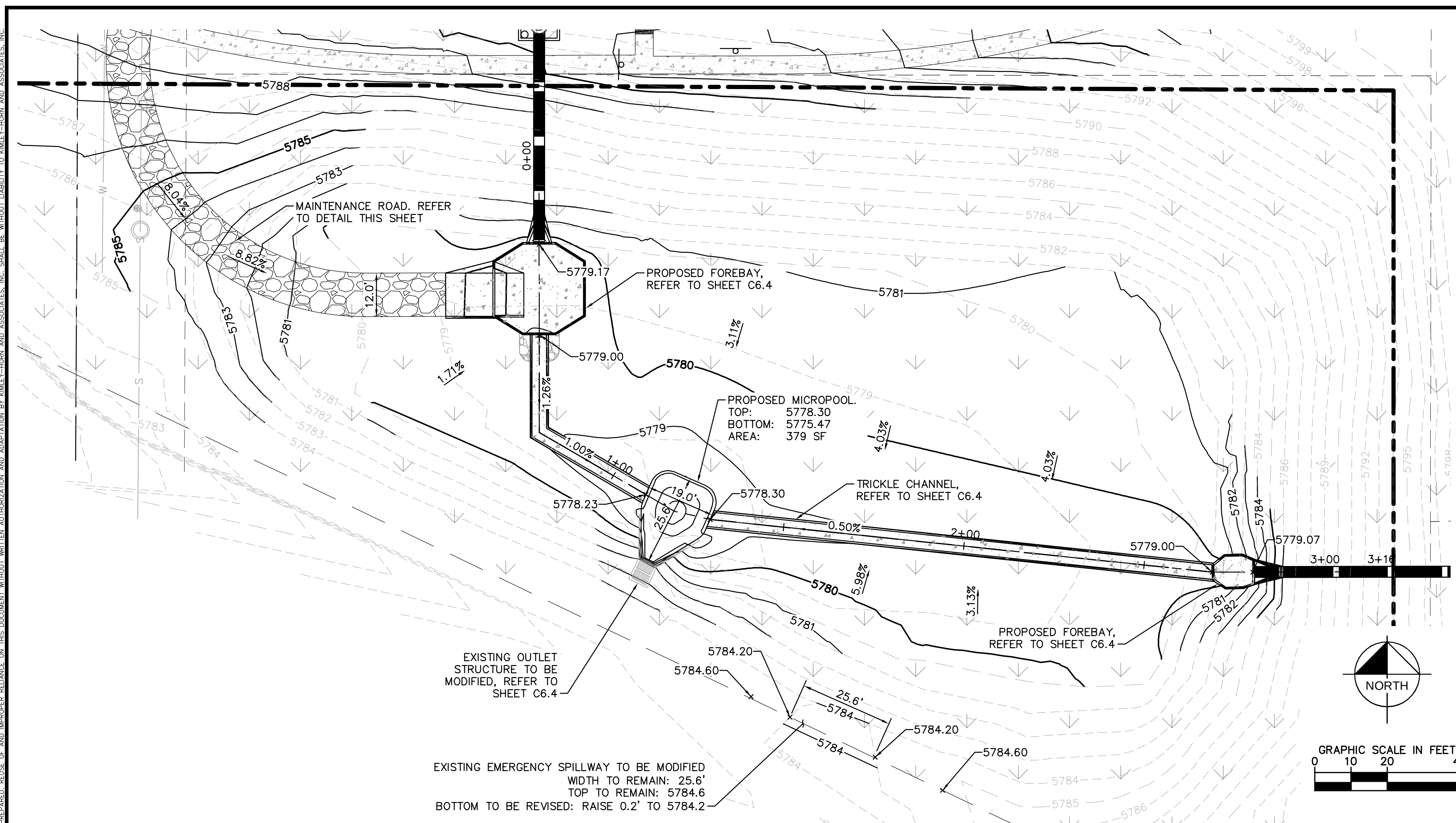
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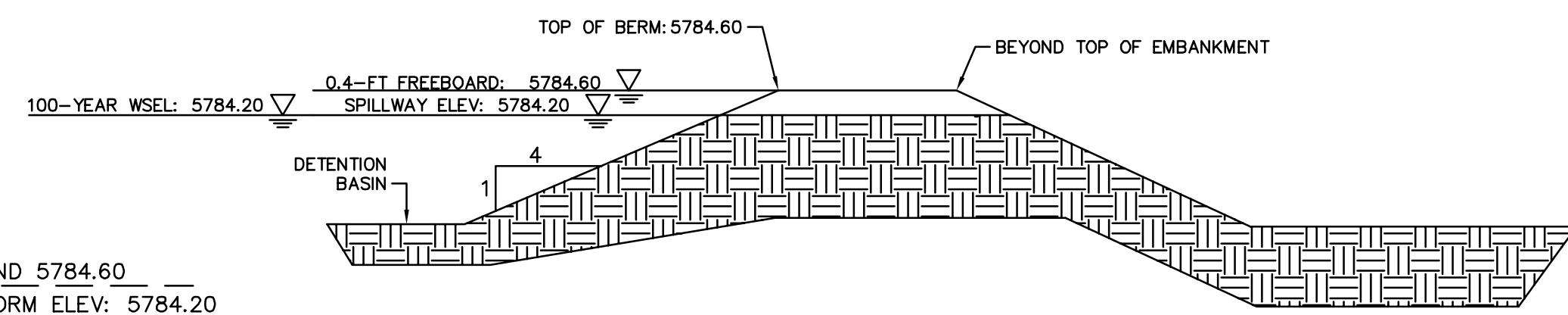
Know what's below.  
Call before you dig.



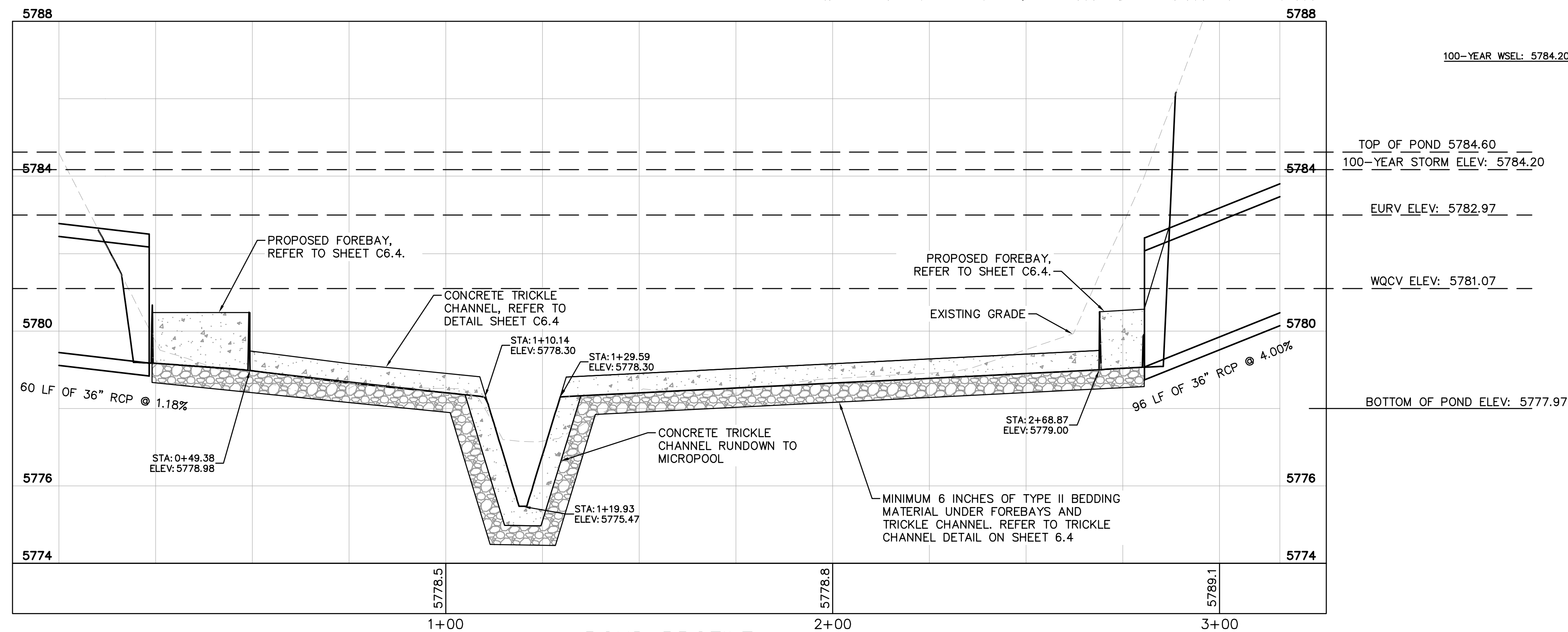
C:\Users\Josh.Kasper\OneDrive\Work\Projects\096502001\ST\_DET.dwg Kasper, Josh 10/9/2019 10:57 AM  
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MAINTENANCE ROAD DETAILS  
N.T.S.



MODIFIED EXISTING EMERGENCY SPILLWAY DETAIL  
N.T.S.



POND PROFILE  
HORIZONTAL SCALE: 1" = 20'  
VERTICAL SCALE: 1" = 2'

| NO. | REVISION | BY | DATE | APPR |
|-----|----------|----|------|------|
|     |          |    |      |      |
|     |          |    |      |      |
|     |          |    |      |      |
|     |          |    |      |      |

**Kimley»Horn**  
2020 KIMLEY-HORN AND ASSOCIATES, INC.  
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Denver, Colorado 80237 (303) 228-2300

DESIGNED BY: DLS  
DRAWN BY: JRK  
CHECKED BY: DLS  
DATE: 04/24/20

PARKER AND PINE FILING 1  
PARKER, CO  
CONSTRUCTION DOCUMENTS  
POND PLANS AND PROFILE

PRELIMINARY  
FOR REVIEW ONLY  
NOT FOR CONSTRUCTION  
**Kimley»Horn**  
Kimley-Horn and Associates, Inc.

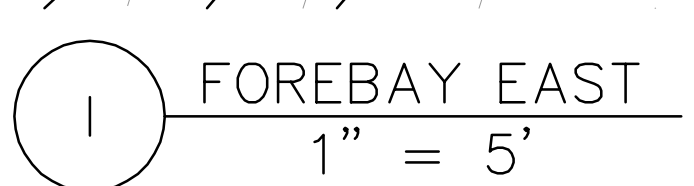
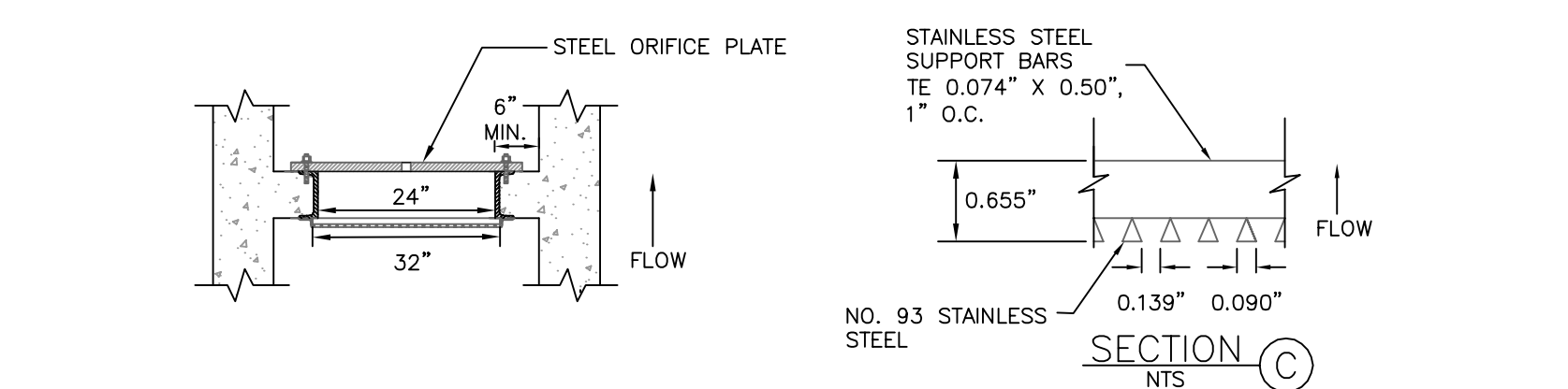
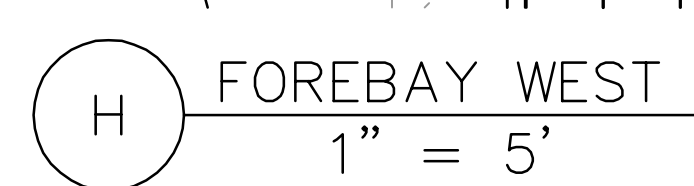
PROJECT NO.  
096502001

DRAWING NAME  
096502001ST\_DET

C6.3







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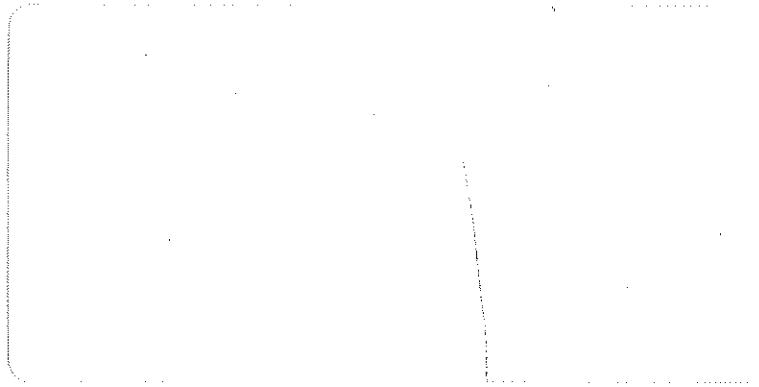


NOTE:

1. REBAR REINFORCEMENT IS ONLY REQUIRED FOR FOREBAYS WITH WALL HEIGHTS GREATER THAN
2. REFER TO PLAN FOR WALL HEIGHT (H)

## APPENDIX F

TOWN OF PARKER  
AUG 13 2004  
PLANNING DEPT.



**Final Drainage Report  
Parker Auto Plaza  
Town of Parker  
Douglas County, Colorado**

Prepared for:

Parker Auto Plaza, LLLP  
% Concepts West Architecture  
202 East Cheyenne Mountain Blvd.  
Suite Q  
Colorado Springs, Colorado 80906

Prepared by:

Kiowa Engineering Corporation  
1604 South 21<sup>st</sup> Street  
Colorado Springs, Colorado 80904

Kiowa Project No. 00056

July 12, 2004



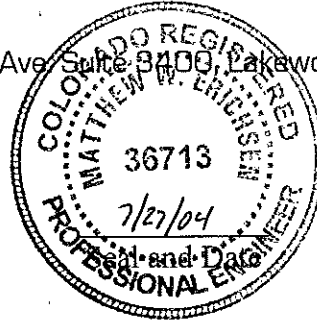
**ENGINEER'S STATEMENT:**

This report for the final design of the Parker Auto Plaza development was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

Kiowa Engineering Corporation, 7175 W. Jefferson Ave Suite 8400, Lakewood, CO 80235

*Matthew W. Ericksen*

Registered Professional Engineer  
State of Colorado # 36713  
(For and on behalf of Kiowa Engineering Corp.)



## Table of Contents

|                                                                                     |          |
|-------------------------------------------------------------------------------------|----------|
| <b>Engineer's Statement</b> .....                                                   | i        |
| <b>Table of Contents</b> .....                                                      | ii       |
| <b>General Location and Description</b> .....                                       | 1        |
| <b>Drainage Basins and Sub-Basins</b> .....                                         |          |
| Major Basin Description .....                                                       | 1        |
| Site Sub-Basin Description .....                                                    | 3        |
| Floodplains.....                                                                    | 3        |
| <b>Drainage Design Criteria</b> .....                                               |          |
| Regulations.....                                                                    | 4        |
| Development Criteria Reference and Constraints .....                                | 5        |
| Hydrologic Criteria .....                                                           | 5        |
| Hydraulic Criteria.....                                                             | 5        |
| <b>Drainage Facility Details</b> .....                                              |          |
| General Concept.....                                                                | 6        |
| Drainage Basin and Storm Sewer System Description .....                             | 6        |
| Detention Basin Facility Description .....                                          | 7        |
| Baldwin Gulch Drainageway Facility Description .....                                | 8        |
| Sculpted Concrete Drop – Cutoff Wall Analysis .....                                 | 9        |
| <b>Environmental Protection Criteria</b> .....                                      | 9        |
| <b>Conclusions</b> .....                                                            | 10       |
| <b>References and Software</b> .....                                                | 11       |
| <b>Appendix</b> .....                                                               | 12       |
| See Appendix for Table of Contents                                                  |          |
| <b>List of Figures (Additional figures and tables are included in the Appendix)</b> |          |
| Figure 3      Vicinity Map.....                                                     | 2        |
| Figure 7      Future Major Watershed Boundaries and Reach Delineations .....        | Appendix |
| Figure 8      Flood Insurance Rate Map.....                                         | Appendix |
| Figure 9      Soil Survey Map .....                                                 | Appendix |

## **General Location and Description**

This report addresses the drainage impacts related to the Parker Auto Plaza development. The development will include construction of automobile sales facilities, an automobile body shop and future commercial site development. The property is located in the northwest quarter and southwest quarter of Section 10, Township 6 South, Range 66 West of the Sixth Principal Meridian. The property lies northwest of the intersection of Parker Road and Lincoln Avenue. It is bounded on the north by Pine Lane, on the east by Parker Road, Dransfeldt Road and MacLachlan Subdivision Nos. 1 & 2, on the south by Lincoln Avenue and on the west by the proposed extension alignment of Twenty Mile Road. The proposed Parker Auto Plaza site includes approximately 52.7 acres. A vicinity map of the area is included as Figure 3.

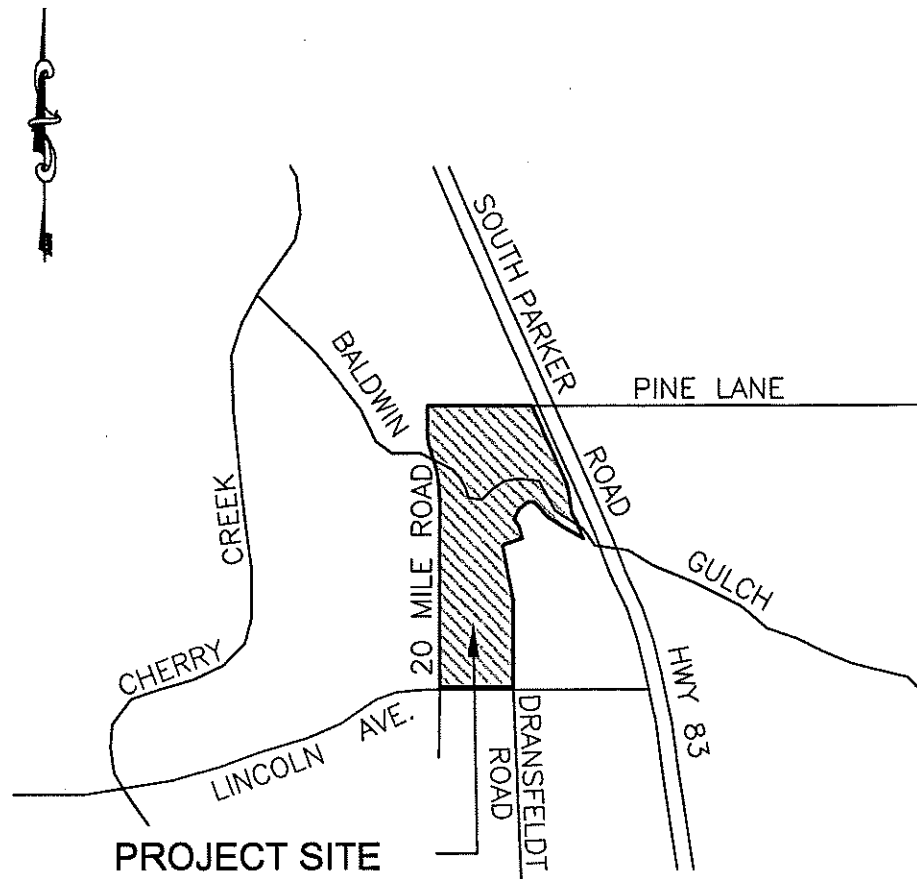
The site is covered by native vegetation, including weeds, sagebrush and a few large and smaller deciduous trees. Baldwin Gulch runs through the property from an existing box culvert under Parker Road to the proposed extension alignment of Twenty Mile Road.

Approximately 31.6 acres of the site will be utilized for the proposed commercial development sites described above. The 8.1 acres that surrounds Baldwin Gulch and the 100-year flood plain will be designated open space. This area will remain undeveloped except for a proposed trail and trailhead area and for channel improvements recommended in the *Baldwin Gulch Outfall Systems Planning Study* prepared by the Urban Drainage and Flood Control District.

## **Drainage Basins and Sub-Basins**

### **Major Basin Description**

The site was part of the MacLachlan Property (of which Filing Nos. 1 & 2 are currently developed). As a result of the review of the final drainage report for the MacLachlan Subdivision No. 1 (S.A. Miro, Inc., March 1994), and the *Newlin and Baldwin Gulches and Basin 4600-09 Outfall Systems Study Preliminary Design Report* (Kiowa Engineering Corporation, December 1994), it is apparent that the site lies within a portion of two major historic basins; Basin 4600-09 and Baldwin Gulch. Basin 4600-09 drains directly into Cherry Creek west of the site. A copy of the Future Major Watershed Boundaries and Reach Delineations, Baldwin Gulch basin 4600-09 is included in the Appendix of this report as Figure 7. The outfall for Baldwin Gulch into Cherry Creek is located approximately one-quarter mile west of the proposed extension of Twenty Mile Road. In the current condition it appears that a portion of the flows from the Basin 4600-09 section of the site are being diverted into Baldwin Gulch by the existing road in the Twenty Mile Road R.O.W. Existing drainage basins are shown on Figure 1 that is located in the map pocket at the end of this report.



**FIGURE 3**  
**VICINITY MAP**  
**PARKER AUTO PLAZA**

## Site Sub-Basin Description

Most of the flows from the developed lots within the MacLachlan subdivision drain to onsite detention basins. These detention basins in turn outfall directly into Baldwin Gulch and will remain in this condition. A small portion of Ponderosa Drive discharges onto the site in the current condition, and will be conveyed across the site by curb and gutter as Dransfeldt Road will be extended to Twenty Mile Road during the development of the site. Channel improvements will be made to Baldwin Gulch as part of the site development. The channel improvements noted in the *Newlin and Baldwin Gulches and Basin 4600-09 Outfall Systems Study (OSP) Preliminary Design Report* were reviewed during the Preliminary Drainage Report (PDR) for the site. The following modifications have been made to the channel improvements outlined in the *OSP* as part of the *PDR* review by UDFCD and the Town of Parker. Sculpted concrete drop structures have been substituted for the check structures shown in the *OSP*. The sculpted drop structures have replaced the checks so that the channel can be constructed to the ultimate longitudinal slope anticipated for sandy soils instead of allowing the channel to degrade over time with check structures as recommended in the *OSP*. This will minimize the amount of sediment that could be conveyed to Cherry Creek resulting from the degradation of the invert along this portion of Baldwin Gulch. The longitudinal slope of the channel was also modified from 0.94% to 0.6% to reduce the flow velocities in the channel. The proposed improvements to Baldwin Gulch are shown on the Drainage Plan, Figure 2. No further onsite drainage improvements are needed to convey flows from MacLachlan Subdivisions through the site.

The development of the site will not change the drainage patterns significantly onsite. However the increase in runoff that accompanies the development of the site will require the construction of two detention basins. The detention basins are located east of the future alignment of Twenty Mile Road to regulate discharge from the site into Baldwin Gulch. A storm sewer system will be required on the parcels south of Baldwin Gulch in order to convey site runoff from drainage basins 1B-12B into Detention Basin B south of Baldwin Gulch. A storm sewer system will also be required to convey flows from drainage basins 1A-5A to Detention Basin A (see Figure 2).

The existing and proposed grading precludes any treatment or detention of the runoff from Twenty Mile Road basins 3C and 4C and Pine Lane basins 1D and 2D. The Twenty Mile Road basins will be released to their historic Baldwin Gulch outfall location. The drainage basins along Pine Lane will be released to their historic outfall location westerly along the south edge of Pine Lane, eventually reaching Baldwin Gulch. The drainage improvements associated with Pine Lane will be completed as part of the Pine Lane extension project by Douglas County.

## Floodplains

The Baldwin Gulch existing 100-year flood plain is shown on Figure 1 located in a map pocket at the end of this report. The 100-year flood plain boundary is based in part on the *1977 Flood Hazard Delineation (FHAD) Report* for Baldwin Gulch. The flood plain boundary was confirmed using Panel Number 080310 0070 D of the FEMA Flood Insurance Rate Map for

Douglas County, shown in Figure 8 which is located in the Appendix of this report. The development of this site will include channel improvements to Baldwin Gulch. These improvements, along with Detention Basin A south of Baldwin Gulch, east of the proposed Twenty Mile Road extension alignment will be the only grading that will occur within the 100-year floodplain. The construction of the channel improvements and attendant grading along the major drainageway will alter the 100-year floodway and floodplain through the site east of the proposed Twenty Mile Road extension. The proposed 100-year floodplain resulting from the proposed channel improvements is shown on Figure 2. A conditional Letter of Map Revision (CLOMR) will be required for this project. The submittal of a CLOMR to FEMA will commence once the design of the Baldwin Gulch improvements are generally approved and accepted by the Town of Parker and the Urban Drainage and Flood Control District.

### **Drainage Design Criteria**

#### **Regulations**

In accordance with the Town of Parker's Floodplain ordinance, no temporary or permanent structures designed for human habitation will be placed in the floodplain. There will be a multi-use trail proposed along the Baldwin Gulch drainageway. The area adjacent to the low flow channel and on overbanks will be revegetated with native grasses, trees, and shrubs.

The development of this site will include improvements to the Baldwin Gulch channel, as stated above. These improvements include four sculpted concrete drop structures as well as grading the channel to conform to the recommended channel section and reinforcing the channel as necessary to minimize the adverse affects of erosion along Baldwin Gulch and the lands adjacent to it. A riprap lined low flow channel of 5-year capacity with a benched channel section above the low flow area is proposed. The total 100-year flooding depth along the channel through the site ranges from four to six-feet. A multi-use trail will follow the channel along the north bench of the drainageway, generally located above the 100-year floodplain. This trail will cross beneath proposed Twenty Mile Road in a three-sided box culvert. The upstream portion of the multi-use trail will cross under Parker Road through the north bay of the existing twin box culvert. The trail will loop up to Parker Road on the north side. The trail will continue south along Parker Road to the existing multi-use trail located on the south side of Baldwin Gulch and east of Parker Road. The plan and profile design for Baldwin Gulch has been included in a map pocket at the end of this report.

The proposed channel improvements will alter the existing channel section for the entire length of Baldwin Gulch within the project site. As a result of field meetings with the U. S. Army Corps of Engineers it was determined that a 404 Permit will not be required for the proposed channel improvements. It was determined that the portion of Baldwin Gulch through the site is not considered as jurisdictional waters of the United States.

## Development Criteria Reference and Constraints

The Final Drainage Report for MacLachlan Subdivision No. 1 includes portions of this site in its analysis of historic drainage basins, however, drainage reports including developed conditions for this site could not be found. This drainage study generally agrees with the Final Drainage Report for MacLachlan Subdivision No. 1 concerning the historic drainage patterns for the site.

The Final Drainage Report for MacLachlan Subdivision No. 1 describes the developed flows of the neighboring subdivision. This study indicates that all flows aside from three small basins will be routed to a detention basin in MacLachlan Subdivision No. 1 and discharged directly into Baldwin Gulch. Two of the three small basins currently discharge onto the project site. When Dransfeldt Road is extended to Twenty Mile Road as a part of the development of this site, runoff from the offsite sub-basins currently discharging will be conveyed by curb and gutter to the storm sewer system in Dransfeldt Road and Twenty Mile Road and from there to Detention Basin B.

## Hydrologic Criteria

Basin runoff was calculated using the Rational Method. Hydrology for Baldwin Gulch was obtained from the Newlin and Baldwin Gulches Outfall Systems Planning Study. The 5-year and 100-year peak discharges for the segment of Baldwin Gulch adjacent to the site are 260 cubic feet per second and 2,100 cubic feet per second, respectively.

## Hydraulic Criteria

The drainage systems and street capacities for this site have been designed to accommodate the 5-year initial storm event and the 100-year major storm event as specified in the Town of Parker, Colorado, *Storm Drainage and Environmental Criteria Manual (SDECM)*. The hydraulic capacities of the curb inlets were determined using the UDINLET computer model developed by the University of Colorado at Denver. The initial storm event water spread was used to help determine the inlet locations in the site. Table 2.4 from the *SDECM* was used to determine the maximum allowable water spread for the initial storm runoff and has been included in the Appendix. An Inlet Capacity Summary spreadsheet is included in the Appendix, showing the inlet capacities and the minor storm water spread in tabular form. Colorado Department of Transportation (CDOT) Type R curb inlets will be used throughout the site. City of Denver Standard No. 16 Open Throat Inlets will be used in areas where there is insufficient area behind the curb for a curb-opening inlet.

Detention basins for this site have been designed to conform to the 10-year and 100-year regulated release rates per the aforementioned manual. Detention basins were sized and discharge rates determined using the UDFCD Detention Formulas. The supporting calculations associated with the sizing of hydraulic facilities for this development are included in the Appendix of this report.

## **Drainage Facility Details**

### **General Concept**

In the current condition, drainage from the proposed site flows into Baldwin Gulch. Calculations for the analysis of existing drainage basins are presented in the appendix at the end of this report. The existing Drainage Plan, including drainage basins are shown in Figure 1. The proposed development seeks to preserve the existing drainage patterns with the exception of routing flows through detention basins prior to discharging into Baldwin Gulch in order to limit flows from the developed site to acceptable levels. Calculations for the analysis of developed basins for this site, as well as calculations for the design of the detention basins and their tributary storm water conveyances are presented in the appendix of this report. The configuration of proposed basins and their related drainage facilities are presented in Figure 2. Offsite runoff impacting the site is minimal and will be conveyed across the site with the extension of Dransfeldt Road to be handled by the drainage facilities discharging to Detention Basin B.

### **Drainage Basin and Storm Sewer System Description**

Runoff from Basin 1A will sheet-flow westerly through a parking lot area to a 10-foot sump curb inlet (Inlet 1). The flows captured by the inlet will be routed to Inlet 2. Drainage from Basin 2A will sheet-flow westerly through a parking lot area to a 15-foot curb inlet in sump condition. The flows will combine with flows from Inlet 1 and be carried by a storm sewer to Detention Basin A. Flows generated from Basin 3A will sheet-flow westerly through a parking lot area to a 10-foot sump curb inlet. A storm sewer will route the flows to Detention Basin A. Runoff generated from Basin 4A will sheet-flow southwesterly through a parking lot area to a 10-foot sump curb inlet. The flows will be routed to Detention Basin A by a storm sewer.

Runoff from Basin 1B will be carried northerly by curb and gutter along the western side of Twenty Mile Road. The runoff will be collected by a 15-foot on grade curb inlet at Dransfeldt Road. Runoff generated within Basin 2B will be carried northerly by curb and gutter along on the eastern side of Twenty Mile Road. The runoff will be collected by a 10-foot on grade curb inlet at Inlet 11. Drainage developed from Basin 3B will sheet-flow westerly through a parking lot area to be collected by a 15-foot sump curb inlet near Twenty Mile Road. The flow will then be carried by a 24-inch RCP to join with flows at Inlet 20. Runoff generated within Basin 4B will sheet-flow west through a parking lot area and will be collected by a 10-foot sump curb inlet. The flow will then be carried to Inlet 20 by a storm sewer. Drainage from Basin 5B will sheet-flow northwest through a parking lot area and will be collected by a 10-foot sump curb inlet. The flow will be routed to Inlet 19 through a storm sewer. Drainage from Basin 6B will sheet-flow northwest through a parking lot area and will be collected by a 5-foot sump curb inlet. The flow will be routed to Detention Basin B through a storm sewer. Drainage from Basin 7B will be carried northwest by the Dransfeldt Road curb and gutter to 15-foot curb inlets on grade at the intersection of Twenty Mile Road. A storm sewer will route the flows into the storm



sewer system along Twenty Mile Road. Runoff generated from Basin 8B will sheet-flow directly to Detention Basin B. Runoff generated from Basin 9B will sheet-flow westerly to a 15-foot sump curb inlet. At this point the runoff will combine with the flows in the 36-inch RCP storm sewer located along the east side of Twenty Mile Road (Twenty Mile Storm Sewer). The storm sewer will continue north to a manhole to the north of Dransfeldt Road. The Twenty Mile Storm Sewer will bend at this manhole and be directed into Detention Basin B. The runoff generated by Basin 10B will be carried along the gutter of the private drive extending into the commercial development area. The flows will continue along the east curb and gutter of Twenty Mile Road to a 20-foot inlet (Inlet 18) on grade at the intersection with Dransfeldt Road. The runoff captured by Inlet 20 will be directed into the Twenty Mile Storm Sewer. Runoff generated within Basin 11B will sheet-flow westerly through a parking lot area and will be collected by a 10-foot sump curb inlet near Twenty Mile Road. The flows will be routed into the Twenty Mile Storm Sewer. Runoff generated within Basin 12B will sheet-flow westerly through a parking lot area and will be collected by a 10-foot sump curb inlet near Twenty Mile Road.

Flows developed within Basin 1C will be carried southeasterly by a grass-lined swale to enter Baldwin Gulch. Runoff from Basin 2C will sheet-flow directly to Baldwin Gulch. Drainage Basins 3C-5C are located along a superelevated portion of Twenty Mile Road. Inlets have been located along this section of Twenty Mile Road to minimize the amount of flows crossing the street at points of superelevation. Drainage generated from Basin 3C will sheet-flow onto the west median curb line of Twenty Mile Road. An inlet will be placed along the west curb of Twenty Mile Road to capture the flows. The flows will be conveyed to Baldwin Gulch through a storm sewer. Flows from Basin 4C will be carried along the west curb and gutter of Twenty Mile Road to Inlet 27A. The flows will be routed by a storm sewer into Inlet 27. Flows from Basin 5C will flow onto the east curb and gutter of Twenty Mile Road to Inlet 25 at the low point. Flows from Basin 6C will flow along the east median curb and gutter of Twenty Mile Road to Inlet 26 at the low point. A storm sewer will route the flows to Inlet 26 and Baldwin Gulch. Runoff generated from Basins 1D and 2D will be handled as part of the Pine Lane Improvements. Runoff generated from Basin 1D is carried northerly along the west curb and gutter onto Pine Lane. The flows from Basin 2D will be captured by an inlet and conveyed to the Pine Lane storm sewer system.

#### **Detention Basin Facility Description**

The required detention volumes for Detention Basin A are 2.06 acre-feet for the 10-year event and 2.97 acre-feet for the 100-year event, which includes the WQCV. Calculations for this detention basin are located in the Appendix of this report. To control the release of flows and allow for pollutant removal, the detention basin is designed as an Extended Detention Basin Sedimentation Facility, as shown in Figure EDB-1 in Volume 3 of the Urban Storm Drainage Criteria Manual, found in the Appendix of this report. The design will include a forebay, trickle channel and emergency spillway. Modifications to the Figure EDB-1 design were made per the request of the Town of Parker. The modifications include the elimination of the micropool and

**APPENDIX A**  
**Hydrologic Calculations**

**Parker Auto Plaza**  
**Time of Concentration (Existing)**

| Basin | Contributing Basins | Slope  |        | Length |         | C <sub>s</sub> | Velocity   |            | T <sub>c</sub> |           | T <sub>c</sub> |
|-------|---------------------|--------|--------|--------|---------|----------------|------------|------------|----------------|-----------|----------------|
|       |                     | O'land | Travel | O'land | Travel  |                | O'land     | Travel     | O'land         | Travel    |                |
| A     |                     | 6.1 %  | 0.9 %  | 150 lf | 1125 lf | 0.01           | 0.2 ft/sec | 0.5 ft/sec | 788 sec.       | 2272 sec. | 51.0 min.      |
| B     |                     | 2.4 %  | 2.5 %  | 150 lf | 1105 lf | 0.01           | 0.1 ft/sec | 1.0 ft/sec | 1077 sec.      | 1163 sec. | 37.3 min.      |
| C     |                     | 1.9 %  | 2.4 %  | 150 lf | 1659 lf | 0.01           | 0.1 ft/sec | 0.9 ft/sec | 1158 sec.      | 1880 sec. | 50.6 min.      |
| D     |                     | 2.5 %  | 3.4 %  | 150 lf | 900 lf  | 0.01           | 0.1 ft/sec | 1.1 ft/sec | 1067 sec.      | 842 sec.  | 31.8 min.      |
| E     |                     | 1.5 %  | 3.9 %  | 150 lf | 814 lf  | 0.01           | 0.1 ft/sec | 0.8 ft/sec | 1268 sec.      | 1072 sec. | 39.0 min.      |

Equations:

$$\text{Time of Concentration (Overland)} = 1.8(1.1 - C_s)L^{0.5} S^{-0.333}$$

C<sub>s</sub> = Runoff coefficient for five-year flow

L = Length of overland flow in feet (Length must be less than 1,000 feet for undeveloped area before entering a channel)

S = Slope of flow path in percent

**Parker Auto Plaza  
Basin Runoff Calculation (Existing)**

| Basin | Contributing Basins | Area       |          | C <sub>10</sub> | C <sub>100</sub> | Time of Concentration | Rainfall Intensity |                  | Runoff          |                  |
|-------|---------------------|------------|----------|-----------------|------------------|-----------------------|--------------------|------------------|-----------------|------------------|
|       |                     |            |          |                 |                  |                       | i <sub>10</sub>    | i <sub>100</sub> | Q <sub>10</sub> | Q <sub>100</sub> |
| A     |                     | 519,090 sf | 11.92 ac | 0.05            | 0.20             | 51.0 min.             | 1.8 in/hr          | 2.9 in/hr        | 1.1 cfs         | 7.0 cfs          |
| B     |                     | 657,300 sf | 15.09 ac | 0.05            | 0.20             | 37.3 min.             | 2.3 in/hr          | 3.6 in/hr        | 1.7 cfs         | 10.8 cfs         |
| C     |                     | 512,500 sf | 11.77 ac | 0.05            | 0.20             | 50.6 min.             | 1.9 in/hr          | 2.9 in/hr        | 1.1 cfs         | 6.9 cfs          |
| D     |                     | 256,610 sf | 5.89 ac  | 0.05            | 0.20             | 31.8 min.             | 2.5 in/hr          | 3.9 in/hr        | 0.7 cfs         | 4.6 cfs          |
| E     |                     | 354,940 sf | 8.15 ac  | 0.05            | 0.20             | 39.0 min.             | 2.2 in/hr          | 3.5 in/hr        | 0.9 cfs         | 5.7 cfs          |

Equations:

$$I = (28.5P) / (10 + t_c)^{0.786}$$

P = One-hour point rainfall depth (in.) P(5yr)=1.39in. P(10yr)=1.64in. P(100yr)=2.60in.

i<sub>5</sub>, i<sub>10</sub>, i<sub>100</sub> = Average 5, 10 and 100-year Rainfall Intensity in inches per hour (Fig 5.1, Town of Parker Storm Drainage and Environmental Criteria Manual)

$$Q = CiA$$

Q = Peak Runoff Rate, in cubic feet per second (cfs)

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

Parker Auto Plaza  
Runoff Coefficient Calculation (Developed)

| Design Point | Basin | Area     | % Area  | C <sub>s</sub> | C <sub>100</sub> | C <sub>s</sub> | C <sub>100</sub> |
|--------------|-------|----------|---------|----------------|------------------|----------------|------------------|
| DP 1         | 1A-4A | 13.96 ac | 90.31 % | 0.81           | 0.88             | 0.73           | 0.79             |
|              | 5A    | 1.50 ac  | 9.69 %  | 0.14           | 0.40             | 0.01           | 0.04             |
|              |       | 15.45 ac | 100.0 % |                |                  | 0.75           | 0.83             |

| Design Point | Basin           | Area     | % Area  | C <sub>s</sub> | C <sub>100</sub> | C <sub>s</sub> | C <sub>100</sub> |
|--------------|-----------------|----------|---------|----------------|------------------|----------------|------------------|
| DP 2         | 1B,3B-7B,9B-13B | 16.83 ac | 85.84 % | 0.81           | 0.88             | 0.70           | 0.76             |
|              | 2B              | 0.94 ac  | 4.78 %  | 0.54           | 0.66             | 0.03           | 0.03             |
|              | 8B              | 1.84 ac  | 9.38 %  | 0.14           | 0.40             | 0.01           | 0.04             |
|              |                 | 19.61 ac | 100.0 % |                |                  | 0.73           | 0.82             |

**Parker Auto Plaza**  
**Time of Concentration (Developed)**

| Basin | Contributing Basins | Slope  |        | Length |         | C <sub>s</sub> | Velocity   |                    | t <sub>c</sub>           |                          | Comp. t <sub>c</sub> | t <sub>c</sub> Check | Final t <sub>c</sub> |
|-------|---------------------|--------|--------|--------|---------|----------------|------------|--------------------|--------------------------|--------------------------|----------------------|----------------------|----------------------|
|       |                     | O'land | Travel | O'land | Travel  |                | O'land     | Travel (Fig. RO-1) | O'land (t <sub>c</sub> ) | Travel (t <sub>c</sub> ) |                      |                      |                      |
| 1A    |                     | 8.0 %  | 3.0 %  | 85 lf  | 430 lf  | 0.14           | 0.2 ft/sec | 3.4 ft/sec         | 8.0 min.                 | 2.1 min.                 | 10.1 min.            | 12.9 min.            | 10.1 min.            |
| 2A    |                     | 3.0 %  | 3.0 %  | 100 lf | 360 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 12.0 min.                | 1.8 min.                 | 13.8 min.            | 12.6 min.            | 12.6 min.            |
| 3A    |                     | 1.0 %  | 3.0 %  | 80 lf  | 410 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 15.5 min.                | 2.0 min.                 | 17.5 min.            | 12.7 min.            | 12.7 min.            |
| 4A    |                     | 3.0 %  | 1.3 %  | 70 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 2.2 ft/sec         | 10.0 min.                | 2.7 min.                 | 12.7 min.            | 12.3 min.            | 12.3 min.            |
| 5A    |                     | 4.0 %  | 1.0 %  | 110 lf | 50 lf   | 0.14           | 0.2 ft/sec | 1.6 ft/sec         | 11.4 min.                | 0.5 min.                 | 11.9 min.            | 10.9 min.            | 10.9 min.            |
| 1B    |                     | 3.0 %  | 1.5 %  | 20 lf  | 500 lf  | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 5.4 min.                 | 3.6 min.                 | 9.0 min.             | 12.9 min.            | 9.0 min.             |
| 2B    |                     | 1.0 %  | 1.5 %  | 200 lf | 550 lf  | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 24.4 min.                | 4.0 min.                 | 28.4 min.            | 14.2 min.            | 14.2 min.            |
| 3B    |                     | 3.0 %  | 1.0 %  | 60 lf  | 230 lf  | 0.14           | 0.1 ft/sec | 2.0 ft/sec         | 9.3 min.                 | 1.9 min.                 | 11.2 min.            | 11.6 min.            | 11.2 min.            |
| 4B    |                     | 8.0 %  | 2.5 %  | 30 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 4.7 min.                 | 1.9 min.                 | 6.6 min.             | 12.1 min.            | 6.6 min.             |
| 5B    |                     | 8.0 %  | 2.0 %  | 40 lf  | 300 lf  | 0.14           | 0.1 ft/sec | 2.8 ft/sec         | 5.5 min.                 | 1.8 min.                 | 7.3 min.             | 11.9 min.            | 7.3 min.             |
| 6B    |                     | 3.0 %  | 3.5 %  | 60 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.7 ft/sec         | 9.3 min.                 | 1.8 min.                 | 11.1 min.            | 12.6 min.            | 11.1 min.            |
| 7B    |                     | 4.0 %  | 4.5 %  | 15 lf  | 540 lf  | 0.14           | 0.1 ft/sec | 4.2 ft/sec         | 4.2 min.                 | 2.1 min.                 | 6.4 min.             | 13.1 min.            | 6.4 min.             |
| 8B    |                     | 3.0 %  | 1.0 %  | 80 lf  | 140 lf  | 0.14           | 0.1 ft/sec | 1.6 ft/sec         | 10.7 min.                | 1.5 min.                 | 12.2 min.            | 11.2 min.            | 11.2 min.            |
| 9B    |                     | 5.0 %  | 3.0 %  | 50 lf  | 350 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 7.1 min.                 | 1.7 min.                 | 8.9 min.             | 12.2 min.            | 8.9 min.             |
| 10B   |                     | 3.0 %  | 2.5 %  | 20 lf  | 500 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 5.4 min.                 | 2.7 min.                 | 8.0 min.             | 12.9 min.            | 8.0 min.             |
| 11B   |                     | 3.0 %  | 2.5 %  | 25 lf  | 250 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 6.0 min.                 | 1.3 min.                 | 7.3 min.             | 11.5 min.            | 7.3 min.             |
| 12B   |                     | 3.0 %  | 2.5 %  | 50 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.1 ft/sec         | 8.5 min.                 | 2.2 min.                 | 10.6 min.            | 12.5 min.            | 10.6 min.            |
| 13B   |                     | 1.0 %  | 1.0 %  | 150 lf | 450 lf  | 0.14           | 0.1 ft/sec | 2.0 ft/sec         | 21.2 min.                | 3.8 min.                 | 24.9 min.            | 13.3 min.            | 13.3 min.            |
| 1C    |                     | 1.0 %  | 2.0 %  | 200 lf | 450 lf  | 0.14           | 0.1 ft/sec | 1.0 ft/sec         | 24.4 min.                | 7.5 min.                 | 31.9 min.            | 13.6 min.            | 13.6 min.            |
| 2C    |                     | 1.0 %  | 1.0 %  | 25 lf  | 1490 lf | 0.14           | 0.0 ft/sec | 1.5 ft/sec         | 8.6 min.                 | 16.6 min.                | 25.2 min.            | 18.4 min.            | 18.4 min.            |
| 3C    |                     | 2.0 %  | 1.0 %  | 150 lf | 700 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 16.8 min.                | 3.4 min.                 | 20.2 min.            | 14.7 min.            | 14.7 min.            |
| 4C    |                     | 1.0 %  | 1.1 %  | 10 lf  | 500 lf  | 0.14           | 0.0 ft/sec | 2.1 ft/sec         | 5.5 min.                 | 4.0 min.                 | 9.4 min.             | 12.8 min.            | 9.4 min.             |
| 5C    |                     | 2.0 %  | 1.0 %  | 60 lf  | 200 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 10.6 min.                | 1.0 min.                 | 11.6 min.            | 11.4 min.            | 11.4 min.            |
| 6C    |                     | 2.0 %  | 1.0 %  | 10 lf  | 340 lf  | 0.14           | 0.0 ft/sec | 1.6 ft/sec         | 4.3 min.                 | 3.5 min.                 | 7.9 min.             | 11.9 min.            | 7.9 min.             |
| 7C    |                     | 2.0 %  | 1.0 %  | 10 lf  | 220 lf  | 0.90           | 0.2 ft/sec | 3.4 ft/sec         | 0.9 min.                 | 1.1 min.                 | 5.0 min.             | 11.3 min.            | 5.0 min.             |
| 1D    |                     | 2.0 %  | 2.0 %  | 10 lf  | 350 lf  | 0.14           | 0.0 ft/sec | 2.8 ft/sec         | 4.3 min.                 | 2.1 min.                 | 6.4 min.             | 12.0 min.            | 6.4 min.             |
| 2D    |                     | 10.0 % | 3.0 %  | 30 lf  | 100 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 4.4 min.                 | 0.5 min.                 | 5.0 min.             | 10.7 min.            | 5.0 min.             |
| 3D    |                     | 10.0 % | 3.0 %  | 10 lf  | 400 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 2.5 min.                 | 2.0 min.                 | 5.0 min.             | 12.3 min.            | 5.0 min.             |
| DP 1  | A Basins            | 1.0 %  | 3.0 %  | 80 lf  | 410 lf  | 0.14           | 0.1 ft/sec | 3.4 ft/sec         | 15.5 min.                | 2.0 min.                 | 17.5 min.            | 12.7 min.            | 12.7 min.            |
| DP 2  | B Basins            | 3.0 %  | 1.5 %  | 80 lf  | 1560 lf | 0.14           | 0.1 ft/sec | 2.3 ft/sec         | 10.7 min.                | 11.3 min.                | 22.0 min.            | 19.1 min.            | 19.1 min.            |

Equations:

$$t_i (\text{Overland}) = 1.8(1.1 - C_s)L^{0.5} S^{-0.333}$$

C<sub>s</sub> = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

$$t_c \text{ Check} = (L/180) + 10$$

L = Overall Length

Fig. RO-1: Average velocities for Estimating Travel Time

**Parker Auto Plaza**  
**Basin Runoff Calculation (Developed)**

| Basin | Contributing Basins | Area       |          | C <sub>s</sub> | C <sub>100</sub> | Time of Concentration | Rainfall Intensity |                  | Runoff         |                  | Basin |
|-------|---------------------|------------|----------|----------------|------------------|-----------------------|--------------------|------------------|----------------|------------------|-------|
|       |                     |            |          |                |                  |                       | i <sub>5</sub>     | i <sub>100</sub> | Q <sub>s</sub> | Q <sub>100</sub> |       |
| 1A    |                     | 124,700 sf | 2.86 ac  | 0.81           | 0.88             | 10.1 min.             | 3.7 in/hr          | 7.0 in/hr        | 8.7 cfs        | 17.7 cfs         | 1A    |
| 2A    |                     | 158,280 sf | 3.63 ac  | 0.81           | 0.88             | 12.6 min.             | 3.4 in/hr          | 6.4 in/hr        | 10.1 cfs       | 20.5 cfs         | 2A    |
| 3A    |                     | 149,800 sf | 3.44 ac  | 0.81           | 0.88             | 12.7 min.             | 3.4 in/hr          | 6.4 in/hr        | 9.5 cfs        | 19.3 cfs         | 3A    |
| 4A    |                     | 175,180 sf | 4.02 ac  | 0.81           | 0.88             | 12.3 min.             | 3.4 in/hr          | 6.4 in/hr        | 11.2 cfs       | 22.8 cfs         | 4A    |
| 5A    |                     | 65,250 sf  | 1.50 ac  | 0.14           | 0.40             | 10.9 min.             | 3.6 in/hr          | 6.8 in/hr        | 0.8 cfs        | 4.1 cfs          | 5A    |
| 1B    |                     | 26,630 sf  | 0.61 ac  | 0.81           | 0.88             | 9.0 min.              | 3.9 in/hr          | 7.3 in/hr        | 1.9 cfs        | 3.9 cfs          | 1B    |
| 2B    |                     | 40,850 sf  | 0.94 ac  | 0.54           | 0.66             | 14.2 min.             | 3.2 in/hr          | 6.1 in/hr        | 1.6 cfs        | 3.8 cfs          | 2B    |
| 3B    |                     | 114,100 sf | 2.62 ac  | 0.81           | 0.88             | 11.2 min.             | 3.6 in/hr          | 6.7 in/hr        | 7.6 cfs        | 15.5 cfs         | 3B    |
| 4B    |                     | 83,300 sf  | 1.91 ac  | 0.81           | 0.88             | 6.6 min.              | 4.4 in/hr          | 8.1 in/hr        | 6.7 cfs        | 13.7 cfs         | 4B    |
| 5B    |                     | 71,200 sf  | 1.63 ac  | 0.81           | 0.88             | 7.3 min.              | 4.2 in/hr          | 7.9 in/hr        | 5.6 cfs        | 11.4 cfs         | 5B    |
| 6B    |                     | 63,550 sf  | 1.46 ac  | 0.81           | 0.88             | 11.1 min.             | 3.6 in/hr          | 6.7 in/hr        | 4.3 cfs        | 8.7 cfs          | 6B    |
| 7B    |                     | 51,720 sf  | 1.19 ac  | 0.81           | 0.88             | 6.4 min.              | 4.4 in/hr          | 8.2 in/hr        | 4.2 cfs        | 8.6 cfs          | 7B    |
| 8B    |                     | 80,100 sf  | 1.84 ac  | 0.14           | 0.40             | 11.2 min.             | 3.6 in/hr          | 6.7 in/hr        | 0.9 cfs        | 4.9 cfs          | 8B    |
| 9B    |                     | 116,400 sf | 2.67 ac  | 0.81           | 0.88             | 8.9 min.              | 3.9 in/hr          | 7.4 in/hr        | 8.5 cfs        | 17.3 cfs         | 9B    |
| 10B   |                     | 46,600 sf  | 1.07 ac  | 0.81           | 0.88             | 8.0 min.              | 4.1 in/hr          | 7.6 in/hr        | 3.5 cfs        | 7.2 cfs          | 10B   |
| 11B   |                     | 59,600 sf  | 1.37 ac  | 0.81           | 0.88             | 7.3 min.              | 4.2 in/hr          | 7.9 in/hr        | 4.7 cfs        | 9.5 cfs          | 11B   |
| 12B   |                     | 100,200 sf | 2.30 ac  | 0.81           | 0.88             | 10.6 min.             | 3.7 in/hr          | 6.9 in/hr        | 6.8 cfs        | 13.9 cfs         | 12B   |
| 13B   |                     | 65,200 sf  | 1.50 ac  | 0.81           | 0.88             | 13.3 min.             | 3.3 in/hr          | 6.2 in/hr        | 4.0 cfs        | 8.2 cfs          | 13B   |
| 1C    |                     | 72,910 sf  | 1.67 ac  | 0.54           | 0.66             | 13.6 min.             | 3.3 in/hr          | 6.2 in/hr        | 3.0 cfs        | 6.8 cfs          | 1C    |
| 2C    |                     | 361,300 sf | 8.29 ac  | 0.14           | 0.40             | 18.4 min.             | 2.9 in/hr          | 5.3 in/hr        | 3.3 cfs        | 17.7 cfs         | 2C    |
| 3C    |                     | 43,100 sf  | 0.99 ac  | 0.81           | 0.88             | 14.7 min.             | 3.2 in/hr          | 6.0 in/hr        | 2.6 cfs        | 5.2 cfs          | 3C    |
| 4C    |                     | 32,500 sf  | 0.75 ac  | 0.81           | 0.88             | 9.4 min.              | 3.8 in/hr          | 7.2 in/hr        | 2.3 cfs        | 4.7 cfs          | 4C    |
| 5C    |                     | 42,640 sf  | 0.98 ac  | 0.81           | 0.88             | 11.4 min.             | 3.6 in/hr          | 6.7 in/hr        | 2.8 cfs        | 5.7 cfs          | 5C    |
| 6C    |                     | 22,020 sf  | 0.51 ac  | 0.81           | 0.88             | 7.9 min.              | 4.1 in/hr          | 7.7 in/hr        | 1.7 cfs        | 3.4 cfs          | 6C    |
| 7C    |                     | 37,700 sf  | 0.87 ac  | 0.90           | 0.96             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 3.7 cfs        | 7.3 cfs          | 7C    |
| 1D    |                     | 21,080 sf  | 0.48 ac  | 0.81           | 0.88             | 6.4 min.              | 4.4 in/hr          | 8.2 in/hr        | 1.7 cfs        | 3.5 cfs          | 1D    |
| 2D    |                     | 17,360 sf  | 0.40 ac  | 0.81           | 0.88             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 1.5 cfs        | 3.1 cfs          | 2D    |
| 3D    |                     | 25,680 sf  | 0.59 ac  | 0.81           | 0.88             | 5.0 min.              | 4.7 in/hr          | 8.8 in/hr        | 2.3 cfs        | 4.6 cfs          | 3D    |
| DP 1  | A Basins            | 673,210 sf | 15.45 ac | 0.75           | 0.83             | 12.7 min.             | 3.4 in/hr          | 6.4 in/hr        | 39 cfs         | 82 cfs           | DP 1  |
| DP 2  | B Basins            | 919,450 sf | 21.11 ac | 0.74           | 0.83             | 19.1 min.             | 2.8 in/hr          | 5.2 in/hr        | 44 cfs         | 92 cfs           | DP 2  |

Equations:

$$I = (28.5P) / (10 + t_c)^{0.786}$$

P = One-hour point rainfall depth (in.) P(5yr)=1.39in. P(100yr)=2.60in.

i<sub>5</sub>, i<sub>10</sub>, i<sub>100</sub> = Average 5, 10 and 100-year Rainfall Intensity in inches per hour (Fig 5.1, Town of Parker Storm Drainage and Environmental Criteria Manual)

$$Q = CiA$$

Q = Peak Runoff Rate, in cubic feet per second (cfs) {Initial Storm=Q<sub>s</sub> Major Storm=Q<sub>100</sub>}

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

TABLE RO-3

Recommended Percentage Imperviousness Values

| Land Use or Surface Characteristics                | Percentage Imperviousness |
|----------------------------------------------------|---------------------------|
| Business:                                          |                           |
| Commercial areas                                   | 95                        |
| Neighborhood areas                                 | 85                        |
| Residential:                                       |                           |
| Single-family                                      | *                         |
| Multi-unit (detached)                              | 60                        |
| Multi-unit (attached)                              | 75                        |
| Half-acre lot or larger                            | *                         |
| Apartments                                         | 80                        |
| Industrial:                                        |                           |
| Light areas                                        | 80                        |
| Heavy areas                                        | 90                        |
| Parks, cemeteries                                  | 5                         |
| Playgrounds                                        | 10                        |
| Schools                                            | 50                        |
| Railroad yard areas                                | 15                        |
| Undeveloped Areas:                                 |                           |
| Historic flow analysis                             | 2                         |
| Greenbelts, agricultural                           | 2                         |
| Off-site flow analysis (when land use not defined) | 45                        |
| Streets:                                           |                           |
| Paved                                              | 100                       |
| Gravel (packed)                                    | 40                        |
| Drive and walks                                    | 90                        |
| Roofs                                              | 90                        |
| Lawns, sandy soil                                  | 0                         |
| Lawns, clayey soil                                 | 0                         |

\* See Figures RO-3 through RO-5 for percentage imperviousness.

Based in part on the data collected by the District since 1969, an empirical relationship between  $C$  and the percentage imperviousness for various storm return periods was developed. Thus, values for  $C$  can be determined using the following equations (Urbonas, Guo and Tucker 1990).

$$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \quad (\text{RO-6})$$

$$C_{CD} = K_{CD} + (0.858i^3 - 0.786i^2 + 0.774i + 0.04) \quad (\text{RO-7})$$

$$C_B = (C_A + C_{CD})/2$$

in which:

$i$  = % imperviousness/100 expressed as a decimal (see Table RO-3)



**TABLE RO-5**  
Runoff Coefficients, *C*

| Percentage<br>Imperviousness | Type C and D NRCS Hydrologic Soil Groups |      |       |       |       |        |
|------------------------------|------------------------------------------|------|-------|-------|-------|--------|
|                              | 2-yr                                     | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| 0%                           | 0.04                                     | 0.15 | 0.25  | 0.37  | 0.44  | 0.50   |
| 5%                           | 0.08                                     | 0.18 | 0.28  | 0.39  | 0.46  | 0.52   |
| 10%                          | 0.11                                     | 0.21 | 0.30  | 0.41  | 0.47  | 0.53   |
| 15%                          | 0.14                                     | 0.24 | 0.32  | 0.43  | 0.49  | 0.54   |
| 20%                          | 0.17                                     | 0.26 | 0.34  | 0.44  | 0.50  | 0.55   |
| 25%                          | 0.20                                     | 0.28 | 0.36  | 0.46  | 0.51  | 0.56   |
| 30%                          | 0.22                                     | 0.30 | 0.38  | 0.47  | 0.52  | 0.57   |
| 35%                          | 0.25                                     | 0.33 | 0.40  | 0.48  | 0.53  | 0.57   |
| 40%                          | 0.28                                     | 0.35 | 0.42  | 0.50  | 0.54  | 0.58   |
| 45%                          | 0.31                                     | 0.37 | 0.44  | 0.51  | 0.55  | 0.59   |
| 50%                          | 0.34                                     | 0.40 | 0.46  | 0.53  | 0.57  | 0.60   |
| 55%                          | 0.37                                     | 0.43 | 0.48  | 0.55  | 0.58  | 0.62   |
| 60%                          | 0.41                                     | 0.46 | 0.51  | 0.57  | 0.60  | 0.63   |
| 65%                          | 0.45                                     | 0.49 | 0.54  | 0.59  | 0.62  | 0.65   |
| 70%                          | 0.49                                     | 0.53 | 0.57  | 0.62  | 0.65  | 0.68   |
| 75%                          | 0.54                                     | 0.58 | 0.62  | 0.66  | 0.68  | 0.71   |
| 80%                          | 0.60                                     | 0.63 | 0.66  | 0.70  | 0.72  | 0.74   |
| 85%                          | 0.66                                     | 0.68 | 0.71  | 0.75  | 0.77  | 0.79   |
| 90%                          | 0.73                                     | 0.75 | 0.77  | 0.80  | 0.82  | 0.83   |
| 95%                          | 0.80                                     | 0.82 | 0.84  | 0.87  | 0.88  | 0.89   |
| 100%                         | 0.89                                     | 0.90 | 0.92  | 0.94  | 0.95  | 0.96   |

| Type B NRCS Hydrologic Soils Group |      |      |      |      |      |      |
|------------------------------------|------|------|------|------|------|------|
| 0%                                 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| 5%                                 | 0.04 | 0.10 | 0.19 | 0.28 | 0.33 | 0.38 |
| 10%                                | 0.06 | 0.14 | 0.22 | 0.31 | 0.36 | 0.40 |
| 15%                                | 0.08 | 0.17 | 0.25 | 0.33 | 0.38 | 0.42 |
| 20%                                | 0.12 | 0.20 | 0.27 | 0.35 | 0.40 | 0.44 |
| 25%                                | 0.15 | 0.22 | 0.30 | 0.37 | 0.41 | 0.46 |
| 30%                                | 0.18 | 0.25 | 0.32 | 0.39 | 0.43 | 0.47 |
| 35%                                | 0.20 | 0.27 | 0.34 | 0.41 | 0.44 | 0.48 |
| 40%                                | 0.23 | 0.30 | 0.36 | 0.42 | 0.46 | 0.50 |
| 45%                                | 0.26 | 0.32 | 0.38 | 0.44 | 0.48 | 0.51 |
| 50%                                | 0.29 | 0.35 | 0.40 | 0.46 | 0.49 | 0.52 |
| 55%                                | 0.33 | 0.38 | 0.43 | 0.48 | 0.51 | 0.54 |
| 60%                                | 0.37 | 0.41 | 0.46 | 0.51 | 0.54 | 0.56 |
| 65%                                | 0.41 | 0.45 | 0.49 | 0.54 | 0.57 | 0.59 |
| 70%                                | 0.45 | 0.49 | 0.53 | 0.58 | 0.60 | 0.62 |
| 75%                                | 0.51 | 0.54 | 0.58 | 0.62 | 0.64 | 0.66 |
| 80%                                | 0.57 | 0.59 | 0.63 | 0.66 | 0.68 | 0.70 |
| 85%                                | 0.63 | 0.66 | 0.69 | 0.72 | 0.73 | 0.75 |
| 90%                                | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 |
| 95%                                | 0.79 | 0.81 | 0.83 | 0.85 | 0.87 | 0.88 |
| 100%                               | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 |

TYPE B

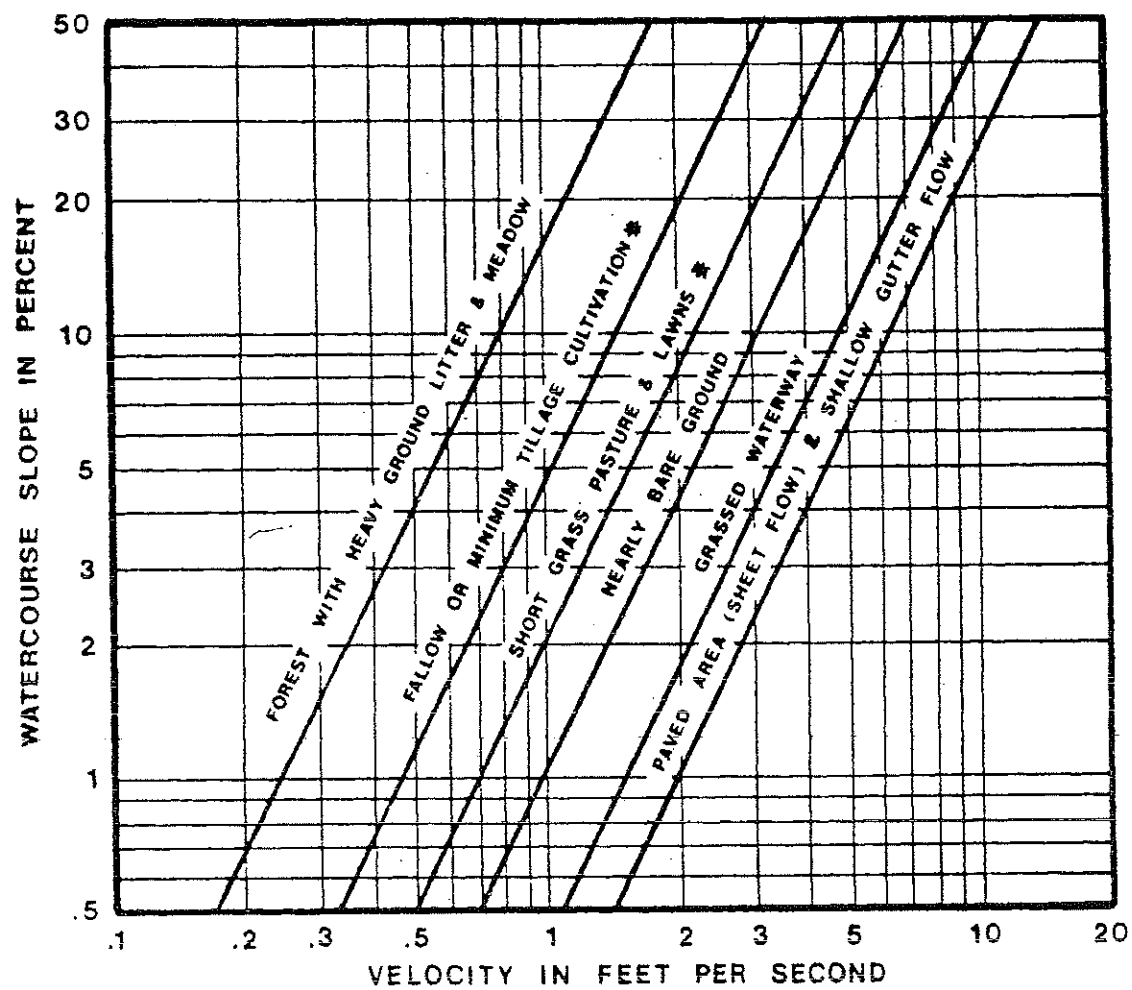


FIGURE RO-1

Estimate of Average Overland Flow Velocity for Use With the Rational Formula

## 5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions are required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (District) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this criteria MANUAL.

## 5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume III- Colorado. The design storm events developed and utilized are the same as those used by the District.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where,  $I$  = rainfall intensity (in/hr)  
 $P_1$  = one-hour point rainfall depth (in)  
 $t_c$  = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

Table 5.1  
ONE-HOUR POINT RAINFALL

| Frequency of Design Event<br>(yr) | One-hour Point Rainfall, $P_1$<br>(in) |
|-----------------------------------|----------------------------------------|
| 2                                 | 0.99                                   |
| 5                                 | 1.39                                   |
| 10                                | 1.64                                   |
| 25                                | 1.98                                   |
| 50                                | 2.31                                   |
| 100                               | 2.60                                   |

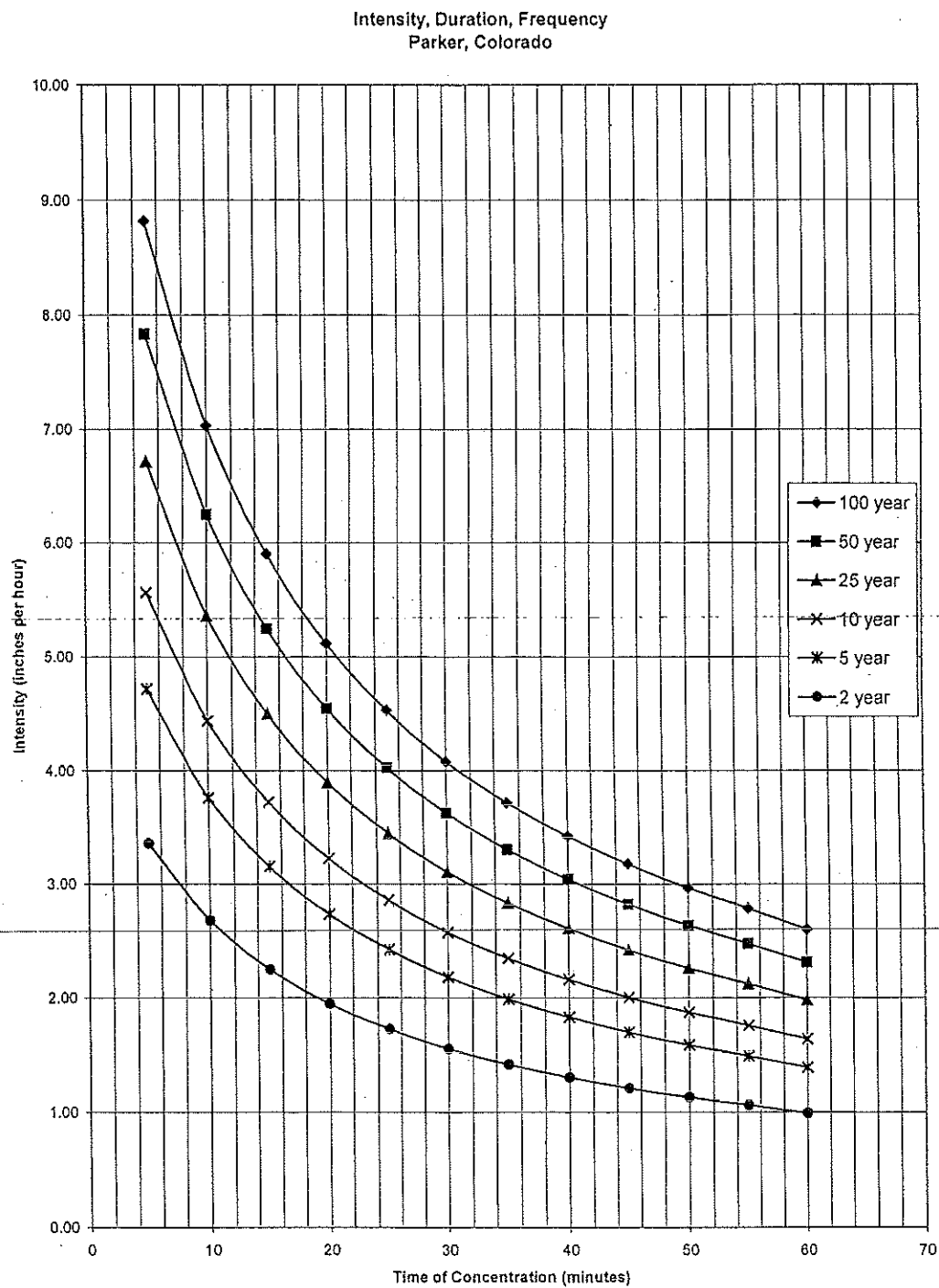


Figure 5.1 Rainfall Intensity Versus Duration Curves for Parker, Colorado

**APPENDIX B**  
**Hydraulic Calculations**

Table 2.3

**RECURRENCE INTERVALS (years) FOR  
INITIAL AND MAJOR STORM RUNOFF DESIGN**

| Land use                       | Initial Storm | Major Storm |
|--------------------------------|---------------|-------------|
| Residential                    | 2             | 100         |
| Open Space/Agricultural        | 2             | 100         |
| School                         | 2             | 100         |
| Commercial/Business/Industrial | 5             | 100         |

### 2.5.1 STREETS

Streets are an integral part of the urban drainage system and may be used for transporting storm runoff up to design limits. The design engineer should recognize that the primary purpose of streets is for traffic. Therefore, use of streets for storm runoff must be limited.

Although street criteria are formulated to allow certain drainage, streets should not routinely be considered as major drainageways. The Town of Parker, prohibits the practice of discharging offsite culverts and other non-local drainage outfalls onto streets. Storm drains should not outfall onto streets, but should be piped to suitable outfalls in a swale, channel, or detention basin. Street criteria should be applied to storm runoff flows emanating from building lots and other streets rather than discharges from major offsite drainageways flowing into streets.

Town of Parker criteria for allowable uses and depth of flow for initial and major storm runoff events is presented in Table 2.4, Table 2.5, and Table 2.6

Table 2.4

**ALLOWABLE USE OF STREETS FOR INITIAL STORM RUNOFF**

| Street Classification | Maximum Theoretical Encroachment                                                                               |
|-----------------------|----------------------------------------------------------------------------------------------------------------|
| Local                 | No curb overtopping. Flow may spread to crown of street.                                                       |
| Collector             | No curb overtopping. Flow spread must leave at least a 10 foot width free of water.                            |
| Arterial              | No curb overtopping. Flow spread must leave at least two lanes free of water, one 10 foot lane each direction. |

*Where no curbing exists, encroachment should not extend past the street right-of-way. The maximum allowable street flow shall be the product of the flow calculated at "maximum theoretical street encroachment" and required reduction factor. See Section 6.4*

Parker Auto Plaza  
Inlet Capacity Summary

| Inlet | Location   | Inlet Size | Inlet Condition | 5yr Flow | 5yr Flow Spread | 100yr Flow + Carry Over to Inlet | 100yr Inlet Capacity | 100yr Flow Past Inlet | Downstream Inlet if Carry Over | Contributing Flows           |
|-------|------------|------------|-----------------|----------|-----------------|----------------------------------|----------------------|-----------------------|--------------------------------|------------------------------|
| 1     | Interior   | 10 ft      | Sump            |          |                 | 17.9 cfs                         | 17.2 cfs             | 1 cfs                 |                                | Basin 1A                     |
| 2     | Interior   | 15 ft      | Sump            |          |                 | 20.7 cfs                         | 24.3 cfs             | (4 cfs)               |                                | Basin 2A                     |
| 3     | Interior   | 10 ft      | Sump            |          |                 | 19.5 cfs                         | 19.1 cfs             | 0 cfs                 |                                | Basin 3A                     |
| 4     | Interior   | 10 ft      | Sump            |          |                 | 23.1 cfs                         | 19.5 cfs             | 4 cfs                 |                                | Basin 4A                     |
| 10    | 20 Mile Rd | 15 ft      | Grade           | 1.9 cfs  | 7.3 ft          | 3.7 cfs                          | 3.6 cfs              | 0 cfs                 | Off Site                       | Basin 1B                     |
| 11    | 20 Mile Rd | 10 ft      | Grade           | 1.6 cfs  | 6.6 ft          | 3.8 cfs                          | 3.0 cfs              | 1 cfs                 | Inlet 18                       | Basin 2B                     |
| 12    | Interior   | 10 ft      | Sump            |          |                 | 8.2 cfs                          | 9.2 cfs              | (1 cfs)               |                                | Basin 13B                    |
| 13    | Interior   | 10 ft      | Sump            |          |                 | 13.7 cfs                         | 13.5 cfs             | 0 cfs                 |                                | Basin 4B                     |
| 14    | Interior   | 10 ft      | Sump            |          |                 | 11.4 cfs                         | 13.6 cfs             | (2 cfs)               |                                | Basin 5B                     |
| 15    | Interior   | 5 ft       | Sump            |          |                 | 8.8 cfs                          | 8.2 cfs              | 1 cfs                 | Detention Basin                | Basin 6B                     |
| 16    | Dransfeldt | 15 ft      | Grade           | 2.1 cfs  | 5.5 ft          | 4.3 cfs                          | 3.6 cfs              | 1 cfs                 | Inlet 27                       | 1/2 Basin 7B                 |
| 16a   | Dransfeldt | 15 ft      | Grade           | 2.1 cfs  | 5.5 ft          | 4.3 cfs                          | 3.6 cfs              | 1 cfs                 | Inlet 27                       | 1/2 Basin 7B                 |
| 17    | Interior   | 15 ft      | Sump            |          |                 | 17.3 cfs                         | 18.9 cfs             | (2 cfs)               |                                | Basin 9B                     |
| 18    | 20 Mile Rd | 15 ft      | Grade           | 3.5 cfs  | 12.3 ft         | 7.2 cfs                          | 6.4 cfs              | 1 cfs                 | Off Site to the west           | Basin 10B, Carry Inlet 11    |
| 19    | Interior   | 10 ft      | Sump            |          |                 | 9.5 cfs                          | 11.3 cfs             | (2 cfs)               |                                | Basin 11B                    |
| 20    | Interior   | 10 ft      | Sump            |          |                 | 13.9 cfs                         | 18.3 cfs             | (4 cfs)               |                                | Basin 12B                    |
| 21    | Interior   | 10 ft      | Sump            |          |                 | 15.5 cfs                         | 15.5 cfs             | 0 cfs                 |                                | Basin 3B                     |
| 25    | 20 Mile Rd | 10 ft      | Sump            | 2.8 cfs  | 9.1 ft          | 7.0 cfs                          | 11.6 cfs             | (5 cfs)               |                                | Basin 5C, Carry Inlet 27     |
| 26    | 20 Mile Rd | 3.25 ft    | Sump            | 1.7 cfs  | 6.9 ft          | 4.3 cfs                          | 5.8 cfs              | (2 cfs)               |                                | Basin 6C, Carry Inlet 27a    |
| 27    | 20 Mile Rd | 10 ft      | Grade           | 2.6 cfs  | 13.7 ft         | 5.9 cfs                          | 3.4 cfs              | 3 cfs                 | Inlet 25                       | Basin 3C, Carry Inlet 16,16a |
| 27a   | 20 Mile Rd | 10 ft      | Grade           | 2.3 cfs  | 10.9 ft         | 4.7 cfs                          | 2.9 cfs              | 2 cfs                 | Inlet 26                       | Basin 4C                     |
| 28    | 20 Mile Rd | 5 ft       | Grade           | 1.5 cfs  | 10.1 ft         | 3.1 cfs                          | 1.6 cfs              | 2 cfs                 |                                | Basin 2D                     |
| 40    | Parker Rd  | 5 ft       | Sump            | 3.7 cfs  | 8.6 ft          | 7.3 cfs                          | 6.2 cfs              | 1 cfs                 | Baldwin Gulch                  | Basin 7C                     |

Town of Parker Criteria (Pg 6-15, Section 6.3.5): A 50% reduction factor should be used on carry over flows when determining the amount of flow entering a downstream inlet, due to Carry Over.

**Table 2.4: Allowable Use of Streets for Initial Storm Runoff (5-year Runoff)**

Collector: No curb overtopping. Flow spread must leave at least a 10-ft width free of water.

**Dransfeldt Rd Maximum Flow Spread = 16.0 ft**

Arterial: No curb overtopping. Flow spread must leave at least two lanes free of water, one 10-ft lane each direction.

**Twenty Mile Rd Maximum Flow Spread = 17.0 ft**

**APPENDIX C**  
**Detention Basin Calculations**



**Parker Auto Plaza  
Detention Basin Calculations**

WQCV = 0.45 inches  
 % Impervious(I) = 95 %

WQCV (Water Quality Capture Volume) taken from Fig. EDB-2, Volume 3 of the Urban Storm Drainage Criteria Manual for the basin imperviousness shown.  
 Percent Impervious taken from Table RO-3, Volume 1 of the Urban Storm Drainage Criteria Manual

**WQCV = 0.045 \* A**  
 $WQCV = WQCV/12 * A * 1.2$   
 A = Area

Required Detention Storage Volume =  $K_i A$

$K_{10} = 0.08835$   
 $K_{100} = 0.14749$

$K_{10} = (0.95I - 1.9)/1000$   
 $K_{100} = (1.78I - 0.002I^2 - 3.56)/1000$

**Unit Flow Release Rate (cfs/acre)**

Hydrologic Soil Group **B**  
 $U_{10} = 0.23$   
 $U_{100} = 0.85$

| Basin             | Total Acres | $V_{10}$   |           | $V_{100}$  |            | WQCV       |           | 10-yr Required Capacity |            | 100-yr Required Capacity |            | Release Rate |           |
|-------------------|-------------|------------|-----------|------------|------------|------------|-----------|-------------------------|------------|--------------------------|------------|--------------|-----------|
|                   |             |            |           |            |            |            |           |                         |            |                          |            | $Q_{10}$     | $Q_{100}$ |
| Detention Basin A | 15.45 ac    | 1.37 ac-ft | 59,460 cf | 2.28 ac-ft | 99,261 cf  | 0.70 ac-ft | 30,285 cf | 2.06 ac-ft              | 89,745 cf  | 2.97 ac-ft               | 129,546 cf | 3.6 cfs      | 13.1 cfs  |
| Detention Basin B | 21.20 ac    | 1.87 ac-ft | 81,589 cf | 3.13 ac-ft | 136,203 cf | 0.95 ac-ft | 41,556 cf | 2.83 ac-ft              | 123,145 cf | 4.08 ac-ft               | 177,759 cf | 4.9 cfs      | 18.0 cfs  |

$V_x = K_x A$

Release Rate = Area \*  $U_x$

$U_x$  = Recommended Maximum Allowable Unit Flow Release Rates (cfs/acre) of Tributary Catchment (Table SO-1, Urban Drainage and Flood Control District - Volume 2)

**Parker Auto Plaza  
Detention Basin Calculations**

**Presedimentation / Forebay Sizing**

**Detention Basin A**

|                       |           |
|-----------------------|-----------|
| WQCV                  | 30,285 cf |
| 10% WQCV              | 3,029 cf  |
| Orifice Eqn Coef. (C) | 0.50      |

| Forebay Pipe Number | Flow     | % Total Flow | Weighted Forebay Area | Forebay Size |              |                 | 5 Minute Drain Flow | Pipes Out of Forebay - Orifice Calculation |             |                 |             |                 |             | Total Flow |
|---------------------|----------|--------------|-----------------------|--------------|--------------|-----------------|---------------------|--------------------------------------------|-------------|-----------------|-------------|-----------------|-------------|------------|
|                     |          |              |                       | Depth        | Surface Area | Semicirc. Radii |                     | Pipe 1 Diameter                            | Pipe 1 Flow | Pipe 2 Diameter | Pipe 2 Flow | Pipe 3 Diameter | Pipe 3 Flow |            |
| S2                  | 37 cfs   | 46.84 %      | 1,418 cf              | 2.0 ft       | 709 sf       | 21 ft           | 4.7 cfs             | 8 inches                                   | 1.8 cfs     | 10 inches       | 2.8 cfs     | 0 inches        | 0.0 cfs     | 4.6 cfs    |
| S3                  | 19 cfs   | 24.05 %      | 728 cf                | 2.0 ft       | 364 sf       | 15 ft           | 2.4 cfs             | 6 inches                                   | 1.0 cfs     | 6 inches        | 1.0 cfs     | 0 inches        | 0.0 cfs     | 2.1 cfs    |
| S4                  | 23 cfs   | 29.11 %      | 882 cf                | 2.0 ft       | 441 sf       | 17 ft           | 2.9 cfs             | 6 inches                                   | 1.0 cfs     | 8 inches        | 1.8 cfs     | 0 inches        | 0.0 cfs     | 2.9 cfs    |
|                     | 79.0 cfs | 100.00 %     | 3,029 cf              |              |              |                 |                     |                                            |             |                 |             |                 |             | 9.5 cfs    |

Orifice Equation:

$$Q = CA(2gH)^{0.5}$$

C = Orifice coefficient (dimensionless)

A = Cross-sectional area of opening, in sf

g = Gravitational acceleration constant, 32.2 ft/sec<sup>2</sup>

H = Head above the centerline of the pipe, in ft

**Detention Basin B**

|                       |           |
|-----------------------|-----------|
| WQCV                  | 41,556 cf |
| 10% WQCV              | 4,156 cf  |
| Orifice Eqn Coef. (C) | 0.50      |

| Forebay Pipe Number | Flow     | % Total Flow | Weighted Forebay Area | Forebay Size |              |                 | 5 Minute Drain Flow | Pipes Out of Forebay - Orifice Calculation |             |                 |             |                 |             | Total Flow |
|---------------------|----------|--------------|-----------------------|--------------|--------------|-----------------|---------------------|--------------------------------------------|-------------|-----------------|-------------|-----------------|-------------|------------|
|                     |          |              |                       | Depth        | Surface Area | Semicirc. Radii |                     | Pipe 1 Diameter                            | Pipe 1 Flow | Pipe 2 Diameter | Pipe 2 Flow | Pipe 3 Diameter | Pipe 3 Flow |            |
| S10                 | 92 cfs   | 100.00 %     | 4,156 cf              | 2.0 ft       | 2,078 sf     | 36 ft           | 13.9 cfs            | 12 inches                                  | 3.9 cfs     | 12 inches       | 3.9 cfs     | 12 inches       | 3.9 cfs     | 11.6 cfs   |
|                     | 92.0 cfs | 100.00 %     | 4,156 cf              |              |              |                 |                     |                                            |             |                 |             |                 |             | 11.6 cfs   |

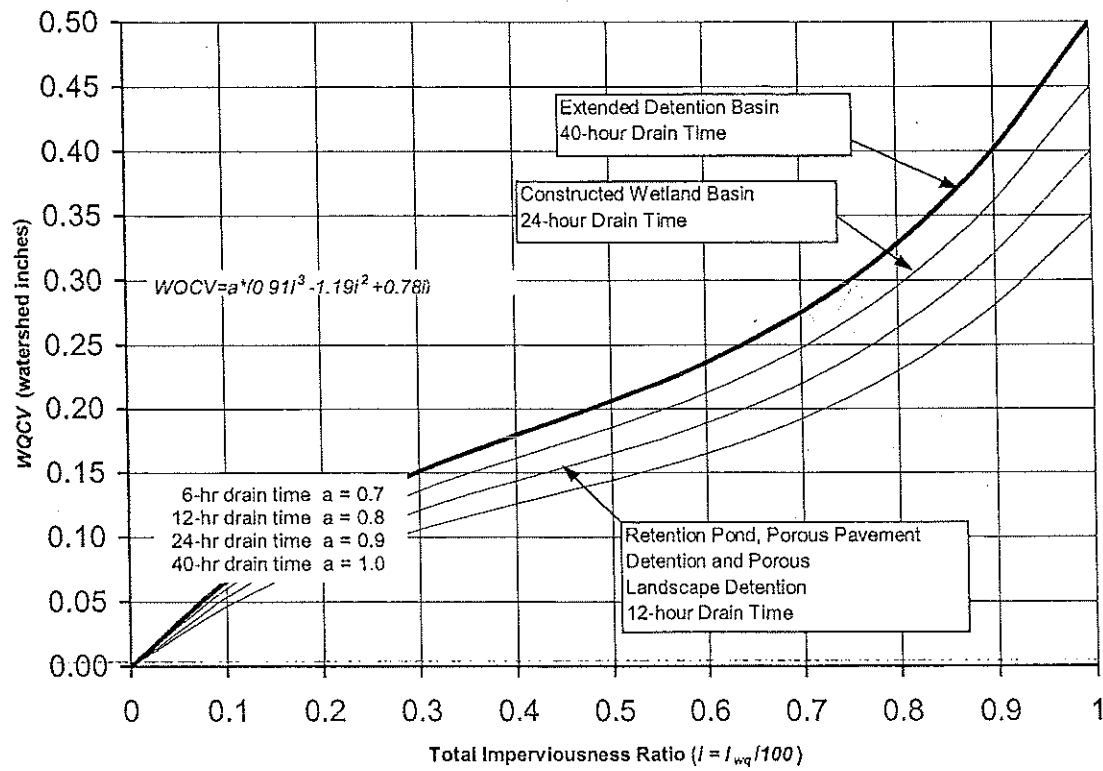


FIGURE EDB-2

Water Quality Capture Volume (WQCV), 80<sup>th</sup> Percentile Runoff Event

attempt to account for the effects of the WQCV on all control levels whenever it performs watershed-level drainage and flood control system master plans.

### **3.2 Sizing of On-Site Detention Facilities**

**3.2.1 Maximum Allowable Unit Release Rates for On-Site Facilities.** The maximum allowable unit release rates per acre for on-site detention facilities for a number of design return periods are listed in Table SO-1. These rates apply unless other rates are recommended in a District-approved master plan.

The predominant soil group for the total tributary catchment shall be used for determining the allowable release rates. Multiply the unit rates provided in Table SO-1 by the tributary catchment's area to obtain the actual design release rates in cubic feet per second (cfs). Whenever Natural Resources Conservation Service (NRCS) soil surveys are not available for the portion of a county being studied, extrapolate their types using soil investigations at the site.

**TABLE SO-1**

Recommended Maximum Allowable Unit Flow Release Rates (cfs/acre) of Tributary Catchment

| Design Return<br>Period<br>(Years) | NRCS Hydrologic Soil Group |      |       |
|------------------------------------|----------------------------|------|-------|
|                                    | A                          | B    | C & D |
| 2                                  | 0.02                       | 0.03 | 0.04  |
| 5                                  | 0.07                       | 0.13 | 0.17  |
| 10                                 | 0.13                       | 0.23 | 0.30  |
| 25                                 | 0.24                       | 0.41 | 0.52  |
| 50                                 | 0.33                       | 0.56 | 0.68  |
| 100                                | 0.50                       | 0.85 | 1.00  |

**3.2.2 Empirical Equations for the Sizing of On-Site Detention Storage Volumes.** Urbanas and Glidden (1983), as part of the District's ongoing hydrologic research, conducted studies that evaluated peak storm runoff flows along major drainageways. The following set of empirical equations provided preliminary estimates of on-site detention facility sizing for areas within the District. They are not intended for use when off-site inflows are present or when multi-stage controls are to be used (e.g., 10- and 100-year peak control) at the storage facility. In addition, these equations are not intended to replace detailed hydrologic and flood routing analysis, or even the analysis using the Rational Formula-based FAA method for the sizing of detention storage volumes. The District does not promote the use of these empirical equations. It does not object, however, to their use by local governments who have adopted them or want to adopt them as minimum requirements for the sizing of on-site detention for small catchments within their jurisdiction. If the District has a master plan that contains specific guidance for detention

**APPENDIX C.1**  
**Detention Basin A Calculations**

Parker Auto Plaza  
Detention Basin Earthwork Calculation

**Detention Basin A**

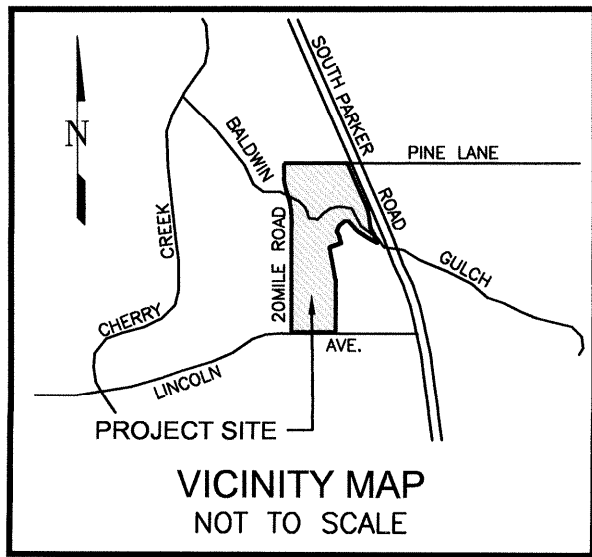
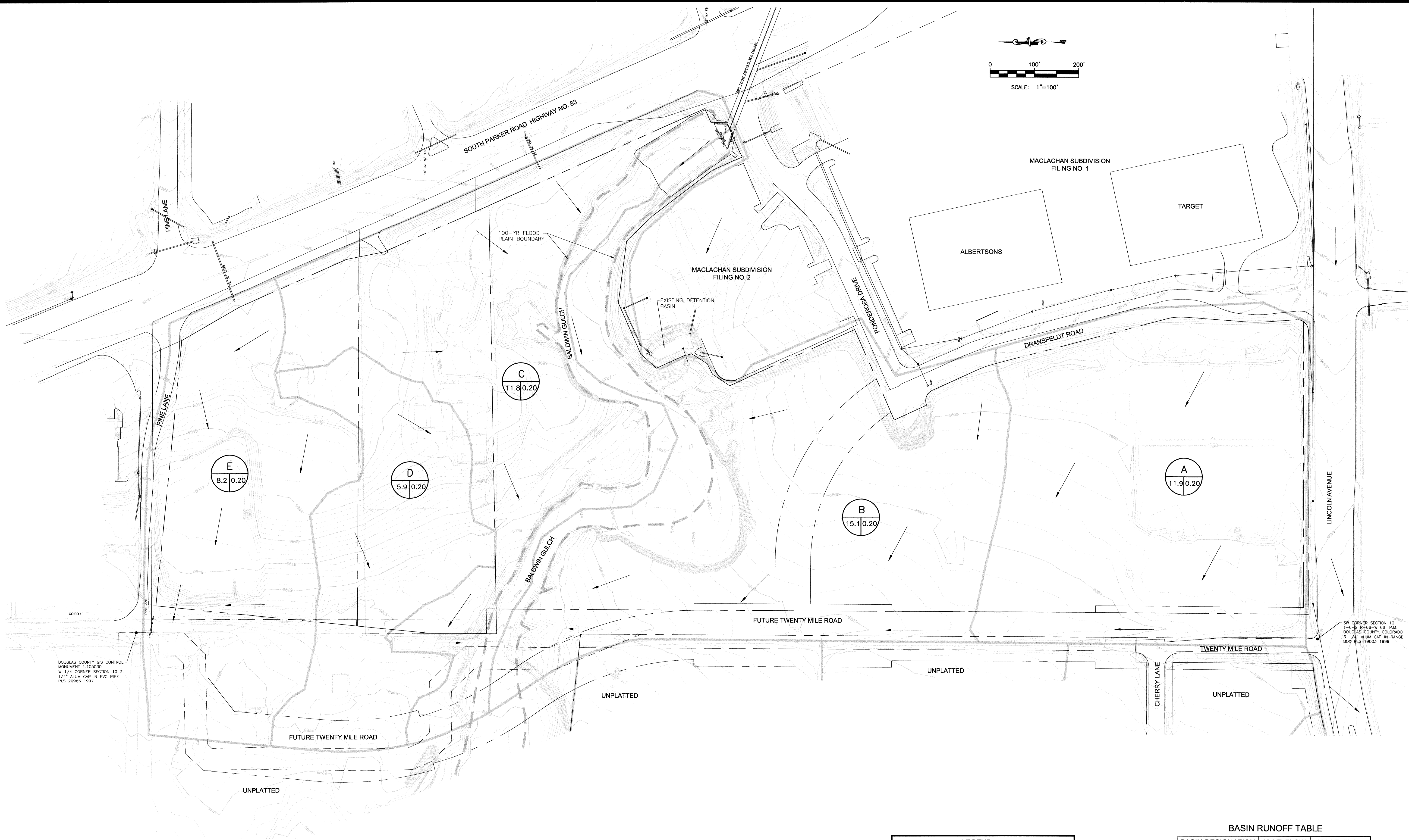
| Elevation | Area      | Avg. Area | Volume    | Basin Depth | Cumulative Basin Volume |             | Elevation |
|-----------|-----------|-----------|-----------|-------------|-------------------------|-------------|-----------|
| 77.7      | 315 sf    | 448 sf    | 134 cf    | 0.3 ft      | 134 cf                  | 0.003 ac-ft | 78        |
| 78        | 580 sf    | 3,743 sf  | 3,743 cf  | 1.3 ft      | 3,877 cf                | 0.09 ac-ft  | 79        |
| 79        | 6,905 sf  | 13,299 sf | 13,299 cf | 2.3 ft      | 17,175 cf               | 0.39 ac-ft  | 80        |
| 80        | 19,692 sf | 22,546 sf | 22,546 cf | 3.3 ft      | 39,721 cf               | 0.91 ac-ft  | 81        |
| 81        | 25,400 sf | 27,000 sf | 27,000 cf | 4.3 ft      | 66,721 cf               | 1.53 ac-ft  | 82        |
| 82        | 28,600 sf | 30,125 sf | 30,125 cf | 5.3 ft      | 96,846 cf               | 2.22 ac-ft  | 83        |
| 83        | 31,650 sf | 33,225 sf | 33,225 cf | 6.3 ft      | 130,071 cf              | 2.99 ac-ft  | 84        |
| 84        | 34,800 sf | 36,075 sf | 36,075 cf | 7.3 ft      | 166,146 cf              | 3.81 ac-ft  | 85        |
| 85        | 37,350 sf |           |           |             |                         |             |           |

Water Quality Capture Volume = 30,285 cf  
WQCV Elevation = 80.58 ft

10yr Water Volume = 89,745 cf  
10yr Water Surface Elevation = 82.76 ft

100yr Water Volume = 129,546 cf  
100yr Water Surface Elevation = 83.98 ft





PROJECT DATUM: ALL ELEVATIONS ARE REFERENCED TO NAVD 88 AS SHOWN ON THE 1998 DOUGLAS COUNTY TABULATION

| LEGEND |                                                     |
|--------|-----------------------------------------------------|
|        | BASIN DESIGNATION                                   |
|        | BASIN AREA (AC) 11.9   0.20 C100 RUNOFF COEFFICIENT |
|        | DIRECTIONAL FLOW ARROW                              |
|        | EXISTING DRAINAGE BASIN BOUNDARY                    |
|        | R.O.W. / PROPERTY LINE                              |

| BASIN RUNOFF TABLE |            |             |
|--------------------|------------|-------------|
| BASIN DESIGNATION  | 10-YR FLOW | 100-YR FLOW |
| A                  | 1.1 cfs    | 7.0 cfs     |
| B                  | 1.7 cfs    | 10.8 cfs    |
| C                  | 1.1 cfs    | 6.9 cfs     |
| D                  | 0.7 cfs    | 4.6 cfs     |
| E                  | 0.9 cfs    | 5.7 cfs     |

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Lakewood, Colorado 80235

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PARKER AUTO PLAZA

EXISTING DRAINAGE PATTERNS

FINAL DRAINAGE REPORT

PARKER, COLORADO

Project No.: 00056

Date: July 12, 2004

Design: MWE

Drawn: MWE

Check: RNW

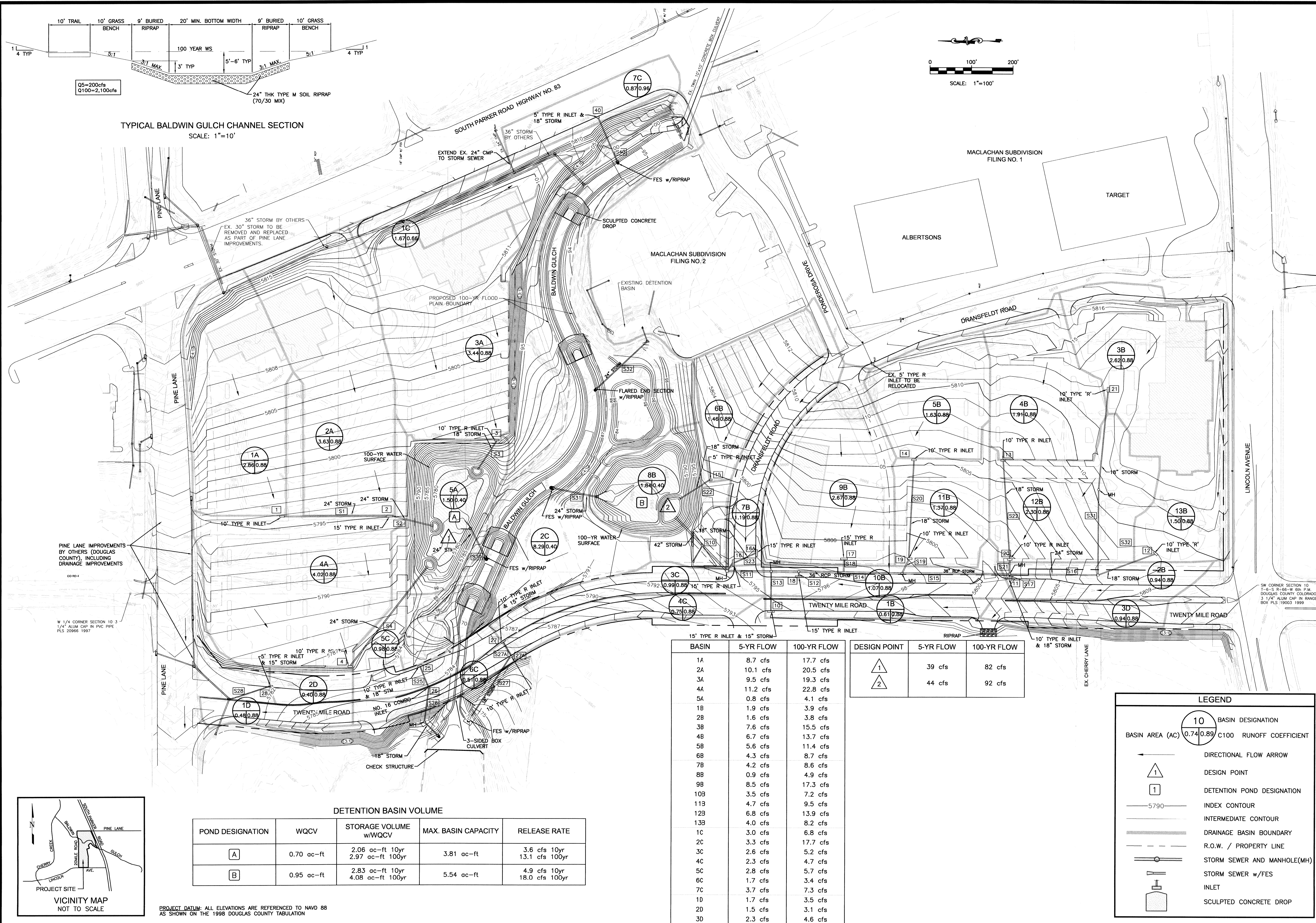
Revisions:

FIGURE

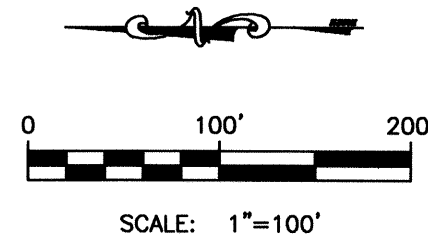
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TYPICAL BALDWIN GULCH CHANNEL SECTION  
SCALE: 1"=10'



| DETENTION BASIN VOLUME |            |                                     |                     |                                |
|------------------------|------------|-------------------------------------|---------------------|--------------------------------|
| POND DESIGNATION       | WQCV       | STORAGE VOLUME<br>w/WQCV            | MAX. BASIN CAPACITY | RELEASE RATE                   |
| A                      | 0.70 ac-ft | 2.08 ac-ft 10yr                     | 3.81 ac-ft          | 3.6 cfs 10yr                   |
|                        |            | 2.97 ac-ft 100yr                    |                     | 13.1 cfs 100yr                 |
| B                      | 0.95 ac-ft | 2.83 ac-ft 10yr<br>4.08 ac-ft 100yr | 5.54 ac-ft          | 4.9 cfs 10yr<br>18.0 cfs 100yr |

| BASIN | 5-YR FLOW | 100-YR FLOW |
|-------|-----------|-------------|
| 1A    | 8.7 cfs   | 17.7 cfs    |
| 2A    | 10.1 cfs  | 20.5 cfs    |
| 3A    | 9.5 cfs   | 19.3 cfs    |
| 4A    | 11.2 cfs  | 22.8 cfs    |
| 5A    | 0.8 cfs   | 4.1 cfs     |
| 1B    | 1.9 cfs   | 3.9 cfs     |
| 2B    | 1.6 cfs   | 3.8 cfs     |
| 3B    | 7.6 cfs   | 15.5 cfs    |
| 4B    | 6.7 cfs   | 13.7 cfs    |
| 5B    | 5.6 cfs   | 11.4 cfs    |
| 6B    | 4.3 cfs   | 8.7 cfs     |
| 7B    | 4.2 cfs   | 8.6 cfs     |
| 8B    | 0.9 cfs   | 4.9 cfs     |
| 9B    | 8.5 cfs   | 17.3 cfs    |
| 10B   | 3.5 cfs   | 7.2 cfs     |
| 11B   | 4.7 cfs   | 9.5 cfs     |
| 12B   | 6.8 cfs   | 13.9 cfs    |
| 13B   | 4.0 cfs   | 8.2 cfs     |
| 1C    | 3.0 cfs   | 6.8 cfs     |
| 2C    | 3.3 cfs   | 17.7 cfs    |
| 3C    | 2.6 cfs   | 5.2 cfs     |
| 4C    | 2.3 cfs   | 4.7 cfs     |
| 5C    | 2.8 cfs   | 5.7 cfs     |
| 6C    | 1.7 cfs   | 3.4 cfs     |
| 7C    | 3.7 cfs   | 7.3 cfs     |
| 1D    | 1.7 cfs   | 3.5 cfs     |
| 2D    | 1.5 cfs   | 3.1 cfs     |
| 3D    | 2.3 cfs   | 4.6 cfs     |

| DESIGN POINT | 5-YR FLOW | 100-YR FLOW |
|--------------|-----------|-------------|
| 1            | 39 cfs    | 82 cfs      |
| 2            | 44 cfs    | 92 cfs      |

LEGEND

10

BASIN DESIGNATION

BASIN AREA (AC) 0.74

C100

RUNOFF COEFFICIENT

→

DIRECTIONAL FLOW ARROW

1

DESIGN POINT

1

DETENTION POND DESIGNATION

—5790—

INDEX CONTOUR

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INTERMEDIATE CONTOUR

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DRAINAGE BASIN BOUNDARY

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R.O.W. / PROPERTY LINE

—+—

STORM SEWER AND MANHOLE(MH)

+

STORM SEWER w/FES

+

INLET

+

SCULPTED CONCRETE DROP

Kiowa Engineering Corporation

7175 West Jefferson Avenue, Suite 3400

Lakewood, Colorado 80235

(303) 692-0369

PARKER AUTO PLAZA

DEVELOPED DRAINAGE PATTERNS

FINAL DRAINAGE REPORT

PARKER, COLORADO

Project No.: 00056

Date: July 12, 2004

Design: MWE

Drawn: MWE

Check: RNW

Revisions:

FIGURE

2

00056DRFg2.dwg/Jul 11, 2004